

Assessment and Provision of Environmental Flows in Mediterranean Watercourses

- Basic Concepts, Methodologies and Emerging Practice

Mediterranean Case Study

SULTAN SAZLIĞI: BIODIVERSITY AND NATURAL RESOURCES MANAGEMENT PILOT PROJECT IN TURKEY (GEF-II)

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1. BACKGROUND

Study area: location and geography

Sultan Marshes (Sultan Sazlığı) is a large wetland complex and one of the seven Ramsar Sites of Turkey and an important bird area that hosts many globally threatened bird species. Over 300 bird species have been recorded in the area. Sultan Marshes is located within the province of Kayseri on the eastern border of the Anatolian plateau (38°.05 - 38°.40 north, 35°.00 - 35°.35 east). It is located at the centre of the Develi closed basin. The basin is surrounded by Mount Erciyes (3916 m) to the North, Develi Mountain (2074 m) to the East, Toros Mountains (Aladağlar) (3373 m) to the South and Karadağ-Hodul Mountains (1937 m) to the West. The elevation of the plain is between 1070 m and 1150 m with an average slope of 2%. Develi Plain has an area of approximately 800 km² and a catchment area of 3190 km².

Typical continental climate prevails in the Develi closed basin. Summer months are dry and hot. The temperature difference between the summer and winter season is high, with July and August being the hottest months (34.2 – 35.3 °C) and January and February the coldest (-15° – -18.3 °C). The annual mean temperature in the basin is 11° C and the long-term mean annual precipitation is 363 mm.

Sultan Marshes Nature Conservation Area covers 17 200 hectares. The Sultan Marshes wetland complex is formed by Yay Lake (3650 ha), which is brackish (Ph 6.8-7.0 and salinity 12 mg/l); Çöl Lake (2600 ha), which is saline (Ph 8.3 and salinity 80 mg/l); Örtülüakar Marsh (3300 ha); and now largely drained Kepir Marsh (1900 ha) to the North. The marshes and lakes are surrounded by wet meadows and salt steppes. These wetlands were all interconnected and formed a whole previous to drainage and irrigation projects. Örtülüakar and Kepir Marshes would fill in and spill into Yay Lake (40-150 cm depth) bringing essential nutrients that made Yay Lake an important feeding area for Flamingos (up to 90.000 individuals) and other wildlife. Yay Lake once full would spill into Col Lake (0-50 cm depth) (Figure 1).

This important wetland area is surrounded by 3 towns and 19 villages. The total population in the Develi Basin is 50 000 people. Agriculture is the main economic activity and about 80 % of the population is in the agricultural sector. Animal husbandry and reed cutting are other important activities. A small number of people derive income from ecotourism (especially birding watching), carpet, and reed weaving.

Sultan Marshes has been degraded considerably as a result of human activities which include large scale irrigation, and drainage projects, use of synthetic fertilizers and pesticides, animal husbandry, reed cutting and illegal hunting. Unsustainable ways of reed cutting and illegal hunting are responsible for negative impacts on flora and fauna within the wetland. Overgrazing damages valuable bird habitats around Sultan Marshes. However, the most damaging activity has been the intensification of irrigated agriculture during the last 20 years. Intensification of agriculture has caused the drainage of valuable wetland habitat, overexploitation of surface and groundwater resources together with water pollution due to high levels of fertilizer, and pesticide use.

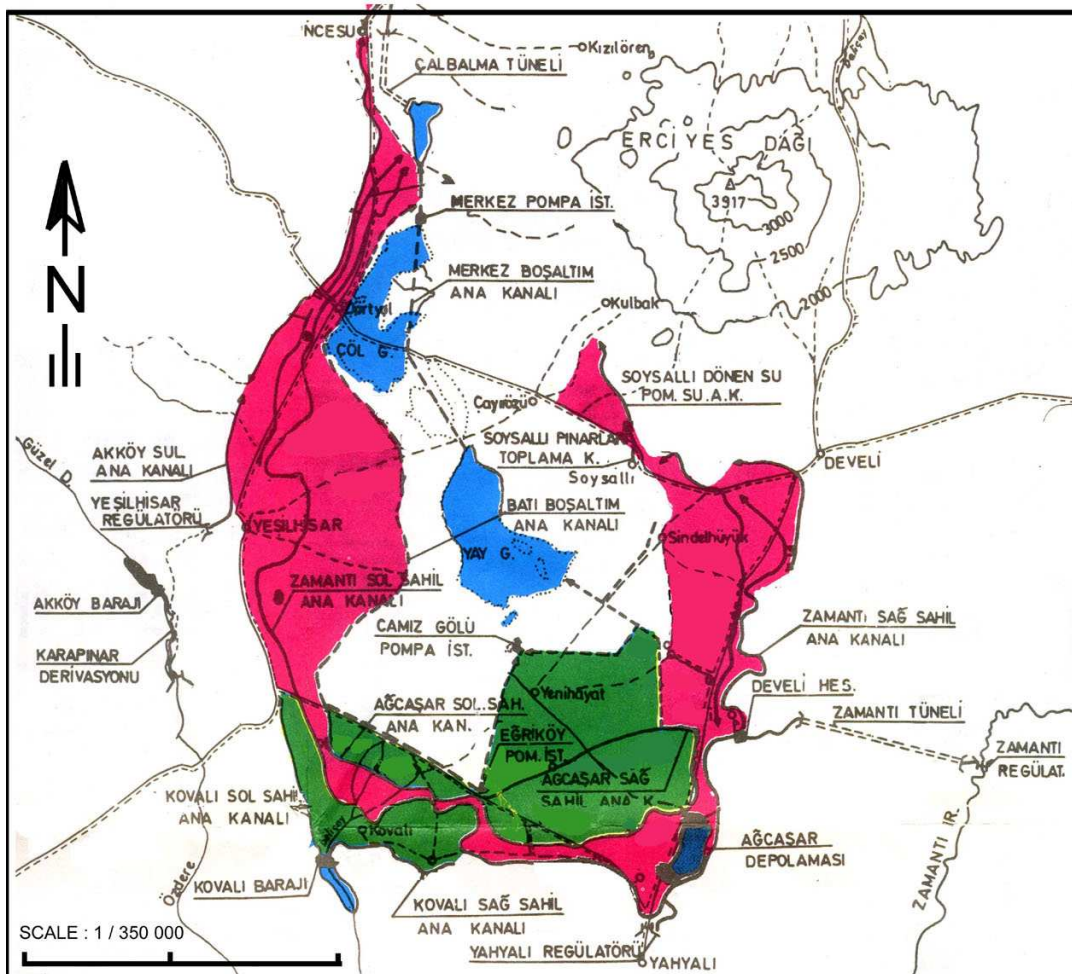
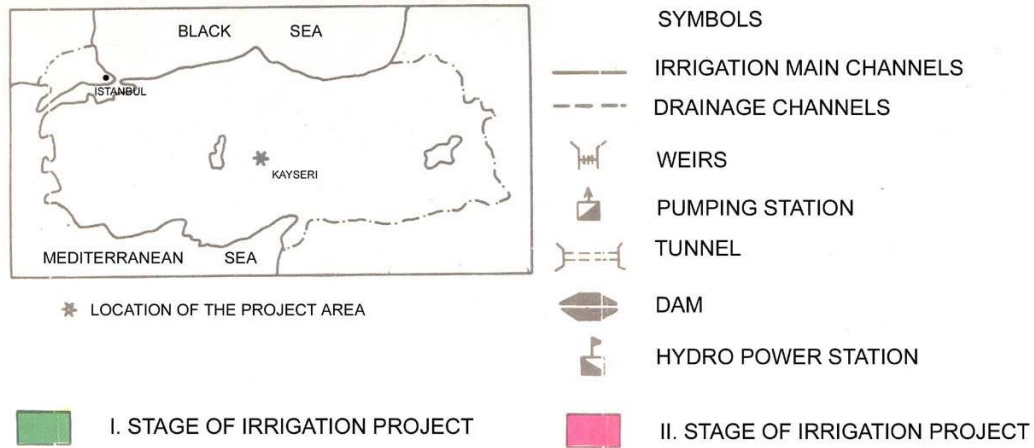


Figure 1. Sultan Marshes and surrounding first and second phase irrigation projects including dams, diversion tunnels and irrigated areas (modified after DSI 1988).

Water resources development for agriculture

In Turkey, The State Hydraulic Works (DSI) and the General Directorate of Rural Services (GDRS) have the legislative authority and responsibility for the realization of irrigation development projects. DSI has the responsibility for large irrigation systems (such as Develi Irrigation Project) whereas

GDRS is responsible for minor irrigation works and on-farm development of irrigation works completed by DSI.

Water resources development activities in the Develi Plain started in 1960's with the Develi Irrigation Project that was planned and implemented by DSI. This project included three dams, several groundwater pumping facilities, irrigation and drainage structures to irrigate a total area of 52500 hectares. The project was initially planned in two stages. First stage included the development of readily available water sources in the basin (such as streams and groundwater). In the second stage, 111-150 million m³ of water will be transferred through an 11 km derivation tunnel from Zamanti River in another basin (Figure 1).

Akköy dam was completed in 1967 and Ağcaşar and Kovalı dams together with the irrigation and drainage canals were completed in 1986 and 1987, respectively. In the first phase, 18,346 hectares have been irrigated by the water collected in the Ağcaşar and Kovalı Dams and groundwater extracted from wells irrigates a total of 9700 hectares. The second stage, construction of the derivation tunnel has been in progress for more than ten years due to funding problems (see Box 1.)

Environmental outcomes of the Develi Irrigation Project were not considered during the planning period in the 1960s. In fact, the first version of the project planned to drain the entire wetland. After Sultan Marshes was declared a "Waterfowl Protection and Reproduction Area" by the Turkish Government in 1971, the initial drainage plan was revised in 1976. After the negotiations between the Ministry of Forestry and DSI, a minimum water level was determined to remain at Sultan Marshes. It was decided that for the survival of Sultan Marshes, the water level at Yay Lake would never go below 1071m altitude. This was an important step for the conservation of Sultan Marshes ecosystem and already an environmental flows approach is in its simplest form.

Later Sultan Marshes was declared a Construction Prohibition Zone in 1993 (by the Ministry of Culture), a Ramsar Site in 1994 and Nature Conservation Area in 1998 (by the Ministry of Environment and Forestry). However, the negative impacts of the drainage and irrigation project and the dams on Sultan Marshes continued so far regardless of its strong conservation status.

Box 1: Phases of the Develi Irrigation Project

Feasibility report for Develi Irrigation Project prepared by DSI	1966
Akköy Dam completed	1967
Planning report for Develi Irrigation Project prepared by DSI	1970
Project revision: Water level in Yay Lake would remain at 1071m altitude	1976
Ağcaşar Dam completed	1986
Kovalı Dam completed	1987
Construction of Zamanti Derivation Tunnel	continued

The need for an Environmental Flow Assessment

After the first phase of the Develi Irrigation Project was completed, Sultan Marshes started to dry out completely in some years. For example, during the 1990-1991 and 2000-2002 periods, the water level went below the surface in Yay Lake and 1 m below surface even in the marshes. The drop in water levels resulted in considerable damage on wetland habitats and on flora and fauna. Number of birds and bird species declined dramatically and globally endangered bird species stopped breeding in the area ever since (Özesmi et al, 1993).

A rough estimation of the reduction water flow into Sultan Marshes was made using precipitation into the watershed before and after the first phase of the Develi Irrigation Project was completed (see Box 2.). In this rough estimate, similar crop patterns, climatic conditions, irrigation water use ratios, and evapotranspiration were assumed. It also assumes equal annual average precipitation (363 mm) and

17% conversion from precipitation to surface flow equalling total 197 million m³. When losses in irrigation are considered before and after the project, the estimated total reduction in inflow was 86 million m³ (see Box 2.) Incidentally the capacity of Kovalı dam is 25 million m³ and the capacity of Ağcaşar is 62 million m³ totalling 87 million m³. While these numbers are rough, they clearly show how irrigation projects have disrupted the environmental flow of Sultan Marshes.

Box 2: Estimated water Inflow into Sultan Marshes before and after the first phase irrigation project

Total surface flow from precipitation in the watershed	197 million m ³
Before the first phase became operational (pre 1985)	
Surface flow used for irrigation in Yeşilhisar	72 million m ³
Remaining surface flow after irrigation	125 million m ³
Irrigation return flow from Yeşilhisar	21 million m ³
Total surface inflow to Sultan Marshes before 1985	146 million m ³
After the first phase became operational (post 1988)	
Surface flow used for irrigation in Yeşilhisar	72 million m ³
Surface flow used for irrigation in Develi	13 million m ³
Surface flow used for irrigation in Yahyalı	108 million m ³
Remaining surface flow after irrigation	4 million m ³
Irrigation return flow from all irrigation areas	56 million m ³
Total surface inflow to Sultan Marshes after 1988	60 million m ³
Reduction in water inflow to Sultan Marshes after 1988	86 million m³

The dams and irrigation project also caused important changes in quality of water. In the freshwater marshes the TDS changed from 350-400 mg/lit before the irrigation project to 450-500 mg/lit after it was implemented and EC changed from 1000-1200 to 1500-1600 µmhos/cm. In Yay Lake the TDS changed from 3300-3500 to 5100 mg/lit and EC from 3500-4000 to 6000-65000 µmhos/cm (DSI, 1998)

Alteration of the hydrology and ecology of Sultan Marshes had several negative effects on the local people. A considerable number of people living in the villages around the Sultan Marshes have direct relationships with the wetland ecosystem. More than 80% of these people are cutting reed for their personal needs (e.g. for feeding their animals, covering roofs of houses and barns) and for obtaining direct income. The reed that is cut is exported to North European countries for thatching roofs and has a total value of 750.000 USD/year. Villagers retain in total 150.000 USD/year from their cumulative sales (Özesmi, 2002). Hence, reed cutting is the second most important activity in the region after agriculture. The water level drop in 2000-2001 affected both the quantity and quality of the reed available for cutting and eventually decreased the villagers' income. The decrease in the availability of reed caused disagreements and friction between reed cutters.

Ecotourism is another other economic activity negatively affected. Sultan Marshes was one of the most important bird areas in Turkey. Being on two migration routes, more than 300 bird species were observed in the previous years. Thus, there is considerable ecotourism potential. There are a few pensions owned by villagers and a number of villagers serve as tourist guides. Decreases in the number of birds and bird species caused a decrease in the number of tourists coming to the area. Furthermore, since the marshes were completely dry, it was not possible to make boat tours into the marshes. Tourists started to call the area a bird's hell instead of its widely advertised status as a bird paradise.

The long-term impact of the disruption and exploitation of natural water resources in the Develi Plain has affected both the ecosystem and the people of Sultan Marshes. It became obvious that the main threat to the ecosystem was unsustainable water resource use and that the restoration of Sultan Marshes was only possible through securing environmental flows. The realization produced a strong need for the assessment and securing of environmental flows to Sultan Marshes.

2. ENVIRONMENTAL FLOW ASSESMENT APPROACH TO BE USED

In 2000, Sultan Marshes was identified as one of the national priority areas and a representative of a wetland and steppe ecosystems in Turkey and selected as a pilot project area in “Biodiversity and Natural Resource Management Project.” This project was prepared by the Ministry of Environment and Forestry in collaboration with the World Bank and financed by the Global Environment Facility (GEF). The pilot project in Sultan Marshes will develop an ecosystem/parks management plan to enable the conservation of the biological diversity and ecological integrity together with people living around the ecosystem. The pilot project will establish a sustainable resource use regime and raise the local capacity to conserve the ecosystem. It is a collaborative project, which includes several government agencies, namely, the General Directorate of National Parks, Game, and Wildlife, and the General Directorate of Forestry of the Ministry of Environment and Forestry, the Ministry of Culture. Participation of local people and local organizations is given special emphasis in every step of the project.

The “Biodiversity and Natural Resource Management” project adopts an integrated planning approach that covers ecological, socio-economical and institutional considerations. The linkages between these factors will be identified and used in the development of an integrated management plan. As the importance of the hydrological issues related to the quality and quantity of water needed by the ecosystem was realized and it became obvious that the need was not met - an action plan was prepared. The first step in this action plan was to start a detailed hydrological and water quality study at Sultan Marshes (Gürer, 2003ab). A water-year long hydrological observation period was started in December 2002 and at the end this hydrological study will interpret the impact of the dams and the irrigation and drainage project. A model will be developed that takes into consideration the needed environmental flows for Sultan Marshes taking into account the agro-economic conditions. The results will be used to develop water management alternatives, which will secure the environmental flows for Sultan Marshes under changing climatic conditions. However the implementation of these alternatives will be a challenge since legislative, economic and social constraints will have to be tackled to eventually restore and conserve the ecosystem.

3. MANAGEMENT ACTIONS: DECISIONS TAKEN AND IMPLICATIONS

The drying out of Sultan Marshes in 2001-2002 precipitated a series of crises meetings attended by the Ministry of Environment and Forestry, State Hydraulic Works, academics and nature conservation NGOs (see Box 3.). In these meetings it was agreed that the excess water after the irrigation season should be emptied into Sultan Marshes, that water from 22 groundwater wells should be discharged into the marsh and the canal to the north that carries water from Soysallı springs should be closed and the water diverted into Yay Lake instead of Çöl Lake, which was considered of less importance.

The Ministry of Environment prepared the “Regulation for Wetland Conservation” in 2002. This document emphasized the importance of wetlands and the need for their sustainable management to meet the objectives of the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat. This legislation enforced the establishment of the “National Wetlands Commission” to regulate and control the sustainable management of wetlands. In the first commission meeting, a “Technical Study Group” was established which includes representatives from the Ministry of Environment and Forestry, General Directorate of National Parks, Ministry of Culture, Ministry of Energy and Natural Resources, Turkish Society for The Protection of Nature, and Bird Research Society.

On 5 July 2002, the Ministry of Environment and Forestry, State Hydraulic Works, academics and nature conservation NGOs met and discussed the problems of the Sultan Marshes and concluded that the water requirements of the ecosystem should be met. They decided that groundwater should be pumped to the Sultan Marshes from 22 wells operated by DSI and that water from Ağcaşar and Kovalı dams would be discharged when the irrigation season was over.

At this meeting, the importance of Soysallı Springs for Sultan Marshes was emphasized. The commission proposed the modernization of irrigation systems in the Develi Basin and exploration of

Box 3. Chronology of the recent activities undertaken at Sultan Marshes

2000: - Sultan Marshes identified as a national priority area in Turkey representing wetland and steppe ecosystems. It became a pilot project area under the “Biodiversity and Natural Resource Management Project – GEF II”.

30 January 2002: - Regulation for the Conservation of Wetlands” was put in force by the Ministry of Environment

16 March 2002 : - Technical Study Group established by the National Wetlands Commission

5 July 2002: - Crises meeting attended by the Ministry of Environment and Forestry, State Hydraulic Works, academics and nature conservation NGOs, where it was agreed that the excess river water after the irrigation season, and water from 22 pumps operated by DSI should be emptied into the marsh and the discharge of Soysallı springs secured for Yay Lake.

14 September 2002: - The National Wetland Commission suggests a field assessment by the Sultan Marshes GEF II Biodiversity and Natural Resource Management Project team and DSI.

21 September 2002: - Experts conduct a field research mission at Sultan Marshes and propose that the spring waters should not be used for irrigation and sent directly to Sultan Marshes after irrigation season.

21 November 2002: - National Wetland Commission’s meeting with the technical experts from local state agriculture units and Irrigation Unions.

December 2002: - The Ministry of Environment and General Directorate of Nature Conservation prepared a report called “The Water Budget of Sultan Marshes and necessary precautions.”

2003: - The investment for the Zamantı Derivation Tunnel was increased to speed up the finalization of the project.

the feasibility of alternative crop cultivation. The commission mentioned the importance of the second phase of the Develi Irrigation Project and the construction of Zamantı Derivation Tunnel. In 2003, the investment for the Zamantı Derivation Tunnel has been increased to speed up the finalization of the project. The extra water brought into the basin should be allocated to meet the environmental flow needs of Sultan Marshes, however there is no project revision on the agenda to secure the water brought into the basin will actually not be used to increase irrigated agriculture, but for the necessary environmental flows of Sultan Marshes.

The commission recommended the development of a new water budget for the Sultan Marshes and Yay Lake that would determine the necessary environmental flows for the ecosystem. However, water quality

issues are still not in the agenda as the main concern continues to be the quantity of water.

On 14 September 2002, the National Wetland Commission suggested a field assessment be conducted by and appropriate multi-disciplinary group of experts. Subsequently, the GEF II Biodiversity and Natural Resource Management Project team and experts from the DSI conducted a field research mission at the Sultan Marshes in September 2002. After this field research mission, it was proposed that the spring waters should not be used for irrigation and sent directly to Sultan Marshes, while stream waters are collected in the Ağcaşar and Kovalı Dams and used for irrigation purposes in the short term. It was reported that 8 million m³ of water was supplied from 22 groundwater wells during that fall.

On 21 November 2002, representatives from the local organizations were invited to the Commission's meeting. The participants included the technical experts from the local state agriculture units and water user organizations. The need for the modernization of irrigation systems, education of local farmers related to new irrigation technologies and supporting of alternative crops were the key issues discussed in this meeting.

4. LESSONS LEARNT

The Sultan Marshes is an example of a valued ecosystem that has been degraded considerably due to the intensification of irrigated agriculture. The natural flow regime of the ecosystem has been altered with the construction of dams, irrigation and drainage structures and overexploitation of water resources.

As most water resource development projects for irrigated agriculture have been developed and planned in the 1960s in Turkey, they lack an environmental focus. During this period the national priority in water resources planning was to achieve economic growth through irrigated farming of cash crops. Because the environmental NGO movement discovered the importance of Sultan Marshes in the 1970s, the wetland complex escaped complete drainage through a project revision. Although a minimum water level of 1071 m altitude was agreed to secure environmental flows, it could not be maintained after the basin wide irrigation scheme became operational. This example shows that rather than setting goals at the wetland itself, agreements have to be reached in terms of water management at the source and distribution based on climatic fluctuations in the region. This is especially important in Mediterranean wetlands, where year to year fluctuations in precipitation and evaporation can be of extreme importance. Projects developed and planned in the 1960s and revised in the 1970s and 1980s, need to be revised taking into consideration the concept and understanding of environmental flows today.

In the Develi plain, the maximum inflow to wetlands occurs also when there is maximum need for water storage in dams after the snow melts. This causes a delay in the natural inflow to the wetlands in spring when reeds and wildlife need water the most. Irrigation water is applied to fields at the beginning of May in Yeşilhisar province, and in June around Develi and Yahyalı. Therefore the safe yield from all the ground water wells opened by DSI and civilians in the region could theoretically be diverted to Sultan Marshes, during March and April before the start of the irrigation season. But this might be prohibitive because of extra energy costs of pumping unless sustainable energy resources are used. Water returning from irrigation occurs in summer when there is maximum evapotranspiration and causes higher loss of water than in spring and is already too late for the ecosystem to realize its functions. Therefore to secure environmental flows, not only the amount, but also the timing of the management of water at the source and distribution becomes essential.

Once the irrigation and drainage projects are put into operation and farmers around wetlands obtain increased yields, it becomes difficult to change management practices. Currently the management of water allocation has been given over to Irrigation Associations in Turkey. Officials elected by farmers, who use the water, govern Irrigation Associations. Therefore, allocation of water for environmental flows is essentially impossible because farmers do not agree to take a cut in their water use. The allocation for environmental flows in dry years causes an uproar among farmers as these are also periods when farmers also suffer from decreased water availability. Institutional theory has shown that water distribution becomes more efficient when it is decentralized and users themselves form institutions. However, the environmental impacts if the decentralization has not been considered and environmental flows did not become part of the agreement of decentralization. Therefore any decentralization of dam, irrigation and drainage operations need to incorporate environmental flow allocations from the very start.

In considering environmental flows, it is important to realize that users of water are free agents that find ways in which to maximize their use of water. In Sultan Marshes this has been both positive and negative. In dry seasons, farmers, especially ones towards the wetland who are at the end of the canal

system who could not receive sufficient water, had groundwater wells opened. This has exacerbated the situation in Sultan Marshes drawing the water level further down. On the other hand in some villages in the basin where irrigation water from the dams are limited or non-existent farmers have started to explore and adopt water saving technologies such as drip-irrigation. Therefore any management practice to secure environmental flows has to consider that farmers are free agents and will try to meet their water needs.

From the experience in Sultan Marshes it becomes apparent that environmental flows cannot be secured when social and economic issues at the local level are not considered. When the projects were developed in the 1960s the conventional development model of the West/North had been adopted. Alternative development models that respect and built upon traditional ways of living or livelihoods were not considered. Therefore decisions were not taken together with local people but decided in the capital. Through the adopted development model that was shown to be the only way, farmers were caught up in the treadmill of conventional agriculture hungry for water and other inputs. However social, economic and ecological sustainability can now only be reached when, policy and implementation decisions are taken by relevant government agencies in consultation with academics and NGOs and with active involvement of the local people in the decision making process. Participation of local people and local organizations during the planning and implementation process enhances the ownership by local people and thus strengthens the sustainability of the project. However the necessary legislative and institutional framework needs to be established so that the right of ecosystems for environmental flows can be also protected.

There seems to be no alternative than an integrated management approach to restore Sultan Marshes ecosystem. Today, securing the environmental flows for Sultan Marshes is not in the hand of one decision-making body. The issue has many facets including the management and operation of dams, irrigation and drainage structures, distribution of water, agricultural practices including farm systems (conventional vs. organic) tillage, choice of crops and related use of fertilizers and pesticides, etc.,. Although the collaboration between different government agencies, and NGOs and farmer representatives is very important for the success, this has been limited as there are many conflicting interests yet no institutional bodies to mediate and enforce decisions to secure environmental flows. To secure environmental flows to Sultan Marshes necessary institutions need to be formed.

“Environmental Flows” is a concept that had already been adopted by government agencies and NGOs in Turkey in the 1970s without naming it. However since the name was not given and the relevant theoretical and practical framework not established policy formation and implementation was not sufficient to secure environmental flows for Sultan Marshes consequently. As scholarship in the area of environmental flows flourishes and experiences are accumulated to provide good examples that deal with social and economic as well as ecological issues in depth, the environmental flows approach adopted in Sultan Marshes will have a larger chance to succeed.

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