HUMAN INTERVENTIONS ON WETLANDS AND THEIR LONG TERM IMPACTS ON HUMAN WELL-BEING A STUDY OF KIZILIRMAK DELTA CASE, SAMSUN, TURKEY

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ABSTRACT

HUMAN INTERVENTIONS ON WETLANDS AND THEIR LONG TERM IMPACTS ON HUMAN WELL-BEING A STUDY OF KIZILIRMAK DELTA CASE, SAMSUN, TURKEY

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Acknowledging the necessity of a detailed understanding of the dynamics and contributions of wetlands in decision making processes, this research aims to identify the trade-offs between human interventions and human well-being in wetlands. Being one of the thirteen Ramsar Sites of Turkey and providing various ecosystem functions, Kızılırmak Delta was determined as the case study area of the research. Following the literature review on wetlands and their valuation, an assessment framework was developed for analyzing the trade-offs in the Kızılırmak Delta. Following this framework, first the importance, values and functions of the delta were defined by evaluation of its ecological, socio-cultural and economic structures and function analysis. Then, the pressures on the delta and their impacts were analyzed through DPSIR (Driving forces, Pressures, State, Impacts and Responses) Framework by action analysis. Finally, the trade-offs in the delta were calculated in monetary terms through valuation of the functions of the delta. Because of time and data constraints only a small portion of the functions of the delta was quantified in monetary terms. Calculated functions of the delta provide 753.531.772 TL worth of services that constitutes the 34 % of total GDP of the delta. This value was accepted as the cost of trade-offs in the delta, because the pressures on the delta would result in the loss of this value.

Key Words: Wetlands, Function Analysis, Action Analysis, DPSIR (Driving forces, Pressures, State, Impacts and Responses) Framework, Valuation, Trade-off Analysis, Kızılırmak Delta

ÖZ

SULAK ALANLAR ÜZERİNDEKİ İNSAN MÜDAHALELERİ VE UZUN DÖNEMDE İNSAN REFAHINA ETKİLERİ KIZILIRMAK DELTASI ÖRNEK OLAY İNCELEMESİ, SAMSUN, TÜRKIYE

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Sulak alan dinamiklerinin ve katkılarının ayrıntılı olarak anlaşılmasının karar alma süreçlerindeki gerekliliğini kabul eden bu araştırma insan müdahaleleri ile insan refahı arasındaki karşılıklı değiş tokuşu tanımlamayı amaçlamaktadır. Türkiye'nin on üç Ramsar Alanı'ndan birisi olan ve çeşitli ekosistem fonksiyonları sunan Kızılırmak Deltası örnek olay alanı olarak belirlenmiştir. Sulak alanlar ve değerlendirilmeleri üzerine bir kaynak taramasının ardından, Kızılırmak Deltası'ndaki karşılıklı değiş tokuşları analiz etmeye yönelik bir değerlendirme çerçevesi oluşturulmuştur. Bu çerçeve kapsamında, öncelikle ekolojik, sosyo-kültürel ve ekonomik yapılarının değerlendirilmesi ve fonksiyon analizi ile deltanın önemi, değerleri ve fonksiyonları tanımlanmıştır. Daha sonra, faaliyet analizi ile deltadaki baskılar ve etkileri SBDET (Sürücü kuvvetler, Baskılar, Durum, Etkiler ve Tepkiler) Çerçevesi kapsamında analiz edilmiştir. Son olarak, deltanın fonksiyonları değerlendirilerek yaşanan alış veriş ilişkileri parasal olarak hesaplanmıştır. Zaman ve veri kısıtlarından dolayı deltanın fonksiyonlarının sadece küçük bir kısmı parasal olarak değerlendirilebilmiştir. Deltanın hesaplanan fonksiyonları 753.531.772 TL değerinde servisler sunarak deltanın GSYH'sının (Gayri Safi Yurtiçi Hasıla) % 34'ünü oluşturmaktadır. Bu değer deltanın alış veriş ilişkilerindeki zarar olarak kabul edilmiştir, çünkü baskılar sonucunda bu değerlerin kaybolma riski vardır.

Anahtar Sözcükler: Sulak Alanlar, Fonksiyon Analizi, Faaliyet Analizi, SBDET (Sürücü kuvvetler, Baskılar, Durum, Etkiler ve Tepkiler) Çerçevesi, Değerleme, Trade-off Analizi, Kızılırmak Deltası

Dedicated to my family;

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CHAPTER 1

INTRODUCTION

1.1. Research Focus

Providing various functions and services through their complex structures and processes, wetlands are rich, productive and important ecosystems. All ecosystems being important, wetlands deserve additional concern because of their complexity, vulnerability and openness that make them the most threatened systems globally and historically. Being an important part of the biosphere and providing various functions and services, wetlands are necessary components for the survival of life on earth and thus they should be sustained in their healthy states.

In spite of their importance; past and current conditions of wetlands stress that they are far from being sustained successfully. They have been perceived as worthless wastelands and converted or lost throughout the history. With the understanding of their functions and services, and becoming aware of the problems following their losses, importance of wetlands is recognized and accepted globally. Following this recognition; studies and researches held; regulations and legislations prepared; international agreements and national conservation policies developed; management and conservation plans prepared and implemented for achieving the sustainability of wetlands. Despite all these efforts and increasing knowledge about wetlands, the general tendency towards their depletion, degradation and losses persist. These changes in the quantity and quality of wetlands trigger further environmental, socio-cultural and economic problems and losses.

Since they are open and sensitive systems, wetlands are highly vulnerable to the activities, pressures and changes induced by natural and especially human based processes. Although natural processes could affect the wetlands, the main reasons of their losses are human based processes. Economically oriented interventions of human beings, for taking advantage of the functions and services of wetlands, change their quality and quantity resulting in their degradation, depletion and losses. Although importance of wetlands and problems following their losses are known, this situation continues as a result of market, intervention and information failures.

The main reason behind all these problems lies up in the value systems of human beings. Economic concerns and anthropocentric perceptions result in the undervaluation and ignorance of wetlands in decision making processes. Although this approach seems economically beneficial in short term, in the long term it causes important environmental, socio-cultural and economic problems through changes in the structure and processes of wetlands. Economic losses following these problems mostly exceed the intended gains however the costs of these losses could not be observed clearly because the contribution of wetlands on human welfare and economy is not apparent. Therefore, solution of these problems, avoidance of losses and achievement of the sustainability of wetlands depend on a better understanding of their contributions to human welfare, especially in economic terms.

One of the most important wetlands of Turkey, Kızılırmak Delta is a good example for observing the processes described above. The delta has been affected by the activities, pressures and changes induced by natural and human based processes throughout the history and the environmental, socio-cultural and economic impacts of these processes are apparent today. Inspite of the affords for solving the problems and conserving the delta, degradation, depletion and losses still persist as a result of market, intervention and information failures. Solution of these problems and failures mainly depends on the understanding of the processes in Kızılırmak Delta and recognizing its functions and contributions to human well-being in the delta.

Thus, main purpose of this research is to explore the trade-offs between human interventions and human well-being in the Kızılırmak Delta. Therefore, for understanding the contributions of Kızılırmak Delta to human well-being, its functions and services were determined first. Then, the pressures and impacts of human interventions on these components were analyzed through a relational framework. Finally the contribution of the delta and the costs of losing these contributions were valued in monetary terms. Defined focus of the research is presented through a logical framework in the Figure 1-1 below.

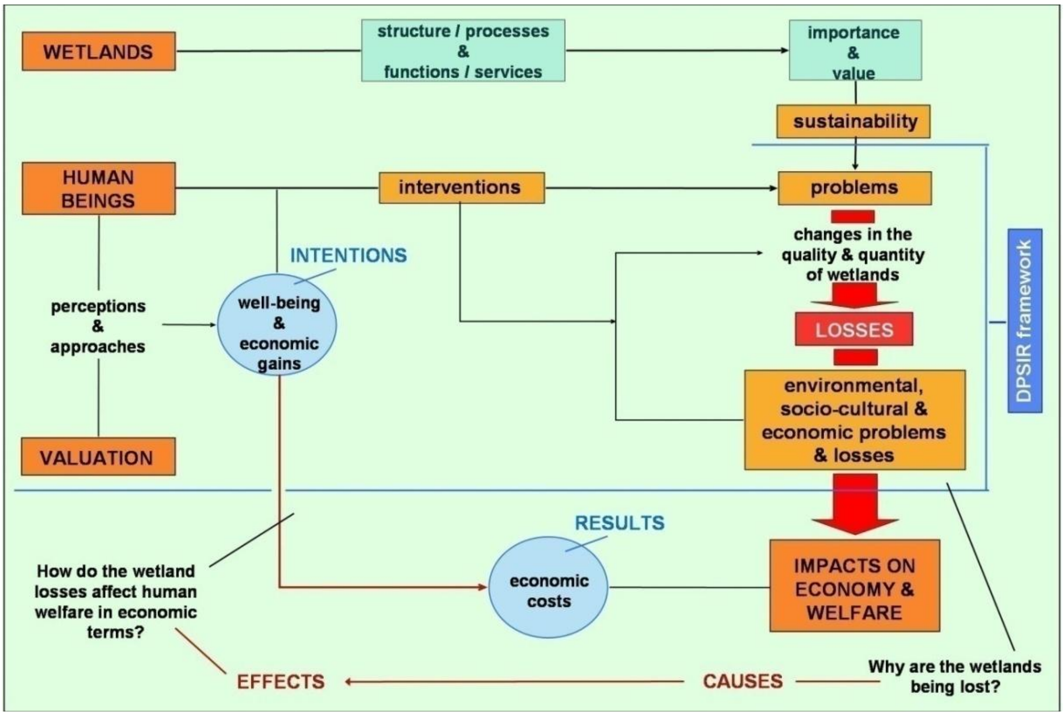

Figure 1-1 Logical Framework

1.2. Background

1.2.1. Definitions of Wetlands

Although wetlands can be defined simply as eco-tones between terrestrial and aquatic ecosystems, because of their dynamic structures and flexible processes, making an exact and detailed definition of them is not so simple. For a clear definition of wetlands, their structure and processes should be defined first.

Wetlands consist of three main components: hydrology, physicochemical environment and biota. Interactions of these interdependent components (with geomorphology, climate and each other) result in wetland processes such as; photosynthesis, transpiration, biogeochemical cycling, decomposition, succession, etc. (Turner et al. 2003, p.8). Synergy of these processes with interdependent components determines the distinguishing features of wetlands that are essential for a detailed definition. Mitsch and Gosselink (2000, p.26) presents three main features as the presence of:

- “…water, either at the surface or within the root zone.”
- “…unique soil conditions that differ from adjacent uplands.”
- “…vegetation adopted to the wet conditions (hydrophytes) and,…absence of flooding-intolerant vegetation.”

Although these features are helpful in defining wetlands, the variety in wetland types, sizes, locations and conditions complicates the definition process. Variety of these properties results in different definitions that are also supported by the differences in personal perceptions, influences, concerns and perspectives (Kent, 1994; Mitsch and Gosselink, 2000). Thus, although efforts for defining wetlands are relatively new, there are various definitions developed by different organizations and institutions depending on their objectives and perspectives (Appendix A).

The main distinction occurs between scientific and managerial (legal) definitions. Scientists need flexible yet rigorous definitions to use in classification, inventory and research practices, while managers need clear and legally binding definitions for development and application of laws, regulations and plans (Mitsch and Gosselink, 2000, p.28). Definition presented by the National Research Council of the U.S. National Academy of Sciences in 1995 is a detailed and comprehensive example of scientific definitions:

> A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physiochemical, biotic, or anthropogenic factors have removed them or prevented their development. (NRC, 1995 in Mitsch and Gosselink, 2000 p.31)

On the other hand, definition presented by the U.S. Army Corps of Engineers in 1984 is a legally accepted and widely used example of managerial definitions:

> The term “wetlands” means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally

include swamps, marshes, bogs, and similar areas. (33 CFR 328.3(b); 1984 in Mitsch and Gosselink, 2000, p.32)

Proper wetland definitions are necessary for both scientific studies and management efforts; however different definitions cause problems when these two fields (science and management) meet in practice. Therefore, a comprehensive, practical and understandable definition is needed for the achievement of research and intervention processes. The definition developed by the Ramsar Convention answers this need. In Article 1.1 of the text of Convention, wetlands are defined as:

> "areas of marsh, fen, peatland 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 six metres" (Ramsar Convention Secretariat, 2006, p.7).

Additionally, in Article 2.1 it is stated that wetlands:

> "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Ramsar Convention Secretariat, 2006, p.7).

This is a broad and managerial definition which includes nearly all water resources except for marines, glaciers and aquifers. Adding water body to the wetlands, this definition diverges from scientific definitions however it is the most accepted definition internationally. According to the Ramsar Convention's web site there are 158 member countries of the convention including Turkey (Ramsar Convention on Wetlands, 2008). Therefore, Ramsar definition of wetlands is used in this research for achieving consistency with planning and management practices in Turkey.

1.2.2. Wetlands in the World and Turkey

Throughout the history, civilizations were established near wetlands and communities lived in dependence and harmony with them, however wetlands were misunderstood until the recent history. Until the second half of the 20th century, wetlands have been perceived as worthless wastelands that are causing odors and illnesses, thus they have been drained and destroyed. Especially after the recognition of their relation with malaria epidemic, drainage of wetlands became a government policy in many countries including Turkey. Wetland management perceived as conversion or destruction of wetlands and they have been converted to agricultural fields or residential areas (Matthews, 1993; Williams, 1993; Özesmi, 1999; Mitsch and Gosselink, 2000; Finlayson, 2005; Ramsar, 2006).

In 1960s, with the recognition of the importance of wetlands as fish and waterfowl habitats, perception of wetland management began to change. In addition to this change, wetland losses and following problems exposed the need for understanding wetland structure and processes. Efforts for understanding the structure and processes of wetlands resulted in the accumulation of knowledge about wetlands and realization of their various functions and services for humans. With the recognition of their functions and services, attitudes to wetlands have started to change. As a result; protection, regulation and management of wetlands became the focal point of various institutions and organizations (Matthews, 1993; Williams, 1993; Özesmi, 1999; Mitsch and Gosselink, 2000; Finlayson, 2005). As a result; protection, regulation and management of wetlands became the focal point of various stakeholders and national and international meetings, conferences, conventions and agreements were established about conservation and sustainability of wetlands. A similar recognition process also took place in Turkey with two decades delay of the action.

For a better understanding of the conditions of wetlands in Turkey today, evolution of the national and international attitudes on wetlands should be analyzed in a historical context. Thus, events and regulations concerning the wetlands are listed through a periodization developed by Özesmi (1999). Özesmi explains the environmental history of Turkey in four periods of: subsistence level agriculture, commercialization of agriculture, modernist revolution and liberal capitalism. Changes in attitudes towards wetlands in national and international levels are analyzed through these four periods here.

- ***Subsistence Level Agriculture Period***

In this period until the 19th century, the pressure on natural resources and wetlands was limited as a result of the subsistence level agricultural production (Özesmi, 1999, pp.56-59).

- ***Commercialization of Agriculture Period***

In this period between the 19th and 20th centuries, the shift from subsistence level agriculture to cash crop production resulted in the exploitation of the natural resources (Özesmi, 1999, pp.60-63). Following the intensive capitulations, bankruptcy of the Ottoman budget increased the economic dependency to the world. In the first half of the 19th century, Ottoman Empire turned into "an agrarian reserve of the expending European capitalist economies" for paying the debts (Özesmi, 1999, p.60).

- 1881 – As a result of the "bankruptcy of the Ottoman budget", Düyun-i Umumiye-i Osmaniye Meclis-i İdaresi was formed for paying the debts of the empire (Özesmi, 1999, p.61).

In spite of the increase in production, food security was lost as a result of the shift from food production to cash crop production. People's relationship with nature and land as a source of food and a part of the livelihood changed and land became a source of profit. Increasing pressures and changing attitudes resulted in the expansion of agricultural fields and exploitation of natural resources (including wetlands) (Özesmi, 1999, pp.60-63).

- 1914-1918 – World War I
- 1919-1922 – War of Independence

During the wars period, trade connections with the world were destroyed resulting in subsistence level production and exploitation of game resources (Özesmi, 1999, p.65).

- 1923 – Foundation of the new Turkish Republic

- ***Modernist Revolution Period***

In this period following the foundation of Turkish Republic, foreign economic control was rejected and "étatism" was taken as the focal point of development affords (Özesmi, 1999, p.74). As Özesmi (1999, p.113) explains, étatism is "state led social and economic development, where the state initiates and owns major industrial investments". Although the development affords were canalized on modernization and national production, pressure on the natural resources persisted in this period.

- 1937 – Hunting Law was enacted
- 1939 – In spite of the law, government supported the eradication of animal pests (especially wolf and wild boar) for supporting the agricultural production (Özesmi, 1999, p.68).
- 1939-1945 – World War II

Following the 1940s, medical treatments and drainage of wetlands for the eradication of malaria, and intensified use of fertilizers and pesticides are resulted in increasing production and population (Özesmi, 1999, p.68-72). As a result of these developments, pressures on natural resources and especially wetlands were intensified.

- 1947 – After the 2nd World War, Marshall Plan was announced following the Truman Doctrine by USA. It was "a massive military and economic aid programme designed to rebuild Europe, open up export markets for the USA and contain communism" (Magnin & Yarar, 1997, p.19).
- 1950 – Democratic Party won the election in Turkey.

- ***Liberal Capitalism Period***

In this period until today, exploitation of the natural resources (including wetlands) has been intensified. The major change that defined this period was the replacement of modernist agenda with the liberal capitalism that has changed the economic and political structure of Turkey. National and international changes that took place in this period are listed in a chronological order here.

- **1950s** – After the election in 1950, state "accepted the status of 'underdeveloped'" to "become a recipient of Marshall donations and credits" (Özesmi, 1999, p.70). In the 1950s, American aid was used for agricultural development in Turkey especially through importing agricultural machinery (e.g. the number of tractors increased from 1750 to 30000 during 1984-1952). Also low-interest credits were provided to the farmers (Magnin & Yarar, 1997, p.19) and infrastructure services were improved through state investments. Following the mechanisation, improvements and the credits, the area under cultivation was increased (14,5 million ha in 1948, 22,5 million ha in 1956, 36 million ha in 1994, i.e. 46,6 % of total surface area) resulting in a decrease in available grazing land (50 % reduction during 1950-1984) (Magnin & Yarar, 1997, p.19).
- 1950 – Convention for the Protection of Birds, took place in Paris (ratified in 1966 by Turkey).
- 1950 – "Law Concerning the Drainage of Swamps" that promotes and facilitates the reclamation of wetlands was enacted.

- 1953 –DSİ (Devlet Su İşleri Genel Müdürlüğü – General Directorate of State Hydraulic Works) was founded with the purpose of “flood control, irrigation, reclamation of marshes, production of hydro-power, provision of drinking water and the taming of rivers” (Magnin & Yarar, 1997, p.19). With the foundation of DSİ following the Law Concerning the Drainage of Swamps, degradation and depletion of wetlands were intensified in the sake of increasing agricultural production.
- 1953 – Law Concerning the Establishment and Functions of the General Directorate of State Water [Hydraulic] Works was enacted.
- 1956 – Forestry Law was enacted.

- **1960s** – With the 1960s, planned development period started and, agricultural and industrial developments continued with five-year development plans. Also global influence on market supported these developments. While values and importance of wetlands started to be recognized in the world in this period; nature conservation issues lost their importance till the 1980s in Turkey (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1960 – “Law on Malaria Eradication” which promotes and facilitates the reclamation of wetlands like the “Law Concerning the Drainage of Swamps” was enacted.
- 1961 – 1961 Turkish Constitution was issued.
- 1966 – Convention for the Protection of Birds (Paris Convention) was ratified
- 1967 – International Wetlands Ecology Technical Meeting took place in Ankara. Meeting concluded with an agreement on the preparation of an international convention (later became Ramsar Convetion) for the conservation of wetlands (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1965-1984 – Agricultural subsidies and incentives resulted in excessive and redundant use of fertilizers (Bayraklı, 1987 in Sarısoy et al., 2007, p.336).

- **1970s** – With the influence of intensified and internationalized concerns about the environmental problems in the World, nature conservation associations and organizations started to form in Turkey.
- 1971 – (Ramsar Convention) Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, Iran was opened for signature and entered in force later in 1975 (ratified in 1994 by Turkey) (Magnin & Yarar, 1997, p.25).

- 1971 – Aqua Products Law was enacted.
- 1972 – United Nations Conference on the Human Environment (Stocholm Conference) was coordinated (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002) and marked a turning point in the development of international environmental policies. Basics of the "Sustainable Development" concept were developed (Erdoğan, 2007, p.100).
- 1972 – Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO) was signed (ratified in 1982 by Turkey).
- 1973 – Convention on International Trade in endangered Species of Wild Fauna and Flora (CITES – Washington Convention) was signed (ratified in 1996 by Turkey).
- 1975 – (Barcelona Convention) Convention for the Protection of the Mediterranean Sea against Pollution was signed (ratified in 1976 by Turkey) and Mediterranean Action Plan was prepared (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1975 – Convention Concerning the Protection of the World Cultural and Natural Heritage (ratified in 1982 by Turkey) was signed.
- 1975 – (Barcelona Convention) Convention for the Protection of the Mediterranean Sea against Pollution was ratified.
- 1978 – Under Secretariat of Environment (Çevre Müstaşarlığı) was founded (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1979 – (Bern Convention) Convention on the Conservation of European Wildlife and Natural Habitats (ratified in 1984) was signed. (Magnin & Yarar, 1997, p.25)
- 1979 – EU, Directive on the Conservation of Wild Birds was published (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1979 – (Bonn Convention) Convention on the Conservation of Migratory Species of Wild Animals was signed and ratified by Turkey (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).

- **1980s –** Following the developments on environmental conservation activities in the World, regulations and governmental organizations concerning the conservation of wetlands were provided.
- 1982 – Protocol on Mediterranean Special Protected Areas (MedSPA – under Barcelona Convention) was signed (ratified in 1988 by Turkey) (Magnin & Yarar, 1997, p.25).

- 1982 – 1982 Turkish Constitution was issued.
- 1982 – “Tourism Promotion Law” which dictates that utmost priority should be given to development of the tourism sector was enacted.
- 1982 – Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO) was signed (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1983 – World Commission on Environment and Development (Brundtland Commission) was convened by U.N. (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1983 – Environment Law was enacted.

Environmental Law gives a definition of the wetlands similar to the Ramsar Convention’s definition. Article 9 of the law includes commands about the conservation of environmental assets. According to the clause (a) of the article 9, conservation of biodiversity and ecosystems should be achieved. It also states that principles about the conservation and management of biodiversity should be developed in collaboration with local administrations, universities, NGOs and other related institutions.

  - Clause (c) of the article 9 states that having conservation status according to national legislation or international conservations, all ecologically sensitive areas should be included in plans. It also emphasizes that these areas should be used and managed according to decisions of the plans.
  - Clause (e) of the article 9 provides commands about the wetlands. Clause (e) emphasizes that conservation of natural structures and ecological balance of wetlands should be achieved. It also states that wetlands must not be filled or drained for reclamation.
  - Clause (e) also states that procedures and principles about the conservation and management of wetlands should be determined with the regulation prepared by the Ministry in association with the related agencies and institutes. This emphasised regulation is the Regulation Concerning the Conservation of Wetlands which was entered into force in 2002 and renewed in 2005.
  - Environment Law also defines the penalties for the activities against the conservation and management of wetlands.

- 1983 – National Parks Law was enacted.

- 1983 – Law on Protection of Cultural and Natural Assets was enacted.
- 1984 - (Bern Convention) Convention on the Conservation of European Wildlife and Natural Habitats was ratified.
- 1987 – The report of the Brundtland Commission, “Our Common Future” was published and “Sustainable Development” concept was developed (Erdoğan, 2007, p.100).
- 1988 – Water Pollution Control Regulation was enacted.
- 1989 – Decree-Law on the Establishment of the Authority for the Protection of Special Areas was enacted.
- 1989 – Environmental Protection Agency for Special Areas was founded (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1989 – The book entitled “Important Bird Areas in Europe” was published by Birdlife International and Wetlands International. The book includes 2444 Important Bird Areas, 79 of which were from Turkey (Magnin & Yarar, 1997, p.7). Listing the important areas for the conservation of birds this study is an important step for the conservation of wetlands.
- 1990 – Coastal Law and the Regulation Concerning the Implementation of Coastal Law was enacted.
- 1990 _ “Important Bird Areas in Turkey Project” was started by DHKD and finished in 1997 (Magnin & Yarar, 1997, p.8).
- 1991 – Decree-Law concerning the Establishment and Functions of the Ministry of Environment was enacted and Ministry of Environment was founded (Magnin & Yarar, 1997, p.23).
- 1991 – Managing Mediterranean Wetlands and Their Birds for the Year 2000 and Beyond Symposium was coordinated in Grado, Italy (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1992 – (Earth Summit or Rio Summit) United Nations Conference on Environment and Development was coordinated in Rio de Janeiro (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002). After the Conference “Sustainable Development” became a global policy (Erdoğan, 2007, p.100). The Earth Summit resulted in the following documents: Rio Declaration on Environment and Development, Agenda 21, Convention on Biological Diversity, Forest Principles, and Framework Convention on Climate Change.

- 1992 – Convention on the Protection of the Black Sea against Pollution was signed in Bucharest (ratified in 1994 by Turkey). 1992 – Convention on Biological Diversity was signed (ratified in 1996 by Turkey).
- 1992 – (Helsinki Convention) Convention on the Protection of the Marine Environment of the Baltic Sea Area was signed.
- Convention on Combating Desertification, Paris (Magnin & Yarar, 1997, p.25)
- 1993 – Environmental Impact Assessment (EIA) Regulation was entered in force.
- 1993 – Prime Minister's Decree on the Conservation of Wetlands was established. Calling for "a revision of all projects that may possibly affect wetland habitats" it was the first legal instrument especially dealing with wetlands (Magnin & Yarar, 1997, p.24).

Promulgated in 1993, the Decree answered the needs about wetlands until the Regulation Concerning the Conservation of Wetlands was entered into force. The Decree provided the following commands about wetlands (Ceran, 2007, pp.94-95).

  - Projects with the possible negative impacts on wetlands should be re-considered.
  - Waste water treatment systems should be established in all the facilities polluting wetlands and the standards of the "Water Pollution Control Regulations" should be achieved.
  - Wrong and excessive fertilizer and pesticide use in agricultural fields surrounding wetlands should be controlled and education programmes should be provided.
  - Development of touristic and industrial facilities especially in the coastlines surrounding lagoons and lakes should be prevented and controlled.
  - Wrong, excessive and illegal hunting, reed cutting and burning in wetlands should be prevented.
  - Surrounding and supporting wetland ecosystems; marsh and meadow communities, forests, etc. should be conserved.
  - Being the responsible organization about wetlands, Ministry of Environment and Forestry should be consulted in all decision making processes concerning the wetlands.

- Coordination and cooperation among the Ministry of Environment and Forestry and related organizations should be developed for achieving the conservation and improvement of the wetlands. Also, monitoring of the wetlands should be achieved.

- 1994 – (Ramsar Convention) Convention on Wetlands of International Importance Especially as Waterfowl Habitat was ratified by Turkey.

Although Turkey had been attending the Conference of Contracting Parties since 1980, the convention was ratified in 30.12.1993 by Turkey (Erdoğan, 2007, p.101). Following 94/5434 numbered Decree of the Council of Ministers, the Convention was promulgated in 21937 numbered official journal in 17.05.1994 and entered into force. Conservation of wetlands became an international issue in Turkey after the entrance of the Convention into force. With ratification of the Convention, Turkey accepted the conservation, development, management and wise use of all the wetlands in its boundaries. 13 wetlands from Turkey were included in the List of Wetlands of International Importance of the Convention (Ceran, 2007, p.90).

- 1995 – Wetlands Bulletin No.2 was notified (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002) and Kuş Gölü, Burdur Gölü, Sultansazlığı, Seyfe Gölü and Göksu Deltası were declared as 'Wetlands of International Importance' of Turkey (Magnin & Yarar, 1997, p.25).
- 1996 – Convention on Biological Diversity was ratified (Magnin & Yarar, 1997, p.25).
- 1996 – National Biodiversity Strategy and Action Plan were prepared (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).
- 1997 – The book entitled "Important Bird Areas in Turkey" was published by DHKD. 97 Important Bird Areas were determined and included in the book (Magnin & Yarar, 1997).
- 1998 – Wetlands Bulletin No.3 was notified and Kızılırmak Deltası, Gediz Deltası, Uluabet Gölü and Akyatan Lagünü were declared as 'Wetlands of International Importance' (in addition to five declared wetlands in 1994) (Ceran, 2007, pp.89-90).

- 1998 – National Environmental Action Plan was prepared by the Ministry of Environment in coordination with the State Planning Organization (Karadeniz, 1995; Arı, 2001; Azcanlı, 2002).

- 2002 – Regulation Concerning the Conservation of Wetlands was entered in force.

Promulgated in 24656 numbered official journal in 30.01.2002 the “Regulation Concerning the Conservation of Wetlands” entered into force and later renewed as it was promulgated in 25818 numbered official journal in 17.05.2005. This regulation is the only legal instrument directly concerning the conservation of wetlands in Turkey. Being prepared depending on the provisions of the Ramsar Convention, this regulation coordinates the implementation of the Convention in Turkey. All the wetlands in Turkey are subject to this regulation thus all the implementations on these areas should be appropriate with the regulation (Ceran, 2007, p.92).

Main purpose of the regulation is defined as the conservation and improvement of the wetlands whether they are internationally important or not and determination of the principles for collaboration and coordination between institutions concerning these issues. Scope of the regulation covers the conservation, wise use and management of wetlands and related habitats with the procedures and principles about Local and National Wetland Commissions (Sulak Alanların Korunması Yönetmeliği, 2005).

The regulation provides guidance on the issues about conservation and use principles, conservation zones and related activities, management plans and their implementation, determination of new Ramsar sites, establishment and operating principles of Local and National Wetland Commissions (Sulak Alanların Korunması Yönetmeliği, 2005).

Local and National Wetland Commissions: Following the regulation, National Wetland Commission was established with the tasks of:

- Consulting and deciding on the issues about wetlands;
- Approving and implementing conservation zones and management plans;
- Working for achieving association and coordination with the national and international agencies and institutes.

- Regulation also proposes the establishment of Local Wetland Commissions for the wetlands with management plans in practice or preparation.

Conservation Zones: Regulation describes four conservation zones of; Absolute Conservation Zone, Wetland Zone, Ecological Interaction Zone and Buffer Zone with their codes of practice. Forbidden and allowed activities on these zones were also provided in the regulation.

- Absolute Conservation Zones are the areas that waterfowls are densely and collectively nesting and breeding; rare and endangered bird species are breeding; and endangered or rare flora species are spread.
- Wetland Zones are the areas composed of habitats like; open water surfaces, lagoons, estuaries, salt marshes, swamps, wet meadows, reed beds and peat lands.
- Ecological Interaction Zones are the areas consisting of habitats like; sea, dunes, beaches, bushes, forests, meadows and rice beds, that are related with and supporting wetland ecosystems.
- Buffer Zones are the areas defined for the conservation of wetland ecosystems. Limited with the borders of the catchment area, they extend at least 2500 m far from the Ecological Interaction Zone.

- 2002 – National Wetland Commission prepared and accepted the National Wetland Strategy 2003-2008 with the purpose of conservation and wise use of wetlands. Strategy provides 70 activities about 12 issues for achieving four main purposes. These 12 issues of the strategy were listed as follows:
    1. Monitoring and valuation
    2. Policies and legislation
    3. Integration of wise use of wetlands with sustainable development
    4. Restoration and rehabilitation
    5. Invasive alien species
    6. Local people and cultural values
    7. Private sector involvement
    8. Communication, education and awareness
    9. Declaration of new Ramsar sites
    10. Management planning and monitoring of Ramsar sites

11. Institutional capacity raising
12. Financing of wetland conservation and wise use

- 2003 – Hunting Law was renewed
- 2003 – Decree-Law concerning the Establishment and Functions of the Ministry of Environment was renewed. According to the Decree-Law; Ministry of Environment and Forestry is the responsible organization with the conservation and management of wetlands in Turkey.
- 2005 – Regulation Concerning the Conservation of Wetlands was renewed and entered in force.
- 2005 – Wetlands Bulletin No.4 was notified and Yumurtalık Lagünü, Meke Gölü and Kızören Obruğu were declared as 'Wetlands of International Importance' (in addition to nine declared wetlands in 1994 and 1998) (Ceran, 2007, pp.89-90).
- 2006 – Environment Law was renewed
- 2009 – Wetlands Bulletin No.5 was notified and Kuyucuk Gölü was declared as Turkey's 13th Wetland of International Importance (Ramsar, 2009).

The Turkish Constitution states that "international treaties which have been ratified by Parliament automatically become law of the land" (Magnin & Yarar, 1997, p.25). Thus, all the ratified Conventions become a part of Turkish law and regulations, and as Magnin & Yarar (1997, p.25) state "they have superior ruling over the existing laws and they may not be challenged before the Constitutional Court". Providing guidance on the conservation and wise use of wetlands, Ramsar Convention is the main guideline for the regulations about wetlands in Turkey. Thus for a better understanding of the conditions of wetlands in Turkey structure and operation of the Ramsar Convention are briefly explained below.

1.2.3. Ramsar Convention

- ***Brief History of Ramsar Convention***

As a response to increasing amounts of degradation and loss of wetlands and decline in numbers of waterfowl in Europe, a programme entitled "Project MAR" was established in 1960. As a part of this project the MAR Conference was organised by Dr. Luc Hoffmann, with the participation of the World Conservation Union (IUCN), Wetlands International

(IWRB) and Birdlife International (ICBP) in 1962 in French Camargue (Ramsar, 2006, p.24). A call for an international convention on wetlands came from this Conference in 1962. After the call, the convention text was developed through a series of international meetings and negotiations, "held mainly under the auspices of IWRB, the guidance of Prof. G.V.T. Matthews, and the leadership of the Government of the Netherlands" (Ramsar, 2006, p.24).

In 1971, the text of the Convention was agreed and signed by the delegates from 18 nations at the international meeting in Ramsar, Iran and with the ratification of Greece in 1975 "The Convention on Wetlands of International Importance especially as Waterfowl Habitat" entered into the force. After its adoption, the Convention was modified in 1982 and 1987, as a result of the "Paris Protocol" and the "Regina Amendments", respectively (Ramsar, 2006, p.24). As the full name of the Convention reflects, at the beginning the main concern of the Convention was the conservation of "waterfowls" however throughout the history its scope was broadened and covered "all aspects of wetland conservation and wise use" (Ramsar, 2006, p.6).

According to the Ramsar Convention's web site, there are 159 Contracting Parties, or member States, in the world. More than 1.873 wetlands have been designated for inclusion in the List of Wetlands of International Importance, covering 184.030.126 hectares (1.84 million square kilometres) (Ramsar, 2009).

- ***Purpose and Mission of the Convention***

Recognizing the importance and value of wetlands and their interdependence with people, Ramsar Convention aims to stop the degradation and loss of wetlands through cooperative and intergovernmental action for the conservation and wise use of wetlands (Ramsar, 2006, p.12).

Acknowledging the need for cooperative and intergovernmental action, the mission of the Ramsar Convention was (adopted by the Parties in 1999 and refined in 2002) stated as "*the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world*" (Ramsar, 2006, p.7).

- ***Structure of the Convention***

The Ramsar Convention operates through continuing partnership and coordination of its main organs of; the Contracting Parties, the Standing Committee, the Convention Secretariat, the Scientific and Technical Review Panel (STRP) and the International Organization Partners (IOPs) (Ramsar, 2006, p.33).

Although, the United Nations Educational, Scientific and Cultural Organization (UNESCO) serves as Depositary for the Convention, it is an independent body responsible only to its Conference of the Contracting Parties (COP) (Ramsar, 2006, p.6).

Conference of the Contacting Parties (COP) is "the policy-making organ of the Convention which adopts decisions (Resolutions and Recommendations) to administer the work of the Convention and improve the way in which the Parties are able to implement its objectives" (Ramsar, 2006, p.33).

Contracting Parties of the Convention meet every three year in COP to:

- "discuss the implementation of the Convention and its further development",
- "consider national experiences",
- "review the status of sites on the List of Wetlands of International Importance",
- "adopt technical and policy guidance for the Parties on matters affecting the wetlands in their territories",
- "promote cooperative activities",
- "receive reports from international organizations",
- "adopt the budget for the Convention secretariat for the ensuing three years" (Ramsar, 2006, p.18).

Contracting Parties work through guidelines that are developed at the COP. For regulating the long term works of the Parties, the Framework for Implementation of the Ramsar Convention was adopted in 1984 for the first time. Until 1996, this framework updated at the COPs and than Strategic plans started to be developed instead (Ramsar, 2006, p.33). The 1st Ramsar Strategic Plan was prepared for the period 1997-2002 and the 2nd Strategic plan was developed for the period 2003-2008. The current Strategic Plan for the period 2009-2015 sets out five "goals" and 28 "strategies" for the Contracting Parties (Ramsar Strategic Plan, 2009-2015).

Between its triennial meetings, the COP is being represented by the "intersessional executive body of the Convention"; the Standing Committee. Members of the Standing Committee are being selected in the COP to serve until the next meeting of the COP (Ramsar, 2006, p.35).

Located in Gland, Switzerland and hosted by the World Conservation Union (IUCN), the Secretariat administers the Convention (Ramsar, 2006, p.18). The Ramsar Secretariat (called the "Bureau") develops synergies with other environment-related conventions by forming communication and cooperation through meetings, joint researches and joint actions (Ramsar, 2006, p.20). The main partners of the Ramsar Convention are:

- The Convention on Biological Diversity (CBD)
- The Convention on Conservation of Migratory Species of Wild Animals (CMS)
- UNESCO World Heritage Convention
- United Nations Convention to Combat Desertification (UNCCD)
- United Nations Framework Convention on Climate Change (UNFCCC)

The Standing Committee selects the members of the Scientific and Technical Review Panel (STRP) which is a subsidiary body of the Convention, providing scientific and technical guidance to the COP. STRP was first established in 1993 with the Resolution 5-5 (Ramsar, 2006, p.40).

The Convention works in cooperation and collaboration with five global non-governmental organizations (NGOs) that have the formal status of "International Organization Partners of the Convention" (Ramsar, 2006, p.45). These five partners (IOPs) of the Convention are:

- Birdlife International (formerly ICBP)
- IUCN – The World Conservation Union
- IWMI – The International Water Management Institute
- Wetlands International (formerly IWRB, the Asian Wetlands Bureau, and Wetlands for the Americas)
- WWF (World Wide Fund for Nature) International

- ***Commitments for the Convention***

Four articles following the 1st Article of the text of Convention provides the four major commitments of the Contracting Parties:

- *Listed sites:* According to *Article 2* of the text, at least one wetland should be included in the “List of Wetlands of International Importance” (the Ramsar List) for accession to Convention and its conservation and wise use should be achieved. Also further wetlands should be designated for the Ramsar list.
- *Wise use:* According to *Article 3* of the text, issues of conservation and wise use of wetlands should be included in the national land use plans of the Contracting Parties.
- *Reserves and training:* According to *Article 4* of the text, nature reserves should be established in the wetlands of the Contracting Parties and training programmes on wetland research, management and conservation should be provided.
- *International cooperation:* According to *Article 5* of the text, consultation and cooperation mechanisms should be developed among Parties, especially about shared systems and species.

The Parties submit triennial National Reports to the Conference of the Contracting Parties for reporting their works and progress in meeting their commitments (Ramsar, 2006, p.18). Although the Convention “is not a regulatory regime and has no punitive sanctions for violations of or defaulting upon treaty commitments”, it is a widely recognized and followed treaty in the world that is accepted in international law. Also many Contracting Parties “embody international Ramsar obligations in national law and/or policy with direct effect in their own court systems” (Ramsar, 2006, p.16). Regulating the decisions and interventions on wetlands in Turkey, “Regulation Concerning the Conservation of Wetlands” (Sulakalanların Korunması Yönetmeliği) is a good example that was prepared depending on the text of the Convention.

In addition to the legal regulations, planning is an important tool in the implementation of the commitments. Importance of planning as a tool for the conservation and wise-use of wetlands was also emphasized among the responsibilities of the Contracting Parties in Resolution 5.1 (1993) of the Conference of the Parties (Framework for the implementation of the Ramsar Convention), as follows (Ramsar, 2006, pp.16-17):

- “to formulate and implement planning so as to promote conservation of listed sites;
- to formulate and implement planning so as to promote the wise use of wetlands;”

1.3. Research Questions

As it was mentioned in the research focus above, this research aims to understand, the trade-offs between human interventions and human well-being by analyzing, especially the long term, economic costs of losing the contributions/functions of the Kızılırmak Delta for testing the hypothesis of: **"Although human interventions on wetlands are economically beneficial in the short term, resulting in the losses of ecosystem functions provided by the wetlands, they cause irreversible changes and economic losses in the long term"**. This hypothesis of the research was tested through answering the following question: How do the function losses affect human well-being in economic terms in the Kızılırmak Delta? But before answering this question primer questions were answered first. A new framework was developed for testing the specific hypothesis of this research and answering its main questions. Main questions of the research were answered by different analyses through the framework as follows.

First the importance of the delta was analyzed by answering the following questions: What is the importance of the Kızılırmak Delta? Why and for whom is the Kızılırmak Delta important? How does the Kızılırmak Delta contribute to human well-being? These questions were answered through the analysis of the Environmental History of the delta, Evaluation of its ecological, socio-cultural and economic structures and analysis of its ecosystem functions (Function Analysis), consecutively.

Then, the following questions were answered for understanding the problems of the delta: What are the problems of the Kızılırmak Delta? Why are the functions of the Kızılırmak Delta being lost at the expense of human well-being? The changes in the Kızılırmak Delta, their reasons and impacts were analyzed by Action Analysis for answering these questions. DPSIR (Driving forces, Pressures, State, Impacts and Response) Framework was used in this analysis.

Finally the following question was answered through Monetary Valuation before analyzing the costs of losing those contributions: How does the Kızılırmak Delta contribute to human well-being in economic terms? Trade-offs between human interventions and human well-being were explained in the end of the analyses.

1.4. Research Approach

As presented in the “Research Process” in Figure 1-2 below, first the theoretical framework of the research was developed while the problem definition was rationalized by answering the questions of: What is the importance of wetlands? Why and for whom the wetlands are important? What are the problems of wetlands? Why are wetlands being lost? What happens as a result of wetland losses? What are the main reasons of wetland losses?

Answering the questions through a comprehensive literature review, first, the functions and services of wetlands were presented and the importance and values of them were defined. Then, wetland losses were explained in a relational process through DPSIR (Driving forces, Pressures, State, Impacts and Responses) Framework and the reasons and results of their problems were revealed. Afterwards, usage and importance of wetland valuation practices and their role in decision making processes were explained. Next, the most common frameworks for integrated assessment and valuation of wetlands were briefly explained and compared. Then, two main parts of these frameworks; function analysis and valuation were explained in detail. Finally, the problems and paradoxes of wetland valuation practices were stated.

Following the literature review and depending on the theoretical framework, main research questions and hypothesis, explained above, were defined in the methodology part. Defining the main hypothesis of the research and acknowledging the strengths and weaknesses of the existing frameworks, a new framework was developed for the specific purpose of the research. The defined questions of the research were answered through this new framework by successive analyses. After designing the structure of the research, the necessary data, their sources and collection processes were defined in details. Following the research design; selection criteria for the Kızılırmak Delta, its general properties and environmental history were briefly explained.

Importance of the Kızılırmak Delta was analyzed by the evaluation of its ecological, socio-cultural and economic structure and its functions/contributions were determined through function analysis. Reasons and results of the problems of the delta were analyzed through DPSIR framework by action analysis. Using this framework, main reasons behind the problems of the Kızılırmak Delta were investigated. Then, economic contributions of the delta to human well-being were calculated through monetary valuation and the costs of losing these functions were analyzed by trade-off analysis. At the end, the study limitations of the research and its contributions to literature were defined in the conclusion part. Also some recommendations were provided for planners and further studies.

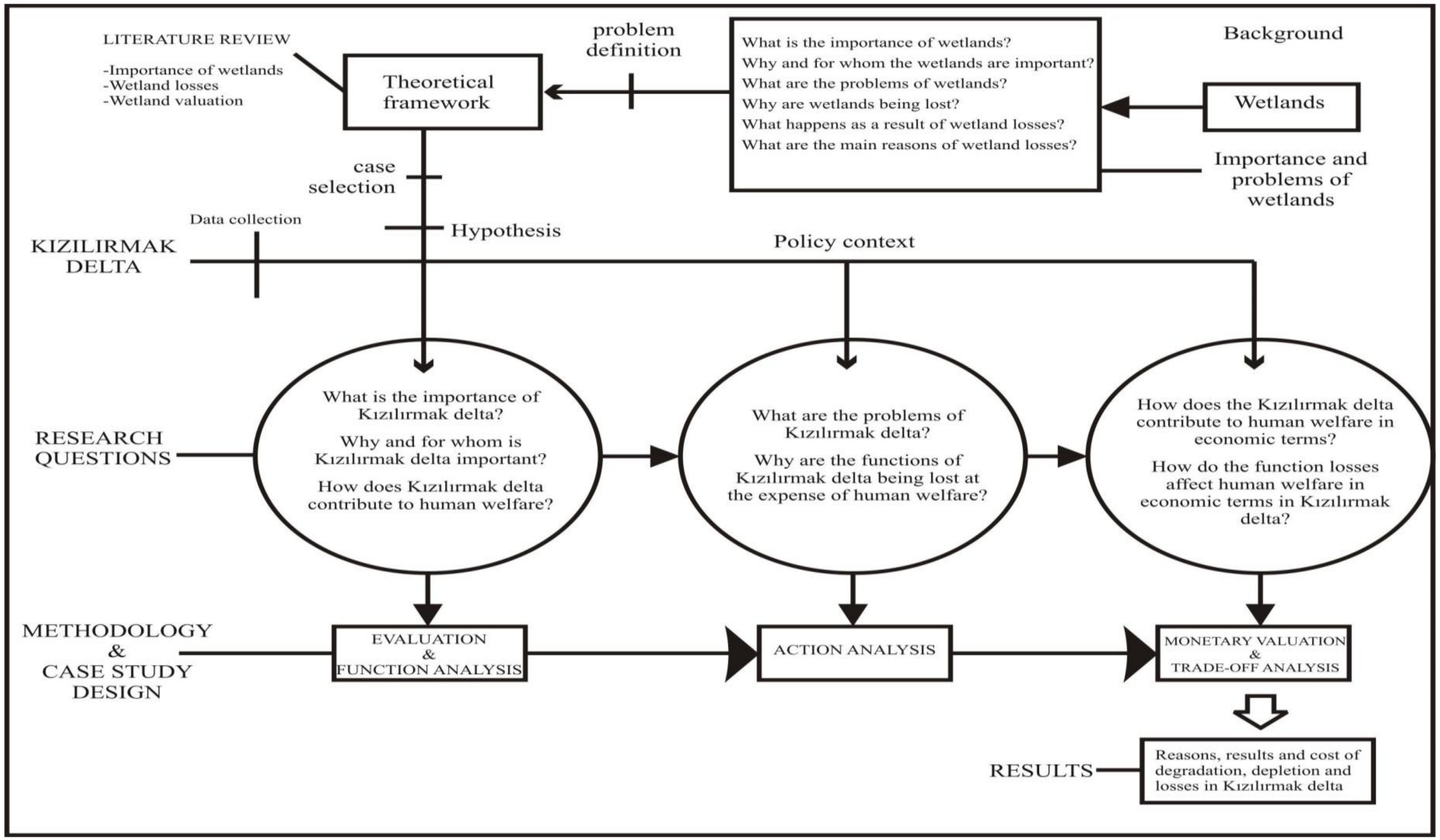

Figure 1-2 Research Process

1.5. Research Relevance and Significance for Planning Discipline

This research about the trade-offs between human interventions and human well-being in the Kızılırmak Delta case is relevant to planners since they are important actors of the decision making processes. As it was mentioned before, wetlands are among the most threatened ecosystems of the world however undervaluation or ignorance of their contributions on human well-being intensifies the pressures on these natural resources. Resulting in the changes on ecological, socio-cultural and economic structures, these pressures cause losses in human well-being. Thus, improvement of human well-being and sustainability of the development depend on the conservation and wise use of wetlands. Therefore, for achieving sustainable development; wetlands and their contributions on human well-being should be recognized and considered in decision making and planning processes.

Developing and implementing a framework for analyzing the dynamics, problems and contributions of wetlands this research provides guidance for planners and researchers. Developed framework can be used for better informed decisions in planning processes by the planners. Understanding the processes in the wetlands, identifying their contributions on human livelihood and analyzing the pressures on them; appropriate policies and strategies can be developed for the plans. Therefore, this framework can be used in analyses parts of planning processes in addition to SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis. Since planners are negotiators among the stakeholders in decision making processes, they should be better informed about the dynamics of the system they are planning. Also with the recognition of the impacts of environmental problems, especially global warming and climate change, on human well-being, representation of natural systems in decision making processes gained importance. Therefore, as negotiators, planners should achieve the representation of wetlands in planning processes. Recognition and understanding of the processes and contributions/functions of wetlands through the developed framework help planners in convincing the stakeholders and support the advocacy of the wetlands.

1.6. Orientation to the Document

In this document, theoretical framework, methodological approach, analyses of the case study and resulting conclusions of the research were presented sequentially. This First Chapter of this document defines the focus, questions and approach of the research and its relevance with the planning discipline. Also it provides the necessary background information about the wetlands in the world and Turkey. Second Chapter outlines the theoretical framework of the research by presenting the importance and problems of wetlands and analyzing the frameworks for their valuation. Third Chapter primarily describes the research design and methodology. Then it introduces the Kızılırmak Delta case and presents the processes and results of the analyses. Fourth Chapter of the document provides the concluding remarks by representing the study limitations, discussions and recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1. Importance of Wetlands

As a result of their various properties, wetlands are intrinsically important ecosystems from an ecocentric point of view. Being the milieu and source for life and diversity, they are important components of biosphere and biodiversity. Consisting of various components and including different relationships and processes, wetlands are rich and productive ecosystems. As Williams (1993, p.9) states they are "amongst the most productive" ecosystems in the world.

As a result of their open and complex structures, wetlands are highly susceptible and vulnerable ecosystems, which are being threatened globally and historically. Being degraded, depleted, lost and becoming less their importance increase consistently. Costanza et al. (1997a, p.259) supports that: "As natural capital ecosystem services become more stressed and more 'scarce' in the future, we can only expect their value to increase. If significant, irreversible thresholds are passed for irreplaceable ecosystem services, their value may quickly jump to infinity." Wetlands are also important ecosystems because of their contributions to human welfare and well-being. Providing various functions (goods and services) for humans, wetlands are approved as important components of human well-being.

Although the importance of wetlands is widely realized today, the level of their importance varies depending on the perceptions, conceptions and philosophical views of different disciplines and schools of thought about their contributions to welfare (De Groot et al. 2006, p.3). Therefore, for understanding the importance of wetlands from anthropocentric point of view, their functions, services and goods should be determined first.

2.1.1.Functions and Services of Wetlands

Turner (et al. 2003 p.9) defines the ecosystem functions as “the result of interactions among characteristics, structure and processes”, while De Groot (1992 in De Groot 2006, pp.176-177) defines them as “the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly”. Ecosystem goods and services are defined by Costanza (et al. 1997a, p.253) as the benefits derived from these functions. These ecosystem goods and services are defined together as ecosystem services for simplicity (Costanza et al., 1997a; De Groot et al., 2006).

Although similar services are determined by different authors, classifications of wetland functions differentiate depending on the preferences and objectives of those authors. For instance, Tiner categorizes the functions of wetlands as: fish and wildlife ‘values’, environmental quality ‘values’ and socio-economic ‘values’ (Tiner, 1984 in Williams, 1993, p. 13), whereas OTA report categorizes as: intrinsic ‘values’ and ecological services and resource ‘values’ (OTA, 1984 in Williams, 1993, p. 13). Acknowledging these categorizations, Williams (1993, p. 13) identifies four interdependent categories of wetland functions as: physical/hydrological, chemical, biological and socio-economic. Services of each of these functions are presented in Table 2-1.

Additionally, In *Wetlands Functions and Values*, Reimold (1994, p. 55) classifies wetland functions as: biological (providing habitat for reproduction, feeding, and resting), physical (flood attenuation, groundwater recharge and sediment entrapment) and chemical (nutrient removal and toxics decontamination) functions while Mitsch and Gosselink (2000, p.572) categorize them in three hierarchical levels of population, ecosystem and global values. Table 2-2 illustrates the classification of Mitsch and Gosselink.

Table 2-1 Classification of Wetland Functions by Williams (1993, pp.13-38)

Physical/Hydrological Functions	Chemical Functions	Biological Functions	Socio-Economic Benefits and Values
• Flood mitigation • Coastal protection • Recharging aquifers • Sediment trapping • Atmospheric and climatic fluctuations	• Pollution trapping • Removal of toxic residues • Waste processing	• Productivity • Habitats	*Consumptive values:* • Food, fish, fowl and fauna, fuel, fibre *Non-consumptive benefits:* • Scenic, recreational, educational, aesthetic, scientific, archaeological, heritage and historical

Table 2-2 Classification of Wetland Functions by Mitsch and Gosselink (2000, pp.572-591)

Population Values	Ecosystem Values	Regional and Global Values
• Animals Harvested for Pelts • Waterfowl and Other Birds • Fish and Shellfish • Timber and Other Vegetation Harvest • Endangered and Threatened Species	• Flood Mitigation • Storm Abatement • Aquifer Recharge • Water Quality Improvement • Aesthetics • Subsistence Use	• Nitrogen Cycle • Sulfur Cycle • Carbon Cycle

Furthermore, Turner et al. (2003, p.11) presents wetland goods and services without categorizing the functions (Table 2-3).

Table 2-3 Wetland Goods and Services by Turner et al. (2003, p.11)

Services	Goods
• Flood control • Prevention saline intrusion • Storm protection/windbreak • Sediment removal • Toxicant removal • Nutrient removal • Groundwater recharge • Groundwater discharge • Erosion control • Wildlife habitat • Fish habitat • Toxicant export • Shoreline stabilization • Micro-climate stabilization • Macro-climate stabilization • Biological diversity provision • Cultural value provision • Historic value provision • Aesthetic value provision • Wilderness value provision	• Forest resources • Agriculture resources • Wildlife resources • Forage resources • Fisheries • Mineral resources • Water transport • Water supply • Recreation/tourism • Aquaculture • Research site • Education site • Fertilizer production • Energy production

On the other hand, Whitten and Bennett (2005, p.6) present wetland services as the benefits of wetland outputs in Table 2-4.

Among previously defined classifications, the one developed by Williams (1993) provides the most appropriate groups for understanding the importance of wetlands. Thus, all the above presented services of wetlands are listed in Williams' classification (by the author of this research) in Table 2-5 and explained below.

Table 2-4 Wetland Outputs and Benefits by Whitten and Bennett (2005, p.6)

Wetland Output	Wetland Benefit
• Waterfowl	• Waterfowl hunted
• Avifauna	• Birds seen and identified
• Avifauna	• Pest control
• Aquatic fauna	• Fish and crustacean food sources
• Flora - trees	• Timber
• Wetland ecosystem	• Scenic vista
• Wetland ecosystem	• Recreation
• Flood-storm mitigation	• Erosion control
• Flood-storm mitigation	• Flood mitigation
• Flora production	• Grazing input
• Non-combustible flora	• Fire break
• Aquifer recharge	• Water supply
• Water storage	• Water supply
• Pollution reduction	• Improved water quality
• Bio-diversity maintenance	• Unknown future benefits
• Wetland ecosystem	• Existence of natural areas

Table 2-5 Functions, Goods and Services of Wetlands (adapted from former studies by the author)

Physical/Hydrological Functions	Chemical Functions	Biological Functions	Socio-Economic Benefits and Values
• Flood control / mitigation / attenuation • Prevention saline intrusion • Coastal protection • Storm protection / windbreak • Erosion control • Groundwater recharge and discharge • Sediment trapping / removal / entrapment • Shoreline stabilization • Micro and macro climate stabilization	• Chemical cycles • Pollution trapping • Removal of toxic residues • Waste processing • Toxicant removal / decontamination / export • Nutrient removal • Water quality maintenance	• Productivity • Habitats • Biological diversity provision • Food chain provision • Ecological balance provision • Endangered and threatened species	*Consumptive values:* • Forest resources • Agriculture resources • Wildlife resources • Forage resources • Fisheries • Mineral resources • Water supply • Water transport • Aquaculture • Fertilizer production • Energy production • Subsistence use *Non-consumptive benefits:* • Scenic value provision • Recreational value provision • Educational value provision • Cultural value provision • Aesthetic value provision • Scientific and educational value provision • Wilderness value provision • Archaeological, heritage and historical value provision

Adapted from Williams, 1993; Mitsch and Gosselink, 2000; Turner et al., 2003; Whitten and Bennett, 2005.

2.1.2. Values of Wetlands

It is apparent that functions of wetlands are also deemed as wetland values by some authors (Williams, 1993; Reimold, 1994; Mitsch and Gosselink, 2000). In Millennium Ecosystem Assessment (2003 in De Groot et al. 2006, p.3) value is defined as "the contribution of an action or object to user-specified goals, objectives, or conditions" and since functions are the contributions of wetlands to human well-being, it is logical to call them as wetland values. In the literature about the importance of wetlands, these values of wetlands are classified as in Figure 2-1 below.

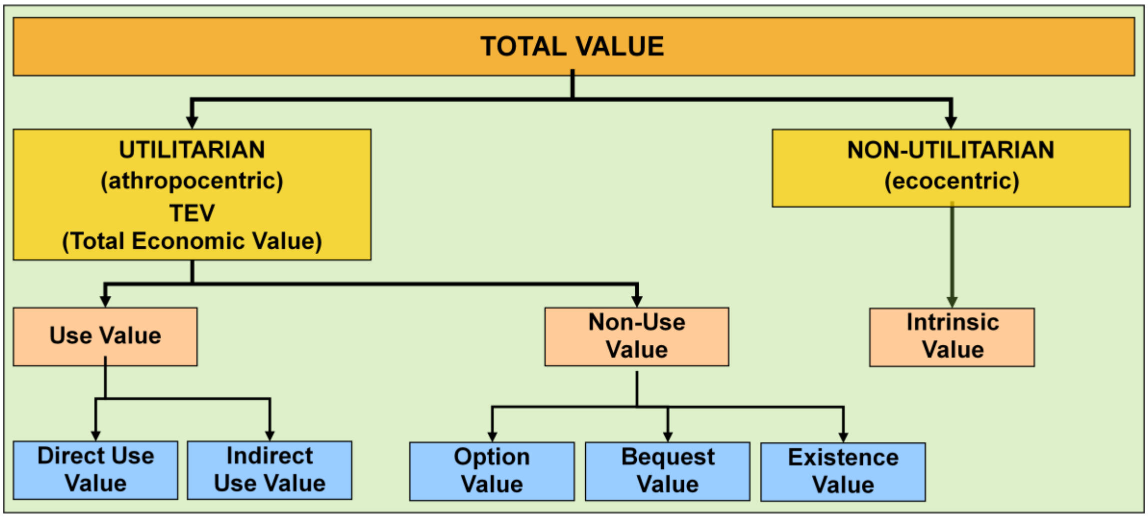

Figure 2-1 Total value of wetlands
(Adapted from MA, 2003; Başak, 2003 and De Groot et al., 2006)

Perception of the total value of wetlands differs depending on the different ethical perspectives. Ecocentric point of view acknowledges the intrinsic values of wetlands while the anthropocentric point of view needs utilitarian explanation for those values. Values of wetlands are defined as Total Economic Values (TEVs) by the utilitarian perspective.

TEV is divided into two main categories of: use values and non-use values (De Groot et al. 2006, p.22). Use values are composed of direct use, indirect use and option values. Direct use values are the values derived from the direct extraction, consumption or enjoyment of the ecosystem goods. Indirect use values are functional values derived from the non-consumptive use of ecosystem services. Option values are the values that will be derived from further use of ecosystem goods and services in a later date. Non-use values are composed of existence and bequest values. Existence value is the value of appreciating the existence of ecosystem features, even if they are not used. Bequest value is the value of passing ecosystem features to future generations (De Groot et al. 2006, p.22).

Although all the above functions and values are realized and appreciated, wetlands are still being degraded, depleted and lost. The reasons behind wetland losses are analyzed in the following part though a relational framework

.

2.2. Wetland Losses

Being used by many countries and institutions afterwards, DPSIR (Driving forces, Pressures, State, Impacts and Responses) Framework was developed by European Environmental Agency in 1999 as a decision supporting system (Giupponi, 2002, p.1). Through this framework (Figure 2-2), the demands causing actions (Driving forces), the interventions that these demands caused (Pressures), the following transformations on the structures and processes of wetlands (Status), the results of these transformations and problems they caused (Effects) and the regulations for their solutions (Responses) could be defined and analyzed within a relational framework (Giupponi, 2002; Turner, et al., 2003).

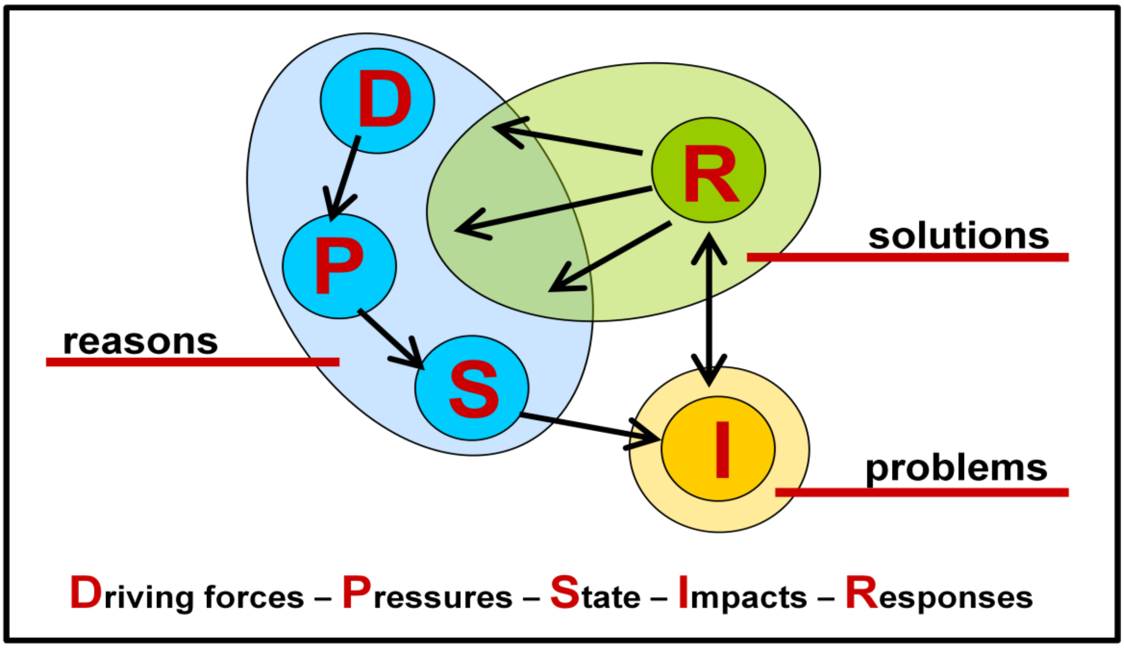

Figure 2-2 DPSIR Framework

Human interventions on wetlands for utilizing their functions and services, result in degradation, depletion and loss of wetlands following the changes in their structures and processes. As a result of their open structures and vulnerable processes wetlands are highly sensitive ecosystems to human interventions. Ignoring the natural structures and processes of wetlands, economically oriented activities result in the losses of wetlands. Former experiences (Williams, 1993; Magnin and Yarar, 1997; Mitsch and Gosselink, 2000; WWF, 2006; Erdem, 2007b) show that these kind of activities cause problems and losses in the ecological, socio-cultural and economic structures of the wetlands. These experiences emphasize the necessity of achieving the conservation, sustainability and wise use of wetlands because otherwise expected goals will not be reached while unexpected losses will occur (Williams, 1993; Karadeniz, 1995; Magnin and Yarar, 1997; Mitsch and Gosselink, 2000; Azcanlı, 2002; WWF, 2006; Erdem, 2007b). For solving the problems of wetlands and preventing their losses, the processes behind their losses should be analyzed through a relational framework. Therefore the interventions on wetlands and their results were defined through the relational DPSIR framework (see Table 2-6).

Table 2-6 Wetland losses through DPSIR Framework

Driving forces (Demands)	Pressures (Interventions)	State (Structure and processes)	Impacts (Problems)	Responses (Regulations)
Urbanization Cultivation Industry Tourism Transportation Mining Energy Conversion Global Warming	Draining and reclamation Land-use changes Dam and channel constructions Exploitation of water resources Excessive pesticide and fertilizer use Waste water and solid waste disposal Introduction of invasive species Excessive and illegal hunting, grazing and reed cutting Climate change and disasters	Hydrological structure Physico-chemical structure Biological and ecologic structure	Changing water regime Pollution Desertification Habitat losses Erosion and floods Biodiversity loss Loss of ecological balance Socio-economic losses	Management plans Laws and regulations Controlling and forbidding chemicals Penalties Restricting use Formation of water treatment systems Controlling interventions Price regulations and demand management

(Adapted from Turner et al., 2003)

Driving forces (D): Demands from activities and sectors like urbanization, cultivation, industry, tourism, etc. and global warming as a result of these activities can be defined as the driving forces of wetland losses.

Pressures (P): Interventions like reclamation, well openning and dam construction for meetig the demands of the previously identified sectors could be defined as the pressures on wetlands. These interventions and their driving forces are related as follows.

- Reclamation for agricultural fields and settlement areas;
- Changing land-use for achieving development in different sectors;
- Dam and channel constructions, well opening and explitation of water resources for irrigation and flood control;
- Excessive and illegal fertilizer and pesticide use for increasing the production;
- Solid waste and waste water disposals without any treatments since they are expensive;
- Introduction of invasive species and excessive grazing, reed cutting and hunting for increasing the profit (Table 2-6).

State (S): Hydrological, physico-chemical, biological and ecologic structures, processes and relations that are being changed as a result of the interventions could be defined as the state.

Impacts (I): Problems like desertfication, pollution and habitat losses of the wetlands could be defined as the impacts.

Responses (R): Regulations like planning, controlling and forbidding for the solution of problems induced by the pressures could be defined as the responses.

2.3. Wetland Valuation

2.3.1.Wetland Valuation

Value is defined as “[t]he contribution of an action or object to user-specified goals, objectives, or conditions”, while valuation is defined as “the process of expressing a value for a particular good or service…in terms of something that can be counted, often money, but also through methods and measures from other disciplines (sociology, ecology and so on)” by Millennium Ecosystem Assessment (2003 in De Groot et al., 2006, p.3).

Also Barbier et al. (1997, p.10) define economic valuation as “the attempt to assign quantitative values to the goods and services provided by environmental resources, whether or not market prices are available to assist…”. Therefore wetland valuation can be defined as a method for assessing the benefits that are gained from the goods and services of wetlands.

2.3.1.1. Usage and Importance of Wetland Valuation

As it was stated above wetland valuation is a tool for analyzing the contributions of wetland ecosystems on the economy and human well-being and this tool can be used for different objectives. Depending on the problem or the objective of the analyses, the scope of the wetland valuation studies changes. Whole functions (total valuation) or just one specific function (partial valuation) of the wetlands can be valued depending on the context of the study however valuation studies are being carried out in three main situations of: Total Economic Value (TEV) Assessment, Trade-off Analysis and Impact Analysis (Barbier et al., 1997, p.26-33; De Groot, 2006, pp.5-7).

1. Total Economic Value (TEV) Assessment: For identifying the total benefits and contributions of wetlands on the economy and human well-being.
2. Trade-off Analysis: For evaluating the benefits and costs of alternative interventions on wetland ecosystems.
3. Impact Analysis: For analyzing the impacts of destructive processes (accidents, natural disasters, illegal or excessive resource uses) on wetland ecosystems and for identifying the costs of changes.

Wetland valuation is an important tool for conservation studies, being helpful in (De Groot, 2006, pp.6-7):

- Determining and showing the contributions of wetlands to economy and human well-being hence increasing the concerns about the conservation and sustainable use of wetlands.
- Showing the benefits of the sustainable use of the wetland services and improving their recognition and involvement in decision making processes.
- Determining the beneficiaries of wetland services and identifying the gainers and losers of possible changes in the provision of those services.

- Revealing the values of wetland services, making wetlands an ingredient of economic welfare indicators.
- Improving knowledge about the operation of ecosystem processes through identifying the functions and services of wetlands.
- Identifying the goods of wetlands and providing market opportunities for those products.
- Determining the costs of changes in the ecosystems (as a result of accidents, natural disasters, illegal or excessive resource uses) and providing information for restoration options and other responses.

2.3.1.2. The Role of Wetland Valuation in Decision Making

History of wetlands proves that wetlands are being converted and lost as a result of the ignorance or undervaluation of their services. As De Groot et al. (2006, p.4) claims; implicit judgments about the values of objects or actions are made in all decision making processes and levels. Therefore, the lack of information about the benefits and values of wetlands results in the degradation and loss of wetlands through mis-judgments however the valuation studies prove that conservation of wetlands and sustainable use of their services are economically more beneficial than their conversion to other uses (Balmford et al., 2002, p.951).

For better decision making processes the benefits of wetlands should be realized, as De Groot et al. (2006, p.3) supports that: “To ensure more balanced decision-making (i.e., that multiple uses and values are considered), it is crucial that the full importance (value) of wetlands should be recognized.” De Groot et al. (2006, p.4) also adds that, “better communication of wetland values, and the costs and benefits of alternative uses of wetlands, to decision-makers and the general public is crucial” for the sustainability of benefits taken from wetlands. Thus, valuation is an important tool for wetland conservation, management and sustainable development.

Acknowledging this importance of wetland valuation on the sustainability and wise use of wetlands, the Ramsar Convention included wetland valuation studies in its 1st Strategic Plan (1997-2002) in 1996 (Barbier et al., 1997). In this and following Strategic Plans, Convention supported the wetland valuation studies and worked for the dissemination of valuation methods (Barbier et al., 1997). Ramsar Convention supported and published two guidelines (Barbier et al., 1997 and De Groot et al. 2006) on wetland valuation studies for the use of decision makers, planners and managers.

2.3.2. Evaluation of Wetland Valuation Frameworks

In spite of the richness of wetland valuation studies in the literature, there are only a few studies that provide a comprehensive assessment framework. Four of these studies (Barbier et al., 1997; De Groot et al., 2002; De Groot, 2006: De Groot et al., 2006) were analyzed and explained here to provide a general understanding of the wetland valuation processes. Especially these four frameworks are analyzed here because only they could be reached at the documentary analysis. These four frameworks (two of which (Barbier et al., 1997 and De Groot et al., 2006) were prepared for Ramsar Convention) are the most common and contemporary studies in the wetland valuation literature.

2.3.2.1. Wetland Valuation Frameworks

- ***Assessment Framework for Economic Valuation of Wetlands (Barbier et al., 1997)***

With the support of Ramsar Convention (following the 1st Strategic Plan 1997-1996) a guideline was prepared by Barbier et al. (1997) and published in 1997, entitled "Economic Valuation of Wetlands: A Guide for Policy Makers and Planners". In this guideline, the framework for the assessment of the economic value of wetlands (developed by Barbier in 1994 for IIED) was presented (Figure 2-3). The assessment framework consists of three stages:

Stage-1: definition of the problem or objective and selection of the appropriate assessment approach

Stage-2: determination of the "value" (functions) of the system and the needed data and data sources

Stage-3: selection of the data collection, analysis and valuation methods and techniques (pp.24-46)

Acknowledging the data and resource constraints, and study limitations Barbier et al. (1997, pp.24-26) accept the difficulties of the determination of financial or economic values of the wetlands. Thus, “physical assessment” of the changes in the goods and services of the wetlands provide an important part of the assessment process.

Stage-1: Through a general analysis, the overall problem of the system is being defined in this stage. Than, depending on the problem definition; one of the three evaluation objectives (impact analysis, partial valuation, total valuation) is selected for the determination of the further assessment approach. Also structure and the boundaries of the system are defined in this stage (Barbier et al., 1997, p.26).

Stage-2: In this stage of the framework, “structural components”, “functions” and “attributes” of the system are analyzed and relevant values are determined for them. Then, direct use, indirect use and non-use values are ranked in terms of importance to the assessment process. Also information needs are determined in this stage (pp.34-39).

Stage-3: Actual assessment takes place in this last stage. Starting from the highest ranking components, values of the “structural components”, “functions” and “attributes” are assessed through appropriate valuation techniques. Finally appropriate appraisal method (e.g. Cost-Benefit Analysis, CBA) can be implemented to the analysis results (pp.40-46).

In addition to the framework, Barbier et al. (1997) present wetland valuation processes of seven case study examples from Nigeria, America, UK, Scotland, Sweden and Indonesia are explained for a better understanding of the valuation practices.

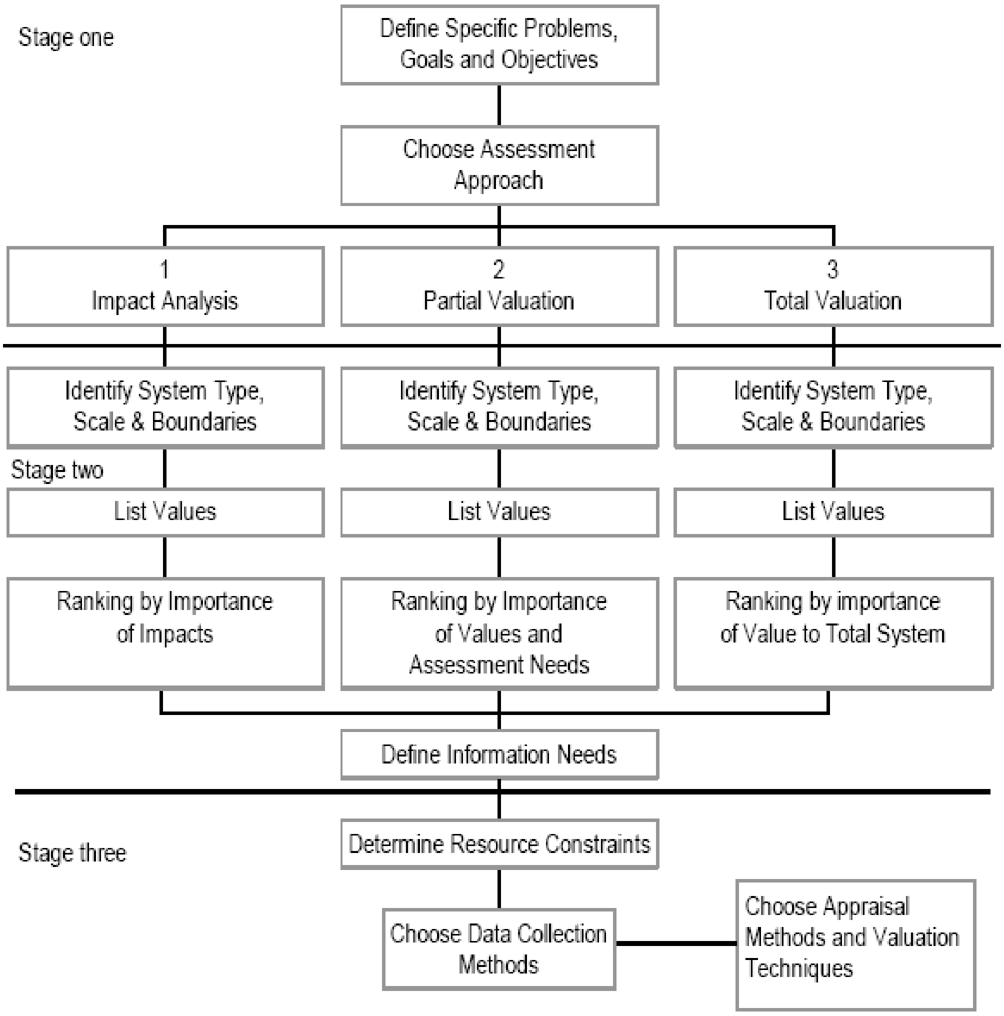

Figure 2-3 The assessment framework for economic valuation of wetlands

(Barbier et al., 1997, p.25)

- ***Frameworks for Integrated Assessment and Valuation of Ecosystem Functions, Goods and Services (De Groot et al., 2002; De Groot, 2006)***

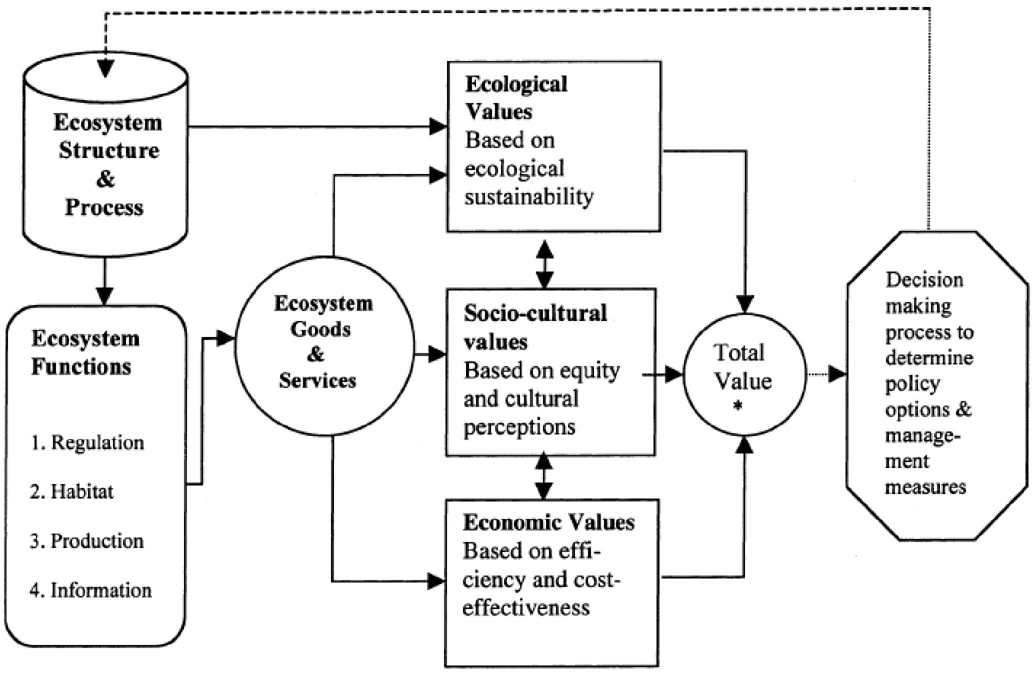

Figure 2-4 Framework for integrated assessment and valuation of ecosystem functions, goods and services
(De Groot et al., 2002, p.394)

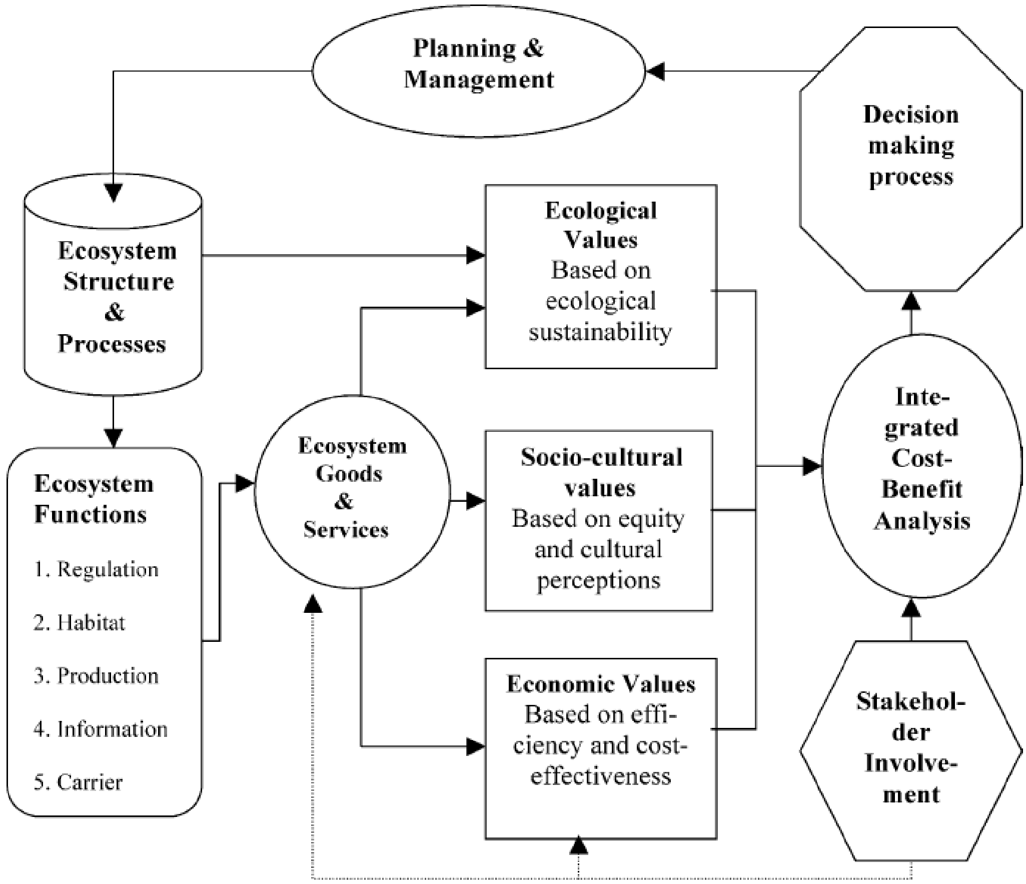

Figure 2-5 Framework for integrated analysis of landscape functions and values

(De Groot, 2006, p.177)

Acknowledging the lack of a systematic typology and comprehensive framework for integrated assessment and valuation of ecosystem functions, goods and services, De Groot et al. (2002) develop a comprehensive framework that is presented in Figure 2-4 above. Later, in 2006 De Groot improves this framework for better planning and decision making practices (see Figure 2-5).

Both of the frameworks are consist of 2 steps of:

Step-1: function analysis – determination of the ecosystem functions of the wetlands

Step-2: valuation of ecosystem functions – determination of the ecological, socio-cultural and economic values of wetlands and their valuation in monetary terms

Step-1: In this step of the frameworks, ecological structure and processes of the wetlands are translated into ecosystem functions. Then, goods and services of these functions are determined for the next step.

Acknowledging the variety of ecosystem functions, goods and services in the literature, De Groot et al. (2000 in De Groot et al. 2002, p.3) classify ecosystem functions into four primary categories of: regulation functions, habitat functions, production functions and information functions. Later in his recent and detailed study in 2006, De Groot (2006, pp.177-178) adds a fifth category of "carrier functions", to this former categorization (see Table 2-7).

Step-2: Previously presented values of ecosystems (direct use, indirect use, non-use, etc.) are combined and explained in three types here: ecological, socio-cultural and economic values. Than the economic contributions of wetland goods and services are determined in monetary terms through appropriate wetland valuation methods.

De Groot (et al., 2002, p.14; 2006, p.181) groups economic valuation methods into four main types as: direct market valuation, indirect market valuation (avoided cost, replacement cost, factor income, travel cost and hedonic pricing), contingent valuation and group valuation.

Table 2-7 Functions, goods and services of natural and semi-natural ecosystems

Functions		Ecosystem processes and components	Goods and services (examples)
Regulation functions		Maintenance of essential ecological processes and life support systems	
1	Gas regulation	Role of ecosystems in bio-geochemical cycles (e.g. CO_2/O_2 balance, ozone layer, etc.)	1.1 UVB-protection by O_3 (preventing disease)
			1.2 Maintenance of (good) air quality
			1.3 Influence on climate (see also function 2)
2	Climate regulation	Influence of land cover and biol. mediated processes (e.g. DMS-production) on climate	Maintenance of a favorable climate (temp., precipitation, etc) for, for example, human habitation, health, cultivation
3	Disturbance prevention	Influence of ecosystem structure on dampening env. disturbances	3.1 Storm protection (e.g. by coral reefs)
			3.2 Flood prevention (e.g. by wetlands and forests)
4	Water regulation	Role of land cover in regulating runoff and river discharge	Drainage and natural irrigation
5	Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers)	Provision of water for consumptive use (e.g. drinking, irrigation and industrial use)
6	Soil retention	Role of vegetation root matrix and soil biota in soil retention	6.1 Maintenance of arable land
			6.2 Prevention of damage from erosion/siltation
7	Soil formation	Weathering of rock, accumulation of organic matter	7.1 Maintenance of productivity on arable land
			7.2 Maintenance of natural productive soils
8	Nutrient regulation	Role of biota in storage and re-cyling of nutrients (e.g. N, P and S)	Maintenance of healthy soils and productive ecosystems
9	Waste treatment	Role of vegetation and biota in removal or breakdown of xenic nutrients and compounds	9.1 Pollution control/detoxification
			9.2 Filtering of dust particles (air quality)
			9.3 Abatement of noise pollution
10	Pollination	Role of biota in movement of floral gametes	10.1 Pollination of wild plant species
			10.2 Pollination of crops
11	Biological control	Population control through trophic-dynamic relations	11.1 Control of pests and diseases
			11.2 Reduction of herbivory (crop damage)
Habitat functions		Providing habitat (suitable living space) for wild plant and animal species	
12	Refugium function	Suitable living space for wild plants and animals	Maintenance of biological and genetic diversity (and, thus, the basis for most other functions)
13	Nursery function	Suitable reproduction-habitat	Maintenance of commercially harvested species
Production functions		Provision of natural resources	
14	Food	Conversion of solar energy into edible plants and animals	14.1 Hunting, gathering of fish, game, fruits, etc.
			14.2 Small-scale subsistence farming and aquaculture
15	Raw materials	Conversion of solar energy into biomass for human construction and other uses	15.1 Building and Manufacturing (e.g. lumber
			15.2 Fuel and energy (e.g. fuel wood
			15.3 Fodder and fertilizer (e.g. krill
16	Genetic resources	Genetic material and evolution in wild plants and animals	16.1 Improve crop resistance to pathogens and pests,
			16.2 Other applications (e.g. health care)

Adapted from De Groot, 1992; Costanza et al., 1997a; De Groot et al., 2002 (De Groot, 2006, p. 179)

Table 2-7 continued

Functions		Ecosystem processes and components	Goods and services (examples)
17	Medicinal resources	Variety in (bio)chemical sub-stances in, and other medicinal uses of, natural biota	17.1 Drugs and pharmaceuticals 17.2 Chemical models and tools 17.3 Test and essay organisms
18	Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	Resources for fashion, handicraft, jewellery, pets, worship, decoration and souvenirs (e.g. furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)
Information functions		Providing opportunities for cognitive development	
19	Aesthetic information	Attractive landscape features	Enjoyment of scenery (scenic roads, housing, etc.)
20	Re-creation	Variety in landscapes with (potential) re-creational uses	Travel to natural ecosystems for eco-tourism and (re-creational) nature study
21	Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting, folklore, national symbols, architect, advertising, etc.
22	Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (i.e. heritage value of natural ecosystems and features)
23	Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions, etc. Use of nature for scientific research
Carrier functions		Providing a suitable substrate or medium for human activities and infrastructure	
24	Habitation	Depending on the specific land use type, different requirements are placed on environmental conditions (e.g. soil stability and fertility, air and water quality, topography, climate, geology, etc.)	Living space (ranging from small settlements to urban areas)
25	Cultivation		Food and raw materials from cultivated land and aquaculture
26	Energy-conversion		Energy-facilities (solar, wind, water, etc.)
27	Mining		Minerals, oil, gold, etc.
28	Waste disposal		Space for solid waste disposal
29	Transportation		Transportation by land and water
30	Tourism-facilities		Tourism-activities (outdoor sports, beach-tourism, etc.)

Adapted from De Groot, 1992 ; Costanza et al., 1997a; De Groot et al., 2002 (De Groot, 2006, p. 180)

With the help of the study of Costanza et al. (1997a), De Groot et al. (2002, p.17) present the relationship between ecosystem functions and the valuation methods. Different valuation methods can be used for each ecosystem function however there seems to be a match between certain functions and methods. Analyzing Costanza et al. (1997a), De Groot et al. (2002, p.16) relate functions with valuation methods as follows:

Regulation Functions – Indirect Market Valuation

Habitat Functions – Direct Market Pricing

Production Functions – Direct Market Pricing and Factor Income

Information Functions – Contingent Valuation, Hedonic Pricing and Market Pricing

- ***Framework for Integrated Assessment and Valuation of Wetland Services (De Groot et al., 2006)***

Explanation of symbols, colours and abbreviations:

Green: the five steps described in this guidance;

White: additional tools and activities which are needed for a full Integrated Assessment, but which are not covered in this guidance;

Mauve: areas of application (i.e., in trade-off analysis to determine policy and management measures); *Red:* the three situations in which Valuation is used: MFU - assessment of options and trade-offs for multi-functional use of wetlands, TEV - assessment of the total contribution (value) of wetlands to the economy at different scales (local, national, or even global), EIA - assessments of the effects/impacts (ecological and socio-economic) of wetland conversion or proposed conversion.

Other abbreviations: PA – Participatory Approach; DSS - Decision Support System; CBA - Cost Benefit Analysis; MCA – Multi-Criteria Analysis.

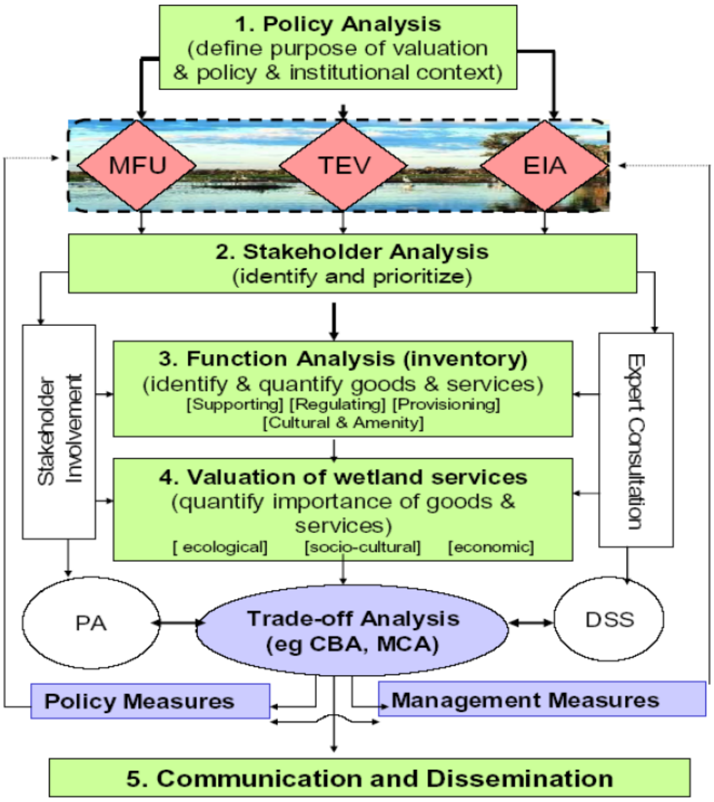

Figure 2-6 Framework for integrated assessment and valuation of wetland services
(De Groot et al., 2006, p.7)

Step-1: policy analysis – definition of policy, institutional context and purpose of valuation

Step-2: stakeholder analysis – identification and prioritization of stakeholders

Step-3: function analysis – identification and quantification of the goods and services of wetlands

Step-4: valuation of the wetland services – quantification of the importance of goods and services of wetlands

Step-5: communication and dissemination

Following former studies (Barbier et al., 1997; Costanza, et al., 1997a; De Groot et al., 2002; etc.), De Groot et al. (2006) developed a guide for Ramsar Convention (Ramsar Technical Report No.3) about valuing the benefits derived from wetland ecosystem services. In this report De Groot et al. design a comprehensive framework for the valuation of wetland functions, goods and services that is presented in the Figure 2-6 above.

The framework is consisting of five main steps: policy analysis, stakeholder analysis, function analysis, valuation of services, and communication and dissemination. Also some additional activities like; "analysis of pressures, trade offs, and management implications" are included in the framework for a better assessment and valuation (De Groot et al., 2006, p.7-8). Steps of the framework and methods for their applications are explained below.

Step-1: Policy Analysis – In this first step of the framework, policy processes and management objectives are analyzed for defining the purpose of valuation and defining the political and institutional context (De Groot et al., 2006, pp.8-9). De Groot et al. (2006, p.8) state that valuation done for one of three purposes as:

- To assess the impact of past or ongoing interventions
- To analyze trade-offs of planned wetland uses
- To determine the Total Value of the intact wetland

De Groot et al. (2006, p.9) state that policy analysis is composed of five main elements; actors and social capital; policy context, statements and measure; policy process and priorities; institutions and organizations; and livelihood strategies, which should be analyzed and identified.

Step-2: Stakeholder Analysis – Since stakeholder involvement is essential in all steps of the valuation processes, stakeholders are analyzed and identified early in the process. Stakeholder analysis is held through following the three main steps of: identification, prioritization and involvement of stakeholders (De Groot et al. 2006, pp.9-10).

Step-3: Function Analysis – The question of "What should be valued?" is answered through function analysis. In this step functions are classified and wetland services are identified first. Than, using the identified services as a checklist the appropriate services for the wetland in question are selected (De Groot et al., 2006, p.15). In this framework De Groot et al. (2006, pp.16-17) use the classification of wetland functions (Table 2-8) that was developed by Finlayson et al (2005, pp.31-32) for Millennium Ecosystem Assessment (MA).

Step-4: Valuation of Wetland Services – In this step; benefits, importance or values of wetland services are quantified and the total value of wetlands are calculated by ecological, socio-cultural, economic indicators and monetary valuation methods. Ecological, socio-cultural and economic values of wetlands are quantified before their monetary valuation (De Groot et al., 2006). In this framework, De Groot et al. (2006, pp.24-25) classifies economic valuation methods into four main types as: direct market valuation, indirect market valuation, surveys and benefit transfer.

Step-5: Communication and Dissemination – Communication and dissemination of the results of the analysis through communication mechanisms.

Table 2-8 Services provided by wetlands

Scale is low •, medium ●, to high: ⬤; not known = ?; blank cells indicate that the service is not considered applicable to the wetland type. The information in the table represents expert opinion for a global average pattern for wetlands; there will be local and regional differences in relative magnitudes.

Services	Comments and Examples	Permanent and Temporary Rivers and Streams	Permanent Lakes, Reservoirs	Seasonal Lakes, Marshes, and Swamps, Including Floodplains	Forested Wetlands, Marshes, and Swamps, Including Floodplains	Alpine and Tundra Wetlands	Springs and Oases	Geothermal Wetlands	Underground Wetlands, Including Caves and Groundwater Systems
Inland Wetlands									
Provisioning									
Food	production of fish, wild game, fruits, grains, and so on	⬤	⬤	⬤	⬤	•	•		
Fresh water	storage and retention of water; provision of water for irrigation and for drinking	⬤	⬤	●	•	•	•		⬤
Fiber and fuel	production of timber, fuelwood, peat, fodder, aggregates	●	●	•	⬤	●	•		
Biochemical products	extraction of materials from biota	•	•	?	?	?	?	?	?
Genetic materials	medicine; genes for resistance to plant pathogens, ornamental species, and so on	•	•	?	•	?	?	?	?
Regulating									
Climate regulation	regulation of greenhouse gases, temperature, precipitation, and other climatic processes; chemical composition of the atmosphere	•	⬤	•	⬤	•		•	•
Hydrological regimes	groundwater recharge and discharge; storage of water for agriculture or industry	⬤	⬤	●	●	•	•		•
Pollution control and detoxification	retention, recovery, and removal of excess nutrients and pollutants	⬤	●	•	●	•	•		●
Erosion protection	retention of soils and prevention of structural change (such as coastal erosion, bank slumping, and so on)	●	•	•	●	?	•		•
Natural hazards	flood control; storm protection	●	⬤	⬤	●	●	•		•
Cultural									
Spiritual and inspirational	personal feelings and well-being; religious significance	⬤	⬤	●	●	•	●	•	•
Recreational	opportunities for tourism and recreational activities	⬤	⬤	●	•	•	•	•	•
Aesthetic	appreciation of natural features	⬤	●	•	●	•	•	•	•
Educational	opportunities for formal and informal education and training	⬤	⬤	●	●	•	•	•	•
Supporting									
Biodiversity	habitats for resident or transient species	⬤	⬤	●	●	•	•	•	•
Soil formation	sediment retention and accumulation of organic matter	⬤	•	●	⬤	•	?	?	
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients	⬤	⬤	⬤	⬤	•	•	?	•
Pollination	support for pollinators	•	•	•	●	•	•		

(Finlayson et al., 2005 in De Groot et al., 2006, p.16)

Table 2-8 continued

Services	Comments and Examples	Estuaries and Marshes	Mangroves	Lagoons, Including Salt Ponds	Intertidal Flats, Beaches, and Dunes	Kelp	Rock and Shell Reefs	Seagrass Beds	Coral Reefs
Coastal Wetlands									
Provisioning									
Food	production of fish, algae, and invertebrates	⬤	⬤	•	●	•	●	•	●
Fresh water	storage and retention of water; provision of water for irrigation and for drinking	•		•					
Fiber, timber, fuel	production of timber, fuelwood, peat, fodder, aggregates	⬤	⬤	●					
Biochemical products	extraction of materials from biota	•	•			•			•
Genetic materials	medicine; genes for resistance to plant pathogens, ornamental species, and so on	•	•	•		●			•
Regulating									
Climate regulation	regulation of greenhouse gases, temperature, precipitation, and other climatic processes; chemical composition of the atmosphere	●	●	●	•		•	•	●
Biological regulation (C11.3)	resistance of species invasions; regulating interactions between different trophic levels; preserving functional diversity and interactions	●	⬤	●	•		•		•
Hydrological regimes	groundwater recharge/discharge; storage of water for agriculture or industry	•		•					
Pollution control and detoxification	retention, recovery, and removal of excess nutrients and pollutants	⬤	⬤	●		?	•	•	•
Erosion protection	retention of soils	●	⬤	•				•	•
Natural hazards	flood control; storm protection	⬤	⬤	•	•	•	●	●	⬤
Cultural									
Spiritual and inspirational	personal feelings and well-being	⬤	•	●	⬤	•	•	•	⬤
Recreational	opportunities for tourism and recreational activities	⬤	•	•	⬤	•			⬤
Aesthetic	appreciation of natural features	●	•	●	●				⬤
Educational	opportunities for formal and informal education and training	•	•	•	•		•		•
Supporting									
Biodiversity	habitats for resident or transient species	●	●	•	⬤	•	⬤	•	⬤
Soil formation	sediment retention and accumulation of organic matter	●	●	•	•				
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients	●	●	●	•	•	•		●

(Finlayson et al., 2005 in De Groot et al., 2006, p.17)

2.3.2.2. General Evaluation of the Frameworks

Four main frameworks for the assessment and valuation of wetlands are briefly presented above. It is recognized that there is an improvement in the frameworks from 1997 to 2006 and there are similarities and differences between them. These similarities and differences are determined here through the analysis of their parts (stages/steps), functions, additional tools and application areas (see Table 2-9 below).

Similarities of the frameworks:

Although they have different numbers of parts or steps the frameworks share the two main parts of; function analysis and valuation of wetland services. These two parts form the body of all the frameworks and they include the actual valuation process. Also, all of the frameworks determine the application areas for the results of analyses. Acknowledging that function analysis and valuation are just tools and small parts of a larger and comprehensive system, frameworks define the possible implementation areas for the results of these analyses (Table 2-9).

Differences of the frameworks:

In spite of the similarities presented above, the frameworks differentiate from each other especially in terms of their parts and functions. These differences reveal the evolution of the frameworks throughout the history.

Although all the frameworks share the same body, frameworks by Barbier et al., 1997 and De Groot et al., 2006 include additional parts. Prior to function analysis part they both include the selection of assessment approaches. Scope and the objective of the analysis are defined in this part. The framework by De Groot et al. 2006 also includes stakeholder analysis and policy analysis parts prior to function analysis. In this later framework, physical, political and social structure of the system is being identified before the function analysis. Also, for sharing the results of the analysis; communication and dissemination mechanisms are included as the last step in De Groot et al., 2006 (Table 2-9).

Table 2-9 Frameworks for integrated assessment and valuation of wetlands

Frameworks	Parts (stages / steps)	Functions	Additional tools	Application areas
by Barbier et al., 1997	Stage-1: selection of assessment approach	Components		Appropriate economic appraisal methods (e.g. Cost Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA), Multi Criteria Analysis (MCA), etc.)
	Stage-2: identification of the component, functions and attributes of the system			
	Stage-3: valuation of the components, functions and attributes of the system	Functions		
		Attributes		
by De Groot et al., 2002	Step-1: function analysis	Regulation functions		Decision making processes
		Habitat functions		
	Step-2: valuation of ecosystem functions	Production functions		
		Information functions		
by De Groot, 2006	Step-1: function analysis	Regulation functions	Stakeholder involvement	Cost Benefit Analysis, Planning and Management
		Habitat functions		
	Step-2: valuation of ecosystem functions	Production functions		
		Information functions		
		Carrier functions		
by De Groot et al., 2006	Step-1: policy analysis	Provisioning	Stakeholder involvement, Expert consultation	Trade-off Analysis (e.g. CBA, MCA, etc.), Policy measures, Management
	Step-2: stakeholder analysis	Regulating		
	Step-3: function analysis	Cultural		
	Step-4: valuation of wetland services			
	Step-5: communication and dissemination	Supporting		

(Adapted from Babier et al., 1997, De Groot et al., 2002, De Groot, 2006 and De Groot et al., 2006)

Classification of functions differentiates for all frameworks. Although the frameworks by De Groot et al., 2002 and De Groot, 2006 have the same classifications the later one includes a fifth group of "carrier functions". Framework by De Groot, 2006 presents the most detailed function classification. Including intensive human activities/pressures as the services of wetlands, it provides a broader perspective for the values of wetlands however these carrier functions should be considered carefully. Sustainable use levels of these functions and the carrying capacity of the wetlands should be analyzed in detail. The framework by De Groot et al., 2006 includes the same functions with the formers but with a slightly different classification. Classification in Barbier et al., 1997, totally differentiates from the other frameworks'.

Earlier frameworks (by Barbier et al., 1997 and De Groot et al., 2002) do not provide any additional tools but following frameworks include stakeholder involvement as a part of the process. In addition, De Groot et al. 2006 include expert consultation as another tool.

All of the frameworks give possible application areas for the results of the analysis. Barbier et al. 1997 recommends only appropriate appraisal methods for further use of the analysis results however following frameworks also claim the use of results in decision making, planning and management processes.

In conclusion, evaluation of the integrated assessment and valuation frameworks reveal that there is an improvement in the frameworks throughout the history. Hence, the last framework by De Groot et al., 2006 is the most comprehensive and detailed one. Since it was provided by the Ramsar Convention for researchers, planners, managers and decision makers from all around the world, it is also the most common framework in the world. Although all of the frameworks are detailed and useful guidelines for assessment processes, it is apparent that they should be arranged to the dynamics of the country and ecosystem in concern.

2.3.3. Function Analysis

As it was explained above; with the "valuation" part, "function analysis" part form the body of all the integrated assessment and valuation frameworks. the actual valuation takes place in these two parts. For a better and detailed valuation, all of the functions provided by the system should be determined through function analysis. Thus, functions to be valued should be listed and classified to be analyzed in the wetland. There are various classifications of the wetland function in the literature (see Table 2-10).

Literature about the importance of the wetlands classifies the functions of wetlands mainly in terms of their structures, sources or scales to understand their dynamics (Table 2-5) however the literature about the valuation of wetlands classifies the wetland functions in terms of their contributions to human well-being. Differences between the classifications of these two literatures can be seen in Table 2-10. In spite of the differences in the classifications, both literatures include the similar functions and services of wetlands.

Although the classification adapted from the literature about importance of wetlands is the most comprehensive and detailed one, the classification from the framework of De Groot, 2006 is the most appropriate for assessment and valuation processes. It includes the carrier functions with the other natural functions (throughout the research, these natural functions are called "sustainable function" by the author). This classification of functions by De Groot, 2006 is explained below.

- Regulation Functions: Functions of ecosystems "to regulate essential ecological processes and life support systems through bio-geochemical cycles and other biospheric processes" (De Groot et al. 2002, p.3). De Groot (2006, p.177) states that, these functions; "maintain a 'healthy' ecosystem at different scale levels and, at the biosphere level, provide and maintain the conditions for life on Earth". He adds that regulation functions are the pre-conditions for all other functions.
- Habitat Functions: Functions of ecosystems to "provide refuge and reproduction-habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and evolutionary processes" (De Groot et al. 2002, p.3). De Groot (2006, p.177) states that these functions "relate to the spatial conditions needed to maintain biotic (and genetic) diversity and evolutionary processes."
- Production Functions: Functions of ecosystems to provide "ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material" (De Groot et al. 2002, p.3).

Table 2-10 Different classifications of wetland function

<table>
<tr><th>SOURCES</th><th colspan="31">FUNCTIONS</th></tr>
<tr><th rowspan="3">Adopted from the literature about the importance of wetlands</th><th colspan="9" rowspan="2">Physical / Hydrological Function</th><th colspan="7" rowspan="2">Chemical Functions</th><th colspan="6" rowspan="2">Biological Functions</th><th colspan="9">Socio-Economic Benefits and Values</th></tr>
<tr><th colspan="8">Consumptive values</th><th>Non-consumptive benefits</th></tr>
<tr><td>Flood control</td><td>Prevention saline intrusion</td><td>Coastal protection</td><td>Storm protection</td><td>Erosion control</td><td>Groundwater recharge and discharge</td><td>Sediment entrapment</td><td>Shoreline stabilization</td><td>Micro and macro climate stabilization</td><td>Chemical cycles</td><td>Pollution trapping</td><td>Removal of toxic residues</td><td>Waste processing</td><td>Toxicant removal</td><td>Nutrient removal</td><td>Water quality maintenance</td><td>Productivity</td><td>Habitats</td><td>Biological diversity provision</td><td>Food chain provision</td><td>Ecological balance provision</td><td>Endangered and threatened species</td><td>Forest, agriculture, wildlife, forage and mineral resources</td><td>Fisheries</td><td>Water supply</td><td>Water transport</td><td>Aquaculture</td><td>Fertilizer production</td><td>Energy production</td><td>Subsistence use</td><td>Scenic, recreational, educational, cultural and aesthetic value provision</td></tr>
<tr><th rowspan="2">Barbier et al., 1997</th><th colspan="9">Components</th><th colspan="9">Functions</th><th colspan="2">Attributes</th><td colspan="11" rowspan="2"></td></tr>
<tr><td>Fish</td><td colspan="2">Timber, fuelwood and tree products</td><td>Wildlife</td><td colspan="2">Fertile land for agriculture</td><td>Water supply</td><td>Water transport</td><td>Peat</td><td>Flood control</td><td>Storm protection</td><td>Groundwater recharge</td><td>Sediment / pollutant retention</td><td>Nutrient retention</td><td colspan="2">Evaporation</td><td colspan="2">Preservation</td><td>Biological diversity</td><td>Cultural heritage</td></tr>
<tr><th>Costanza et al., 1997a</th><td>Gas regulation</td><td colspan="2">Climate regulation</td><td>Disturbance regulation</td><td colspan="2">Water regulation</td><td>Water supply</td><td>Erosion control and sediment retention</td><td>Soil formation</td><td>Nutrient cycling</td><td>Waste treatment</td><td>Pollination</td><td>Biological control</td><td>Refugia</td><td colspan="2">Food production</td><td>Raw materials</td><td>Genetic resources</td><td>Recreation</td><td>Cultural</td><td colspan="11"></td></tr>
<tr><th rowspan="2">De Groot et al., 2002</th><th colspan="13">Regulation Functions</th><th colspan="2">Habitat Functions</th><th colspan="5">Production Functions</th><th colspan="5">Information Functions</th><td colspan="6" rowspan="2"></td></tr>
<tr><td>Gas regulation</td><td colspan="2">Climate regulation</td><td>Disturbance prevention</td><td colspan="2">Water regulation</td><td>Water supply</td><td>Soil retention</td><td>Soil formation</td><td>Nutrient regulation</td><td>Waste treatment</td><td>Pollination</td><td>Biological control</td><td>Refugium function</td><td>Nursery function</td><td>Food</td><td>Raw materials</td><td>Genetic resources</td><td>Medicinal resources</td><td>Ornamental resources</td><td>Aesthetic information</td><td>Recreation</td><td>Cultural and artistic information</td><td>Spiritual and historic information</td><td>Science and education</td></tr>
</table>

Table 2-10 continued

SOURCES	FUNCTIONS	
De Groot, 2006	Regulation Functions	Gas regulation; Climate regulation; Disturbance prevention; Water regulation; Water supply; Soil retention; Soil formation; Nutrient regulation; Waste treatment; Pollination; Biological control
	Habitat Functions	Refugium function; Nursery function
	Production Functions	Food; Raw materials; Genetic resources; Medicinal resources; Ornamental resources
	Information Functions	Aesthetic information; Recreation; Cultural and artistic information; Spiritual and historic information; Science and education
	Carrier Functions	Habitation; Cultivation; Energy conversion; Mining; Waste disposal; Transportation; Tourism facilities
Finlayson et al., 2005	Provisioning	Food; Fresh water; Fiber, timber, fuel; Biochemical products; Genetic materials
	Regulating	Climate regulation; Biological regulation; Hydrological regimes; Pollution control & detoxification; Erosion protection; Natural hazards
	Cultural	Spiritual and inspirational; Recreational; Aesthetic; Educational
	Supporting	Biodiversity; Pollination; Soil formation; Nutrient cycling
De Groot et al., 2006	Provisioning	Food; Fresh water; Fiber, fuel and other raw materials; Biochemical products and medicinal resources; Genetic materials; Ornamental species
	Regulating	Air quality regulation; Climate regulation; Biological regulation; Hydrological regimes; Pollution control & detoxification; Erosion protection; Natural hazard mitigation
	Cultural & Amenity	Cultural heritage and identity; Spiritual and artistic inspiration; Recreational; Aesthetic; Educational
	Supporting	Biodiversity and nursery; Soil formation; Nutrient cycling

- Information Functions: Functions of ecosystems to “provide an essential ‘reference function’ and contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, re-creation and aesthetic experience” (De Groot et al. 2002, pp.3-4).
- Carrier Functions: Functions of ecosystems to provide “space and a suitable substrate (soil) or medium (water, air) to support the associated infrastructure” for human activities like cultivation, habitation and transportation (De Groot, 2006, p.178). Carrier functions depend on the permanent conversion of natural systems into other land uses, thus the provision of these functions “on a sustainable basis is usually limited”. Although these carrier functions depend on the conversion into ‘single-function’ uses, the new uses usually provide different goods and services. Therefore, for a better understanding of the costs and benefits of these functions, trade-off analyses are needed (De Groot, 2006, p.178).

2.3.4. Valuation of Wetland Services

After the functions and services of the wetlands were defined through function analysis, values of these services are determined and calculated by evaluation criteria and monetary valuation techniques, respectively.

2.3.4.1. Total Value of Wetland Ecosystems

De Groot and his friends (De Groot et al., 2002; De Groot, 2006; De Groot et al., 2006) classify the previously presented (Figure 2-1) values of wetlands, into three groups of; ecological, socio-cultural and economic values (Figure 2-7) for an easier assessment of their contributions to human well-being. Prior to monetary valuation of the services of wetlands, their contributions to human well-being are being analyzed and determined qualitatively in terms of ecological, socio-cultural and economic valuation criteria.

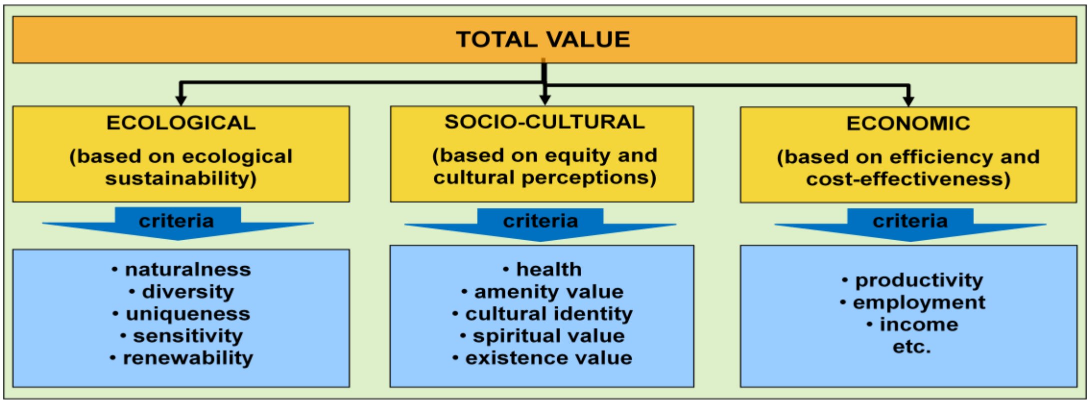

Figure 2-7 Components of the total value of wetlands
(Adapted from De Groot et al., 2006, p.18)

- ***Ecological Values:*** De Groot (et al. 2002, p.14; 2006, p.180) states that the ecological values of ecosystems are "determined both by the integrity of the regulation and habitat functions of the ecosystem and by ecosystem parameters such as complexity, diversity, and rarity". Ecological values of wetlands are explained through the causal relationships between the parts of the system (De Groot et al. 2006, p.18). Criteria and indicators that are used for ecological valuation are listed in (Figure 2-8) below. As De Groot states ecological values of wetlands can be related with their regulation and habitat functions.

Criteria	Short description	Measurement units/indicators
Naturalness/integrity (representativeness)	Degree of human presence in terms of physical, chemical or biological disturbance	- Quality of air, water, and soil - % key species present - % of min. critical ecosystem size
Diversity	Variety of life in all its forms, including ecosystems, species & genetic diversity	- number of ecosystems/ geographical unit - number of species/surface area
Uniqueness/rarity	Local, national or global rarity of ecosystems and species	- number of endemic species & subspecies
Fragility/vulnerability (resilience/resistance)	Sensitivity of ecosystems to human disturbance	- energy budget (GPP/NPP[1]) - carrying capacity
Renewability/recreatability	The possibility for spontaneous renewability or human-aided restoration of ecosystems	- complexity & diversity - succession stage/-time/NPP - (restoration costs)

[1] GPP – Gross Primary Production; NPP = Net Primary Production

Figure 2-8 Ecological valuation criteria and measurement indicators
(De Groot et al., 2006, p.21)

- ***Socio-cultural Values:*** Influencing physical and mental health, and historical, national, ethical, religious and spiritual values, wetlands are crucial sources of non-material well-being. Representing these properties, socio-cultural values of wetlands are composed of: therapeutic, amenity, heritage, spiritual and existence values (De Groot et al. 2006, p.20). Criteria and indicators that are used for socio-cultural valuation are listed in Figure 2-9. Socio-cultural values of wetlands can be related with their information functions.

- ***Economic Values:*** As it was presented above (in 2.1.2. Values of Wetlands), Total Economic Value (TEV) concept is used for defining the economic values of ecosystems in the literature (Figure 2-10). All wetland functions and services provide contributions to economy directly or indirectly through productivity, employment, income, etc. Thus, all the functions (regulation, habitat, production, information and carrier functions) can be related with economic values the wetlands and these economic values of wetlands can be quantified through monetary valuation techniques.

Socio-cultural criteria	Short description	Measurement units/indicators
Therapeutic value	The provision of medicines, clean air, water & soil, space for recreation and outdoor sports, and general therapeutic effects of nature on peoples' *mental and physical well-being*	- Suitability and capacity of natural systems to provide "health services" - Restorative and regenerative effects on people's performance - Socio-economic benefits from reduced health costs & conditions
Amenity value	Importance of nature for *cognitive development*, mental relaxation artistic inspiration, aesthetic enjoyment and recreational benefits.	- Aesthetic quality of landscapes - Recreational features and use - Artistic features and use - Preference studies
Heritage value	Importance of nature as reference to personal or collective *history and cultural identity*	- Historic sites, features and artefacts - Designated cultural landscapes - Cultural traditions and knowledge
Spiritual value	Importance of nature in symbols and elements with *sacred, religious and spiritual significance*	- Presence of sacred sites or features - Role of ecosystems and/or species in religious ceremonies & sacred texts
Existence value	Importance people attach to nature for *ethical* reasons (*intrinsic* value) and inter-generational equity (*bequest* value). Also referred to as "warm glow-value"	- Expressed (through, e.g., donations and voluntary work) or stated preference for nature protection for ethical reasons

Figure 2-9 Socio-cultural valuation criteria and measurement indicators
(De Groot et al., 2006, p.21)

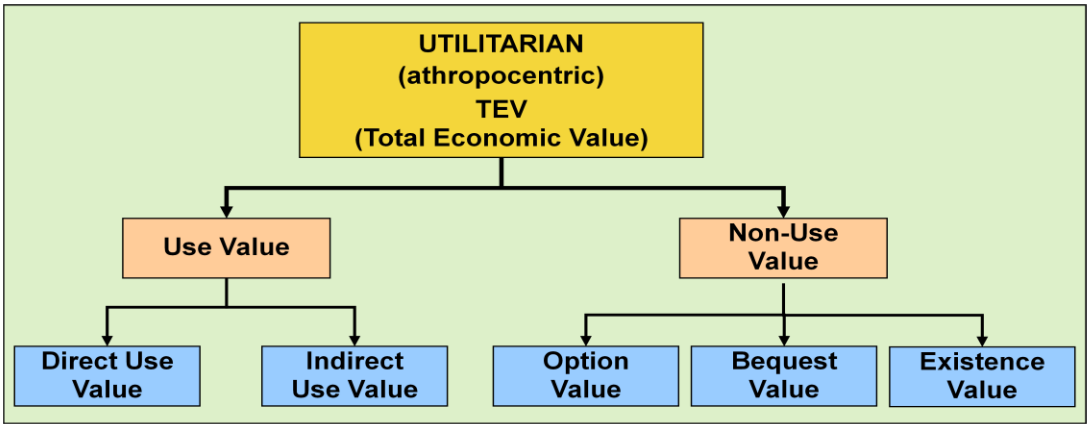

Figure 2-10 Total Economic Value of Wetlands
(Adapted from MA, 2003; Başak, 2003 and De Groot et al., 2006, p.18)

2.3.4.2. Monetary Valuation Techniques

Monetary valuation techniques are being used for quantifying the values of wetlands by using money as the common denominator of the value of wetland services. There are numerous monetary valuation techniques and various classifications of them in the literature (Barbier et al., 1997; De Groot et al., 2002; Finlayson et al., 2005; De Groot, 2006; De Groot et al., 2006, etc.). Through a comprehensive literature review, following techniques are determined and classified for the research by the author:

- ***Direct Market Valuation Methods***

These methods are used for determining the exchange values of ecosystem services and goods in the market (De Groot et al. 2002; De Groot, 2006; De Groot et al., 2006).

- ***Market prices method:*** Calculation of the prices or exchange values of the wetland services (goods like fish and services like recreation) in trade (De Groot et al., 2006; Barbier et al., 1997).
- ***Efficiency (shadow) prices method:*** "Use of market prices but adjusted for transfer payments, market imperfections and policy distortions. May also incorporate distribution weights, where equality concerns are made explicit" (Barbier et al., 1997, p.123).
- ***Factor income (production factor) method:*** Assessment of the contributions of wetland services on production processes and outputs (contributions of clean water provision on fishery) (De Groot et al., 2006, p.24; Barbier et al., 1997, p.124; Finlayson et al., 2005, p.62). This method is used when "ecosystem services enhance incomes" (De Groot et al. 2002, p.15; De Groot, 2006, p.181).
- ***Public pricing method:*** Calculation of the expenditures on wetland services and their management (incentives, subsidies, taxes, etc.) (De Groot et al., 2006, p.24).

- ***Indirect Market Valuation Methods***

These methods are used for estimating the value of the services and goods that are not sold in the market. Various techniques can be used for different services and goods "to establish the (revealed) 'Willingness To Pay' or 'Willingness To Accept' compensation for the availability or loss of these services" (De Groot et al. 2002, p.15; De Groot, 2006, p.181).

- ***Related good method:*** Estimation of the value of a non-marketed good or service with reference to a possible marketed substitute (Barbier et al., 1997, p.125).
- ***Avoided (damage) cost method:*** Assessment of the benefits from avoidance of possible damages (from flood, storm, etc.). This method is used when "services allow society to avoid costs that would have been incurred in the absence of those services" (De Groot et al. 2002, p.15; De Groot, 2006, p.181; Finlayson et al., 2005, p.62).
- ***Travel cost method:*** Calculation of the expenditures on wetland services in terms of time and distance being spent (e.g. calculation of the time and money spent for visiting a wetland) (De Groot et al., 2006 p.24; Barbier et al., 1997. p.124; Finlayson et al., 2005, p.62). This method is applied when "use of ecosystem services requires travel" (De Groot et al. 2002, p.15; De Groot, 2006, p.181).
- ***Hedonic pricing method:*** Assessment of the impact of the wetland services on the price of related goods and services (changing house prices with the changing distance to wetlands) (De Groot et al., 2006, p.24; Barbier et al., 1997, p.123; Finalyson et al., 2005, p.62). This method is applied when "service demand is reflected in the prices people pay for associated goods" (De Groot et al. 2002, p.15; De Groot, 2006, p.181).

- ***Constructed Market Methods***

These methods are used for directly measuring the willingness to pay of inhabitants through provision of a experimental or hypothetical markets for the non-marketed services (Barbier et al., 1997, p.126).

- ***Simulated market method:*** Measuring the price of wetland goods or services through an experimental market that "money actually changes hands" (Barbier et al., 1997, p.126).
- ***Contingent valuation method:*** Assessment of the people's willingness to pay for a service or acceptance for compensation of a lost service, through questionnaires or interviews (De Groot et al., 2006, p25). This method is used to seize the values derived by individuals about hypothetical scenarios (De Groot et al. 2002, p.15; De Groot, 2006, p.181; Barbier et al., 1997, p.126; Finayson et al., 2005, p.62).

- *Group valuation method:* This method is used to determine the value of services and goods through group deliberation (De Groot et al. 2002, p.15; De Groot, 2006, p.181; De Groot et al., 2006, p.25).
- *Contingent ranking method:* Assessment of the preferences for goods or services in qualitative terms (Barbier et al., 1997, p.126)

- ***Cost-Based Valuation Methods***

These methods measure the costs of using; managing or conserving wetlands and their services in terms of expenditures on these affords (Barbier et al., 1997, p.127).

- ***Indirect opportunity cost method:*** Measurement of the "wages foregone by labour in production of non-marketed goods" (Barbier et al., 1997, p.127).
- ***Mitigation and restoration cost method:*** Calculation of the expenditures on the actions for mitigating or averting the negative effects of service losses or for restoration of the wetland services (De Groot et al., 2006, p.24; Finlayson et al., 2005, p.62).
- ***Replacement (substitution) cost method****:* Calculation of the cost of human made or artificial substitutes for wetland services (such as the cost of construction and management of an artificial water treatment system instead of natural wetland) (De Groot et al., 2006, p.24; Barbier et al., 1997, p.127; Finalyson et al., 2005, p.62). This method is applied when "services could be replaced with human-made systems" (De Groot et al. 2002, p.15; De Groot, 2006, p.181).
- ***Relocation cost method:*** Measurement of the cost of relocating communities in danger (Barbier et al., 1997, p.128).
- ***Preventive expenditure method:*** Calculation of the cost of preventing possible damages (Barbier et al., 1997, p.128).

- ***Benefit Transfer Method***

This method is used for transferring the results of the study from a similar wetland to study area however this is not a reliable method since wetlands are complex systems and valuation is a context based afford (De Groot et al., 2006, p.25).

Despite the differences among them, each of the presented methods can be used for assessing the values of more than one function. Acknowledging the use of different methods for each service, De Groot et al. (2006, p.27) recall the double-counting risk and emphasize the necessity of a rank-ordering of the methods for each service. Thus, for avoiding double counting and reaching more reliable values, valuation methods should be ranked for each function and service so that the most appropriate one could be used in the analysis. Table 2-11 provides an example of rank ordering developed by De Groot at al. (2006, p.25).

Table 2-11 The relationship between ecosystem functions and services and monetary valuation technique

In the columns, the most used method on which the calculation was based is indicated with +++, the second most with ++, etc.; open circles indicate that that method was not used in the Costanza *et al.* (1997) study but could potentially also be applied to that service.

ECOSYSTEM FUNCTIONS (and associated services - see Table 6)	Maximum monetary values (US$/ha Year)[1]	Direct Market Pricing[2]	Indirect Market Pricing					Contingent Valuation	Group Valuation
			Avoided Cost	Replacement cost	Factor Income	Travel cost	Hedonic pricing		
Regulating services									
1. Gas regulation	265		+++	o	o			o	o
2. Climate regulation	223		+++	o	o		o	o	o
3. Disturbance regulation	7,240		+++	++	o		o	+	o
4. Water regulation	5,445	+	++	o	+++		o	o	o
5. Water supply	7,600	+++	o	++	o	o	o	o	o
6. Soil retention	245		+++	++	o		o	o	o
9. Waste treatment	6,696		o	+++	o		o	++	o
10. Pollination	25	o	+	+++	++			o	o
11. Biological control	78	+	o	+++	++			o	o
Supporting services									
12. Refugium function	1,523	+++		o	o		o	++	o
13. Nursery function	195	+++	o	o	o		o	o	o
7. Soil formation	10		+++	o	o			o	o
8. Nutrient cycling	21,100		o	+++	o			o	o
Provisioning services									
14. Food	2,761	+++		o	++			+	o
15. Raw materials	1,014	+++		o	++			+	o
16. Genetic resources	112	+++		o	++			o	o
17. Medicinal resources		+++	o	o	++			o	o
18. Ornamental resources	145	+++		o	++		o	o	o
Cultural services									
19 Aesthetic information	1,760			o		o	+++	o	o
20 Recreation & tourism	6,000	+++		o	++	++	+	+++	
21 Cultural & artistic	25	o			o	o	o	+++	o
22 Spiritual & historic						o	o	+++	o
23 Science & education		+++			o	o		o	o

[1] Dollar values are based on Costanza *et al.* (1997) and apply to different ecosystems (e.g., waste treatment is mainly provided by coastal wetlands and recreational benefits are, on a per hectare basis, highest in coral reefs). These monetary values are examples for illustrative purposes only: actual values will vary from location to location, depending on ecological, biogeographic and socio-economic conditions.

[2] Based on added value only (i.e., market price minus capital and labour costs, typically about 80%).

(De Groot et al., 2006, p.25)

2.3.5. Problems & Paradoxes of Wetland Valuation

Wetland valuation practices reveal that there are several problems and paradoxes of valuation studies (Mitsch and Gosselink, 2000, pp.604-609). Some of these problems and paradoxes can be listed as follows:

- Since "value" is an anthropocentric term, wetland valuation practices mainly depend on human perception and preferences hence, ignore the intrinsic processes (Mitsch and Gosselink, 2000, p.604).
- Wetlands are complex and multifunctional ecosystems and single evaluators try to assess the value of all their commodities however the most of the commodities can not be valued. Additionally, the perception, preference and judgement of the evaluator influence the assessment process which usually results in under-valuation (Mitsch and Gosselink, 2000, p.604).
- Some of the public services of wetlands are not used by their owners or local users. In spite of their public services, these wetlands may not provide private benefits to their owners or users, while their conversion to other land uses may provide economic benefits (Mitsch and Gosselink, 2000, p.604).
- Scale and location of the wetlands influence the valuation processes. Level and impact of services differ depending on the scale and location of the wetland, which affects the judgment of the evaluator (Mitsch and Gosselink, 2000, p.605).
- In addition to the scale and location of wetlands, their "place in total regional landscape" (interspersion) and "degree of linkage with other ecosystems" affect the valuation process. Also, changes in the surrounding human population affect the total and marginal value of wetlands. Increasing human population results in degradation and depletion of wetlands and loss of their services and values (Mitsch and Gosselink, 2000, p.605).
- Although human projects provide services and benefits for limited time frames, wetlands provide public services for very long time periods. Values of wetlands are infinite unless they are converted or lost. Otherwise their values will be lost forever because their losses are irreversible (Mitsch and Gosselink, 2000, p.605).
- Economic values of development projects or investments exceed that of wetlands in short terms, however values of wetlands persist for further generation while projects' can not (Mitsch and Gosselink, 2000, p.606).

- Perceptions about the values of wetlands differentiate depending on the economic, socio-cultural and spatial differences (Mitsch and Gosselink, 2000, pp.606-607).
- Valuation of ecosystems results in the comparison of the values of different ecosystems, which can lead to the sacrifice of lower value systems for the valuable ones. This kind of a replacement seems possible in technical terms, however each interdependent ecosystem has unique values that can not be ignored. Also aggregation of the values of adjacent systems creates a synergy that is higher than the sum of individual systems (Mitsch and Gosselink, 2000, pp.607-608).
- According to Costanza et al. (1997a, p.258) in spite of the fact that many goods and services are included in the valuation processes there are still others that are not included.
- Costanza et al (1997a, p.258) states that assumption of the unconstraint of "thresholds, discontinuities or irreversibilities in the ecosystem response functions" results in the underestimation of the total value.
- Ignorance of the infrastructure value of wetlands results in underestimation of the total value (Costanza et al., 1997a, p.258).
- Costanza et al. (1997a, p. 258) states that the estimations are based on the "static 'snapshots'" of complex and dynamic systems which "ignores the complex interdependencies between the services" and the impacts of non-linearities and thresholds.

Mitsch and Gosselink (2000, p.609) state that because of the problems and paradoxes of "valuation of natural ecosystems, many ecologists oppose their economic valuation, since it implies that natural systems can be equated in the market place to other market products." Than they (Mitsch and Gosselink, 2000, p.609) add that despite these problems and paradoxes, valuation practices "have raised public awareness of the high value of the goods and services of nature, and in this way helped in efforts to conserve natural resources." It is apparent that in spite of their problems, valuation studies are useful tools for conservation practices.

CHAPTER 3

METHODOLOGY & CASE STUDY DESIGN

3.1. Hypothesis and Questions

Wetlands are important and valuable ecosystems with their contributions to human well-being however they are being degraded, depleted and lost as a result of human interventions for development. Although these interventions provide economic benefits in the short term, inducing pressures on the natural processes they result in losses in human well-being in the long term. Aiming gains in the short term, these interventions cause losses in the long term. For better informed decision making processes these dynamics of the wetlands should be understood. Thus, this research aims to explore the long term impacts of human interventions on human well-being in wetland ecosystems.

After the rationalization of the problem definition by a comprehensive literature review through the theoretical framework, main hypothesis of the research: **"Although human interventions on wetlands are economically beneficial in the short term, resulting in the losses of ecosystem functions provided by the wetlands, they cause irreversible changes and economic losses in the long term"** was developed and tested in the Kızılırmak Delta case.

Following questions were answered to identify the contributions of Kızılırmak Delta to human well-being and to determine the costs of losing these contributions (functions) of the delta. For the analysis of the issues, indicators in Table 3-1 are used.

- What is the importance of the Kızılırmak Delta?
- Why and for whom is the Kızılırmak Delta important?
    - Identification of the ecological, socio-cultural and economic values of the Kızılırmak Delta.

- How does the Kızılırmak Delta contribute to human well-being?
    - Determination of the regulation, habitat, production, information and carrier functions of the Kızılırmak Delta.

- What are the problems of the Kızılırmak Delta?
- Why are the functions of the Kızılırmak Delta being lost at the expense of human well-being?
    - Analysis of the changes in the Kızılırmak Delta and their reasons.

- How does the Kızılırmak Delta contribute to human well-being in economic terms?
- How do the function losses affect human well-being in economic terms in the Kızılırmak Delta?
    - Determination of the impacts of changes in the Kızılırmak Delta

For answering these research questions through analyzing the issues a comprehensive framework was needed. Since each issue required a different method for its analysis, a new framework with interrelated methods was developed for this research. Rationale and structure of this framework were explained in the Research Design part below.

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Table 3-1 Questions, issues and indicator

<table>
<tr><td>QUESTIONS</td><td>What is the importance of the Kızılırmak Delta?</td><td colspan="2">Why and for whom is the Kızılırmak Delta important?</td><td colspan="5">How does the Kızılırmak Delta contribute to human well-being?</td><td>What are the problems of the Kızılırmak Delta?</td><td>Why are the functions of the Kızılırmak Delta being lost at the expense of human well-being?</td><td>How does the Kızılırmak Delta contribute to human well-being in economic terms?</td><td>How do the function losses affect human well-being in economic terms in the Kızılırmak Delta?</td></tr>
<tr><td>ISSUES</td><td colspan="3">Identification of the ecological, socio-cultural and economic values of the Kızılırmak Delta</td><td colspan="5">Determination of the regulation, habitat, production, information and carrier functions</td><td colspan="2">Analysis of the changes in the Kızılırmak Delta and their reasons</td><td colspan="2">Determination of the impacts of changes in the Kzılırmak Delta</td></tr>
<tr><td>INDICATORS</td><td>conservation status, communities, biodiversity</td><td>historical and archaeological heritage, recreational areas, crafts and traditions</td><td>farming, animal husbandry, fishery, gathering</td><td>regulation functions</td><td>habitat functions</td><td>production functions</td><td>information functions</td><td>carrier functions</td><td colspan="2">driving forces, pressures, state, impacts, responses</td><td>gains / benefits</td><td>losses / costs</td></tr>
<tr><td>METHODS</td><td colspan="3">EVALUATION</td><td colspan="5">FUNCTION ANALYSIS</td><td colspan="2">ACTION ANALYSIS</td><td colspan="2">MONETARY VALUATION & TRADE-OFF ANALYSIS</td></tr>
<tr><td rowspan="2">DATA SOURCES</td><td colspan="12">Eken et al., 2006; Magnin and Yarar, 1997; Özbek et al., 2007; Özesmi, 1999; Özesmi, 2003; Sarısoy et al., 2007; Yeniyurt et al., 2008; Yılmaz, 2007</td></tr>
<tr><td colspan="12">Bafra County Directorate of Agriculture; Ondokuz Mayıs County Directorate of Agriculture; Alaçam County Directorate of Agriculture; Bafra Chamber of Agriculture; County Directorate of State Hydraulic Works; Bafra, Forestry Operation Directorate; Bafra Municipality; Doğanca Municipality; Doğanca Water Products Cooperative; Samsun, Nature and Wildlife Conservation Association</td></tr>
<tr><td>DATA COLLECTION</td><td colspan="12">• Documentary Analysis • Interviews • Observations</td></tr>
</table>

3.2. Research Design

Defined research questions were answered by analyzing the related issues through a series of analyses. For a detailed and holistic analysis of the research hypothesis, identified methods integrated through an assessment framework with additional tools and application areas (Figure 3-1). Although there are various frameworks for integrating assessment and valuation of wetlands in the literature, a new framework was needed for the specific hypothesis of the research. The frameworks that were evaluated in the literature review part provided guidance for the development of this new framework (see Table 2-9). Especially the framework developed by De Groot et al., 2006 for the 3rd Ramsar Technical Report provided main reference.

As it was mentioned before, all the evaluated frameworks are consisting of two main parts of; “Function Analysis” and “Valuation”. These two parts were included in the new framework with an additional part of “Action Analysis”. Since the main purpose of this research was to explore the impacts of human interventions on wetlands, analysis of human activities and their impacts through DPSIR Framework were included as a part of the main body of the framework.

Also, for a better understanding of the dynamics of the system qualitative assessment of the values of the system (“Evaluation” of ecological, socio-cultural and economic structure) was included prior to the function analysis part. Although De Groot et al., 2006 gives evaluation as a part of the valuation part, it was taken to former steps for supporting the general understanding of the system.

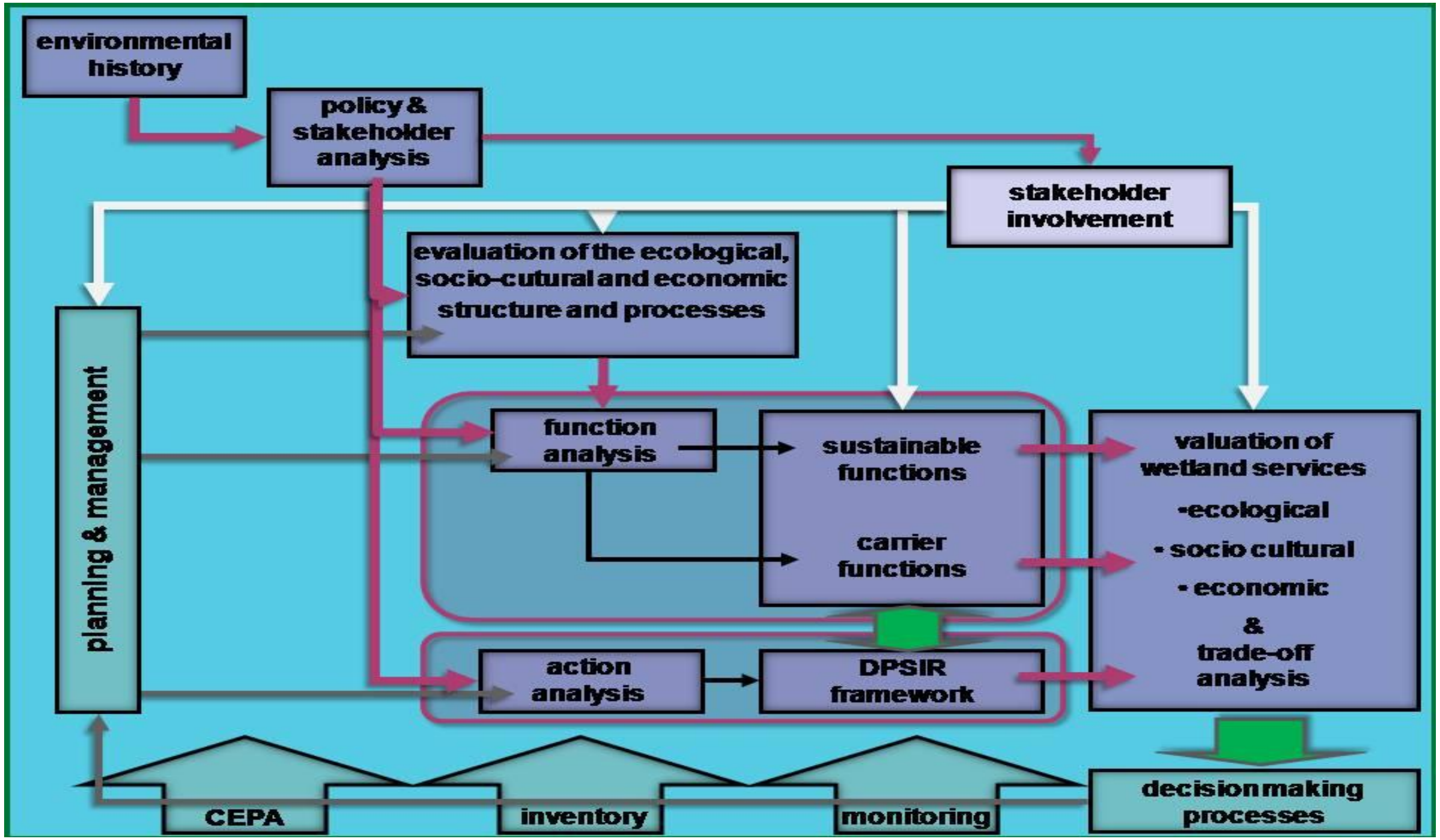

Figure 3-1 Framework for integrated assessment of the Kızılırmak Delta ecosystem

Identification of the Environmental History of the wetland was included as the first part of the framework for understanding the general tendency in the system. Policy and stakeholder analyses, from the framework by De Groot et al., 2006, were taken as a part of environmental history. Although some frameworks (by Barbier et al., 1997 and De Groot et al., 2006) provide a part about the selection of assessment objective or approaches, this new framework did not. Since the main purpose of the research was defined as exploring the trade-off between human interventions and well-being, objective of the framework was apparent however this framework could also be used for other purposes (total valuation and impact analysis) in further studies. It should be emphasized that this framework was not used for the calculation of the total value of the delta. Monetary valuation was just a tool (part) of the framework which was used for calculating the costs of trade-offs between human interventions and well-being.

Additional tools and application areas were also presented in the framework. Although it could not be achieved in this research, "Stakeholder Involvement" was taken as an important tool for all parts of the framework. Also, like all the former frameworks the possible "Application Areas" were defined for the results of the analyses. Since this framework was developed as a tool for supporting further researches and decision making processes, the further application areas for its results were also defined. Being provided and supported by the Ramsar Convention; CEPA (The Convention's Programme on Communication, Education and Public Awareness), inventory and monitoring processes were also taken as important application areas.

Research questions were classified under three groups, which form the main body of the framework, depending on their focal points and types of methods used for their analysis. The first group of questions about the importance and contributions of the Kızılırmak Delta was answered through analysis of its function (in the *Function Analysis* part) following the evaluation of its ecological, socio-cultural and economic structures (the *Evaluation* part). Through environmental history, evaluation and function analysis the dynamics and importance of the delta were identified. Second group about the processes behind the problems of the Kızılırmak Delta was answered by analyzing human activities through DPSIR Framework (in the *Action Analysis* part). Pressures and their impacts on the delta were analyzed through a relational perspective. The last group about the impacts of the changes in the Kızılırmak Delta was answered through the valuation of trade-offs in the delta (in the *Valuation and Trade-off Analysis* part). Costs of the impacts on the delta were calculated through monetary valuation. For a better understanding of this new framework, its parts were briefly explained below.

The general tendency of the system was identified through an analysis of the environmental history of the wetland ecosystem. Evolution of the human activities and pressures on the environment were analyzed through a chronological order. Policy context and important stakeholders of the system were also determined through an analysis of the environmental history of the system.

Total value of the system analyzed through qualitative assessment of its ecological, socio-cultural and economic structures using different evaluation criteria. Following the results of this evaluation, the functions and services provided by the delta were analyzed. A check list for the functions and services of wetlands was prepared following the different classifications in the literature (Table 3-2). The classification provided by De Groot, 2006 was taken as reference and functions from all other classification were included in this classification. This classification was taken as a reference because it was including the human activities (carrier functions) as a part of the functions of the wetland however a new classification was generated in this new framework. Other natural functions (called as Sustainable Functions in this framework) were separated from the carrier functions.

Human interventions were analyzed with their reasons and results through DPSIR (Driving forces, Pressures, State, Impacts, and Responses) framework in the action analysis part. Main pressures on the wetlands and the processes behind them were determined through the relational (DPSIR) framework and major problems were determined with following losses.

In the last part of the framework the cost of human interventions are analyzed through monetary valuation and trade-off analysis, respectively. The contributions of the wetlands on human well-being (functions) were calculated through monetary valuation and the costs of losing these contributions were analyzed. Values of previously determined functions of the wetlands were calculated through appropriate monetary valuation techniques and costs of losing these functions were determined in this part of the framework.

Only the values of carrier, production and some regulation functions could be assessed in the delta. Costs of losing some regulation functions were determined through the calculation of the costs of impacts following their losses however these were partial and random impacts. Values of carrier and production functions were calculated by using their market prices and production amounts.

Possible application areas for the results of the analyses were also defined at the end of the framework. Although this framework was generated for this research mainly, it could be used for other purposes in further studies. Providing a general understanding of the dynamics and the values of the system, results of this framework could be used in planning, management and decision making processes. Also these results can be used in the further researches about the system. In addition, use of these results in inventory, monitoring and communication processes was also mentioned in the framework. Inventory, monitoring and communication (CEPA) processes are important application tools of the Ramsar Convention and the results of this framework could support these processes.

Last but not the least, stakeholder involvement included as an important tool for all the parts of the framework. Although it could not be achieved in this research, involvement of stakeholders should be achieved from the beginning of the analysis processes in further studies. Assessment of the structure of wetlands and their valuation are interdisciplinary processes that could and should not be made by single researchers. Participation of all the stakeholder groups and different disciplines should be achieved for the success of the analyses however since this was a research for master thesis done by a single researcher; stakeholder involvement was not achieved.

3.3. Data, Data Sources & Collection Processes

Research data are mainly provided from a comprehensive documentary analysis and supported by in-depth interview studies held in the field. Also observations from the site visits provided important inputs to research process. Research mainly based on three major data sources about the Kızılırmak Delta by Özesmi, 1999, Sarısoy, et al. 2007 and Yılmaz, 2007. In addition to these major data sources, Eken et al. 2006; Magnin & Yarar, 1997; Özbek et al. 2007; Özesmi, 2003; Yeniyurt et al. 2008 were also used in the documentary analysis. In addition to written documents extra information were generated from the institutions and people in the field. Although these sources provided the core content for the database, results of in-depth interview studies were also considered in especially action analysis.

Nearly all of the written documents about the Kızılırmak Delta were collected and analyzed before the first site visit. Through these documentary analyses, missing data were determined and interview questions were prepared. Possible data sources from the site were defined before the visit and investigated in the site (Table 3-1). New data were generated from especially; Bafra, 19 Mayıs and Alaçam County Directorates of Agriculture, Bafra Chamber of Agriculture, County Directorate of State Hydraulic Works, Bafra Hunting and Shooting Club, Nature and Wildlife Conservation Association of Samsun and Provincial Directorate of Environment and Forestry in the field. Most of the needed data were collected by face to face conversations but some written documents were also taken from these institutions.

The 1st site visit lasted 5 days among 10-14 August 2009 while the 2nd one lasted 6 days among 13-19 October 2009. In total 13 in-depth interviews (Appendix B) were conducted with the local people from different stakeholder groups of Kızılırmak Delta. Interview form (Appendix C) was prepared before the site visit and the conversations mainly oriented by the form. Conversations lasted for 30 minutes in average and additional questions were asked when it was necessary. For a better understanding of the delta different districts/villages and communities were visited and structure and processes were observed during those 11 days. Also additional conversations generated with the inhabitants of the delta without following the interview form.

All the generated data from documentary analysis and site visits were synthesized and used in the analyses through the developed framework. Before the analyses, physical structure and the boundaries of the Kızılırmak Delta were briefly explained in the case description part below. Environmental History of the delta was also briefly presented in this part.

3.4. Case Description

3.4.1. Case Selection Criteria

Since the main purpose of the research is to explore the contributions of wetlands to human welfare and to determine the long term costs of losing these contributions; the case should be an important and rich wetland that has been influenced by human activities. Being one of the most important wetlands of Turkey and having ecological, socio-cultural and economic problems, Kızılırmak Delta was a good candidate for case area selection. In addition, data availability, recently finished management plan and related researches supported the selection of Kızılırmak Delta as the case study area.

3.4.2. Kızılırmak Delta, Samsun, Turkey

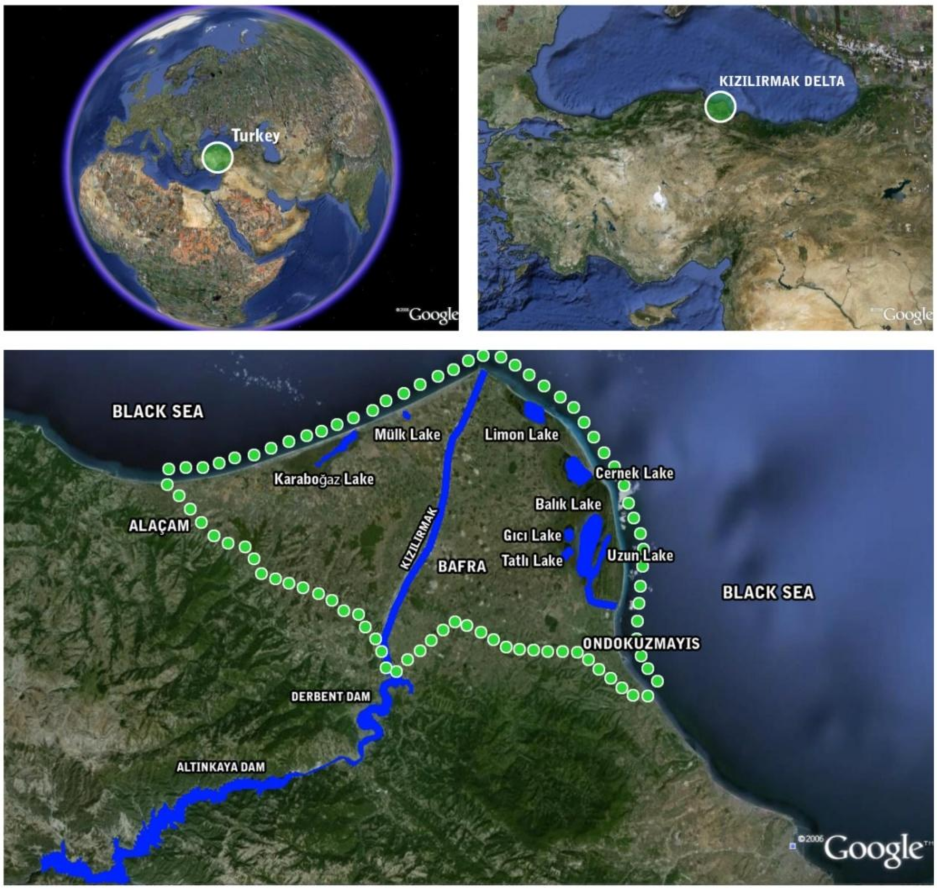

Figure 3-2 Location of Kızılırmak Delta at the Black Sea Coast of Turkey

3.4.2.1. Geographical Location & General Structure

Research area, the Kızılırmak Delta (a.k.a. Bafra Plain) is located in the Black Sea Region of Turkey where the Kızılırmak River flows into the Black Sea. The research area is bounded by the Taflan (Kurugökçe) river to the east, the Alaçam (Uluçay) river to the west, Derbent Village to the south and the Black Sea to the north. The area is within the jurisdiction of Bafra, Ondokuzmayıs and Alaçam counties and Samsun province (Figure 3-2).

The coordinates of the delta are 41º 36' N and 36º 05' E where the elevation starts from sea level (0 m) and increases up to 150 m to the south (Sarısoy, H.D. et al., 2007, pp. 17, 44). The delta covers an area of approximately 56.000 ha that includes 12.000 ha of bottomland hardwood forest, lagoons, dunes, etc. and 37.590 ha agricultural land (Sarısoy, H.D. et al., 2007, pp. 18).

3.4.2.2. Climate

Kızılırmak Delta shares the general characteristics of the climate of Samsun. The climate in the area is warm and dry in the summers, mild and wet in winters and foggy and wet in springs (Büyükgüngör, 1996 in Sarısoy, H.D. et al., 2007, p.61).

According to the measurements between 1978 and 2005 winds intensify in winters in Bafra. Dominant wind direction is SE (Sarısoy, H.D. et al., 2007, p.61). According to the temperature measurements between 1975 and 2005, Bafra has the highest average monthly temperature of 31,6 ºC in July and the lowest average monthly temperature of -2,9 ºC in February. The highest monthly temperature of 40,4 ºC was seen in August while the lowest monthly temperature of -8,2 ºC was seen in January. The mean annual temperature is 13,5 ºC in Bafra (Sarısoy, H.D. et al., 2007, p.65).

The most rainy month of Bafra is October with 101,2 mm rainfall while the driest month is July (Sarısoy, H.D. et al., 2007, p.65). The mean annual rainfall is 754,9 mm in Bafra. Although snow falls in the delta it stays on average 10,4 days a year (Yılmaz, C., 2007, pp.44-45). According to the measurements between 1975 and 2005, Bafra has the highest air pressure of 20,62 mb in August and the lowest air pressure of 6,71 mb in January. Bafra has the highest average monthly evaporation rate of 5,60 mm in July and the lowest average monthly evaporation rate of 1,41 mm in December (Sarısoy, H.D. et al., 2007, p.70).

3.4.2.3. Geology and Geomorphology

With the accumulation of sediment load on the mouth of the Kızılırmak River three delta plains formed, consequentially. The first delta plain formed about 300.000 years ago and followed by the formation of second delta plain about 100.000 years ago. The third and the last delta plain which covers the largest area and includes the major communities (such as lagoons, forests, dunes, etc.), formed nearly 10.000 years ago (Özesmi, 1999, p.26).

Shapes of western and eastern coasts of the delta differentiate as a result of the directions of winds and wave action. Because of the “dominant NNW winds and wave action” western coast of the delta is straighter than the eastern coast. Strong winds in the western coast of the delta resulted in the formation of high dunes. Formation of Karaboğaz Lake was a result of this wind action in the western coast of the delta (Özesmi, 1999, p.27). The structure of the eastern coast of the delta was mainly influenced by the sediment load brought by the river and the wave currents with an “average velocity of 0.5 sea miles per hour” (Akkan, 1970 in Özesmi, 1999, p.27). Sediments brought by the wave currents formed barriers on the eastern coast of the delta resulting in the formation of a series of lagoons. Later, a bottomland hardwood forest was formed on the low lying areas of the southern dunes (Özesmi, 1992 in Özesmi, 1999, p.27).

3.4.2.4. Hydrology

Delta wetlands receive water through ground and surface water flows from the river, local streams, channels, dunes and direct precipitation while they lose water through ground and surface water flows and evapotranspiration (Hollis, 1994 in Özesmi, 1999, p.29).

“[H]ave been channelled and straightened for irrigation and flood control purposes by the State Hydraulic Works”, more than 20 local streams feed the wetlands of the delta (DSİ, 1986 in Özesmi, 1999, p.29). The channels are being used for irrigation by the villagers while the returning waters are being drained into the wetlands through these channels carrying silt, fertilizer and pesticides. An interception channel was built by State Hydraulic

Works for draining the polluted waters of the channels to the sea. As a result of the lack of natural drainage in the areas below 2 m elevation, 7 pumping stations were needed for pumping the water out of the interception channel (DSİ, 1986; DSİ, 1992 in Özesmi, 1999, p.30).

Groundwater of the delta receives water from the river and also through precipitation and surface water flows while losing through discharges into the sea. Also water is being extracted from wells (20 l/sec per each well) for irrigation by villagers (Karaalioğlu and İslamoğlu, 1988 in Özesmi, 1999, p.30). “The total amount of sustainable groundwater yield from the delta is estimated at 36 million m^3 per year (DSİ, 1966 in Özesmi, 1999, p.30)”.

3.4.2.5. History of the Kızılırmak Delta

Kızılırmak Delta is consisting of three delta plains that completed their formation 300.000 years (1st delta plain), 100.000 years (2nd delta plain) and 10.000 years (3rd delta plain) ago (Özesmi, 1999, p.57). Following the first human footprints at 5000-4000 B.C. (Yılmaz, 2007, p.68) different civilizations consecutively settled on the delta, as follows (Özesmi, 1999; Yılmaz, 2007):

- 3500 B.C. : The first constant human settlements (Pre Hittite early Chalcolithic inhabitants)
- 3000-2000 B.C. : Early bronze age
- 1900-1800 B.C. : Early Hittite period
- 19th cent. B.C. : İkiztepe settlement (till the Middle Bronze age)
- 1650-1200 B.C. : Hittite
- 7th cent. B.C. : Paphlagonians
- 6th cent. B.C. : Lydians
- 546 B.C. : Persians
- 302-71 B.C. : Kingdom of Pontus
- 71 B.C. – 395 A.D. : Roman Empire
- 395-1086 : Byzantine Empire
- 1214 : Seljukians
- 1420 : Ottoman Empire

Environmental history of the Kızılırmak Delta after 1420 is briefly explained below, through the periodization developed by Özesmi (1999).

- ***Subsistence Level Agriculture Period***

In this period until the 19^{th} century, settlements and agricultural production activities took place on the higher slopes of the 2^{nd} delta plain and the 3^{rd} delta plain was in its pristine state. It was "mostly covered with marshes and extensive bottomland hardwood forests" (Özesmi, 1999, p.58). Wood was an important construction material for settlements, as a result of the richness of forests in the delta (Özesmi, 1999, p.59).

- ***Commercialization of Agriculture Period***

General tendency for the exploitation of the natural resources for paying the debts of Ottoman Empire affected the delta in this period between 19^{th} century and 1923 (foundation of the new Turkish Republic) (Özesmi, 1999, pp.60-63). In this period, Anatolia became an "agrarian reserve" of the capitalist economies and the Kızılırmak Delta turned into a tobacco production centre of this reserve. In the early 19^{th} century, the delta became an exporter of tobacco, especially to United Kingdom and the USA. With the 19^{th} century, general production structure of the delta shifted from subsistence level agriculture to cash crop (tobacco) production for "mercantilist and industrial economies in Europe and USA" (Özesmi, 1999, p.60).

In the second half of the 19^{th} century, the increase in the tobacco production was followed by a rapid development and population increase which in turn increased the exploitation of resources and conversion of natural areas (Özesmi, 1999, p.61). Formation of "French Tobacco Company (Fransız Rejisi)" in 1884 followed the formation of Düyun-i Umumiye-i Osmaniye Meclis-i İdaresi in 1881. Foreign control and pressure on production increased with the formation of the company (Özesmi, 1999, p.61). Following the intensification of cash crop production, inhabitants of the delta lost their food security and started to hunt the game resources in the lower delta plain. These conditions changed the relationship between the inhabitants and their environment hence the over-exploitation of delta resources started. Although the trade connections with the World were destroyed during the war period between 1914 and 1922 (1914-1918, World War I and 1919-1922, War of Independence) exploitation of the resources continued for sustaining the livelihood (Özesmi, 1999, pp.60-65).

- ***Modernist Revolution Period***

After the foundation of Turkish Republic in 1923, inhabitant's relationship with the delta changed as a result of two main developments. First, following the repatriation treaty with Greece, non-Muslim minorities in the delta replaced with Moslem minorities from Greece. These new comers developed new relations with the delta. Second, refusing the foreign economic control, the new government formed the "National Monopoly (Ulusal Tekel)" in 1923 and "the foreign monopoly on tobacco was broken" (Özesmi, 1999, p.65).

Until the 2nd World War, cash crop production lost its importance but in the war period state started to support the production of tobacco. Also eradication of animal pests (especially wolf and wild boar) was supported by the state for increasing the area under cultivation and Bafra Hunting Club was opened in 1942 (Özesmi, 1999, pp.66-95).

Upper (2nd) delta plain was covered with tobacco and people started to settle in the lower (3rd) plain. In these new settlements, tiles used instead of thatches on the roofs and tile factories opened in 1940. With the 1940s deforestation of the delta started to fuel tile furnaces. Also, population increase following the decrease in malaria incidences by medical treatments and drainage of wetlands intensified the deforestation of the delta (Özesmi, 1999, pp.68-82). Pressure on the natural areas increased with the intensified use of fertilizers and pesticides after the 2nd World War (Özesmi, 1999, p.72). Modernist Revolution period ended with the election Democratic Party in 1950.

- ***Liberal Capitalism Period***

Exploitation of natural resources for agricultural production was intensified with the support of Marshall Plan and following low interest credits in the 1950s. Also state investments on infrastructure such as roads supported the conversion of forests into agricultural land (Özesmi, 1999, p.71). Followed by communal hunts, deforestation resulted in the elimination of wild cat, wild boar, wolf, jackal, fox, deer and pheasant (*Phasianus colchicus*) from the delta (Özesmi, 1999, p.95).

In 1951, malaria incidence reduced 50 % as a result of advanced medication and extensive use of DDT. Later in 1954, some of the drainage channels (Figure 3-3) were built, to drain swamps, control mosquito and prevent floods (Özesmi, 1999, pp.72-74). Since "foreign debts were no longer considered a threat to the national sovereignty" in this period, large dam constructions were taken into agenda. In 1960, Hirfanlı Dam was built on the Kızılırmak River and caused a reduction in sediment load from 23.1 million tons/year to 18 million tons/year (Yılmaz, 2007, p.22).

Figure 3-3 An example of drainage channels
(Source: Personal archive - taken by Barbaros Gürçay)

As a result of global influence on market in 1960s, conversion of the lower delta to agricultural fields intensified and with the losses of grazing areas and wet meadows, grazing practices reduced in the delta. In spite of the increasing amount of land in tobacco agriculture and increasing tobacco production, the inhabitants of the delta suffered from poverty because of the surplus problem and decreasing prices (Özesmi, 1999, pp.71-72).

With the 1970s, eradication of the malaria achieved in the delta however with the drainage of wetlands it caused increasing human dominance in the lower delta (Özesmi, 1999, p.73). In 1971, a plan to rehabilitate and construct further drainage and irrigation channels was completed and with the 1980s dam and channel construction started according to the plans (Özesmi, 1999, p.74-90).

In 1979, 4000 ha area covering the Cernek Lake declared a no-hunting reserve; "Permanent Wildlife Reserve" (Magnin & Yarar, 1997, p.159) and later in 1984 it was changed into a 3850 ha "Cernek Lake Waterfowl Protection and Production Area". Also there were plans to declare the area a National Park in 1978 but a proposal by the Infrastructure Planning Bureau in 1980 denied by the Department of National Parks (Özesmi, 1999, p.101). Despite the conservation concerns, vacation home (Figure 3-4) buildings started on the coast of the delta with 1979 (Özesmi, 1999, p.98). Although a court order for the demolition of all the vacation homes by the Galeriç forest was issued, it was never enforced. Thus the number of houses increased from 60 to 230 by 1997 (Özesmi, 1999, p.104). Now there are 300 houses in the delta and constructions still continue (Sarısoy et al., 2007, p.365).

Figure 3-4 Vacation homes on the eastern coast of the delta
(Source: Personal archive - taken by Barbaros Gürçay)

With the 1980s, public participation on decision making processes about the delta increased with the formation of Yörükler, Doğanca, Sarıköy, and Emenli-Habilli-Şirinköy fishing cooperatives and Wildlife Conservation Society of Samsun (SDKD – Samsun Doğayı Koruma Derneği) (Özesmi, 1999, pp.90-101). Constructions of Altınkaya and Derbent Dams and Hydroelectric Power Plants finished in 1987 and 1991 respectively (Figure 3-5). Following the constructions of these dams, sediment load of the river decreased from 18 million tons/year to 0.46 million tons/year which later, between 1990 and 2000, caused a 1 km regression of the delta to south (Yılmaz, 2007, pp.22-25).

Figure 3-5 Derbent Dam and Hydroelectric Power Plant
(Source: Personal archive - taken by Barbaros Gürçay)

In 1986, Bafra Plain Irrigation Project was put into practice with a revision to extend the irrigation and drainage channels to elevations under 2 m. This revision necessitated the construction of 7 pumping stations with energy needs (Yılmaz, 2007, p.149). With the revision of the project, conversion threats on the wet meadows increased.

Then, in 1991 a contract to construct 1st Phase of Bafra Plain Right Coast Irrigation Project, for the irrigation (Figure 3-6) of 14279 ha land, was awarded and by the end of the 2005, 8000 ha land got irrigation water (Yılmaz, 2007, p.149). Later in 1992, interception channels were constructed for collecting the waters of drainage channels and discharging to the sea (Yılmaz, 2007, p.25).

Figure 3-6 An example of irrigation channels
(Source: Personel archive - taken by Barbaros Gürçay)

In 1996, a contract to construct Bafra Plain Left Coast Irrigation Project, for the irrigation of 19122 ha land, was awarded and the construction still continues today (Yılmaz, 2007, p.150). Also "Environmental Management Plan" (Çevre Düzeni Planı) regulations were passed jointly by the Ministry of Environment and Ministry of Public Works (Özesmi, 1999, p.104).

After the entrance of DHKD (Doğal Hayatı Koruma Derneği) to the stage of conservation in the delta in 1992, all the wetlands in the eastern part of the delta became “Natural Sit” (Magnin & Yarar, 1997, p.159). Kızılırmak Delta was designated a Ramsar Site and 21700 ha area covering all the wetlands was included in the List of Ramsar Convention (Özesmi, 1999, p.99; Yılmaz, 2007, p. 66).

Following the regression of the delta one plain (I) and two forked (Y) fenders were constructed on the eastern coast of the delta in 1999, mainly for stopping the degradation and sea water intrusion on the interception channel. Construction of 4^{th}, 5^{th}, 6^{th}, 7^{th} and 8^{th} fenders (Figure 3-7) followed first three fenders in 2000 (Yılmaz, 2007, p.25). Later in 2001-2002 “western fender” was constructed on the western coast and followed by the construction of 9^{th} fender (Yılmaz, 2007, pp.29-32).

Figure 3-7 Fenders on the eastern coast of the delta
(Source: Personal archive - taken by Barbaros Gürçay)

3.5. Analyses

3.5.1.Evaluation and Function Analysis

Questions about the importance of Kızılırmak Delta were answered through evaluation and function analysis. First, ecological, socio-cultural and economic values of Kızılırmak Delta were assessed by the evaluation of its ecological, socio-cultural and economic structures through documentary analysis. Then, functions and services of the delta were determined by using the list of functions and services of wetlands (Table 3-2) as a check list. Existence of the previously determined functions of wetlands in Kızılırmak Delta was analyzed.

3.5.1.1. Ecological, socio-cultural and economic values of Kızılırmak Delta

3.5.1.1.1. Ecological values of Kızılırmak Delta

Ecological structure of Kızılırmak Delta was analyzed by using the ecological valuation criteria, which were presented by De Groot et al. (2006, p.21). Naturalness/integrity, diversity, uniqueness/rarity, fragility/vulnerability and renewability/recreatability of the delta investigated through documentary analysis and the major components of the delta's ecological value were determined. These components of the ecological value of delta were classified under three groups of: communities, biodiversity and conservation status. These groups provide the ecological valuation criteria and represent the ecological values of delta.

Communities

As Özesmi (1999, p.45) states; the physical, biological and chemical structure and processes of the delta "provide a diversity of environments that help form rich communities". A community is defined by Ricklefs (1990 in Özesmi, U., 1999, p.32) as "interacting populations of different species defined by the place in which they live". According to Özesmi (1999) the Kızılırmak Delta is consist of six main biological communities; dune communities, bottomland hardwood forest community, lagoon communities, freshwater marsh and wet meadow communities, river community and agricultural communities (Appendix F). Also, according to Bern Convention criteria delta includes three threated habitat types of: Öksin halophilic swamps (tuzcul bataklıkları), South Black Sea permanent sand dunes(Güney Karadeniz sabit kumulları) and Southeast Europe ashen (dişbudak)-oak (meşe)-alder (kızılağaç) forests (Güneydoğu Avrupa dişbudak-meşe-kızılağaç ormanları) (Özhatay et al., 2003 in Sarısoy et al., 2007, p.30)

Dune Communities: Dune communities (Figure 3-8) are surrounded by Black Sea from north and by lagoons, freshwater marsh and wet meadow, bottomland hardwood forest and agricultural communities from south. Ranging between 10-700 m widths, dunes are formed by the sediments brought by the Kızılırmak River (Özesmi, U., 1999, p.33). Rich flora of the dune communities host large populations of mammals and provide resting and breeding space for, especially migrant, birds. Dunes are also important fields for animal grazing (Özesmi, U., 1999, pp.33-35).

Figure 3-8 Dune Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Figure 3-9 Galeriç Bottomland Hardwood Forest Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Bottomland Hardwood Forest Communities: Galeriç bottomland hardwood forest (Figure 3) is located in the eastern part of the delta, bounded by the dunes to the east. Hosting a rich flora, the forest provides habitats for diverse fauna, especially birds and mammals. Approximately 1200 ha forest is one of the most important communities of the delta with its rich bird diversity. Hydrologically connected to the lagoons, the forest is flooded with water in winter and spring (Özesmi, U., 1999, pp.35-37). The forest is owned by a group of people and it is being used for melon and vegetable production. Also the trees are being cut following a forest management plan (Özesmi, U., 1999, p.37).

Lagoon Communities: Aligning parallel to the shore, lagoons (Figure 3-10) are located on the eastern and western half of the delta. Total surface area of lagoons change among 15.000 ha and 2500 ha, and the maximum depth is 3 m while the average depth is 1.5 m (Yılmaz, 2007, pp.61-62). Although the lagoons on the eastern half of the delta were interconnected historically, Liman and Tuzlu Göl lagoons are recently isolated as a result of sedimentation. The lagoons are shallow and according to Vollenmeider Classification they are classified as eutrophic to polytrophic (Özesmi, U., 1999, p.38). The lagoons host a variety of flora and fauna including emergent and submergent vegetation, brakish water tolerant species and fishes. Also the lagoons provide wintering, staging and breeding habitats for birds (Özesmi, U., 1999, pp.38-39).

Freshwater Marsh and Wet Meadow Communities: Freshwater marshes and wet meadows (Figure 3-11) surround the lagoons and as a result of water level rises the lagoons inundate to them. Freshwater marshes turn into wet meadows in the higher elevations (Özesmi, U., 1999, p.40). Rich marsh and meadow vegetation host a variety o fauna. Freshwater marsh and wet meadow communities especially provide breeding, staging and wintering habitat for a great diversity of birds (Özesmi, U., 1999, p.40). The communities also contribute to human life through reed cutting and grazing. In return, these activities support and maintain the habitats in the communities (Özesmi, U., 1999, p.41).

River Communities: Although the naturality of the Kızılırmak River (Figure 3-12) was depleted following the construction of dams and artificial levees, it still provides habitat for fish and bird species. Sand and gravel banks and little islands on the river provide breeding habitats for different bird species (Özesmi, U., 1999, p.42).

Figure 3-10 Lagoon Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Figure 3-11 Freshwater Marsh and Wet Meadow Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Agricultural Communities: Agricultural communities (Figure 3-13) cover the south of other biological communities and expand into the foothills of the North Anatolian Mountain Range. The agricultural communities in the lower part of the delta are used for rice agricuture while the upper parts are covered by small grains, corns, sun flowers and vegetables (Apan et al., 1993 and Köksal, 1972 in Özesmi, U., 1999, p.43). Also the foothills are reserved for tabacco agriculture (Anonim, 1966 in Özesmi, U., 1999, p.43). Small and independent fields of the community create a diverse landscape. Fields, gardens, small graves, hedges and old trees provide habitat for a variety of fauna, especially birds (Özesmi, U., 1999, p.43).

<u>Biodiversity</u>

As a result of the variety and integrity of its communities and habitats, Kızılırmak Delta provides a very rich biodiversity. Delta includes various taxons and species of plants, algae, zooplanktons, benthic, invertebrates, vertebrates and birds (Sarısoy et al., 2007, pp.119-189).

Algae: There are 213 taxons of 7 algae classes in Kızılırmak Delta. According to Sarısoy et al. (2007, p.138) 88 taxons of Bacillariophycea, 60 taxons of Chlorophycea, 39 taxons of Cyanophytacea, 17 taxons of Euglenophycea, 4 taxons of Dinophyceae, 3 taxons of Crysophyceae and 2 taxons of Crysophycea are determined in the delta (These taxons of algea are listed in the Appendix G).

Zooplanktons: There are 48 species of zooplanktons in the delta. According to Sarısoy et al. (2007, p.155) 28 species of Rotifera, 15 species of Cladocera and 5 species of Copepoda are determined in the delta (These species of zooplanktons are listed in the Appendix G).

Benthic: There are 35 taxons of benthic in the delta. According to Sarısoy et al. (2007, p.162) 11 taxons of Gastropoda, 4 taxons of Bivalvia, 2 taxons of Clitellata, 1 taxon of Crustacea and 17 taxons of Insecta are determined in the delta (These taxons of benthic are listed in the Appendix G).

Plants: According to Sarısoy et al. (2007, p.119) although delta does not include endemic flora species, there are 18 taxons of vulnerable plants *(Rhaponticum serratuloides*, *Ambrosia elatior*, *Schoenoplectus triqueter*, *Stachys maritime*, *Jurinea kilaea*, *Tournefortia sibirica*,

Figure 3-12 River Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Figure 3-13 Agricultural Communities
(Source: Personal archive - taken by Barbaros Gürçay)

Lactuca tatarica, *Pancratium maritimum*, *Leucojum aestivum*, *Aster tripolium*, *Thelypteris palustris*, *Euphorbia lucida*, *Corispermum filifolium*, *Periploca graeca var. vestita*, *Chenopodium chenopodioides*, *Digitaria sabulosa*, *Schoenoplectus x carinatus* (*S. lacustris subsp. tabernaemontanii x S. trigueter*), *Pterocarya fraxinifolia)* in the Kızılırmak Delta. Also there are 14 aquatic plant species and 25 coastal swamp plant species in the delta (Sarısoy et al., 2007, p.122). (A list of these plant species are given in the Appendix G)

Invertebrates and vertebrates: According to Sarısoy et al. (2007, p.174) 71 species of invertebrates are determined in the delta. Also, there are 83 species of vertebrates in the delta. According to Sarısoy et al. (2007, pp.176-183) 29 fish species (1 endemic), 7 frog species, 2 salamander species, 12 reptile species (2 turtle, 5 lizard and 5 snake species) and 33 mammalian species are determined in the delta.

Birds: Sarısoy et al. (2007, p.187) state that 317 bird species (nearly %69 of the bird species determined in Turkey) are determined in the delta. 214 of these 317 bird species are observed during field surveys for the management plan. Also, it is determined that 80 species certainly breed in the field while there is breeding possibility for 118 species (Sarısoy et al., 2007, pp.196-197). According to Sarısoy et al., (2007, pp.188-189) 57.600 waterfowl was determined in the delta in 2007.

<u>Conservation status</u>

Delta includes areas with different conservation status as a result of the richness and variety of its habitats and species. Existence of habitats and species that are providing the criteria of different conservation status resulted in the designation of various conservation areas. Delta includes areas with Important Nature Area (INA) (Önemli Doğa Alanı, ÖDA), Important Bird Area (IBA) (Önemli Kuş Alanı, ÖKA), Natural Site (Doğal Sit), Wildlife Development Area (Yaban Hayatı Geliştirme Sahası) and Ramsar Area (Ramsar Alanı) status (Appendix D).

3.5.1.1.2. Socio-cultural values of Kızılırmak Delta

Socio-cultural structure of Kızılırmak Delta was analyzed by using the socio-cultural valuation criteria, which were presented by De Groot et al. (2006, p.21). Therapeutic, amenity, heritage, spiritual and existence values of the delta investigated through documentary analysis and the major components of the delta's socio-cultural value were determined. These components of the socio-cultural value of delta were classified under three groups of: historical and archaeological heritage, recreational areas, and crafts and traditions. These groups provide the socio-cultural valuation criteria and represent the socio-cultural values of delta.

Historical and archaeological heritage

The first human existence in Kızılırmak Delta dates back to 4000 B.C. and continues until today (Yılmaz, 2007, p.69). This long history of human influence on the delta provides a great deal of historical and archaeological heritage. Rich heritage of the delta includes 57 barrows (höyük), 48 tumuluses, 6 settlement areas, 25 peaces from archaic times, 5 rock tombs, 7 castles, 5 mosques, 2 shrines (türbe), 3 hammams, 5 fountains, 1 bridge (Figure 3-14), 1 covered bazaar, more than 1000 arsenious copper pieces, nearly 600 bone, horn and stone pieces, 10211 pieces of pot, and historical houses (Sarısoy et al., 2007, pp.297-298; Yılmaz, 2007, pp.205-208).

Figure 3-14 Historical Kızılırmak Bridge
(Source: Personal archive - taken by Barbaros Gürçay)

Recreational areas

Biological communities and habitats of Kızılırmak Delta provide various recreational areas that are valuable socio-culturally. Coasts, beaches, lagoons, forests and waterfalls are some of these valuable areas. There are also specific locations such as Şahinkaya valley, “Klimalı Kaya” cave and the mouth of Kızılırmak River (Sarısoy et al., 2007, p.299; Yılmaz, 2007, pp.202-203).

Crafts and traditions

As a result of long human history, Kızılırmak Delta accommodates crafts and traditions that provide socio-cultural value. Rug weaving, basket knitting and mine embroidery are the traditional crafts in the delta. Also 10211 pieces of pot indicate the importance of pottery in history and culture of the field. In addition cosmopolitan structure of the community provides rich diversity of folk songs and dances (Sarısoy et al., 2007, pp.297-300; Yılmaz, 2007, p.210). Additionally, water buffalo is an important component of the local culture in delta.

3.5.1.1.3. Economic values of Kızılırmak Delta

Economic values of Kızılırmak Delta were investigated through an analysis of the economic structure of the delta. Although total economic value of the delta was composed of direct use, indirect use, option, bequest and existence values, only direct use values were determined here. Other parts of the total economic value of delta were investigated through function analysis and monetary valuation. All functions and services of Kızılırmak Delta could be valued in economic terms but these functions should have been analyzed first, thus they were determined in the function analysis part. Direct use value of Kızılırmak Delta is composed of the practices that have direct economic returns to community. These practices include; farming, animal husbandry, fishing, reed cutting, gathering, energy conversion and mining. Local economy depends on these practices provided by the delta.

3.5.1.2. Functions and services of Kızılırmak Delta

Kızılırmak Delta contributes to human welfare through provision of various functions which were defined before as “the capacity of natural processes and components to provide goods and services that satisfy human needs, directly or indirectly” (De Groot, 2006, pp.176-177).

Thus for a better understanding of the importance and value of Kızılırmak Delta, its contributions were analyzed through function analysis here.

List of functions and services of wetlands (Table 3-2) was used as a check list for investigating the functions and services of Kızılırmak Delta. Existence of these previously defined functions in Kızılırmak Delta was investigated through documentary analysis. Regulation, habitat, production, information, and carrier functions were analyzed and presented with their services below.

3.5.1.2.1. Regulation functions

As stated before, regulation functions provide pre-conditions for other functions by regulating and maintaining the "ecological processes and life support systems through bio-geochemical cycles and other biospheric processes" (De Groot et al., 2002, p.3). Most probably Kızılırmak Delta provides all the regulation functions presented in the check list however only a limited portion of its functions and services could be determined through documentary analysis because of the lack of information about those functions. Determined regulation functions and services of Kızılırmak Delta were listed and described below.

Gas and climate regulation

Interactions within and between the rich, diverse and interdependent communities and habitats of Kızılırmak Delta result in biogeochemical cycles and ecological processes which are important components of atmospheric and climatic processes. Although it is apparent that the delta provides gas and climate regulation functions, information about the influence of Kızılırmak Delta on gas and climate regulation could not be found from the documentary analysis.

Table 3-2 List of Functions and Services of Wetlands

SUSTAINABLE FUNCTIONS		CARRIER FUNCTIONS
Regulation Functions	Gas and Climate Regulation	Habitation
	Disturbance Prevention (Natural hazard mitigation)	Cultivation
	Water Regulation (Hydrological regimes)	Energy Conversion
	Soil Retention and Formation	Mining
	Nutrient Regulation and Waste Treatment	Waste Disposal
	Pollination and Biological Control	Transportation
Habitat Functions	Refugium and Nursery	Tourism Facilities
Production Functions	Food Provision	
	Water Provision	
	Raw Materials Provision	
	Genetic, Medicinal and Ornamental Resources Provision	
Information Functions	Aesthetic Information	
	Recreation	
	Cultural and Artistic Information	
	Spiritual and Historic Information	
	Science and Education	

(Adapted from Costanza et al., 1997a; De Groot et al., 2002; De Groot, 2006 ; De Groot et al., 2006)

Disturbance prevention

Kızılırmak Delta provides disturbance prevention function through abatement of the affects of storms and floods. Being both a riverine and coastal wetland, delta absolutely provides storm abatement and flood mitigation services, however information about the influence of Kızılırmak Delta on these services could not be found through the documentary analysis.

Water regulation

Kızılırmak Delta provides water regulation function through hydrological processes within and between wetlands, groundwaters, channels, streams and rivers. Capturing, storing and gradually releasing water, these components regulate the hydrological regime of the delta. In addition, storing and providing water for usage, drinking and irrigation, these components support life in the delta.

Main water inputs to the wetlands are groundwater from rivers and channels, surface water from streams, channels and surface runoff, and direct precipitation in the delta whereas, the major output are through evapotranspiration, surface flow and groundwater output into the sea (Hollis, 1994 in Özesmi, 1999, p.29). Groundwaters in the delta are recharged from rivers, precipitation and surface flows while discharged by extraction from wells and infiltration into the sea (DSİ, 1966 in Özesmi, 1999, p.30).

Being the main water resources, groundwaters, wetlands and the river are the major components of the water regulation function in the delta. Groundwaters are being extracted from the wells in delta with an estimated amount of 20 l/day for each well and 36 million m^3 per year (DSİ, 1966 in Özesmi, 1999, pp.30-31). Groundwater reserve of the delta is estimated to be 95,2 x 106 m^3/year (DSİ, 1986 in Yılmaz, 2007, p.60). According to Sarısoy et al. (2007, p.81) there are more than 1500 caisson wells that are used for drinking, usage and irrigation water provision. Also, Kızılırmak River is an important part of the hydrological structure. Average flow of the river is observed to be 188.08 m^3/sec between 1962 and 2006 (Sarısoy, et al., 2007, p.76).

With a maximum surface area of 134 km^2 in the wet periods, wetlands are the most important components of the hydrological structure. Their total surface area decreases to 24.4 km^2 in the dry periods (Sarısoy, et al., 2007, p.81).

Soil retention and formation

Being formed as a result of the accumulation and retention of sediments brought by Kızılırmak River, Kızılırmak Delta provides soil retention and formation functions. History of the development of delta plains proves the importance of the delta in soil retention and formation. Before the construction of dams, Kızılırmak was carrying 23.1 million metric tons of sediment per year to the delta however with the construction of last dam (Derbent Dam) sediment load reduced to 0.46 million metric tons per year (Özesmi, 1999, p.76). Sediment hold in the dams resulted in coastal erosion and the delta regressed 1 km between 1990 and 2000 (Yılmaz, 2007, pp.22-25). These losses following the reduction in the sediment load reveal the importance of soil retention and formation functions of the delta.

Nutrient regulation and waste treatment

Kızılırmak Delta provides nutrient regulation and waste treatment functions through biogeochemical cycles and ecological processes within and between its biological communities. Excess pollutants and nutrients are being retained, recovered and removed from the system by biotic and abiotic processes. As Mitsch and Gosselink (2000, p.196) states; wetlands are the sources, sinks and transformers of nutrients and chemicals. Through biotic processes, such as primary production, nutrient cycling, organic matter accumulation and export, nutrients are being regulated in the delta (Mitsch and Gosselink, 2000, pp.147-152). In addition, transformation of chemicals such as; nitrogen, phosphorus, sulfur, carbon, iron and manganese result in the treatment of wastes that enter in the system (Mitsch and Gosselink, 2000, pp.165-187).

As a result of; excessive fertilizer and pesticide use in intensive agricultural practices, increasing amounts of waste disposals from human settlements and carriage of the nutrients and pollutants to the wetlands (by channels and leakages), pollution is the main problem in the delta. According to Sarısoy et al. (2007, p.173) all the wetlands in the delta are eutrophic resulting in algal blooms. Eutrophication and algal blooms indicate that the delta is exceeded its carrying capacity for providing nutrient regulation and waste treatment functions.

Pollination and biological control

Accommodating various habitats and rich biodiversity, Kızılırmak Delta provides pollination and biological control functions however information about the influence of Kızılırmak Delta on these functions could not be found through the documentary analysis.

3.5.1.2.2. Habitat functions

<u>Refugium and nursery</u>

Hosting a very rich biodiversity through various habitats and communities Kızılırmak Delta provides refugium and nursery functions. As it was presented in the ecological values of the delta, Kızılırmak Delta includes rich dune, bottomland hardwood forest, lagoon, freshwater marsh and wet meadow, river and agricultural communities that provide breeding, feeding and resting habitats for various species (Appendix F & Appendix G). Existence of various communities and species further support the maintenance of biological and genetic diversity.

3.5.1.2.3. Production functions

As a result of richness and variety of its habitats and biodiversity, Kızılırmak Delta provides various natural resources that are valuable for the inhabitants of the delta. Originating in natural processes and growing in the wild these resources are being gathered by the people, without any production costs. They only involve labour costs and provide higher incomes than agricultural labourers get. Being harvested by the most economically marginalized group of farmers these products are being "used locally, marketed nationwide and exported to foreign countries" (Özesmi, 1999, p.86).

<u>Food provision</u>

Through conversion of solar energy into edible plants and animals Kızılırmak Delta provides food for its inhabitants. Fish, game animals, local plants and animals are the main edible natural products of the delta (Appendix E).

Although it has been declining mainly because of pollution and excessive fishing, fishery is still one of the most important economic activities in the delta. Common carp (*Cyprinus carpio L.*), zander (*Stizostedion lucioperca L.*), flathead mullet (*Mugil cephalus*), and crayfish (*Astacus leptodactilus*) are being caught from the lagoons (amounts of caught fishes are listed in Table 3-3 below) while wels catfish (*Siluris glanis*), common carp (*Cyprinus carpio L.*) and rudd (*Scadinius erytrobhtalmus*) are being caught from the Kızılırmak River (Sarısoy et al., 2007, pp.355-356). Although sturgeon species (*Huso, Acipenser sp.*) were important components of the Kızılırmak River, as a result of the dams and over-fishing for caviar they became extinct in the river (Özesmi, 1999, p42).

Hunting of game animals is another natural product use practice in the delta. There are 1500 hunters in Kızılırmak Delta, 1000 of which are unauthorized hunters (Anon., 2006b in Sarısoy et al., 2007, p.361). Depending on the conversation with interviewee-6 (the president of Bafra Hunting and Shooting Association), Table 3-4 about the per year hunts of a hunter is generated below (See Appendix E for hunting areas).

Table 3-3 Amount of the fishes caught in Kızılırmak Delta

Years	Common carp (Sazan) tones	Zander (Sudak) tones	Flathead mullet (Kefal) tones	Crayfish (Kerevit) tones
1980*	150	15	15	.
1981*	175	20	10	.
1982*	200	17	12	.
1983*	67,2	10	7,5	.
1984*	70,8	19,4	2,8	13
1985*	65	15,3	19,3	14
1986*	67	11,8	34,8	26
1987	62,5	11	15	25
1988	60	2,5	9,3	22
1989	50,7	28,6	7	21
1990	18,8	5,7	5,9	20
1991	32,8	14,6	25	19
1992	63,1	14,6	25,4	16
1993	19,8	13,7	25,8	15,5
2002	1,6	3,5	3,3	13,8
2003	1,7	2,8	2,8	9,4
2004	2,1	2,6	2,2	5,9
2005	2,1	2,4	2,5	1,5

(Anon., 2007d; *Bircan, R., 1987 in Sarısoy et al., 2007, pp.356-357)

Since there are 1500 hunters in the delta, with the assumption that a hunter hunts 171 game resources in a year it can be said that approximately (171 x 1500) 256500 game resources are being hunted from Kızılırmak Delta in a year.

Table 3-4 Total hunts of a hunter per year

Game names		Number of hunting (a hunter per year)	Number of games hunted (a hunter per year)	Total
sakarmeke	eurasian coot	12	3	36
ördek	duck	20	3	60
tavşan	rabbit	10	2	20
bıldırcın	quail	5	5	25
üveyik	turtle dove	2	4	8
çulluk	curlew	10	2	20
domuz	boar	8*	5	40
	Total	**59**	**24**	**209**
* By groups of 15-20 hunters thus a hunter hunts approximately 2 boars a year.				

(Source: Interview with interviewee-6)

Another important source of food in the delta is local plants and animals. Some of these gathered products are being used in the delta while some are being exported. *Bellis perennis, Morus alba, Morus nigra, Ficus carica, Orchis spp, Daucus carota, Hordeum spp., Corylus avellana, Punica granatum, Pyrecantha coccinea, Pyrus communis, Cornus mas, Cydonia oblonga, Prunus spinosa, P. Domestica, Malva sylvestris, Rubus idaeus, Rubus sanctus, Smilax excelsa, Urtica dioica, Salicornia europaea* and *Salvia verticillata* are the main edible plants used by the people in the delta (Sarısoy et al., 2007, pp.122-123). Plants like; *Medicago spp, Vicia spp, Lathyrus spp, Trifolium spp, Elymus spp, Paspalum paspolodes* and *Poa pratensis* are being used for feeding the animals (Sarısoy et al., 2007, p.123). In addition to plants, frogs and snails are also being gathered from the delta since 1992. Frogs are being gathering by 60 workers in 120 days of summer and autumn months while snails are being gathered by 70 workers in March, April and June in the delta (Sarısoy et al., 2007, p.364; sea also Appendix-4 for gathering areas). Gathered frogs and snails are being sold to agents from Bafra and Samsun who market them to big cities of Turkey and foreign countries.

Water provision

Although the waters are polluted and the wetlands are eutrophic delta still provides water for industrial use and irrigation of agricultural fields. Derbent Dam (constructed in 1991) holds 2.9 million m³ of water that is being used for irrigation of the delta (Yılmaz, 2007, p.178). With the irrigation works following the construction of Derbent Dam 60 % of the eastern coast is being irrigated by channels while 20 % by wells and other 20 % by drainage channels. Since the works have not started in the western coast yet, 90 % of the land is being irrigated from wells and 10 % by streams from Kızılırmak River (Anon., 2007a in Sarısoy et al., 2007, p.337). With 95,2 x 106 m³/year groundwater reserve delta also provides groundwater for consumptive uses (DSİ, 1986 in Yılmaz, 2007, p.60).

Raw materials provision

Özesmi (1999, p.86) states that the most important natural product use is the harvesting of aquatic vegetation species of; sharp-pointed rush (*Juncus acutus*) ("goga" by local people), common reed (*Phragmites australis*), reedmace (*Typha angustifolia*), and bulrush (*Scirpus lacustris*). Common reed (Phragmites australis), reedmace (Typha angustifolia) and bulrush (Scirpus lacustris) are being cut (Figure 3-15) by 350-400 people from nearly 130 dwellings of Doğanca, Yörükler and Sarıköy Villages (Sarısoy et al., 2007, p.352) (Annual amounts of these reeds being cut are listed in Table 3-5 below). Most of the reeds are being exported from Doğanca Village (to the Netherlands, etc.) to be used as isolation material on the roofs. On the other hand, the reeds from Sarıköy, Üçpınar and Ermenli Villages are being sold in local market after being processed in houses (Sarısoy et al., 2007, p.352) (reed-beds are presented in Appendix E).

Table 3-5 Numbers of reed ties from Sarıköy, Doğanca and Yörükler Villages

numbers of reed ties			
Years	Sarıköy	Doğanca	Yörükler
2002	14.000	20.000	20.000
2003	16.000	16.000	15.000
2004	18.000	24.000	17.000
2005	20.000	30.000	28.000
numbers are the ties of 35 cm width and 150 cm length			

(Anon., 2007d in Sarısoy et al., 2007, p.352)

Figure 3-15 Reed cutting worksite
(Source: Personal archive - taken by Barbaros Gürçay)

Figure 3-16 Reed and goga beds
(Source: Personal archive - taken by Barbaros Gürçay)

Reeds are being used for making baskets, skeps, etc., covering the roofs of buildings (houses and animal shelters), and lying on the grounds of barns (Sarısoy et al., 2007, p.352). In spite of its economic benefits for local people, within sustainable use limits, reed cutting is also beneficial for the wetland ecosystems. Pollutant and nutrient stocks in the aquatic systems are being removed from the system by reed cutting. Also, reed cutting results in the regeneration and resurgence of the vegetation (Özesmi, 1999 in Sarısoy et al., 2007, pp.353-354).

After being gathered and dried by the villagers from Yörükler, Doğanca and Sarıköy Villages, gogas (*Juncus acutus*) (Figure 3-16) are being sold to intermediaries from the region. These intermediaries export gogas to big cities of Turkey (Ankara, Adana, Sivas, etc.) where the florists use goga in bouquet making (Sarısoy et al., 2007, p.354). Numbers of households and people gathering goga and amount of gogas gathered are listed in Table 3-6 below (goga gathering areas are presented in Appendix E).

Table 3-6 Goga gathering from Sarıköy, Doğanca and Yörükler Villages

goga gathering			
	number of households	number of people gathering goga	amounts of (wet) goga gathered kg
Doğanca	20	80	70.000
Yörükler	60	250	250.000
Sarıköy	25	100	50.000
TOTAL	105	430	370.000

(Anon., 2007e in Sarısoy et al., 2007, p.354)

Genetic, medicinal and ornamental resources provision

Rich biodiversity and diverse communities of Kızılırmak Delta provide genetic resources. Delta hosts and supports the genetic material and evolution of the species. Some plant and animal species of delta provide medical use services. *Leucojum aestivum, Arum maculatum, Plantago lanceolata, Tamus communis, Althaea officinalis, Asparagus officinalis, Chondrilla juncea, Teucrium polium, Teucrium chamaedrys, Cionura erecta* and *Hypericum perforatum* are the main medicinal plants of the delta (Sarısoy et al., 2007, pp. 126, 363-364).

Although, summer snowflake (*Leucojum aestium*) flowers are being gathered in Samsun, Bafra and Terme with their pedicles for being sold to florists, they are also being used in medical treatments. In 2006, 19.500 kg of Leucojum aestium was exported from the region (Sarısoy et al., 2007, p.363). Gathered from Yörükler Village in 2006, for the first time, lords and ladies (*Arum maculatum*) (danayağı or filkulağı by local people) was used in medical treatments as pacificator (Sarısoy et al., 2007, p.364) (summer snowflake and lords and ladies gathering areas are presented in Appendix E).

Leeches are the main medicinal animals provided by the delta. Being gathered from delta by 30 workers of a company from Samsun, Çarşamba leeches are being exported to France, Italy and Japan for medical uses. According to Sarısoy et al. (2007, p.364) 3 tones of leeches are being gathered annually during 50 windless days of May, June and July (leech gathering areas are presented in Appendix E).

Kızılırmak Delta also provides ornamental resources such as: *Iris pseudocorus, Rosa canina, Pancratium maritimum, Nymphaea alba, Cladium mariscus, Ruscus aculeatus, Narcissus tazetta, Viola occulta* and *V. Sieheana* (Sarısoy et al., 2007, pp.125-126) and versatile resources like: *Laurus nobilis, Crataegus monogyna, C. Microphylla, Hippophae rhamnoides, Trachomitum venetum* and *Arum maculatum* (Sarısoy et al., 2007, pp.126-127)

3.5.1.2.4. Information functions

Kızılırmak Delta provides opportunities for cognitive development through the variety of its natural features with aesthetic, recreational, cultural, artistic, spiritual, historic, scientific and educational values. Directly influencing the daily lives of the inhabitants of delta, these values are very important for the sustainability of life on delta. Most of these values are determined through historical and archaeological heritage, recreational areas, and crafts and traditions above. Although delta provides all mentioned values above, only the formerly determined ones could be found from the documentary analysis.

3.5.1.2.5. Carrier functions

Accommodating humans since 3500 B.C. Kızılırmak Delta has a very long carrier functions provision history. As it has been presented in the history of Kızılırmak Delta above, human activities evolved from an environmentally sound and sustainable level to unsustainable state. Today delta is dominated by the human activities through conversion of its multifunctional habitats into single function services such as; habitation, cultivation, energy conversion, mining and waste disposal. These carrier functions of the delta are presented below.

<u>Habitation</u>

Including Bafra, Ondokuzmayıs and Alaçam counties with their villages delta provides living spaces for approximately 210000 people (Yılmaz, 2007, p.141). Accommodation of the people in delta provides demand for other carrier functions and triggers further pressures on natural functions.

<u>Cultivation</u>

Being the main and dominant economic activity in the delta, agricultural production is getting intensified. Construction of Derbent Dam, implementation of drainage and irrigation channels and mechanization of the production raised the pressure of agriculture on the delta. Approximately 25000 people from 32 villages of Kızılırmak Delta make their living through agricultural production (Anon., 2007b in Sarısoy et al. 2007, p.337). 251220 da of area is being cultivated and 493245 tons of crops are being produced from the delta (Anon., 2009). Animal husbandry is another important economic activity which is mainly being done in villages close to wetlands. Numbers of animals are listed in the Table 3-7 below. Although it has been declining, delta has the largest water buffalo (Figure 3-17) population in Turkey (Sarısoy et al., 2007, p.342). Changes in the water buffalo population of delta are presented in Table 3-8 below.

Table 3-7 Number of animals in Kızılırmak Delta

years	**sheep (native-other)**	**hair goat**	**cattle**	**water buffalo**	**horse**	**hinny**	**donkey**
2003	57.500	3.245	41.700	4.050	523	2.172	332
2005	30.000	2.000	40.200	2.800	200	1.000	175
2006	30.000	2.000	37.800	2.200	150	850	125
2008	32.000	2.065	39.500	2.500	550	2.100	350

(Anon., 2009)

Table 3-8 Water buffalo population in Kızılırmak Delta

water buffalo (manda) populations								
1990	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
10.000	5.750	4.950	4.700	4.550	4.100	3.750	3.550	2.800

(Anon., 2007b in Sarısoy et al., 2007, p.342)

Figure 3-17 Water buffalos
(Source: Personal archive - taken by Barbaros Gürçay)

Energy conversion

Resulted in various problems, Altınkaya (1987) and Derbent (1991) Dams and Hydroelectric Power Plants were constructed for answering the energy need of Kızılırmak Delta and providing irrigation water. Generating energy for the delta, Plants also distribute the energy out of the delta through interconnected system (Yılmaz, 2007, p.178). General properties of Altınkaya and Derbent Dams and HPPs are listed in the Table 3-9 below.

Table 3-9 Properties of Altınkaya and Derbent Dams and HPPs

Dams	Dam Volume	Installed Power	Energy Generation
Altınkaya Dam and Hydroelectric Power Plant	16 million m^3	700 MW	1632 billion kWh/year
Derbent Dam and Hydroelectric Power Plant	2.9 million m^3	58.3 MW	257 million kWh/year

(Adapted from Yılmaz, 2007, p.178)

Mining

Once supported and operated by government, sand and gravel extraction from especially Kızılırmak river bed was continued for a long time. Sand and gravel extraction resulted in sea water intrusion to river through reduction in river level and structural problems on Derbent Dam and Kızılırmak Bridge (Sarısoy et al., 2007, pp.359-360). Although it was forbidden in 2004 illegal extraction continued in the delta. Total amount of sand and gravel extracted from the delta is calculated to be 17.600.000 m^3. With the 2007 prices total value of extracted sand and gravel is calculated as 176.000.000 TL (Anon., 2007f in Sarısoy et al., 2007, p.360).

Waste disposal

Kızılırmak Delta provides space for solid waste disposal of Bafra, Ondokuzmayıs and Alaçam counties. Bafra produces 180-200 tones solid waste per day while Alaçam and Ondokuzmayıs produce 10-20 tons a day. Wastes of these counties accumulate through unsanitary disposal on the delta (Yılmaz, 2007, p.214-215). Leakages from wastes infiltrate into river and groundwaters causing pollution.

Also waste waters of these settlements are being discharged into Kızılırmak River or Black Sea through channels. Although Bafra and Ondokuzmayıs use biological treatment before discharge, Alaçam discharges directly to Black Sea without any treatment (Yılmaz, 2007, p.214-215). According to an environmental engineer working in Municipality of Bafra, biological treatment plant discharges 10000-12000 m^3/day waste water to Kızılırmak River after treatment. Since villages of the delta do not have any sewage system, they use cesspits for waste water discharge which further pollute groundwaters through leakages.

3.5.2.Action Analysis through DPSIR Framework

Questions about the problems of Kızılırmak Delta were answered by action analysis through DPSIR framework. Problems of the delta, their reasons and results were analyzed through documentary analysis and in-depth interviews. Also, analyses were supported with the observations from the site. Human actions, or pressures, were taken as the focal point of DPSIR framework and driving forces behind these pressures, following changes, impacts of these changes and human responses to these impacts were analyzed and determined through documentary analysis. As a result of the analyses, 7 major pressures are determined and each action analyzed separately while the related actions were presented together.

Action analysis reveals that the pressures on the delta are being induced by the carrier functions. All 7 determined pressures are the results of intensive human use of the carrier functions. Exceeding the carrying capacity of the delta these carrier functions cause changes in natural systems that result in the degradation and loss of sustainable (regulation, habitat, production and information) functions. This conflict between carrier and sustainable functions were analyzed below.

3.5.2.1. Dam constructions

Processes following the constructions of dams represented through a relational framework in Figure 3-18 below. Dams are constructed on Kızılırmak River for hydroelectric power generation and water provision however they are followed by reduction in river flows and sediment accumulations as a result of water and sediment holds in dam barriers. These changes on the state of the delta resulted in various impacts that lead to further impacts on the system. Aquifer recharges are decreased as a result of reduction in the river flows. Development of the delta is nearly stopped and productivity decreased because of the reduction in sediment accumulation and alluvial deposit.

As a result of decreasing sediment load delta lost its resistance against winds and waves that leads to coastal regression. Sea water intrusion resulted in salinization, desertification and decreasing productivity through increasing groundwater levels. Also degradation of lagoon barriers and ecological balance lead to degradation, depletion and losses in the lagoons. Regression of coastline became a threat for the interception channel and 9 fenders were constructed for retaining the coastline however erosion still persists on the east of the fenders. Negative impacts of the dam constructions became apparent in a short term and 10 years after the construction of dams the fenders are constructed on the mouth of Kızılırmak Delta.

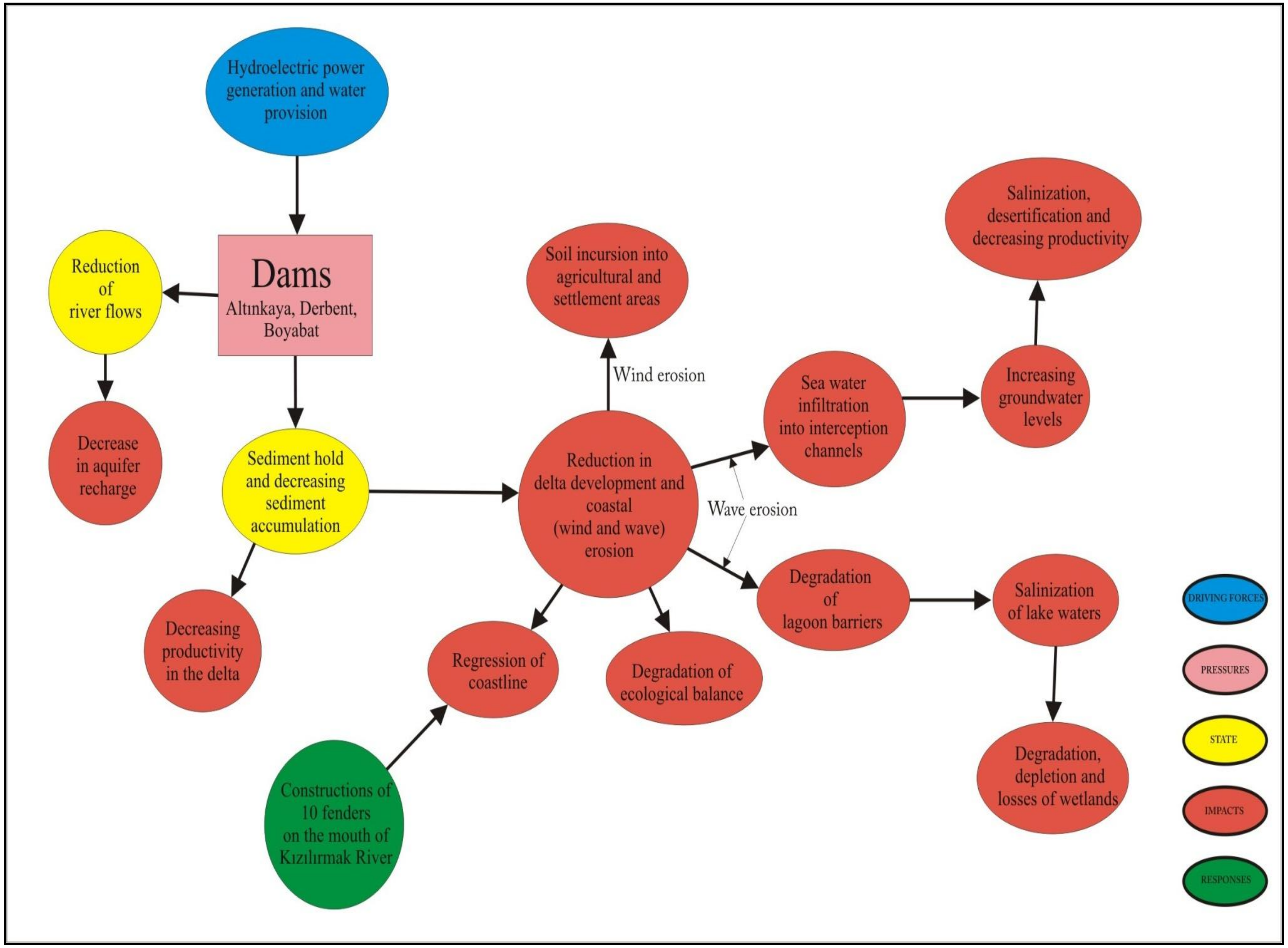

Figure 3-18 Dam construction through DPSIR Framework

3.5.2.2. Channel constructions and pesticide and fertilizer uses

Processes following the constructions of channels and uses of pesticides and fertilizers are presented through a relational framework in Figure 3-19 below. Channels are constructed for drainage, irrigation and flood control purposes in Kızılırmak Delta and mainly resulted in intensification of agricultural production. In addition to increasing pressure of agricultural production, channel constructions are caused various changes in the delta. Carriage of sediments and organic and inorganic matters to wetlands through the channels caused wetlands and their connections with the sea to be filled. As a result of water releases through channels, water levels increased and caused floods. These floods further caused product losses, transportation problems and salinization. Therefore new channels were constructed for water discharge however they leaded to salinization through sea water intrusion by channels. Changing hydrological regime and holding waters, channels are also intensified the degradation, depletion and losses of habitats, especially bottomland hardwood forests.

Channels are the major sources of pollution in the delta. Constructions of the channels intensified the agricultural production which leaded to increasing use of fertilizers and pesticides. Supported by subsidies and incentives, unconscious and excessive use of fertilizers and pesticides expanded in the delta. Residues of extensively used fertilizers and pesticides are brought into wetlands by the channels and caused pollution through accumulation. Pollution causes eutrophication, algal bloom and anaerobic conditions that result in the losses of aquatic organisms through methane and sulfur release. Also accumulated chemicals penetrate into food chains and cause health problems and deaths of especially fish and birds. Degradation, depletion or losses in the flora and fauna affects the production directly and indirectly. Reductions in the amounts of animals such as water buffalo and fish directly affect animal husbandry and fishery in the delta. On the other hand, even little changes in the ecosystem affect the production indirectly. For example, degradation of soil fauna causes depletion of the productivity of the soil that leads to loss of arable lands.

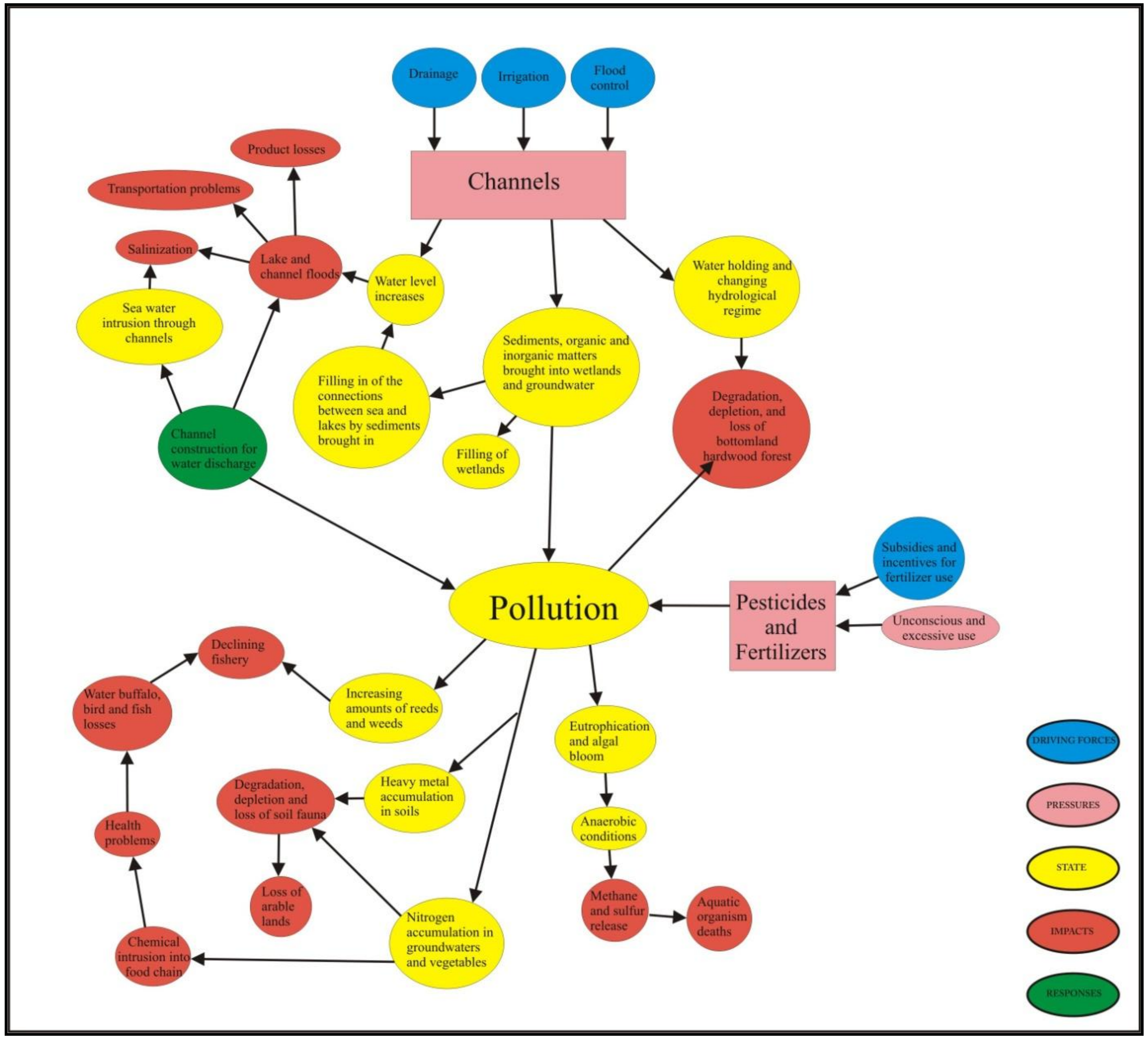

Figure 3-19 Channel constructions and pesticide and fertilizer uses through DPSIR Framework

3.5.2.3. Unsustainable agricultural practices

Unsustainable agricultural practices and following processes are presented through a relational framework in Figure 3-20 below. Unsustainable agricultural practices such as; introduction of new seeds and exotic species, exploitation of water resources for irrigation, intensification and extension of production, stubble and reed burning, bottomland hardwood forest logging and land reclamation result in degradation of the physico-chemical and biological structure of the soil. Followed by excessive water use, waterlogged soils cause salinization of soil and groundwaters. These changes on the structure of the soil induce habitat and biodiversity losses. Although these pressures are applied for increasing the agricultural production they results in losses of arable lands and decreasing productivity. As a result, intended gains stay limited and unexpected impacts cost important losses.

3.5.2.4. Waste water and solid waste disposal and housing developments

Processes following waste water and solid waste disposals and housing developments are presented together in Figure 3-21 below. Waste waters are being either discharged directly to the Black Sea or discharged to Kızılırmak River through sewages in the cities however industrial waste waters are being discharged without treatment. In spite of the treatments, accumulation in the channels, wetlands and groundwaters cause pollution. Leakages from cesspits and solid waste storage areas are also flow into groundwaters and wetlands. These flows augment the pollution in delta and intensify the impacts presented before. In addition to those impacts, pollution also causes flavor, odor, toxicity and aquatic organism deaths. Being the sources of pollution, new housing developments increase the pollution in the delta. Also their constructions change the landuse of the delta through degradation of coastal dunes and river beds for sand and gravel extraction, and conversion of communities to settlement areas. Further, these changes trigger habitat and biodiversity losses.

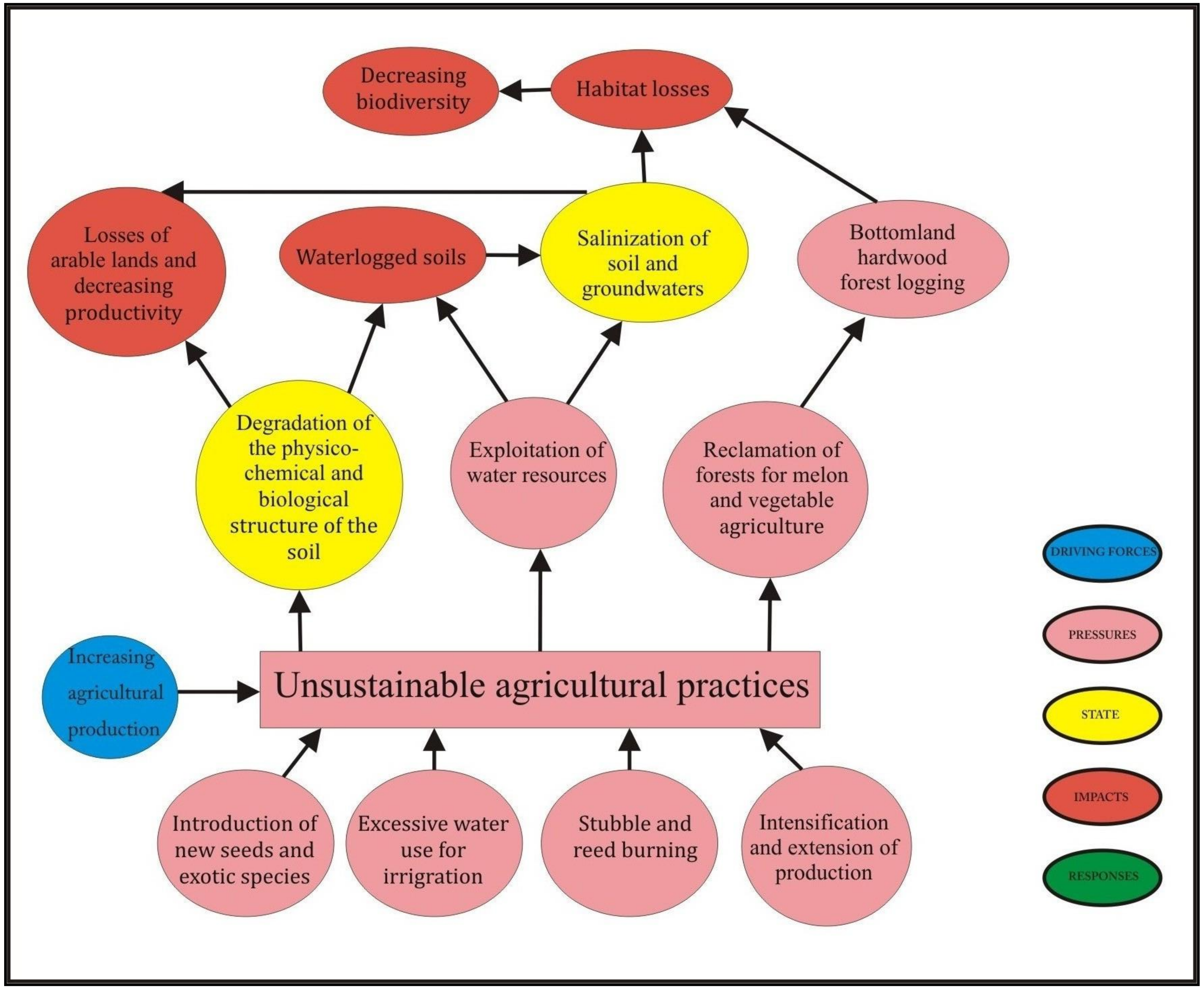

Figure 3-20 Unsustainable agricultural practices through DPSIR Framework

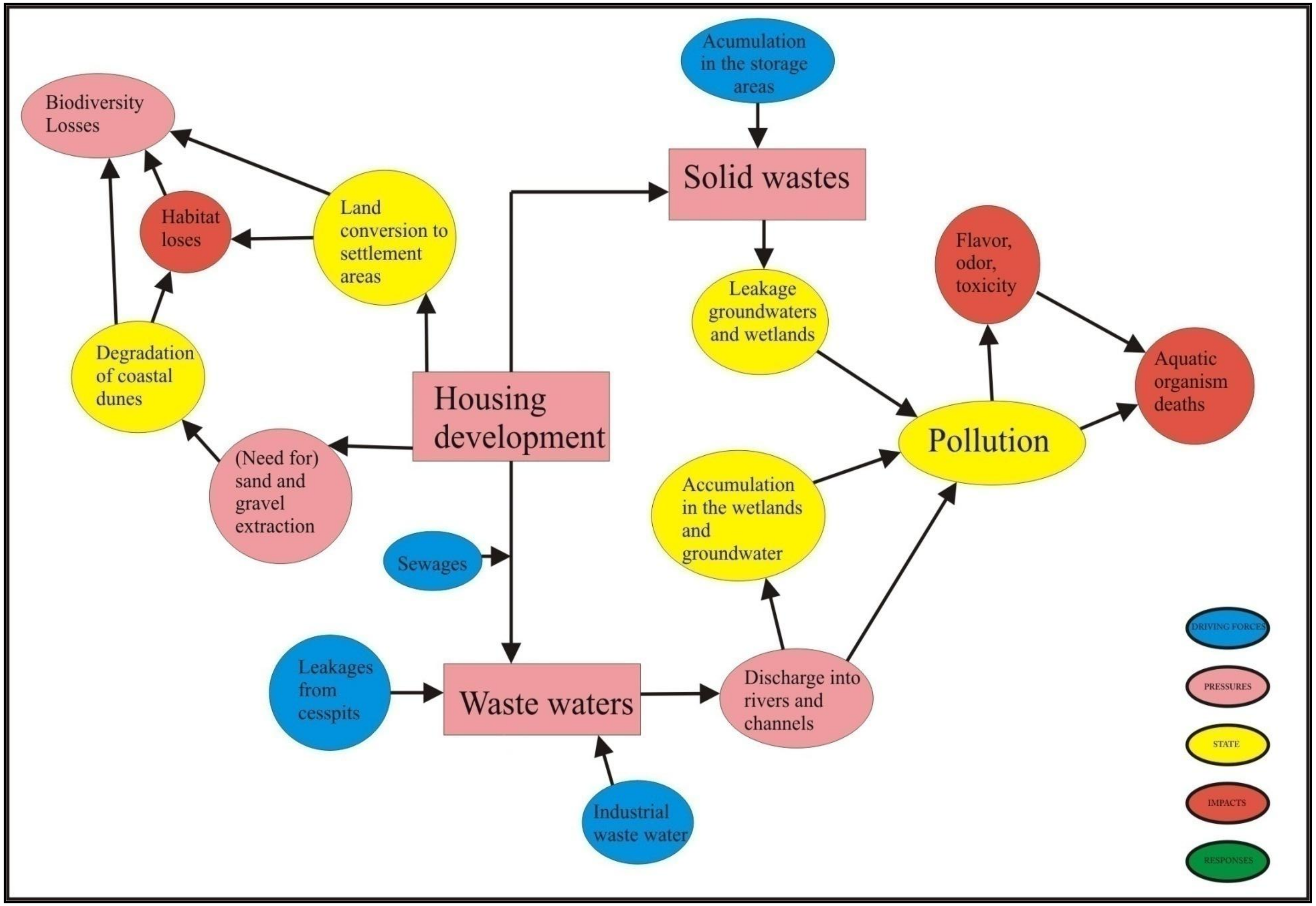

Figure 3-21 Waste water and solid waste disposal and housing developments through DPSIR Framework

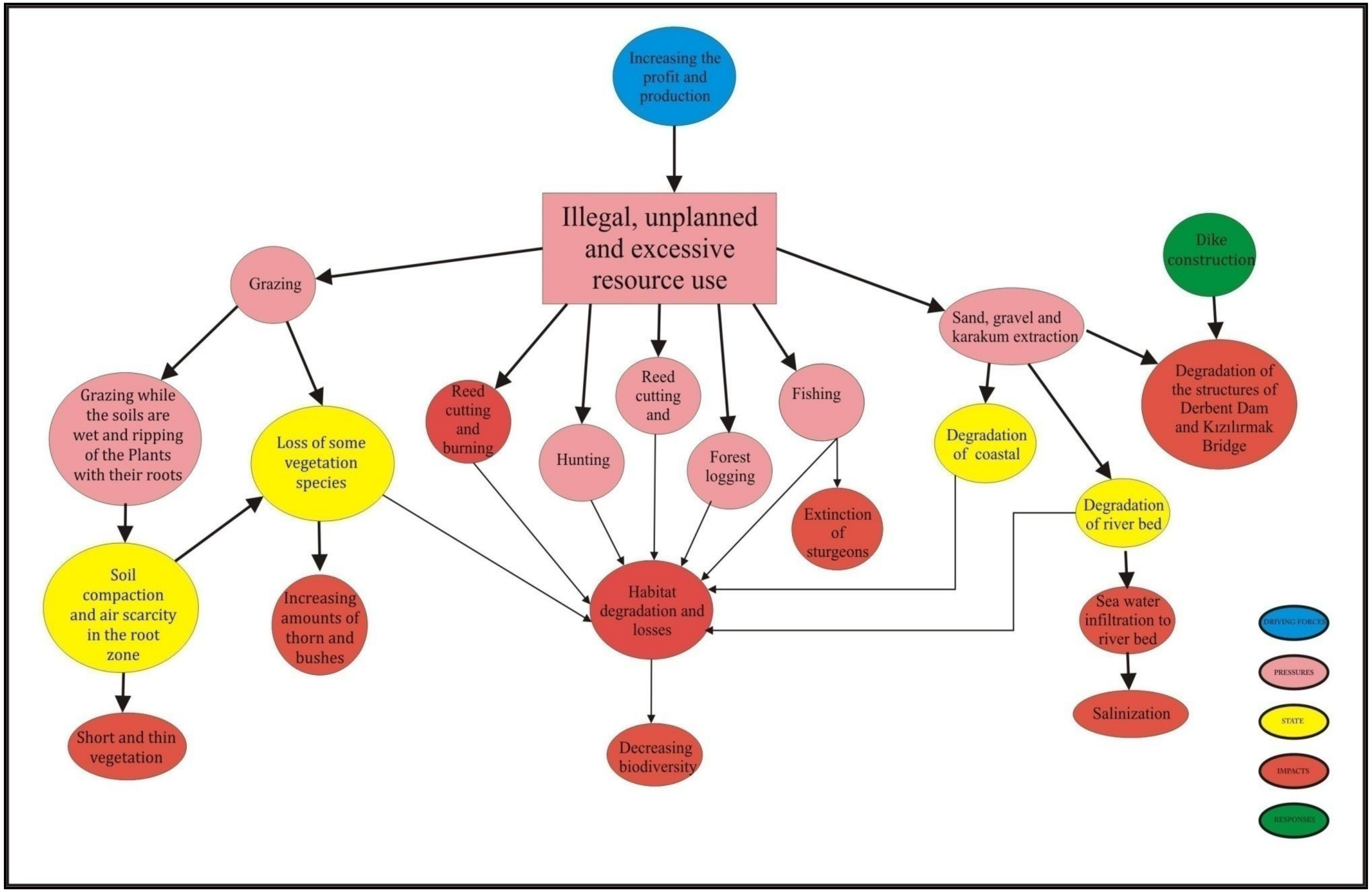

Figure 3-22 Illegal, unplanned and excessive resource use through DPSIR Framework

3.5.2.5. Illegal, unplanned and excessive resource use

Illegal, unplanned and excessive resource use practices, including excessive grazing and sand, gravel and karakum extraction are presented through a relational framework in the Figure 3-22 above. Although, reed cutting, hunting, gathering, fishing, grazing and forestry are sustainable human activities in the delta, illegal, unplanned and excessive practices in these activities result in especially ecological and economic losses. Illegal, unplanned and excessive resource uses cause habitat and biodiversity losses which in return affect these practices. For example, illegal and excessive fishing of sturgeons for caviars was resulted in the extinction of sturgeons in the delta. In addition to ecological impacts, sturgeon fishery was also collapsed in the delta as a result of the extinction. Excessive and unplanned grazing practices cause attenuation and loss of vegetation. Grazing in the early and wet periods leads to soil compaction and air scarcity in the root zone which in return changes the vegetation. Amounts of thorns and bushes increase while some species get lost. Also changes in the vegetation further triggers habitat and biodiversity losses. Although they are forbidden, sand, gravel and karakum extraction practices were continued for a long time illegally. According to interviewee-9, a member of the responsible governmental organization, these practices are totally stopped today however their impacts still persist. Extractions from coastal dunes and river bed resulted in the degradation of these communities that is followed by habitat losses. Also degradation of river bed resulted in salinization through sea water infiltration to river. In addition, physical structures of Derbent Dam and Kızılırmak Bridge are corrupted following the extractions from river bed. As a result, a dike is constructed to protect the bridge.

3.5.3. Valuation and Trade-off Analysis

Importance and values of Kızılırmak Delta were determined and its problems were analyzed so far. Results of the analyses show that; Kızılırmak Delta provides functions that are important and valuable for human existence however these (especially sustainable) functions are being degraded or lost as a result of human activities and interventions. Although the short term impacts of these losses could be negligible, in the long term they result in important changes. Action analysis showed that intensive use of carrier functions exceeded the carrying capacity of the delta and resulted in degradations or losses in the provision of sustainable functions.

Action analysis presented the impacts and results of the losses through a relational framework however the economic impacts of these losses should also be determined. Thus, contributions of the functions and the costs of losing them were analyzed in economic terms through monetary valuation and trade-off analysis.

3.5.3.1. Valuation of regulation functions

Gas and climate regulation

As it was mentioned before, although it is apparent that the delta provides gas and climate regulation functions, information about the influence of Kızılırmak Delta on gas and climate regulation could not be found from the documentary analysis. Therefore benefit transfer method was used for estimating the potential value of the gas and climate regulation function of the delta.

Results of the research by Costanza et al. (1997a, 1997b) were used for benefit transfer. Representing the total economic value of 17 ecosystem services for 16 biomes all over the world, "Supplementary Information" document (Costanza, et al., 1997b) of "The Value of World's Ecosystem Services and Natural Capital" entitled document (Costanza et al., 1997a) provides detailed information about the values for ecosystem functions. The document provides annual values per hectar for ecosystem functions of 16 biomes. Therefore the areas of the communities of Kızılırmak Delta were calculated first.

Using ArcGIS data from Doğa Derneği (Anon., 2009d), total areas of the communities of the Kızılırmak Delta were calculated (Table 3-10). Than these communities were associated to appropriate biomes from Costanza et al. (1997b) and they were grouped under three biomes of lake (lagoon communities), mangroves (bottomland hardwood forest communities) and swamp (reed, marsh, swamp, and meadow communities).

About gas and climate regulation functions, Costanza et al. (1997b) provides only the value of carbon sequestration service of swamps. Using the results of a study about Malaysia in 1990 (Kumari, 1995 in Costanza et al., 1997b) Costanza et al. (1997b) estimates the value of carbon sequestration service of swamps as 265 dollar (with 1994 prices) per ha per year.

Swamps (reed, marsh, swamp, and meadow communities) of the Kızılırmak Delta cover a total area of 8527 ha. (Table 3-10). Thus, the swamps of the delta provides (265 $/ha.yr x 8527 ha. = 2.259.655 $/yr) 2.259.655 dollar worth of (with 1994 prices) carbon sequestration service per year. 1 dollar taken as 1,5 TL (August 2009, İstanbul Stock Exchange), delta provides 3.389.483 TL worth of carbon sequestration service per year.

Table 3-10 Total areas of the communities of the Kızılırmak Delta

Communities	Areas
Galeriç Bottomland Hardwood Forest	2194 ha
Lagoon	1921 ha
Reed	977 ha
Marsh	1474 ha
Swamp	5559 ha
Meadow	517 ha

Disturbance prevention

Although they have been constructed to control floods and increase agricultural production, irrigation and drainage channels sometimes cause floods and product losses, themselves. Following the heavy rainfalls, waters are being released from Derbent Dam as a result of increasing water levels. These water releases result in the flooding of agricultural fields and losses of products. According to the data from Bafra, County Directorate of Agriculture, such floods were occurred in January 2006 and July 2009 (Anon., 2009c). Through the valuation of the lost products, cost of losing the disturbance prevention function is determined below:

As a result of flood in January 2006, 1721 da field of 32 households from Fener Village and 1432 da field of 67 households from Koşu Village have been flooded. Loss of products from 3153 da field was costed 1.028.565 TL with 2006 prices (Anon., 2009c).

Impacts of recent flood in July 2009 were not documented yet, thus they are calculated from approximate values. According to the interviews in Bafra, County Directorate of Agriculture, approximately 3000 da field of nearly 250 households was flooded in July. Crops from 500 da of tomato, 100 da of watermelon and 2400 da of pepper for sauce fields were lost (Anon., 2009). Costs of the losses are calculated using the productivity of the fields for each crop (see Table 3-11). Productivity of tomato, watermelon and pepper for sauce are 5000 kg/da, 5000kg/da and 3000 kg/da respectively. Thus it is estimated that 2.500.000 kg tomato, 500.000 kg watermelon and 7.200.000 kg pepper for sauce were lost in the flood. As it can be seen from the table 3-11 total cost of the losses following the flood is 3.595.000 TL in 2009 prices.

Table 3-11 Amount and cost of losses following the flooding in July 2009

Crops	**Lost field (da)**	**Productivity (kg/da)**	**Lost product (kg)**	**Price (TL/kg)**	**Cost of losses (TL)**
tomato	500	5000	2500000	0,4	1000000
watermelon	100	5000	500000	0,15	75000
pepper for sauce	2400	3000	7200000	0,35	2520000
total	**3000**		**10200000**		**3595000**

(Anon., 2009c)

<u>Soil retention and formation</u>

As presented in the function analysis part before, existence of Kızılırmak Delta and provision of its all functions depend on the accumulation of sediments brought by the Kızılırmak River. Constant sediment flow and accumulation are the basis of soil formation and retention in the delta. Also diverse vegetations of the communities of delta play an important role in soil retention and formation through weathering of rock, accumulation of organic matter and sediment.

Assessment of the monetary values of soil retention and formation functions is a difficult task especially with the lack of necessary data as in the case of Kızılırmak Delta. In addition, information about the valuation methods of these functions could not be found in the literature. Thus, instead of a direct valuation of these functions, a replacement cost method for the valuation of the cost of losing these functions is determined here.

Since erosion protection is a direct service of these functions, cost of losing erosion protection service could be calculated for the assessment of the monetary values of these functions. As it has been explained before (in the history part), following the constructions of dams on Kızılırmak River, amount of the sediments brought by the river was decreased from 23.1 million metric tons to 0.46 million metric tons per year (Özesmi, 1999, p.76). As a result of the reduction in the sediment load, delta regressed 1 km in 10 years following the construction of the last (Derbent) dam (Yılmaz, 2007, pp.22-25). According to interviewee-9, an agricultural engineer working in General Directorate of Stat Hydraulic Works (DSİ), 1793 da of land has been lost as a result of coastal erosion until today. As it was presented in the history part, 10 fenders were constructed on the mouth of Kızılırmak River for erosion protection, between 1999 and 2002 (Yılmaz, 2007, pp.27-33).

Although fenders succeeded in the protection of the part of coast they were constructed, erosion persists in the east and west of the fenders (Yılmaz, 2007, pp.27-33). Thus, according to interviewee-9 there is a project for the construction of new fenders on the western coast of the delta.

Costs of these projects and constructions could be used for valuation of soil retention and formation functions however information about the costs of these projects could not be reached. In further researches the costs of former and new fender projects will be used for the monetary valuation of these functions.

Soil retention and formation functions also maintain productivity in the delta. Since this service of the functions is assessed in food provision (production functions) and cultivation (carrier functions) functions, it is not calculated here for avoiding double counting.

<u>Nutrient regulation and waste treatment</u>

Kızılırmak Delta provides nutrient regulation and waste treatment functions through biogeochemical cycles and ecological processes in its biological communities, however as it was presented in the function analysis part before; delta has exceeded its carrying capacity for providing these functions. Although eutrophication and algal bloom in the wetlands indicate the pollution in the delta, waste disposals to delta still persist. Since wetlands are polluted, or eutrophic, they could not perform their nutrient regulation and waste treatment functions completely however nutrient and waste accumulation continues as a result of the leakages and direct disposals from industrial, agricultural and urban areas.

Since there are different origins/sources of the nutrients and pollutants, and various methods for their treatment, valuation of the nutrient regulation and waste treatment functions through replacement cost method (through assessment of the cost of using artificial treatment facilities instead of wetlands) requires long term and detailed analyses of each source. Instead of an analysis of the cost of replacing these functions, their potential benefits are assessed for simplicity.

As a result of an interview with Yetiş, Ü. (Prof. Dr., Department of Environmental Engineering, Middle East Technical University) it was ascertained that in their pristine states wetlands provide a waste treatment service of 50 $/year worth per person. Assuming that the wetlands did not exceed their carrying capacity, approximately 210.000 people (2005 population by Yılmaz, 2007, pp.140-141) benefits from waste treatment service of the wetlands in the delta. Thus, delta provides 10.500.000 $ worth nutrient regulation and waste treatment functions per year. 1 dollar taken as 1,5 TL (August 2009, İstanbul Stock Exchange), delta provides 15.750.000 TL worth of nutrient regulation and waste treatment functions per year.

3.5.3.2. Valuation of habitat functions

Refugium and nursery

As it was mentioned before, hosting a very rich biodiversity through various habitats and communities the Kızılırmak Delta provides refugium and nursery functions, however their economic values could not be calculated because of the data constraints. Therefore benefit transfer method was used for estimating the potential value of the refugium and nursery functions of the delta.

Results of the research by Costanza et al. (1997a, 1997b) and the total areas of the communities of the delta (Table 3-10) were used for benefit transfer. About habitat functions, Costanza et al. (1997b) provides only the values of refugium and nursery functions of swamps and mangroves. Using the results of different studies by Kumari (1995), Pearce & Maron (1994) and Gren & Soderqvist (1994); Costanza et al. (1997b) estimate the average value of refugium and nursery functions of swamps as 439 dollar (with 1994 prices) per ha per year. Also, using the results of a study about Thailand by Christensen (1982); Costanza et al. (1997b) estimate the value of refugium and nursery functions of mangroves as 143 dollar (with 1994 prices) per ha per year.

Swamps (reed, marsh, swamp, and meadow communities) cover 8527 ha and mangroves (Galeriç bottomland hardwood forest) cover 2192 ha area in the Kızılırmak Delta (Table 3-10). Thus, the swamps of the delta provide (439 $/ha.yr x 8527 ha. = 3.743.353 $/yr) 3.743.353 dollar worth of (with 1994 prices) refugium and nursery functions per year, while the mangroves of the delta provide (143 $/ha.yr x 2192 ha. = 313.456 $/yr) 313.456 dollar worth of (with 1994 prices) refugium and nursery functions per year. As a result, delta provides 4.056.809 dollar worth of (with 1994 prices) refugium and nursery functions per year. 1 dollar taken as 1,5 TL (August 2009, İstanbul Stock Exchange), it makes 6.085.214 TL.

3.5.3.3. Valuation of production functions

Food provision

Kızılırmak Delta provides food for humans without any efforts for cultivation. Members of the delta's flora and fauna, these natural products are being gathered by inhabitants of the delta. As it was mentioned before, these natural products are being used locally, sold nationwide or exported to foreign countries.

Fish is an important member of delta fauna and fishery is one of the most important economic activities in the delta. Although the amounts of caught fish have been decreasing (see Table 3-3), fishery still provides a great deal of income for delta inhabitants. According to Samsun Provincial Directorate of Agriculture data; 2,1 tons of common carp, 2,4 tones of zander, 2,5 tons of flathead mullet and 1,5 tons of crayfish were caught in 2005 (Anon., 2007d in Sarısoy et al., 2007, pp.356-357). Yılmaz (2007, p.177) states that only approximately 1/5 of the caught fishes are being registered, thus the amounts are taken as 10,5 tons of common carp, 12 tones of zander, 12,5 tons of flathead mullet and 7,5 tons of crayfish for 2005. According to interviewee-13, a Doğanca Water Products Cooperative member, 2009 prices for 1kg of common carp, zander, flathead mullet and crayfish are 3,5

TL, 4 TL, 4 TL and 7,5 TL respectively (Table 3-12). Using 2009 prices for 2005 amounts, total revenue from fishery is calculated to be 38.200 TL.

Table 3-12 Revenue from fishery in Kızılırmak Delta

Years	Common Carp (Sazan) tones	Zander (Sudak) tones	Flathead Mullet (Kefal) tones	Crayfish (Kerevit) tones	TOTAL (TL)
2005 *	2,1	2,4	2,5	1,5	
prices (TL/ton) **	3500	4000	4000	7500	
TOTAL (TL)	**7.350**	**9.600**	**10.000**	**11.250**	**38.200**

* Anon., 2007d in Sarısoy et al., 2007, pp.356-357; ** interviewee-13

Although delta provides various edible plants to inhabitants, data about the amounts and prices of these products could not be found during this research. In addition to edible plants delta also provides edible animals such as frogs and snails. As mentioned before, these products are being exported to big cities of Turkey and foreign countries mostly.

Sarısoy et al. (2007, p.364) present the amounts of gathered frogs and snails as 400 and 150 tons respectively however interviews with an agent and the gatherers revealed that these amounts are more than realistic. According to the agent from Bafra, who collects and exports all the gathered frogs and snails in the delta, 15 tons of frog and 60 tons of snail were collected in 2008 from the delta. He also stated the prices of frog and snail as 3 TL/kg and 1,5 TL/kg, respectively. Using this information, total revenue from frog and snail gathering is calculated as 135.000 TL (see Table 3-13).

Table 3-13 Revenue from frog and snail gathering in Kızılırmak Delta

Products	Amount (tons)	Price (TL/kg)	Revenue (TL)
Frog	15	3	45.000
Snail	60	1,5	90.000
TOTAL			**135.000**

Raw materials provision

Being used for making baskets, skeps, bouquets, etc., covering the roofs of buildings and lying on the grounds of barns, reeds and goga are the main raw materials provided by Kızılırmak Delta. Amounts of common reed (*Phragmites australis*), reedmace (*Typha angustifolia*), and bulrush (*Scirpus lacustris*) gathered in 2005 and amount of sharp-pointed rush (*Juncus acutus*) (goga) gathered in 2006 are presented in Table 3-14 below. 2009 prices of these products are determined through in-depth interviews on the site as 0,5 TL/tie for reeds and 0,4 TL/kg for goga. Annual revenues of reed cutting and goga gathering are calculated as 39.000 TL and 148.000 TL respectively. The total annual revenue from these products is calculated as 187.000 TL (see Table 3-14).

Table 3-14 Revenue from reed cutting and goga gathering in Kızılırmak Delta

Products	Amount	Price	Revenue (TL)
Reed	78.000 tie *	0,5 (TL/tie)	39.000
Goga	370.000 kg **	0,4 (TL/kg)	148.000
TOTAL			**187.000**

* Anon., 2007d in Sarısoy et al., 2007, p.352; ** Anon., 2007e in Sarısoy et al., 2007, p.354

Medicinal resources provision

Kızılırmak Delta provides various medicinal resources however most of their amounts and prices could not be found in this research. Only the amounts and prices of summer snowflake (*Leucojum aestium*) and leech could be found. According to Sarısoy et al. (2007, p.363) 19.500 kg of summer snowflakes were gathered in 2006. Price of 1 kg of summer snowflake is stated as 700-800 TL in Sarısoy et al. (2007, p.277) however since this is a very high price for 1 kg of product it is estimated that the price was given wrong. Taking the price as 0,75 TL total revenue from summer snowflakes gathering is calculated to be 14.625 TL (with 2007 prices) per year. In addition, although the amount and price of gathered leeches are presented in Sarısoy et al. (2007, p.364), they were checked in the site and 2009 amounts and price of gathered leeches are determined as 3 tons and 0,75 TL/kg through interviews. Total revenue from leech gathering is calculated as 2.250 TL with 2009 prices.

3.5.3.4. Valuation of carrier functions

Cultivation

Kızılırmak Delta provides cultivation function through the provision of necessary conditions and milieu for agriculture and animal husbandry. Two major economic activities of the delta, agriculture and animal husbandry depends on the processes and communities of the delta. As a result of the productivity of the soil and the unique conditions provided by the delta, various crops and animal species are being cultivated. Economic values of these services are analyzed through direct valuation method. Data, taken from Bafra, 19 Mayıs and Alaçam County Directorates of Agriculture are used for the monetary valuation of these functions. Plantation area, amount of production, price and revenue from production are presented and total revenue from agriculture is calculated in Table 3-15 below. From agricultural production in 2008 a total of 687.639.500 TL revenue was received.

Table 3-15 Revenue from agricultural production in Kızılırmak Delta

Products (annual)			Plantation Area (da)	Amount of Production (tons)	Price (TL/kg)	Revenue (TL)
Cereals	buğday	wheat	347.000	175.250	0,50	87.625.000
	arpa	barley	23.350	11.623	0,40	4.649.200
	mısır	corn	62.300	55.020	0,45	24.759.000
	çeltik	paddy	72.011	64.659	1,10	71.124.900
	pirinç	rice		33.125	2,50	82.812.500
	Sub-total		**504.661**	**339.677**		**270.970.600**
Industrial plants	tütün	tobacco	59.500	6.190	6,75	41.782.500
	şeker pancarı	sugar beet	10.140	71.980	0,20	14.396.000
	Sub-total		**69.640**	**78.170**		**56.178.500**
Feeding crops	fiğ	common vetch	140.900	29.980	3,50	104.930.000
	yonca	clover	800	960	0,30	288.000
	mısır (silajlık)	corn	5.000	15.000	0,10	1.500.000
	Sub-total		**146.700**	**45.940**		**106.718.000**
Vegetables	beyaz lahana	white cabbage	25.440	88.370	0,60	53.022.000
	kırmızı lahana	red cabbage	22.230	64.851	0,75	48.638.250
	yaprak lahana	leaf cabbage	530	616	0,60	369.600
	brüksel lahana	brussels sprouts	100	150	1,00	150.000
	kereviz	celeriac	20	40	1,50	60.000
	marul	lettuce	8.400	8.520	2	17.040.000
	ıspanak	spinach	9.085	10.170	0,75	7.627.500
	maydonoz	sanicle	250	250	1,50	375.000
	tere	pepper grass	60	6	2	12.000
	semizotu	purslane	50	50	0,75	37.500
	roka	rocket	60	6	2	12.000
	dereotu	dill	80	8	2	16.000
	nane	mint	50	5	2	10.000
	pırasa	leek	3.450	11.313	0,30	3.393.900
	taze fasulye	green beans	9.386	8.465	0,75	6.348.750
	kuru fasulye	white beans	7.000	650	5	3.250.000
	bezelye	peas	2.000	2.000	1,25	2.500.000
	barbunya	common bean	200	200	4	800.000
	bamya	gombo/okra	300	150	2,50	375.000
	balkabağı	winter squash	720	1.390	0,50	695.000
	kavun	melon	11.230	44.660	0,30	13.398.000
	karpuz	watermelon	14.250	69.500	0,15	10.425.000
	kabak (sakız)	marrow	370	735	0,50	367.500
	hıyar	cucumber	1.117	4.390	0,35	1.536.500
	patlıcan	aubergine	3.060	6.120	0,35	2.142.000
	domates	tomato	16.423	79.736	0,40	31.894.400
	enginar	artichoke	250	500	1,50	750.000
	biber (dolmalık)	bellpepper	1.578	3.877	0,50	1.938.500
	biber (sivri)	green pepper	1.210	2.920	0,50	1.460.000
	biber (salçalık)	pepper for sauce	25.400	76.000	0,35	26.600.000
	sarımsak	garlic	103	203	3	609.000
	soğan (kuru)	onion	650	1.275	0,50	637.500
	soğan (taze)	green onion	306	309	2	618.000
	kırmızı pancar	red beet	500	1.500	0,50	750.000
	turp (bayır)	horse radish	690	2.030	0,35	710.500
	turp (kırmızı)	red radish	390	1.130	0,35	395.500
	havuç	carrot	280	810	0,75	607.500
	patates	potato	5.500	21.500	0,50	10.750.000
	karnabahar	cauliflower	2.500	5.000	0,65	3.250.000
	brokoli	broccoli	1.000	200	1	200.000
	Sub-total		**176.218**	**519.605**		**253.772.400**
TOTAL			**897.219**	**983.392**		**687.639.500**

(Anon., 2009a; Anon., 2009b and Anon. 2009c)

Amounts and prices of sheep, cattle and water-buffalo species in 2008 and total revenue received are presented and calculated in Table 3-16 below. Only the revenue from animals younger than 24 months were calculated since other calculations was done in terms of a year. From animal husbandry in Kızılırmak Delta in 2008 a total of 36.695.500 TL revenue was received.

Table 3-16 Revenue from animal husbandry in Kızılırmak Delta

Products		Price (TL)	Revenue (TL)
sheep (native-other)			
< 6 months (kuzu)	6.700	140	938.000
6-12 months (toklu)	5.000	170	850.000
12-24 months (şişek)	10.400	190	1.976.000
cattle (pure culture)			
< 12 months (dana)	3.585	1.300	4.660.500
12-24 months (tosun)	1.150	1.900	2.185.000
12-24 months (düve)	1.960	1.700	3.332.000
cattle (culture cross-breed)			
< 12 months (dana)	5.460	700	3.822.000
12-24 months (tosun)	3.720	1.300	4.836.000
12-24 months (düve)	3.605	1.100	3.965.500
cattle (native-other)			
< 12 months (dana)	6.260	500	3.130.000
12-24 months (tosun)	2.460	1.000	2.460.000
12-24 months (düve)	2.560	600	1.536.000
water buffalo			
< 12 months (dana)	1.175	700	822.500
12-24 months (tosun)	430	1.200	516.000
12-24 months (düve)	1.190	1.400	1.666.000
TOTAL (TL)			**36.695.500**

(Anon., 2009a; Anon., 2009b and Anon., 2009c)

3.5.3.5. Results

Although a very limited number of functions of the delta could be analyzed, the results (Table 3-17) present the importance of delta on local and national economy. Although only a small portion of the regulation, habitat, production and carrier functions of the delta could be valued; delta provides 753.531.772 TL worth of functions according to the results of the analyses. Analyzed regulation functions provide 22.734.483 TL worth of services while habitat functions provide 6.085.214 TL and production functions provide 377.075 TL worth of services. Inducing pressures on the delta, carrier functions provide 724.335.000 TL worth of services (Table 3-17).

Table 3-17 Economic contributions of Kızılırmak Delta

Functions & Services		TOTAL Revenue or Cost (TL)
Regulation Functions		
Gas and Climate Regulation	Carbon sequestration	3.389.483
Disturbance prevention	Cost of flooding	3.595.000
Nutrient regulation and waste treatment		15.750.000
	sub-total	22.734.483
Habitat Functions		
Refugium and Nursery		6.085.214
Production Functions		
Food provision	Fishery	38.200
	Frog gathering	45.000
	Snail gathering	90.000
Raw materials provision	Reed cutting	39.000
	Goga gathering	148.000
Medicinal resources provision	Summer snowflake gathering	14.625
	Leech gathering	2.250
	sub-total	377.075
Carrier Functions		
Cultivation	Agriculture	687.639.500
	Animal husbandry	36.695.500
	sub-total	724.335.000
	TOTAL (TL)	**753.531.772**

Using the data from DPT (Dinçer et al., 2003, p.216) and TÜİK (2008), GDP per capita for Samsun in 2008 was calculated as 10.566 TL with 2008 prices. The most recent population of the delta was provided by Yılmaz (2007, pp.140-141) for 2005 as 210.000 people. Using the 2005 population of the delta with the GDP per capita for Samsun, GDP of the delta was calculated as (210.000 X 10.566 TL) 2.218.860.000 TL. Thus, it is identified that the calculated functions provide 34 % (753.531.772 TL / 2.218.860.000 TL X 100) of the total GDP of the delta.

Results of the valuation showed that even a limited portion of the functions of delta provides an important amount of contribution to local and national economy. Despite the fact that total value of these functions emphasizes the importance of Kızılırmak Delta, dominance of the values provided by carrier functions should be considered. Although the production and carrier functions of the delta were valued through direct market pricing methods, the regulation functions were analyzed through replacement and damage cost methods. Therefore the trade-offs in the delta were included in the valuation of regulation functions.

Values of carrier functions were included with the values of sustainable functions however it could be assessed in to ways. First, value provided by these carrier functions could be taken as a part of the value of delta because delta provides milieu for their provision. Second, if the provision of these functions exceeds the carrying capacity of the delta, they would result in the losses of the value they generated. Also, results of action analysis revealed that, exceeding sustainable use limits, the carrier functions are inducing pressures on the provision of other functions. Problems of the delta prove that the carrying capacity of the delta has been exceeded. Thus the value generated from the carrier functions could also be taken as the value of trade-offs between human interventions and well-being. Although production, habitat and carrier functions were valued through direct market pricing and benefit transfer methods their value can be added to the value of regulation functions as the cost of trade-offs in the delta. Since, the exploitation of the natural resources in the delta will result in the loss of these production, habitat and carrier functions, it will cause a 730.797.289 TL worth of economic loss in the end (Table 3-17).

Economic values of the most of the valuable (especially regulation, habitat and information) functions of the delta could not be calculated in the research because of the study limitations described below. In addition only a small part of the regulation and habitat functions could be valued. Thus the results of the monetary valuation analyses are far from giving the total value of the Kızılırmak Delta. Therefore trade-offs between the human interventions and well-being could not be analyzed completely. It is apparent that although the carrier functions provide great economic value for the inhabitants of the delta, if all the sustainable functions of the delta could be valued, contribution of carrier functions would provide only a small part of the total value of the delta.

CHAPTER 4

CONCLUSIONS

4.1. Study Limitations

Investigating the impacts of human interventions on Kızılırmak Delta and their long term impacts especially on economic terms through various analyses, this research involves a number of limitations. These limitations are explained as information and data constraints, complexity of the system, subjectivity and inadequacy of valuation, and imperfect assumptions and superficial analyses below:

- Information and data constraints: As mentioned before this research mainly depends on documentary analysis thus the values, function and processes of Kızılırmak Delta were analyzed through the available documents mostly. Also in-depth interviews with stakeholders supported the findings. Although there were various sources about the delta a limited portion of them could answer the needs of the analyses used in the research. In addition to these data constraints about Kızılırmak Delta, adequate information about the methods and techniques of some analyses could not be reached in the research process. Especially restricted information about the monetary valuation methods and techniques limited the number of the functions being valued. Although there were plenty of articles and web sites about valuation of ecosystem function most of them could not be reached and the reached ones were broad and superficial abstracts of former researches generally. Thus, most of the methods for monetary valuation of the functions of Kızılırmak Delta were developed by the researcher in the research processes.

- Complexity of the systems: Including various communities and covering a wide geography Kızılırmak Delta is a rich ecosystem. This rich ecosystem provides various interdependencies and processes that are difficult to observe and understand mostly. Long history of human activities on the delta intensifies the complexity of the system. Through action analysis the processes on this complex system tried to be understood however only the apparent ones could be determined.

- Subjectivity and inadequacy of valuation: A product of anthropocentric perspectives, valuation of ecosystem functions depends on value systems of the evaluators. Thus, total values of the functions could not be assessed completely because of the limited understanding of the complex systems. For overcoming this deficiency, valuation processes require interdisciplinary practices. Being a master thesis this research was done by a single researcher with limited information about the processes of complex systems. Thus, the valuation of the functions mainly depended on the ability and perspective of the single researcher.

- Imperfect assumptions and superficial analyses: Aggregation of the limitations presented above resulted in the construction of imperfect assumptions for the analyses. Supported by time and data limitations these assumptions were followed by superficial analyses.

4.2. Discussions

As it has been mentioned from the beginning of this document, wetlands are among the most productive and important ecosystems of the world. Providing various ecosystem functions they are also valuable components of human well-being however their contributions are being ignored or undervalued in decision making processes. This ignorance causes increasing human pressures on wetlands resulting in further ecological, socio-cultural and economic problems. It is apparent that wetland losses are more than just environmental problems, affecting human well-being they are issues of development problematic. Conservation and sustainable use of wetlands are important issues for sustainable development affords and achievements depend on a detailed understanding of the dynamics and contributions of wetlands. Especially pressures on wetlands should be determined in detail with their impacts for better decision making processes. Thus, main aim of this research was to determine the impacts of human interventions on human well-being in the

Kızılırmak Delta case. Therefore, trade-offs between human interventions and well-being in the Kızılırmak Delta were analyzed in the research.

Through a comprehensive literature review the problem definition was rationalized and the methodology of the research was developed. Although there were various frameworks for valuation and integrated assessment of wetlands, a new framework was developed for the specific hypothesis of this research. Main purpose of this new framework was analyzing the trade-offs between human interventions and human well-being in the Kızılırmak Delta. For achieving this purpose different assessment tools were integrated through the framework. Although this framework was developed following the guidance of existing frameworks it differentiates from them.

First of all, all the existing frameworks were developed for assessing the economic values of the ecosystem functions of wetlands therefore valuation is the focal point and main purpose of these frameworks. Aiming to analyze the dynamics of the system and to identify the trade-offs between pressures and impacts the new framework had a different focal point. Valuation was just a part of this integrated assessment process. Although existing frameworks provide three main research objectives (total valuation, impact analysis, trade-off analysis) this framework had the determined objective of trade-off analysis.

Second, in spite of the fact that trade-off analysis was defined as the main objective of the framework, followed approach differentiated from the existing (Barbier et al., 1997 and De Groot et al., 2006) frameworks'. Existing frameworks analyze the trade-offs between alternative projects for defining the most valuable one to be implemented. Thus they are future oriented approaches however the new framework analyzed the pressures and impacts on wetlands in a historical and relational context. Identifying the existing conditions and dynamics of the system it provides guidance for the further decision making processes. In spite of the study limitations explained above, this framework provided a detailed understanding of the dynamics of the Kızılırmak Delta within the boundaries of reached documents.

Finally, implementation process of this new framework differentiates from the existing ones'. Although the existing frameworks were implemented by interdisciplinary groups in long time periods, the newly developed was used by a single researcher with time and data limitations. In spite of the limitations, framework provides a detailed structure that can be used in further studies by larger groups for longer time periods. Additional tools and application areas were determined for further uses in the framework.

Being developed for testing the specific hypothesis of this research, the new framework implemented in the Kızılırmak Delta case. Although results of the analyses provide clues about the trade-offs between human interventions and well-being, because of the study limitations presented above, most of them could not be presented in quantitative terms. Through documentary analysis, functions and total value of the delta determined in qualitative terms however as a result of the document constraints most of the functions could not be valued. Only the production and carrier functions of the delta could be valued. Information functions could not be valued while a small portion of the regulation and habitat functions were valued. Thus, the value generated by the carrier functions (pressures) exceeded the values of sustainable functions however evaluation, function analysis and action analysis parts of the framework showed that this was not the case. It is apparent that most of the functions and values of the Kızılırmak Delta and the impacts on it could not be quantified.

Because of their widespread recognition in the delta livelihood, the carrier functions of the Kızılırmak Delta were easily quantified in monetary terms while the sustainable functions could not. Having a direct market for their services, the carrier functions could be valued easily while the sustainable functions could only be analyzed through their apparent services. Also, despite the action analysis most of the pressures and impacts of carrier functions on sustainable functions could not be analyzed totally. Thus, while the benefits of human interventions on wetlands could be calculated, their costs on human well-being could not. Long term impacts of human interventions could not be calculated while the short term benefits were taken into account.

As an alternative, the total value of the delta could be analyzed through benefit transfer method but it was not preferred because the main purpose of the research was to calculate the trade-offs but not the total value. Besides, benefit transfer method was used for calculating some regulation and habitat functions. As a result impacts of the changes were tried to be valued through the framework but in the further studies the total value of the delta could be calculated.

4.3. Focal Points for Planners

Conflict between development and conservation, or human activities and nature, is an important issue for planners to be considered. Providing various ecosystem functions and services, natural areas and resources are important components of human well-being however their contributions and values are generally being ignored. This ignorance intensifies the conflict between development affords and natural systems resulting in the losses of natural resources. Although these losses are being considered as just environmental problems, resulting in changes and losses in the ecological, socio-cultural and economic structures of the community they are important components of development problematic. With the recognition of the impacts of global warming and climate change on the ecological, socio-cultural and economic structures, environmental issues and ecological concerns are getting importance in decision making processes. It is apparent that with the increasing human interventions on natural resources, the importance of ecological concerns in decision making and planning processes will grow in the future.

Conservation and wise use of natural resources are important conditions for the achievement and sustainability of development. In spite of this relationship between development and conservation, pressures on natural systems persist as a result of the lack of understanding and recognition of their structures, processes and contributions. Therefore, achievement and sustainability of development depends on the understanding and acknowledgement of the structures and processes of natural systems and their contributions on human well-being.

Being the most threatened ecosystems of the world, wetlands are also among the most productive and rich ecosystems. As a result of this irony, wetlands provide good examples about the trade-offs between human interventions on nature and their impacts on human well-being. Although they are important parts of human livelihood and well-being, wetlands are generally being ignored in decision making processes. Even if they have been taken into account, they are being considered as areas to be converted into other uses or just borders to be protected. In spite of this general tendency, ecosystem approach provides a different holistic perspective. According to this approach, wetlands (as all natural systems) are important parts of human life that should be understood, managed, used and conserved.

As it has been presented in this document, lack of understanding and recognition of the structures, processes and contributions of wetlands result in their degradation, depletion and losses however achievement of a sustainable development depends on achieving the conservation and wise-use of them. Thus, for achieving the sustainable development the structures, processes and contributions of the wetlands should be understood and the impacts of human interventions on these properties should be analyzed. Also the long term impacts of these interventions on the human well-being should be considered in decision making processes. Dealing with the development problems of cities and regions, planners should adopt ecosystem approach and consider the impacts of human interventions on the well-being through analyses of the structures, processes, dynamics and contributions of wetlands.

Although problem analysis is an important part of planning processes, wetlands are being ignored or taken solely as areas to be conserved. This shallow approach results in the exclusion of wetlands from decision making processes however they should be considered as stakeholders of the system and should be included in the process. Since participation and stakeholder involvement are important principles of planning processes, these stakeholders; wetlands should also be represented in these processes. Representation of wetlands in planning processes is a task of planners, since they are objective negotiators in these processes. Although carrier and some production functions of the wetlands being considered, most of their functions are not even taken into account in planning processes. For an exact representation of wetlands, planners should understand the conditions and dynamics of wetlands. Thus structures, processes and contributions of wetlands, pressures on these components and their long term impacts should be analyzed in detail prior to planning processes. The framework developed in this research provides the necessary tools for analyzing these components. Through analysis of the functions provided by wetlands and valuation of their contributions to economy, wetlands would be exactly represented among other stakeholders. Also for a stronger advocacy of them, long term impacts of the pressures on wetlands should be determined in especially monetary terms.

As it has been explained in the methodology part, through successive and interrelated steps of the framework, conditions and dynamics of wetlands can be analyzed in detail. Although the conditions and dynamics of the system in question are being analyzed through SWOT (Strengths, Weaknesses, Opportunities and Threats) Analysis in planning processes, natural resources are being ignored in this analysis. Thus, for inclusion of natural resources (especially wetlands) in planning practices, the developed framework should be followed in addition to SWOT Analysis. Although it could not be achieved in this research because of the study limitations, stakeholder involvement should be achieved from the beginning of the framework. It is apparent that through the framework the contributions and problems of wetlands are being analyzed thus perceptions of the local inhabitants should be included in the analysis process. Therefore, in depth interviews, questionnaires, contingent valuation methods and cognitive mapping could be used for determining and including the perceptions of the stakeholders. This is also important for the accountability of the planning practices.

Despite the limitations presented above, this research provides guidance for planners in the analysis and valuation of the functions of wetlands through a case study of Kızılırmak Delta. Results of this research will contribute to implementation processes of 2008-2012 Management Plan of Kızılırmak Delta. Using the results of this research, long term impacts of their activities and interventions would be presented to the stakeholder in a clear and detailed way while the natural resources are being represented. Also, presenting the processes in a relational framework, this research helps to find and act directly to the main reasons of the impacts in the delta. In addition, results of the research could be used in futher application areas such as cost-benefit analysis, planning and management processes, inventories, etc.

4.4. Recommendations for Further Studies

Testing the main hypothesis of the research, trade-offs between human interventions and human well-being were analyzed through the developed framework in the Kızılırmak Delta case however further researches could be made about the case using the framework. Although the framework was used for analyzing the trade-offs it could also be used for calculating the total value of the delta. For providing a detailed understanding of the delta and supporting the decision making processes total value of the delta should be calculated in quantitative terms. Although the total value of the delta was presented in qualitative terms in this research, because of the defined purpose of the research and the study limitations a quantitative or monetary assessment of the delta could not be done.

Avoiding the study limitations through a more comprehensive and detailed research the total value could be calculated. Values of the most of the functions (especially information, habitat and regulation functions) could not be calculated in this research because of the time and data constraints. Achieving the involvement of all the stakeholders and local inhabitants in the valuation process total value of the delta could be calculated in monetary terms.

Contingent valuation methods could be used in a long term participatory process. Although the contingent valuation methods are not suitable for the case of Turkey because of the information limitations and economic constraints of the citizens, these shortcomings could be achieved through awareness raising activities prior to the analyses. As it was mentioned above, an interdisciplinary approach should be followed thus stakeholder involvement and expert consultation should be achieved in the process.

For supporting the results of the contingent valuation methods, benefit transfer method could also be included in the research process. For better and credible benefit transfers, communities and habitats of the delta should be analyzed and they should be classified in terms of global terminology. Then, values of similar systems of the world could be transferred for valuing the specific functions of the delta. Although each ecosystem has unique dynamics and values, an approximate value could be calculated through benefit transfer. Because of the limitations, benefit transfer method was only used for estimating the values of gas and climate regulation; and refugium and nursery functions of the delta, in this research.

Since valuation is just a tool for supporting the decision making processes, the results of these further studies should be shared and disseminated. As it was presented in the framework the results of the analysis could be used in inventories and education and awareness raising programmes. Through dissemination of the results, better informed decision making processes could be achieved.

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APPENDIX A

SOME NATIONAL DEFINITIONS IN CHRONOLOGICAL ORDER

Definition presented by the U.S. Fish and Wildlife Service in a publication named Circular 39 in 1956:

> The term “wetlands” … refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs, and deep lakes are not included. Neither are water areas that are so temporary as to have little or no effect on the development of moist-soil vegetation. (Shaw and Fredine 1956 in Mitsch and Gosselink, 2000, p. 29)

Definition presented by the International Union for the Conservation of Nature and Natural Resources (IUCN) at the first meeting of Convention on Wetlands of International Importance Especially as Waterfowl Habitat in Ramsar, Iran, in 1971:

> areas of marsh, fen, peatland 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 six meters'. (Navid, 1989; Finlayson and Moser, 1991 in Mitsch and Gosselink, 2000, p.31)

Definition presented by the U.S. Fish and Wildlife Service in a report entitled Classification of Wetlands and Deepwater Habitats of the United States in 1979:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. … Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soils; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. (Cowardin et al. 1979 in Mitsch and Gosselink, 2000, p. 29)

Definition presented by the Canadian National Wetlands Working Group in 1979:

> land that has the water table at, near, or above the land surface or which is saturated for a long enough period to promote wetland or aquatic processes as indicated by hydric soils, hydrophilic vegetation, and various kinds of biological activity which are adapted to the wet environment. (Tarnocai 1979, in Mitsch and Gosselink, 2003, p.30)

Definition presented by the U.S. Army Corps of Engineers for the implementation of a dredge-and-fill permit system required by Section 404 of the 1977 Clean Water Act Amendments in 1984:

> The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (33 CFR 328.3(b); 1984 in Mitsch and Gosselink, 2000, p.32)

Definition presented by the U.S. Natural Resources Conservation Service of U.S. Department of Agriculture in the 1985 Food Security Act:

> The term "wetland" except when such term is part of the term "converted wetland" means land that-
>
> (A) has a predominance of hydric soils;
> (B) is inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and
> (C) under normal circumstances does support a prevalence of such vegetation.
>
> For purposes of this Act and any other Act, this term shall not include lands in Alaska identified as having high potential for agricultural development which have a predominance of permafrost soils. (16 CFR 801(a)(16); 1985 in Mitsch and Gosselink, 2000, p.33)

Definition presented by the Canadian National Wetlands Working Group in the book Wetlands of Canada in 1988:

> land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment. (Tarnocai et al. 1988, in Mitsch and Gosselink, 2000, p.30)

According to Mitsch and Gosselink (2000, p. 30) this is "the official definition of wetlands in Canada".

Definition presented by the National Research Council of the U.S. National Academy of Sciences in a report entitled Wetlands: Characteristics and Boundaries, in 1995:

> A wetland is an ecosystem that depends on constant or recurrent, shallow inundation or saturation at or near the surface of the substrate. The minimum essential characteristics of a wetland are recurrent, sustained inundation or saturation at or near the surface and the presence of physical, chemical, and biological features reflective of recurrent, sustained inundation or saturation. Common diagnostic features of wetlands are hydric soils and hydrophytic vegetation. These features will be present except where specific physiochemical, biotic, or anthropogenic factors have removed them or prevented their development. (NRC, 1995 in Mitsch and Gosselink, 2000 p. 31)

Definition presented by the Commonwealth Government of Australia, in 1997:

> "Wetland" is the more general and more modern name for what we call swamps, billabongs, lakes, saltmarshes, mudflats and mangroves. Wetlands are simply areas that have acquired special characteristics from being wet on a semi-regular basis. The term also applies to depressions in the landscape of our more arid regions that only occasionally hold water but which, when they do, teem with life and become environmental focal points. (Commonwealth Government of Australia 1997 in Whitten and Bennett, 2005, p. 3)

Definition presented by the Ducks Unlimited, in 2001:

> Wetlands are areas inundated, or saturated, by surface water or groundwater that support hydric, or water-loving, vegetation. Wetlands also are known as swamps, marshes, bogs, and many other localised names. Wetlands are the most productive ecosystems on earth, and they continue to be destroyed at an alarming rate. Wetlands provide us with benefits such as:
>
> - clean water in lakes and rivers;
> - groundwater recharge;
> - moderation of flooding and soil erosion;
> - commercial and recreational fishing; and
> - boating, swimming and other outdoor activities. (Ducks Unlimited 2001 in Whitten and Bennett, 2005, p. 3)

Definition presented by the Sierra Club, in 2001:

> Lands that are transitional between terrestrial and aquatic ecosystems wherein the water table is usually at or near the surface and the Iand is covered periodically by shallow water; those lands must have one or more of the following attributes:
>
> - at least periodically, it supports predominantly hydrophytes;
> - its substrate is predominantly undrained by hydric soil; and/or
> - its substrate is non-soil and is saturated with water or covered by shallow water at sometime during the growing season of each year. (Sierra Club 2001 in Whitten and Bennett, 2005, p. 3)

APPENDIX B

INTERVIEWEE PROFILES

Table B-1 Interviewee Profiles

Interviewees	Profession	Occupation	Education
Interviewee-1	Biologist – Bird watcher	Local NGO Worker	M.Sc. Degree / PhD. Student
Interviewee-2	Farmer & Fisher	Water Products Cooperative Member	Primary School Graduate
Interviewee-3	Agricultural Engineer	Government Worker	University Graduate
Interviewee-4	Agricultural Engineer	Government Worker	University Graduate
Interviewee-5	Farmer & Hunter	Hunting and Shooting Association Member	Secondary School Graduate
Interviewee-6	Hunter	Hunting and Shooting Association Member	High School Graduate
Interviewee-7	Farmer	-	Secondary School Graduate
Interviewee-8	Farmer	-	Secondary School Graduate
Interviewee-9	Agricultural Engineer	Government Worker	M.Sc. Degree / PhD. Student
Interviewee-10	Farmer	Municipality Worker	High School Graduate
Interviewee-11	Farmer	Municipality Worker	Primary School Graduate
Interviewee-12	Biologist – Bird watcher	Local NGO Worker	M.Sc. Degree / PhD. Student
Interviewee-13	Fisher	Water Products Cooperative Member	Primary School Graduate

During 5 days among 10-14 August 2009, in-depth interviews were conducted with 13 local people from different stakeholder groups of Kızılırmak Delta. 13 interviewees are composed of 6 farmers, 3 government workers, 2 local NGO members, 1 fisher and 1 hunter. In addition, 2 of the 6 farmers are also municipality workers, 1 is fisher and 1 is hunter. Profiles of the interviewees were briefly presented in the table above. Interviewees are referred by their numbers in the text when it was necessary.

APPENDIX C

IN-DEPTH INTERVIEW FORM

Name / Surname:	Date:
Age:	Location:
Gender:	Time:
Occupation:	Duration:
Education:	

1. What are the most important components/variables/processes of the Kızılırmak Delta?

2. Are there any problems/changes/losses that you observe about these components/variables/processes? If so what are they?

3. How do these problems/changes/losses affect your life? Are there any personal losses or gains of yourself?

4. What kind of environmental, economic, social or cultural impacts/effects do these problems/changes/losses have?

5. What would be the reasons of these problems/changes/losses? Who are the responsible people or organizations?

6. What is being done for solving these problems/changes/losses? Who are the responsible people or organizations?

7. Are these efforts/attempts enough? What else can be done?

8. Is the Kızılırmak Delta valuable for you? What are the environmental, economic, social or cultural properties/components that make the delta valuable?

9. Are there any improvements in these properties/components? If so, what are they?

10. Are there any losses in these properties/components? If so, what are they?

APPENDIX D

MAP OF CONSERVATION STATUS IN THE KIZILIRMAK DELTA

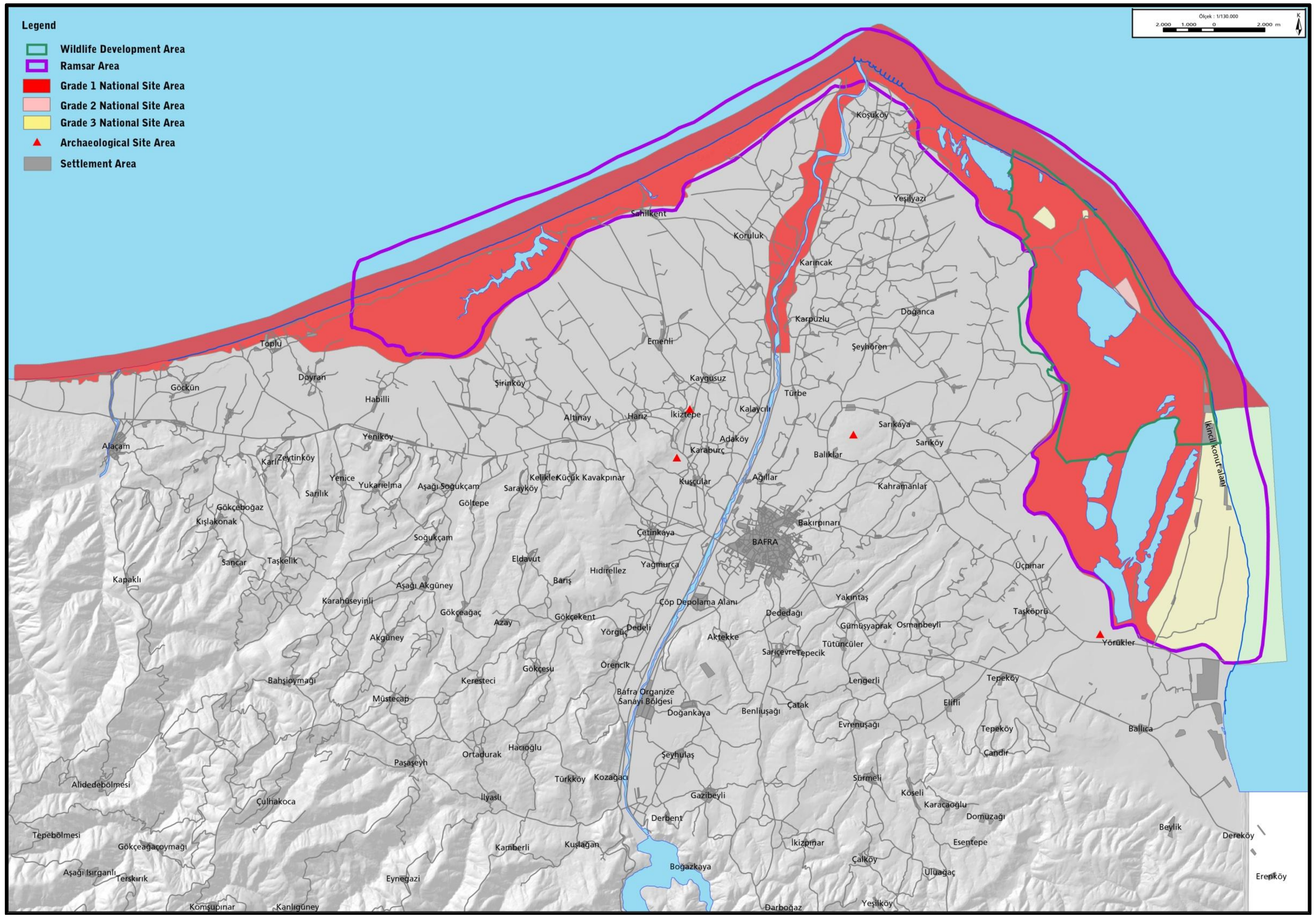

Figure D-1 Map of Conservation Status in the Kızılırmak Delta
(Adapted from Sarısoy et al., 2007, p.610)

APPENDIX E

MAP OF NATURAL RESOURCE USE IN THE KIZILIRMAK DELTA

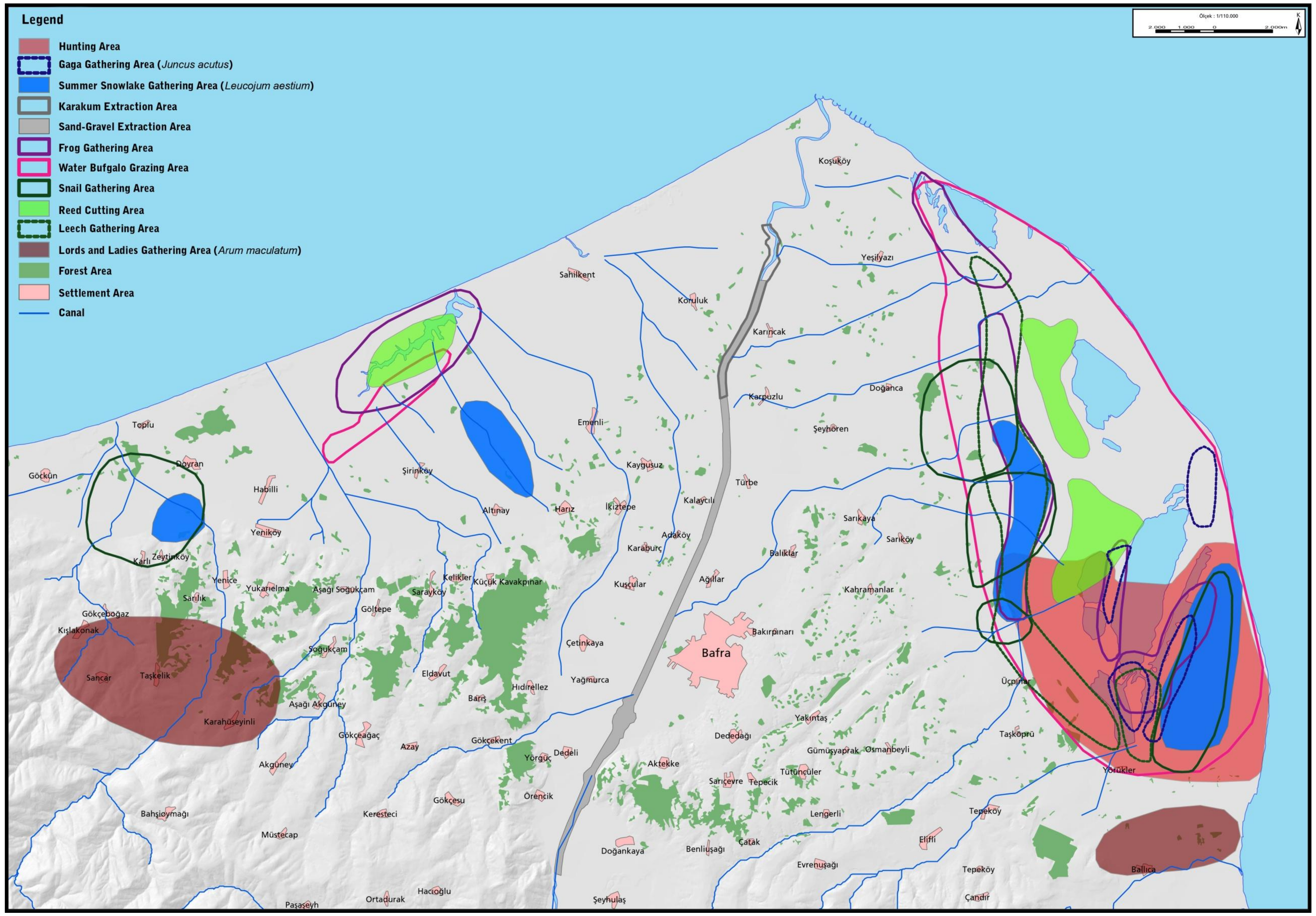

Figure E-1 Map of Natural Resource Use in the Kızılırmak Delta
(Adapted from Sarısoy et al., 2007, p.628)

APPENDIX F

MAP OF LAND USE IN THE KIZILIRMAK DELTA

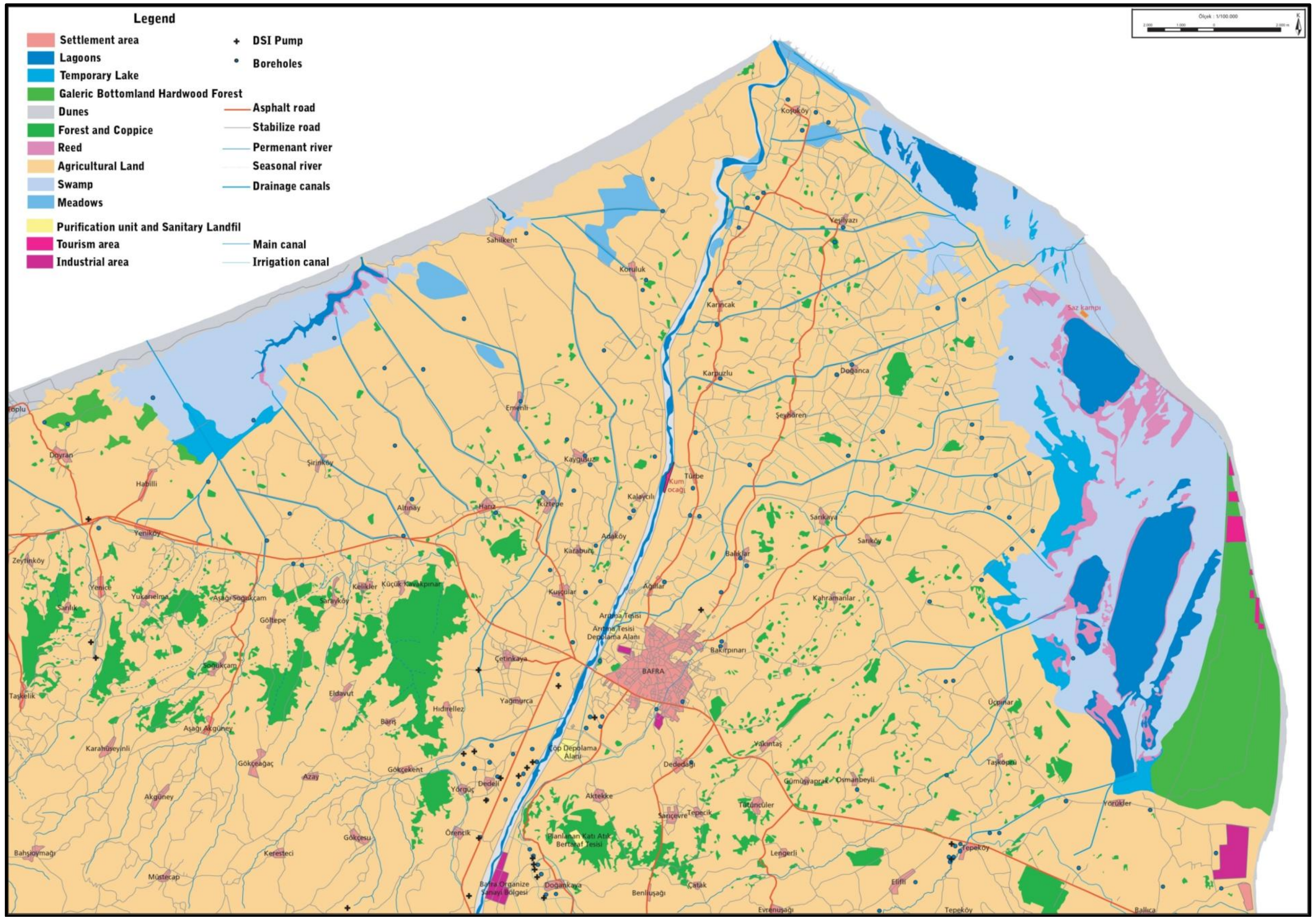

Figure F-1 Map of Land Use in the Kızılırmak Delta
(Adapted from Sarısoy et al., 2007, p.627)

APPENDIX G

COMPONENTS OF THE BIODIVERSITY OF DELTA

Table G-1 Algae species of the Kızılırmak Delta

	Number of species in the delta	Yörükler	Doğanca	Liman	Mülk	Karaboğaz
BACILLARIOPHYCEA	**88**	52	55	40	40	50
CHLOROPHYCEA	**60**	23	43	18	12	24
CYANOPHYCEA	**39**	16	28	11	13	20
EUGLENOPHYCEA	**17**	10	13	6	4	10
DİNOPHYCEA	**4**	4	3	2	2	4
CHRYSOPHYCEA	**3**	2	---	1	---	1
CRYPTOPHYCEA	**2**	1	1	1	1	2
TOPLAM	**213**	108	143	79	72	111

(Adapted from Sarısoy et al., 2007, p.138)

Table G-2 Zooplankton species of the Kızılırmak Delta

	Number of species in the delta	Yörükler	Doğanca	Liman	Mülk	Karaboğaz
ROTİFERA	**28**	25	12	8	10	14
CLADOCERA	**15**	12	8	4	3	2
COPEPODA	**5**	2	3	3	2	3
TOPLAM	**48**	**39**	**23**	**15**	**15**	**19**

(Adapted from Sarısoy et al., 2007, p.155)

Table G-3 Benthic species of the Kızılırmak Delta

	Number of species in the delta	Yörükler	Doğanca	Liman	Mülk	Karaboğaz
GASTROPODA	**11**	8	8	3	4	5
BİVALVİA	**4**	3	3	2	2	3
CLITELLA	**2**	2	2	2	1	2
CRUSTACEA	**1**	1	1	1	1	1
INSECTA	**17**	13	12	9	9	7
TOPLAM	**35**	**27**	**26**	**17**	**17**	**18**

(Adapted from Sarısoy et al., 2007, p.162)

Table G-4 Plant species of the Kızılırmak Delta

Aquatic Plant Species	Cernek	Balıklı	Liman	Karaboğaz	Gıcı	Tatlı	Uzun	Irrigation Channels
1. Lemna minor	a*	a		a	a			b*
2.Ceratophyllum demersum	a	a		a	a	a		b
3. Myriophyllum spicatum		a		a	a	a	b	b
4. Potamogeton crispus		a						
5. Potamogeton perfoliatus		a						
6. Potamogeton pectinatus	a	a		a				
7. Potamogeton berchtoldii	a			a				
8. Potamogeton lucens					a	a		b
9. Ruppia maritima							b	
10. Nymphaea alba					a			b
11. Potamogeton nodosus							b	b
12. Hydrocharis morsus-ranae							b	
13. Potamogeton natans				a				
14. Ranunculus sp								b
15. Alisma plantago-aquatica		a		a				
16. Alisma lanceolatum							b	
Swamp Plant Species								
17. Phragmites australis			b	a	a			b
18. Schoenoplectus lacustris subsp tabernamontanii			b	a	a			b
19. Tyhpa latifolia								b
20. Cyperus longus	a			a			b	
21. Calystegia sepium subsp sepium	a			a			b	
22. Typha angustifolia			b	a				b
23. Sparganium erectum				a	a			
24. Paspalum paspalodes	a				a			
25. Rorippa austriaca					a			
26. Typha domingensis					a			
27. Schoenoplectus litoralis	a			a				
28. Thalictrum lucidum							b	
29. Butomus umbelletus		a			a			b
30. Carex atrata							b	
31. Nasturtium officinale								b
32. Glycyrrhisa glabra				b				
33. Juncus articulatus	a							
34. Samolus valerandi	a						b	
35. Mentha aquatica	a							
36. Pulicaria dysenterica				a				
37. Juncus littoralis			b	a			b	b
38. Lythrum salicaria							b	
39. Potamogeton pesctinatus				a				

a*= from literature, (Seçmen, Ö., 1997) b*= from field research

(Adapted from Sarısoy et al., 2007, pp.122-123)