

BENEFITS OF DAMS FOR THE ECOSYSTEM: THE SAMPLE OF KARKAMIŞ DAM (TURKEY)

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Abstract

Dams, though built for several purposes such as energy, irrigation and flood prevention, are harmful for the ecology and cause loss of many cultural assets. Hence, dam construction is generally considered as environmentally unfriendly. Still, there are some exceptions. One of them is Karkamış Dam Lake (Turkey). Built on the Euphrates River, one of the biggest rivers in the Middle East, was completed in 2000. Upon accumulation of water in the dam lake, the wide surrounding valley area was covered, forming the Karkamış wetland coated with reeds and swamp lands. This, in turn, increased attraction and biodiversity of the semi-arid lands around the dam. As an example, while there were 40 thousand birds in the Karkamış wetland in 2001, it drastically increased to 118.434 in 2005. According to the 2011 data, the Karkamış wetland is in the 10th rank among important bird areas in Turkey. Currently there are 110 bird species, 46 reptiles and Amphibians, 13 fish, 6 butterfly, 57 spider, and 11 mammal species across the Karkamış wetland. In this study, the situation before and after construction of the Karkamış dam is discussed. For this purpose, the changes of swamp and reeds caused by the Karkamış Dam are monitored with remote sensing technique. Such change brought about some positive changes in biodiversity, too. Besides, other practices with potential harmful effects on abovementioned development is investigated along with the future of the dam lake.

Keywords. Karkamış Dam, Turkey, Wetlands, Biodiversity.

1. INTRODUCTION

The nature is heavily degraded and ecosystem drastically changes as a consequence of anthropogenic factors. In particular, civil structures such as houses, roads, bridges, tunnels and dams cause profound changes in even complete destruction of the natural environment. Dams have good effects like power generating, flood mitigation and irrigation (Sönmez, 2012). On the other hand, they have some negative effects such as devastating agricultural areas (Koday, 1999), forcing migration (Bakırcı, 2002), damaging the flora and fauna relocation (Yıldırım, 2005; Sever, 2005) (Nilsson & Berggren, 2000). Hence, it is a painful decision to choose proper sites for constructing dams. Another major problem concerning dams is the fact that dam lakes are filled with siltation in a period as short as 30-100 years resulting in their being unusable (Strahler & Strahler, 2006; p. 557). This distinguishes dams from renewable power resources to a certain extent. Siltation in dams and thus coming to the end of their economic life brings about other problems like revising the dams and designing river beds (Bednarek, 2001).

The studies cited above indicate that dams have major disadvantages for the ecosystem despite economic measures. Furthermore, since they block flow of materials, they cause some of the wetlands especially in deltas, which are backbones of ecosystems, to lose their importance and many of them to be lost after flooded by dams (Kingsford, 2000, p. 111). Present study shows that dams have some benefits for the ecosystem in spite of all disadvantages for it. For instance, once water is caught in dams, Lake Ecosystem emerges in the dam area and a new habitat is formed. Also gradual siltation of dam lakes can turn low level dams like Karkamış Dam into wetlands.

It must be remembered that in 1890's, drainage was started on wetlands just for malaria control in Turkey. However, with the help of developed technology also, such works were expanded to include flood plains and lakes beyond reeds and swamps for gaining agricultural areas. This increasingly continues in not only Turkey but also other countries. As an example, Mediterranean countries lost almost 70 % of all their wetlands in that period (Önder, 2008). This in turn boosted ecological importance of shallow dams situated on north-south migratory routes such as Karkamış Dam. As a matter of fact, Karkamış Dam discussed in present study is currently a prominent wetland where birds stop over and hatch. It has gained even more importance owing to the fact that Karkamış Dam is situated in a semi-arid area, surrounding wetlands are drained already and it is located on north-south migratory routes. In this study, focus is placed on physical development of Karkamış wetland as well as resulting changes taking place in the ecosystem and other potential future problems.

2. MATERIAL AND METHODS

This study is aimed at investigating the relationship between emerging of Karkamış Dam Reservoir consequential biological diversity in and surrounding the reservoir. In this scope, the changes seen in natural landscape of the study area are addressed as three different stages: before construction of the dam reservoir, formation of the dam reservoir and after formation of the dam reservoir. In this way, quantitative data were sought regarding transformation of the study area and its close surrounding over time. Landsat TM satellite images were used to reveal the change taking place in natural landscape of the study area over time. In order to identify the areal change of Karkamış Dam Reservoir and its wetland as correctly as possible, the satellite images were taken from August, which is the driest period around the year. The Landsat TM images dated 31 August 1990, 18 August 2000 and 25 August 2011 were used in the study.

The images used for the study were divided into 6 groups as meadows, water surface, wetlands, bare surfaces, and dry and irrigated farming lands. Meadows include lands covered with steps and fallow areas, while dry farming lands include cereal fields besides vineyards, pistachio and olive orchards. Bare lands contain unplanted surfaces, whereas irrigated lands include reeds, swamps and shallow water surfaces.

The study also aims to identify ecological effects of the new physical environment formed by the dam reservoir. To this end, field work was carried out for observation and wetland biodiversity introduced by the dam reservoir in the study area. Collected data and observations were used to identify the relationship between the dam reservoir and ecological balance in the area.

3. LOCATION AND STRUCTURAL CHARACTERISTICS OF KARKAMIŞ DAM

Karkamış Dam and its wetland are located on the Euphrates River within borders of Karkamış town of Gaziantep province in Turkey. Situated around Turkey-Syria border, the study area is 200 km from the Mediterranean (Figure 1), with an altitude of approximately 385 m.



Figure 1. The location of Karkamış dam.

Karkamış Wetland is under administration of Karkamış town of Gaziantep province 75 km from the center of Gaziantep. It is situated in the east of Karkamış and south of Birecik town of Şanlıurfa province. In the south of the wetland is located Carablus province of Syria (Figure 1). Total area is around 10.400 ha currently (Figure 5, Table 1). Besides, inside the study area are hydrophore stands along the Euphrates river bed. The wetland ecosystem is surrounded by semi-desert areas and steppes in the east (Karkamış

Kaymakamlığı, 2014). The study field is also located on the migratory routes in the north-south axis (Figure 2). Particularly since 1960's, even small wetlands have gained more importance across Turkey as a result of drying of reeds in Ereğli, Gavur Lake swamp, Amik and Seyfe Lakes, which are host, egg-laying and overwintering place for birds located on the passage paths. This fact makes Karkamış wetland even more precious.

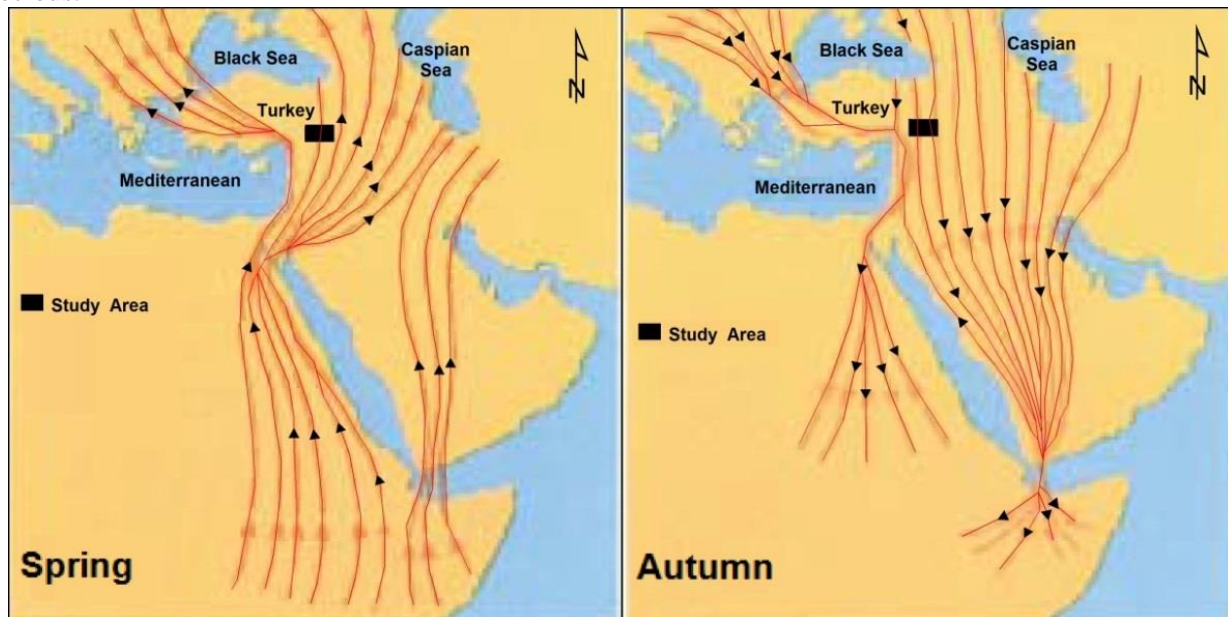


Figure 2. North-south migratory routes (drawn from Can, 2004).

The Karkamış Dam and HEP are on the Euphrates River 4,5 km from the Syria border. It represents the first example of concrete gravity earth fill dam in Turkey referred to as river plant. Having the installed capacity of 180 MW, the plant is expected to generate 652 GWh electric per year (Dsi, 2014).

4. CHANGES IN OUTLOOK OF KARKAMIŞ DAM AND ITS IMMEDIATE ENVIRONMENT (1990-2011)

This section is dedicated to describing changes that took place in both natural and anthropogenic scene of the dam area and its immediate surroundings throughout the 31 years before and after construction of the dam. Landsat TM satellite images from August 1990, 2000 and 2011 were used to capture abovementioned changes. The images were classified by using remote sensing, and the results are given below along with relevant maps.

According to the images, meadows occupied quite a large area (55,4 %) in and around the Karkamış dam reservoir in 1990. During the same period, approximately 17,7 % of the area completely lacked land cover, and 16,5 % was comprised of dry farming lands. 8,45 % of the rest of the area was irrigated farming land, whereas 1,8 % was water surface and only 15 % covered wetlands (Figure 3, Table 1).

In the study area, also land cover and land use went through a change after completion of the construction in 2000 and catching of water in the reservoir. The satellite images from 2000 reveal that nearly 36,6 % of the study area was in meadows, while bare lands constitutes 27,4 % of the whole area. At the same time, 19,8 % of the area was used for dry farming, while 10,5 % for irrigated farming. 3,9 % of the rest of the land was water surface, and wetlands occupied 1,8 % of the whole area (Figure 4, Table 1).

It was seen in the satellite images of 2011 that approximately 37,3 % of the was used for dry farming and 24,8 % was covered by meadows then. While bare lands covered 23 % of the study area, 8,6 % of the area was used for irrigated farming. 4,1 % of the remaining area was covered with water surface, and 2,2 % was comprised of wetlands (Figure 5, Table 1).

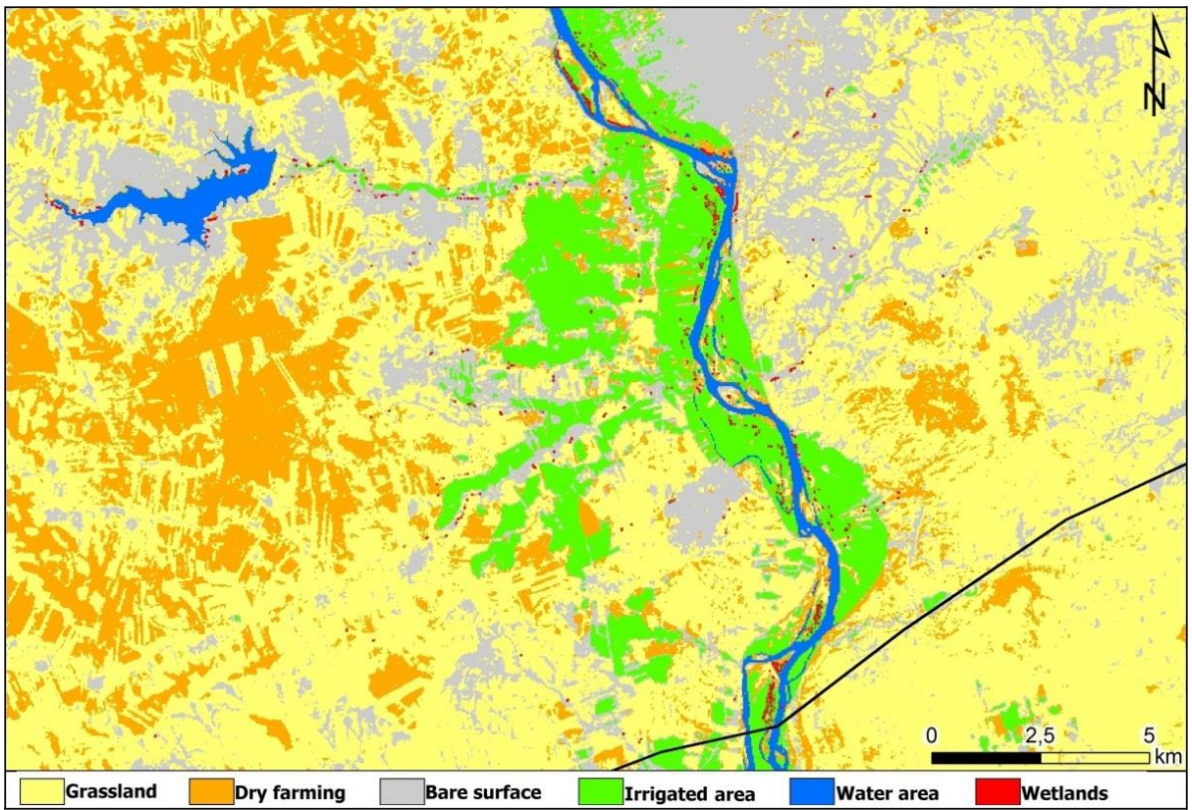


Figure 3. Land cover and land use of Karkamış dam lake and immediate environment (1990).

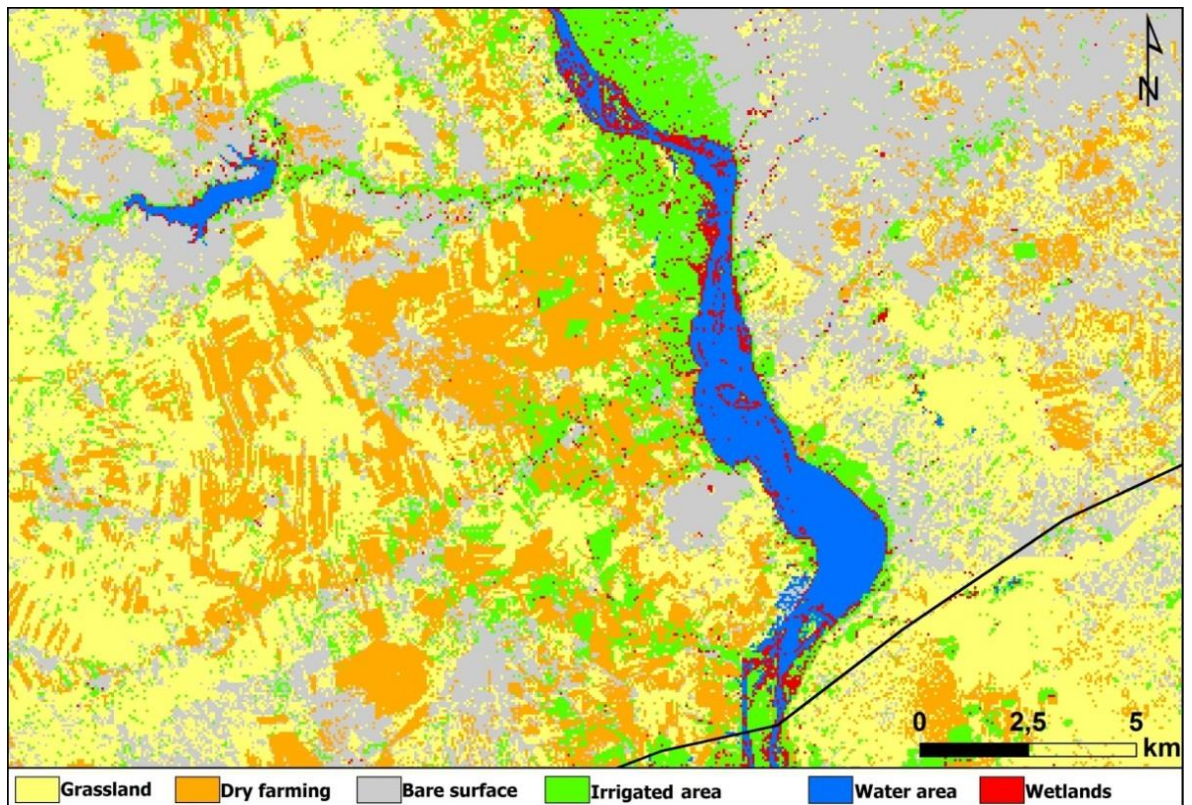


Figure 4. Land cover and land use of Karkamış dam lake and immediate environment (2000).

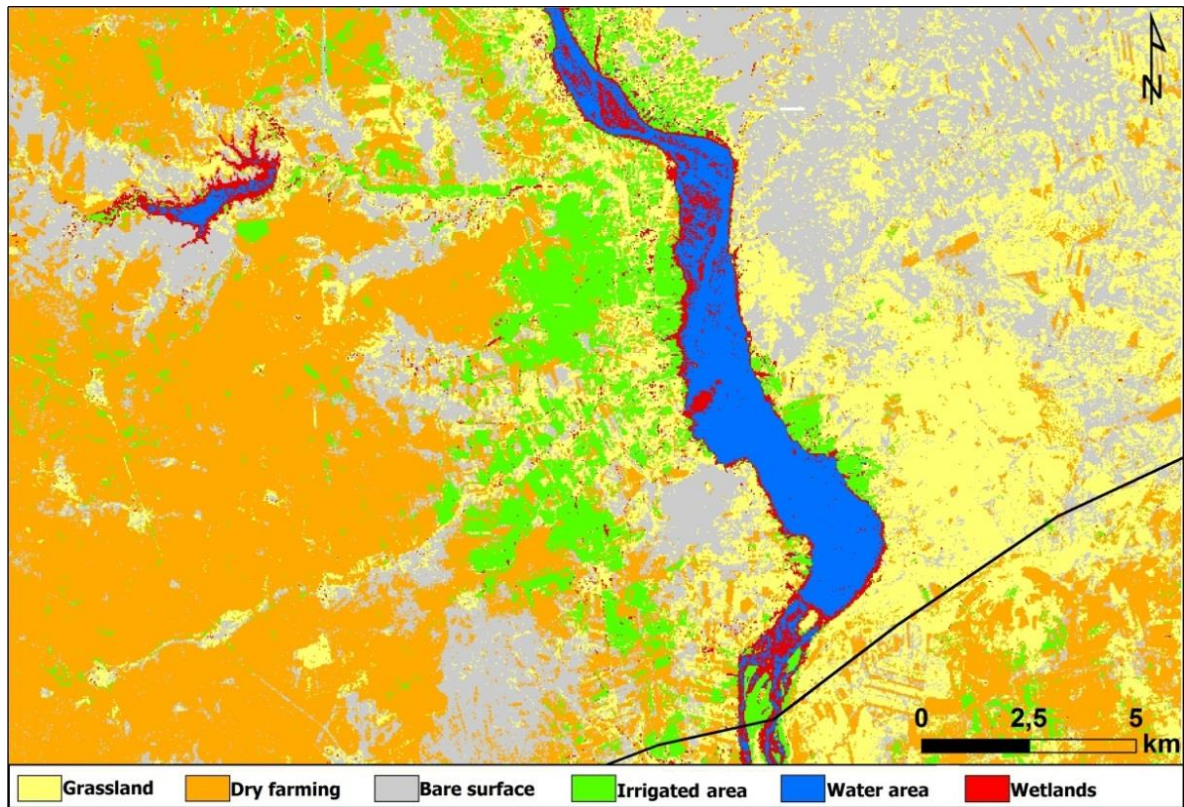


Figure 5. Land cover and land use of Karkamış dam lake and immediate environment (2011).

Table 1. Changes in land cover and land use of Karkamış dam lake and immediate environment (1990-2011)

	1990		2000		2011	
	Area (km ²)	Percentage (%)	Area (km ²)	Percentage (%)	Area (km ²)	Percentage (%)
Irrigated area	38,2	8,45	48,7	10,5	39,5	8,6
Dry farming	76,1	16,5	91	19,8	171,4	37,3
Bare surface	81,4	17,7	126,1	27,4	105,7	23
Water area	8,5	1,8	17,5	3,9	18,5	4,1
Wetlands	0,7	0,15	8,1	1,8	10,4	2,2
Grassland	254,6	55,4	168,1	36,6	114	24,8

As seen in Table 1, both wetlands and water covered areas constantly increased once the dam construction was completed and water catchment was started. While meadows got smaller against expansion of dry farming lands, irrigated lands did not see major changes (Table 1).

5. ECOLOGICAL BENEFITS OF THE KARKAMIŞ DAM

Wetlands are regarded as sources of natural beauty all over the world thanks to the biological diversity they harbour. In a sense, they are the most important ecosystems due to their natural function and economic values. Wetlands adjust water regime of their region by feeding or depleting the underground waters, storing floodwater, preventing overflows and sea water penetration on coasts. They also shelter many species with high ecological and commercial value mainly including fish and waterfowls due to their rich plant and animal diversity (Özuslu & Tel, 2010, p. 9).

Turkey contains the second richest wetlands in Europe and Middle East following former Commonwealth States. Thus, it became a party to the Ramsar Contract in 1994. In the following period, it included Manyas Lake, Burdur Lake, Sultan Reeds, Seyfe Lake and Göksu Delta, which are wetlands bearing international importance, in 1994 yılında. Then, Kızılırmak Delta, Gediz Delta, Ulubat Lake and Akyatan Lagoon were covered under the same agreement in 1998. Turkey has become one of the leading

countries concerning wetlands in its geographical area due to the fact that Turkey is situated in the middle belt between different climates, it is surrounded by seas with different ecological characteristics in three sides, and altitude difference across the whole country exceeds 5000 m (Özuslu & Tel, 2010, p. 11-12). Karkamış is one of the wetlands gaining more importance shortly in Turkey.

Karkamış wetland on the Euphrates has come into prominence since construction of the Karkamış dam in 2000. Though the river valley partly had wetlands before construction of Karkamış Dam, those were quite narrow and held low potential for feeding and harbouring of the creatures. However, in 2000 reeds and swamps started to expand fast in shallow areas surrounding the dam lake once the Karkamış Dam was built and water was filled in the lake. Siltation in the dam lake caused even faster expansion of such reeds and swamps across wide areas. As a result, current wetland of Karkamış was formed.

There are two main habitats as wetland and steppes in and around Karkamış wetland. Having suitable climatic conditions, rich food sources and habitats with diverse ecological characteristics, it is among rich wetlands of Turkey sheltering rich wildlife. Therefore, various plant and animal species belonging to distinct ecosystems can be seen together in that area. This in turn increases biodiversity of the Karkamış wetland. So far 813 plant taxons, 46 reptiles and amphibians, 13 fish, 6 butterfly, 57 spider, 11 mammal and 110 bird taxons have been identified across the area. Moreover, it is home to Euphrates turtle, which is an endangered species. Though it is a leading host for many living creatures, Karkamış wetland is even more important for birds.

Karkamış Dam has become a substantial area for birds, and the number of birds overwintering, growing or hosting there has shown a drastic increase. More than 20 thousand birds hover over this land every winter though the number changes by year. In 2005, 118.434 birds were counted (Eken et al. 2006, p. 448), whereas 73.964 birds were counted on 8 February in 2007. In 2007, it was the 6th largest example considering the number of birds counted in Turkey. In the same year, it was recorded as the 15th largest habitat for hosting birds with 28 bird species (Onmuş, 2007, p. 14-15). On 5 February 2011, 27334 birds were counted in Karkamış wetland, which was the 10th in Turkey then (Erciyas Yavuz & Kartal, 2011, p. 18). According to the counting held at 13 different points on 26 January 2013, total 41295 birds were counted in Karkamış Dam. This figure corresponds to almost half of all birds (97232) counted all over the South-eastern Anatolia during the same period (26 January -1 February) (Erciyas Yavuz & Boyla, 2013, p. 35). To illustrate, Karkamış wetland is one of the five areas with highest number of waterfowls in Turkey according to the midwinter counting (Türkiye Sulak Alanları, 2014). Also as indicated by the data above, Karkamış Dam is gaining more and more importance for birds. Due to that, it was listed as IBA (Important Bird Areas) in the book titled "Important Bird Areas in Turkey - 2004 Update" published by the Nature Society under sponsorship of the BirdLife International, the Royal Society for the Protection of Birds (RSPB), Ministry of Agriculture, Nature and Food Quality in the Netherlands, Baku – Tbilisi-Ceyhan Pipeline Company and Atlas Magazine (İzler, 2011, p. 458).

Veritably, Karkamış Dam is one of the areas visited by francolin (*Francolinus francolinus*) and pygmy cormorant (*Phalacrocorax pygmeus*), which are on the red list as endangered species in both Turkey and world. Moreover, endangered marbled teal (*Marmaronetta angustirostris*) grows in that area though in small numbers. Other rare bird species nesting in the Karkamış wetland include striated scops owl (*Otus brucei*), short-toed lark (*Ammomanes deserti*) and pied kingfisher (*Ceryle rudis*) (Eken et al. 2006, p. 448).

Besides ecological benefits, Karkamış Dam has also economic benefits such as power generating, irrigation and fishery. Specifically, fishery has been increasing fast in recent years. Currently, there are nearly 500 (467) fish screens in the Karkamış Dam.

6. CONCLUSION AND DISCUSSION

It was found in the study that changes took place in both land cover and land use in and around the study area between 1990 and 2011. As for land use, almost 50 % of the meadows disappeared, while dry farming lands expanded above 120 %. The data show that meadows were replaced by dry farming lands at a great extent. Majority of the dry framing lands are used for producing pistachio and olive.

In addition, formation of the dam reservoir significantly increased the amount of water surface and wetland. This in turn increased ecological importance of the semi-arid study area located on chief migratory routes. Evidence can be seen from increased number of waterfowls overwintering, hatching and feeding there, which is currently above 40 thousands. This figure represents approximately half of the all waterfowls counted in mid-winter all around South-eastern Anatolia. As a result, the study area was listed among important bird areas in Turkey. Additionally, many new species of plant and animals emerged in the newly

formed setting. As a consequence, formation of the dam brought a new habitat though existing habitat was damaged.

Today wetlands in the study area are not at stake. Still, constant increase of fish farms and accumulation of fishmeal in the bottom of the dam might cause problems in the future primarily including water and sound pollution. Thus, the area should be monitored seriously. In addition, biodiversity in the study area is ensured mainly by existence of shallow areas; thus, water height should be kept at optimum levels all around the year.

As a conclusion, dams are harmful to the ecological environment. However, they might have considerable benefits for the ecological environment provided that suitable physical conditions are available. Karkamış Dam is an example for benefits of dams.

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