ISTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

A METHOD FOR SUSTAINABLE DEVELOPMENT IN A RIVER BASIN:GAME THEORY

Ph.D. Thesis by
Arzu BAŞARAN UYSAL, M.Sc.

Department : **Urban and Regional Planning**

Programme: **Regional Planning**

DECEMBER 2005

ISTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

A METHOD FOR SUSTAINABLE DEVELOPMENT IN A RIVER BASIN:GAME THEORY

Ph.D. Thesis by
Arzu BAŞARAN UYSAL, M.Sc.

(502992414)

Date of submission : 18 July 2005

Date of defence examination: 12 December 2005

Supervisor (Chairman): Prof. Dr. Fulin BÖLEN

Members of the Examining Committee Prof.Dr. Yücel ÜNAL (İKÜ)

Prof.Dr. Bilsen Beler BAYKAL (İTÜ)

Prof.Dr. Zekai GÖRGÜLÜ (YTÜ)

Assoc. Prof.Dr. İlker TOPÇU (İTÜ)

DECEMBER 2005

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

NEHİR HAVZALARINDA SÜRDÜRÜLEBİLİR GELİŞME İÇİN BİR YÖNTEM : OYUN TEORİSİ

DOKTORA TEZİ

Arzu BAŞARAN UYSAL

(502992414)

Tezin Enstitüye Verildiği Tarih : 18 Temmuz 2005

Tezin Savunulduğu Tarih: 12 Aralık 2005

Tez Danışmanı: Prof. Dr. Fulin BÖLEN

Diğer Jüri Üyeleri Prof.Dr. Yücel ÜNAL (İKÜ)

Prof.Dr. Bilsen Beler BAYKAL (İTÜ)

Prof.Dr. Zekai GÖRGÜLÜ (YTÜ)

Doç.Dr. İlker TOPÇU (İTÜ)

ARALIK 2005

PREFACE

Preserving natural resources and environmental issues have long been topics for the planning bodies. New methods and ecological approaches are being developed due to the increasing environmental problems. Environmental problems which have undergone diverse dimensions in developing or underdeveloped countries are shaping national economies. Turkey also follows the global developments in environmental issues and improves its environmental policies as well as considering environment in planning strategies. One of the most difficult aspects has been fast changes in environmental planning and its management. Although there have been numerous authorities, laws and regulations; these have been revised and new ones are formed. In 2004, the Ministry of Environment and Forestry passed 54 new regulations. “Public Administration Reform” which proposes fundamental changes in administrative terms is being discussed in the Turkish Grand National Assembly. Due to this new regulation, Metropolitan Municipalities’ Law was revised in 2004.

In this thesis, “game theory” is used as a new approach to environment protection problems and for planning decision making process. “Game theory” is a mathematical model which regained importance in recent years. Its popularity is derived from the interesting life story of Jr. John Nash who shared a Nobel Prize together with Selten and Harasani. Von Neumann who is one of the first to apply this theory in economics has stated “If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is." We believe that this theory is an efficient analytical method for solving complicated planning problems.

First of all I would very much like to thank my thesis advisor, Prof. Dr. Fulin Bölen who has inspired and supported me about working on the game theory. She has been not only an advisor but a real guide for me, always. I would also like to thank Prof. Dr. Bilsen Beler Baykal, Prof. Dr. Yücel Ünal, Asis. Prof. İlker Topçu and Prof. Dr. Benan Zeki Orbay for their help and their opinions on my work. This thesis is a real multidiscipline work, and all the members of the examining committee have been a valuable piece for me to get my puzzle together. I also appreciate my mother and my father who have taught me the virtuousness of knowledge. Finally I would like to thank my husband, Can Devrim Uysal, who has supported and encouraged me during the preparation of this thesis.

July, 2005 Arzu Başaran Uysal

CONTENTS

LIST OF ABBREVIATIONS

BMM	:	Bursa Metropolitan Municipality
BOSAB	:	Bursa Organized Industrial District
DOSAB	:	Demirtaş Organized Industrial District
EEC	:	European Economic Community
EIA	:	Environmental Impact Assessment
EPA	:	Environmental Protection Agency of the United States
EU	:	European Union
GIS	:	Geographic Information Systems
ICWE	:	International Conference on Water and the Environment
ILA	:	International Law Association
NEPA	:	United States National Environmental Policy Act
NGO	:	Non-Governmental Organization
OECD	:	Organization for Economic Cooperation and Development
OID	:	Organized Industrial District
SEA	:	Strategic Environmental Impact Assessment
SIS	:	State Institute of Statistic
DSI	:	General Directorate of State Hydraulic Works
UNCED	:	United Nations Conference on Environment and Development
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environmental Programme
WCED	:	United Nations World Commission on Environment and Development
WHO	:	World Health Organization
WSSD	:	United Nations World Summit on Sustainable Development

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

n_i	:	Set of All Pure Strategies of Player i
i	:	Player
S_i	:	Set of Pure Strategy
s_i	:	Pure Strategy of Player i
s_{-i}	:	Opponent Player's Pure Strategy
Γ	:	A Strategic Form Game
$u_i(s)$	:	Payoff Function
s^*_i	:	Dominant Strategy of Player i
s'_i	:	Dominated Strategy of Player i

NEHİR HAVZALARINDA SÜRDÜRÜLEBİLİR GELİŞME İÇİN BİR YÖNTEM: OYUN TEORİSİ

ÖZET

1950li yılların sonunda “çevre”, hem bilimsel alanda, hem de politik alanda önemli bir gündem olarak tartışılmaya başlandı. II. Dünya savaşı sonrası endüstriyel kalkınma yarışı sonucu, özellikle nüfusun ve sanayinin yığıldığı büyük kentlerde, çevre sorunları ilk sinyallerini vermeye başladı. Doğal çevre ve insan arasındaki ilişki her zaman bölge bilimi ve şehir planlamasının konusu olmuştur, ancak çevre sorunlarındaki artış ve problemlerin boyutu planlamada “çevre” kavramının daha etkin olarak ele alınmasını zorunlu kılmaktadır. Değişen ihtiyaçlar ve hedefler doğrultusunda planlama disiplini de gelişmektedir ve çevrenin korunması ilkesi yeni planlama yaklaşımlarında yerini almaktadır.

Bu çalışmanın ikinci bölümünde, artan çevre sorunları karşısında, dünyada değişen çevre kavramı, geliştirilen çevre politikaları ve Türkiye’ye yansımaları tartışılmaktadır. Çevre -su, orman, toprak gibi- içerdiği doğal kaynaklar nedeniyle ekonomi ile doğrudan ilişki içindedir. Doğal kaynaklar ekonomik değer taşımaktadırlar ve sonsuz değillerdir. Bu nedenle ekonomik kalkınma ve çevre arasında iki yönlü bir ilişki bulunmaktadır; birincisi kıt kaynakların paylaşımı ve tükenmesi, ikincisi ise ekonomik faaliyetler sonucu oluşan negatif dışsallıklardır.

Çevre sorunlarının kamuoyuna yansımasında 1960lı yıllarda yapılan çalışmaların ve yayınların etkisi olmuş, çevre kirliliğinin doğal yaşamı ve insan sağlığını tehdit etmesi, nüfus artışının ve tüketim alışkanlıklarının yaratacağı olumsuz etkiler tartışılmaya başlanmıştır. Bu yıllarda yaşanan bazı çevre kazaları bahsedilen tehlikenin boyutlarının anlaşılmasını sağlamıştır. Ayrıca çevre felaketleri, çevre sorunlarının ulusal sınırlar ile sınırlı olmadığını göstermektedir. 1960lı ve 1970li yıllar özellikle gelişmiş ülkelerin çevre mevzuatlarını ve çevre yönetimlerini oluşturdukları yıllar oldu. Çevre politikalarının oluşturulması konusunda ilk büyük uluslararası adım 1972 yılında Stokholm’de yapılan Birleşmiş Milletler Çevre Konferansı’dır.

Ekonomik gelişme ile birlikte çevrenin korunması ilkesini benimseyen “sürdürülebilir kalkınma” kavramı, içerdiği çelişkilere rağmen, 1980li ve 1990lı yıllarda en çok tartışılan ve çevre politikalarını etkileyen kavram oldu. 1992 yılında Rio de Janerio kentinde yapılan Birleşmiş Milletler Çevre ve Kalkınma Konferansı ve 2002 yılında, Johannesburg kentinde yapılan “Birleşmiş Milletler Sürdürülebilir Kalkınmada Dünya Zirvesi”, sürdürülebilir kalkınma yaklaşımlarının uygulamaya geçirilmesinde etkili oldular. Sürdürülebilir kalkınma politikaları “kirleten öder pensibinin” yanında “tahmin ve önleme” yaklaşımlarının da geliştirilmesini önermektedir. Bu nedenle “çevresel etki değerlendirmesi”, “stratejik planlama” gibi yaklaşımlar çevrenin korunmasında önem kazanmaktadır.

İkinci bölümün sonunda, Türkiye'deki planlama sistemi ve havza planlama tartışılmaktadır. Dünyadaki gelişmelere paralel olarak Türkiye de 1970li yıllardan itibaren çevre politikalarını oluşturmaya başladı. 1983 yılında Çevre Kanunu yürürlüğe girdi ve çevre kirliliğini önlemeyi amaçlayan birçok yönetmelik çıkarıldı. 1991 yılında Çevre Bakanlığı kuruldu. Bu gelişmelerin yanında "çevre" kavramının, planlama mevzuatındaki yeri hala tartışılmaktadır. Planlama mevzuatında tanımlanan plan türleri ve yetkili kurumlara rağmen, "çevre (düzeni) planları" kurumlar arası çatışmaya neden olmaktadır. Ayrıca dünyada doğal kaynak olarak suyun korunması ve kullanımına dair geliştirilen "entegre havza planlama ve yönetimi", Türkiye'de henüz kurumsallaşmamıştır. İçme suyu havzalarının planlanmasından ve korunmasından sorumlu olan Devlet Su İşleri Bölge Müdürlükleri bile havza ölçeğinde örgütlenmemiştir. Çevre ve Orman Bakanlığı ve Metropoliten Belediyeler de su havzaları ile ilgili planlama yetkisine sahiptirler. Yetkili kurumların varlığına rağmen su havzalarının birden çok il, ilçe ve belediyeyi kapsaması, havzaların planlanmasını ve korunmasını zorlaştırmaktadır.

Tez çalışmasının üçüncü bölümünde, planlamada çok sayıda aktörün karar verme sürecini analiz etmemezi kolaylaştıracak bir matematiksel yöntem olarak "oyun teorisi" incelenmiştir. Karar ve fayda teorileri temelinde gelişmiş olan oyun teorisi, tarafların karşılıklı etkileşimli karar verme süreçlerini analiz etmektedir. Teoride, karşılıklı çıkarları çatışan oyuncular rasyonel davranarak, kazançlarını maksimize ederler. Yani her oyuncu kendisi için en iyi olan stratejiyi seçer.

Oyun teorisinin temelleri 18.yüzyıla kadar uzansada, 1920li yıllarda Fransız matematikçi Emile Borel'in yaptığı çalışmalar ilk modern çalışmalar olarak kabul edilmektedir. Ancak teorinin sosyal bilimlerde kullanılmasını sağlayan en önemli çalışma Von Neuman ve Morgenstern (1944) in "Oyun Teorisi ve Ekonomik Davranış" adlı eserleri olmuştur. Teoride "oyuncu", "strateji", "kazanç", "bilgi", "denge" gibi temel elemanlar bulunmaktadır. Teori, "iki kişili oyunlar" ve "çok sayıda oyuncunun bulunduğu oyunlar"da "işbirliğinin olduğu" ya da "işbirliğinin olmadığı" durumlarda, her oyuncunun kazancının maksimum olduğu "denge" noktasını araştırmaktadır. Oyunda, oyuncuların seçtikleri stratejiler sonucunda kazanmayı bekledikleri fayda, kazanç olarak tanımlanmaktadır. Oyunlar "sıfır toplamlı" olabilecekleri gibi "sıfır toplamlı olmayan" oyunlar da olabilir. Oyuncular işbirliği (ya da pazarlık) yaparak kazançlarını artırabilirler. Bunun yanında oyun teorisi, oyuncuların işbirliği olmayan durumlarda nasıl karar vereceklerini de araştırmaktadır. İşbirliğinin olmadığı durumlarda, sıfır toplamlı olmayan oyunlar sosyal bilimlerde en çok modellenen oyunlar olmaktadır.

Her oyunda bazı temel kabullerin yapılması gerekmektedir. Oyuncunun hangi şartlar altında karar verdiği bu kabuller ile belirlenir. Her bir oyuncunun diğerinin stratejilerini ve seçecekleri strateji sonucu elde edecekleri kazancı bilmeleri durumunda oyun "mükemmel bilgili" oyun olarak tanımlanmaktadır. Ayrıca, oyunun kuralları tüm oyuncular tarafından biliniyorsa bu oyun "tam bilgili oyun"dur. Oyun teorisi ayrıca, statik-dinamik, bir kere oynanan-tekrar eden, oyuncuların aynı anda karar verdikleri-sıra ile karar verdikleri oyunlar gibi farklı yaklaşımları da analiz etmektedir. Bir oyunun en iyi strateji çifti, o oyunun denge noktası olarak tanımlanmaktadır. İki kişili oyunlarda minimax, baskınlık ve Nash dengesi gibi oyunların çözümlerine ilişkin yaklaşımlar bulunmaktadır.

Oyun teorisi geniş olarak ekonomide kullanılmakta olsa da, uluslararası ilişkiler, politika, hukuk, sosyoloji, psikoloji, yönetim bilimleri ve biyoloji gibi alanlarda da uygulanmaktadır. Oyun teorisi planlamada 1960lı yıllarda yer seçimi problemlerinde kullanılırken, 1990lı yıllardan itibaren hava kirliliğinin azaltılması, su havzalarında suyun paylaşımı gibi çevre problemlerinde kullanılmaktadır. Oyun teorisi, çatışmanın yaşandığı ve işbirliğinin olmadığı ortamlardaki karar verme sürecini ve denge noktalarını araştırması nedeniyle, planlamada yaşanan benzer sorunların çözümünü kolaylaştıracaktır. Ayrıca, stratejik planlama yaklaşımında, stratejilerin değerlendirilmesinde yardımcı bir yöntem olarak kullanılması faydalı olacaktır.

Dördüncü bölümde, bir su havzasındaki stratejik karar verme sürecinin incelenmesi amacıyla alan analizi yapılmıştır. Türkiyenin üçüncü büyük sanayi şehrinin bulunduğu Nilüfer Çayı Alt Havzası çalışma alanı olarak seçilmiştir. Nilüfer Çayı Alt Havzası gelişen sanayinin yanında sahip olduğu verimli tarım toprakları nedeniyle de, Türkiye ekonomisinde önemli bir yere sahiptir. Bursa kentinin karakteristik yapısının önemli bir parçası olan Nilüfer Çayı, Bursa metropolü ve alt havzada yer alan diğer yerleşmelerin evsel, endüstriyel atıksuları ve tarımsal sulama sularının tekrar çaya dönmesi sonucu kirlenmektedir. Bursa kentinin 2000 yılı nüfusu 2 milyonu aşmıştır ve yapılan nüfus projeksiyonu çalışmalarına göre metropoliten alanda 2020 yılında 3.3 milyon insanın yaşaması beklenmektedir.

Alt havzada tüm yerleşmelerde kanalizasyon sistemi bulunmasına karşın, yalnızca Bursa kentinin evsel nitelikli arıtma tesisi bulunmaktadır. Ayrıca sanayi tesislerinin de büyük çoğunluğunda (%58.5) arıtma tesisi bulunmamaktadır. Nilüfer Çayı Alt Havzası'nda 6 organize sanayi bölgesi ve 2 küçük sanayi sitesi ve çok sayıda dağınık olarak yerleşmiş sanayi tesisi bulunmaktadır. Yalnızca bir organize sanayi bölgesinde genel arıtma tesisi bulunmaktadır. Organize sanayi bölgeleri, genellikle ilçe ve belde belediyelerinin plan kararları ile oluşan sanayi alanlarının daha sonra organize sanayi bölgesi haline getirilmesi ile oluşmuştur. Bu nedenle planlı ve altyapısı gelişmiş sanayi alanları değillerdir. Arıtma tesisi olmayan kuruluşların çalışmaya devam etmesi, alt havzada aktörlerin çevre mevzuatına uygun hareket etmediklerini göstermektedir.

Alt havzada, gelişmekte olan bir diğer sektör tarımdır. Bursa'da tarımsal üretim, tarıma dayalı sanayinin gelişmesi ile birlikte artmıştır. Devlet İstatistik Enstitüsü verilerine göre sanayi ve hizmet sektörlerinde işgücü artarken, tarımsal işgücü azalmaktadır, ancak sulama olanaklarının artması, teknolojik yenilikler ve pazarın genişlemesi nedeni ile tarımsal üretimin ve buna bağlı olarak gelirin arttığı görülmektedir. Alt havzada su temini ve suyun sektörler arasında paylaşımı temel problemdir. Bu problemin kısa vadede çözüldüğü görülmektedir; Bursa kentine içme suyunu sağlayan Doğancı Barajı korunmaktadır, yeraltı su rezervleri sanayiye tahsis edilmiş ve tarımsal kullanım için göl ve göletler inşa edilmiştir. Nilüfer Çayı bu sektörler tarafından kullanılamamakta ve kirletilmeye devam etmektedir. Ancak bu çözüm sürdürülebilir değildir. Devlet Su İşleri tarafından 1979-1982 yılları arasında ve daha sonra 1998-1999 yılları arasında 18 yıl ara ile yapılan iki çalışma Nilüfer Çayı'nda kirliliğin artarak devam ettiğini, suyun artık hiçbir amaçla kullanılamayacağını göstermektedir. Ayrıca, kirliliğin akarsu yoluyla taşınması, kullanıcılar arasındaki çatışmayı artırmaktadır.

Alt havzada planlama ve çevre konusunda karar veren 45 resmi kurum (bakanlıklar, bölge ve il teşkilatları ve belediyeler) tespit edilmiştir. Bu kurumlar birbirlerinden bağımsız olarak karar alabilmekte, strateji geliştirebilmekte ve plan yapabilmektedirler. Alt havzada karar veren kurumlar arasında koordinasyon ve işbirliği bulunmamaktadır. Çok sayıda karar veren kurum olması ve aralarındaki çatışmalar, çevrenin olumsuz yönde etkilenmesine neden olmaktadır. 1998 yılında onaylanan, Bursa 2020 Strateji Planı'nda, bölgede gelişen sanayinin yer seçimi ve sanayi kaynaklı kirliliğin en temel problem olduğu vurgulanmaktadır. Bu planda, kentin gelişmesi, sanayinin yapılanması gibi stratejilerin yanında tarım alanlarının korunması, su kirliliğinin önlenmesi gibi korumaya yönelik stratejiler de geliştirilmiştir. Dördüncü bölümün sonunda, alt havzada karar veren aktörler, stratejileri ve çatışma konuları tespit edilmiştir.

Çalışmanın son bölümü olan beşinci bölümde, alt havzada Büyükşehir Belediyesi'nin yeni sanayi alanlarının oluşturulması ve sanayi kaynaklı su kirliliğinin önlenmesi stratejilerine karşılık, küçük ölçekli bir sanayi yatırımcısının alt havzadaki yer seçme stratejileri, oyun teorisi yardımı ile modellenmiştir. Büyükşehir Belediyesi (A oyuncusu) için altı (6) strateji tanımlanmıştır ve bu stratejilerinin tamamı, Bursa 2020 Strateji Planı'nda yer almaktadır. Diğer yandan sanayicinin (B oyuncusu) stratejileri alt havzada seçebileceği yer alternatiflerinden oluşmaktadır. B oyuncusu için yedi (7) strateji tanımlanmıştır.

Büyükşehir Belediyesi ve sanayi yatırımcısı arasındaki etkileşimli karar verme süreci iki durum için analiz edilmiştir. Birinci oyunda (Oyun I) mevcut durum, yani oyuncuların çevre maliyetlerini düşünmeden karar vermeleri, analiz edilmiştir. Oyun I'de, A oyuncusunun kazancı, iki kritere göre belirlenmiştir, (a) seçtiği strateji sanayi gelirlerini arttırıyor mu?, ve (b) B oyuncusunun tercihine bağlı olarak stratejisi gerçekleşiyor mu? B oyuncusunun kazancı ise, sanayi alanı olarak seçtiği yerin arazi fiyatı, altyapı katılım bedeli ve izin alma süreci ile belirlenmiştir. İkinci durumun analiz edildiği Oyun II'de ise, tüm oyuncuların mevcut plan kararlarına ve çevre mevzuatına uygun davranmaları halinde, kazançlarındaki değişim irdelenmektedir. Oyun II'de, çevre maliyetleri üçüncü kriter olarak değerlendirilmektedir. Her iki oyunda da oyuncuların işbirliği yapmadan karar verme durumları analiz edilmiştir. Oyunlar sıfır toplamlı olmayan ve tam bilgili oyunlardır. Oyunların sunumunda stratejik form kullanılmıştır.

Çalışmanın sonucunda, birinci oyunda beş tane en iyi strateji çifti (Nash dengesi) tespit edilmiştir; (S_{A1}, S_{B7}) (S_{A2}, S_{B7}) (S_{A3}, S_{B7}) (S_{A5}, S_{B7}) and (S_{A6}, S_{B7}). Nash dengesine göre, Büyükşehir Belediye'sinin seçtiği strateji ne olursa olsun, sanayici yatırım maliyetlerini en aza indirdiği, sanayi alanlarına yakın ancak planlı alanlar dışındaki ucuz arazileri seçmektedir. Bu durumda sanayici ve yerel yönetim arasında çatışma devam etmektedir. Ayrıca, birinci oyunda, sanayici maksimum kazancı sağlarken Büyükşehir Belediyesi daima kaybetmektedir.

Çevre maliyetlerinin üçüncü kriter olarak değerlendirildiği ikinci oyunda ise, Büyükşehir Belediyesi sanayi gelirlerini arttırırken aynı zamanda çevre maliyetlerinin de arttığını kabul etmektedir. Diğer yandan, sanayici çevre mevzuatına uygun hareket etmez ise tesisinin çalışmasına izin verilmeyeceğini bilmektedir. Oyun II'de 11 tane Nash dengesi bulunmaktadır. Bu en iyi strateji çiftlerinden dördü, her iki oyuncunun da maksimum kazancı elde ettiği kararlardır. Yani, Büyükşehir Belediyesi çevrenin korunması ile ilgili dört stratejiyi de benimsemesi halinde kazançlı olmaktadır. Üstelik sanayici de birinci oyundaki kadar kazanmaktadır.

Sonuç olarak, birinci oyunda büyükşehir belediyesi daima kaybederken, çevre maliyetlerinin dikkate alındığı ikinci oyunda kazanmaktadır. Bir başka deyişle, bu oyunda büyükşehir belediyesi kazançlarını artırmaktadır. Üstelik sanayici de birinci oyundaki kadar kazanmaktadır. Özetle, mevzuata uygun haraket edildiğinde her iki oyuncu da kazanacaktır ve sürdürülebilirlik mümkün olacaktır. İkinci oyun sürdürülebilir gelişmenin mümkün olduğunu göstermektedir.

A METHOD FOR SUSTAINABLE DEVELOPMENT IN A RIVER BASIN: GAME THEORY

SUMMARY

Towards the end of the 1950s, the concept of “environment” started to appear in the agenda of scientific and political environs. As a result of economic development after World War II, especially in the populated and industrialized big cities, environmental devastation occurred. The relationship between man and the environment has always been a concern for regional science and urban planning. However it has become an obligation to handle “environment” more effectively in planning as a result of the increase in environmental problems. Due to changing needs and targets, planning disciplines also develop and environmental protection takes its place in the new planning approaches.

In the second part of this study, changes in environmental concepts and environmental policies are being discussed with respect to the world and Turkey. Environment is in direct relationship with economy as a result of scarcity of natural resources and negative environmental externalities as an outcome of economic activities. Natural resources carry an important value for the economy and they are limited.

In the 1960s, several studies helped environmental issues to be discussed in public forum. The threat of pollution on health and nature, negative effects of increasing population and consumption habits were discussed. Environmental disasters in the period have made the dimensions of this threat more visible. These accidents have also shown that the issue is not only limited to the national borders. Thus the 1960s and the 1970s have witnessed countries, especially developed ones, enacting their environmental legislations and establishing environmental management systems. The first biggest international step was taken in the United Nation’s Conference on the Human Environment which took place in Stockholm, in 1972.

The concept of “sustainable development” has been an effective and widely discussed concept of the 80s and 90s despite its contradictory aspects. The UN Conference on Environment and Development (UNCED) which was held in Rio de Janeiro in 1992 and the UN World Summit on Sustainable Development (WSSD) which was held in Johannesburg in 2002 were effective in environmental regulations on national laws and on the start of applications concerning sustainability approaches. Sustainability includes “react and cure” together with “polluter pays principle”. As a result approaches like environmental impact assessment and strategic planning gain importance in environmental preservation.

In the end of the second part, planning system and basin planning are discussed in Turkey. Parallel to the developments around the world, Turkey has started to develop its own environmental policies since the 70s. In 1983, the Environmental Law was

passed and many environmental regulations have been passed. The Ministry of Environment was established in 1991. However, the concept of the environment has been still discussed in the planning legislation. Besides, in spite of the fact that many planning types and many authorities have been indicated in planning legislation, it is not clear who is in charge of environmental planning. It becomes chaotic as numerous institutions are authorized. Besides, basin planning and management which is developed to protect natural water resources and their use are not institutionalized in Turkey. Even the General Directorate of State Hydraulic Works (DSİ in Turkish acronym) is not organized according to basin scale. Other legislative bodies in basin planning are the Ministry of Environment and Forestry, and Metropolitan Municipalities. However as water basins are within the territories of diverse provinces and districts, it is very difficult to plan and protect them.

In the third part of this thesis, the game theory is examined as a mathematical method. Game theory which analyzes the strategic decision making process interactively, is based on decision and utility theories. It is accepted that decisions of the parties involved are rational ones, thus each party wants to maximize its benefits and chooses the best strategy in order to achieve this.

Although the basis of game theory was established in the 18th century, Emile Borel's studies in the 1920s are accepted as the first modern studies. Still, von Neuman and Morgenstern's (1944) work "Game Theory and Economical Behaviour" was the one which let this theory to be used in the area of social sciences. Game theory has elements like "player", "strategy", "payoff", "information" and "equilibrium". Theory has two fields of analysis; "n person/two-person game" and "cooperative/non-cooperative game". In the game, utility expected by the players as a result of their chosen strategies is named as payoff. Games might be "zero sum" or "non-zero sum". Players can decide whether to cooperate or to bargain. Besides, game theory also explores how the players would act under non-cooperative circumstances. In social sciences, non-cooperative and non-zero sum games are mostly used as models.

In each game, several basic assumptions have to be made. By these assumptions, it becomes clear under which circumstances the player decides. If each player knows about the others' strategy and the benefits that will come out of these strategies then the game is identified as a "perfect information" game. On the other hand if the rules of the game are acknowledged by all the players of the game then the game is identified as "completed information". Furthermore, game theory has different approaches such as static-dynamic game, one shot-repeated game. A game's best strategy pair is considered as that game's equilibrium. Minimax theorem, dominance, and Nash equilibrium are solving approaches in two-person games.

Although game theory is widely used in economy, it is also used in international relations, politics, law, sociology, psychology, management sciences and biology. Game theory used in planning concerning location in 1960s. It is used environmental problems such as diminishing air pollution, water-sharing in basins since 1990s. As a result, game theory approach would make it easier to analyze terms like conflicts, strategies and cooperation in planning. Furthermore, game theory helps evaluation of strategies in the strategic planning approaches.

In the fourth part, strategic decision making process is analyzed in a watershed. The Nilüfer Stream watershed is chosen for case study; this region covers the third biggest industrial city (Bursa) of Turkey. The Nilüfer watershed has an important place within the Turkish economy; both as an industrial area and as an agricultural one. The Nilüfer Stream is part of the characteristics of Bursa city but city establishment and habitation in the watershed area has caused domestic wastewater, industrial wastewater and agricultural water discharges have polluted the stream. Bursa had a population of more than 2 million in 2000. By 2020, population is estimated to become 3.3 million in the metropolitan area.

There is a sewerage system in all the settlements of the watershed, but Bursa metropolitan area has only a common domestic wastewater treatment plant. Furthermore, many industrial plants (%58.5) in Bursa have no industrial wastewater treatment plants. Today, there are 6 "organized industrial districts" and 2 "small scale industrial areas" which discharge their waste into the Nilüfer Stream. There are no industrial wastewater treatment plants in any of the districts except one. Besides, there are other industrial plants in the district which are spread around. Organized industrial districts are mostly built as industrial areas by the initiatives and planning of district and sub-district municipalities and then they become organized industrial districts. Therefore, infrastructure of these industrial districts is not completed. This situation indicated that actors do not behave properly according to environmental regulation.

Agriculture is another developing sector in the watershed. Agricultural productivity has grown parallel to the industry depending on agriculture in Bursa. On the other hand, the labour force has increased in industry and service fields whereas it has decreased in agriculture. Despite this fact agricultural production and its share in gross domestic production proportion has increased as a result of technological developments, better irrigation facilities and broadening of agricultural markets. In the watershed, the main problem is the supply of water and its distribution among sectors. At present, this problem is solved on a short-term basis. Doğancı Dam which supplies the drinking water for the city is well preserved. Ground water reserves are given over to industry; for agricultural use, artificial lakes and ponds are built. The Nilüfer Stream can not be used by any of the sectors and it is being polluted. Present situation is not sustainable for long term. The DSİ has conducted two studies, one during 1979-1982 and the second during 1998-1999. These have shown that pollution in the Nilüfer Stream is increasing with time and its water can not be used for any sort of use. Moreover, pollution is carried by the stream which causes conflicts among the stakeholders.

45 different official authorities are in charge of planning and environmental issues concerning the watershed. These bodies can decide, develop strategies, and make plan independently. Consequently, there is no co-ordination and cooperation among authorities. Too many authorities and inevitable conflicts among them have negative effects on environmental issues. The Bursa 2020 Strategic Plan which was approved in 1998 states that industrial location and industrial pollution are primary problems. City development strategies, industrial structure, as well as protection of agricultural terrains and prevention of water pollution are covered in this plan. In the end of the forth chapter, decision makers in the watershed, their major strategies and topics of the conflicts are determined.

In the fifth and last part of this study, game theory is used to analyze the location strategy of a small scale textile industrial investor versus the Metropolitan Municipality's strategies to appoint new industrial areas and to prevent the water pollution caused by industry. Six strategies are determined by the Metropolitan Municipality (Player A) and all of these strategies are mentioned in the Bursa Strategy Plan. Seven location strategies are defined for industrial investor (Player B).

Interactive decision making process between the Metropolitan Municipality and the industrial investor is analyzed for both cases. In the first game (Game I), the status quo, in other words decisions that do not consider environmental costs are analyzed. It is observed that plants which do not have acceptable effluent standards continue to function. Thus players do not act according to the existing environmental legislation. In the first game (Game I), payoffs of player A are determined according to two criteria; (a) does the chosen strategy increase its industrial income?, and (b) is player A's strategy realized in accordance with Player B's preferred strategy? Player B's payoffs are determined according to the land price, infrastructure, participation fee and duration for the permit. In Game II, analysis is based on players' acting in accordance with environmental legislation and according to the plan decisions. In Game II, environmental costs are considered as the third criteria. In both games, the case of players' decision making without any cooperation is analyzed. Games are "non-zero sum" and "complete information" games. Strategic form is used representation of games.

In the result of the study, in Game I, there are five Nash equilibriums which are the (S_{A1}, S_{B7}) (S_{A2}, S_{B7}) (S_{A3}, S_{B7}) (S_{A5}, S_{B7}) and (S_{A6}, S_{B7}) outcomes. According to "Nash equilibrium", free from the Metropolitan Municipality's strategy, industrial investor chooses the cheapest land for which he could get the permit easily. Industrial investor's decisions are for low cost and for areas which are close to industrial districts. However, while industrial investor wins, metropolitan Municipality always loses in the first game. In this sense, conflicts between the industrial investors and local authorities will continue and environmental problems will increase.

In Game II, environmental costs are evaluated as the third criteria. Metropolitan Municipality foresees that while its industrial income increases, its environmental costs also increase. On the other hand industrial investor is also aware of the fact that the plant will not be permitted to function unless he fulfils the requirements for environmental legislations. There are eleven Nash equilibriums in Game II. Four of these best strategy duets are the ones in which both Players get the maximum payoff. Therefore Metropolitan Municipality would benefit from it if it adopts these four strategies about environmental preservation. In short, when Player B chooses for S_{B1}, four of the strategies of Player A will bring maximum benefit. This would also mean that more strategies which are needed for protecting environment will become acceptable for Player A.

In conclusion, while the Metropolitan Municipality always loses in the first game, she wins in the second game which considered environmental costs. Namely, Metropolitan Municipality has increased payoff in this game. Furthermore, industrial enterprise can gain in the second game at least first. Briefly, both players will benefit if they act according to legislation, and sustainability is possible, and the second game demonstrates that sustainable development is possible.

1. INTRODUCTION: AIM AND METHOD

An increase in the World's population and the economic development policies after the II. World War sped up the consumption of natural resources and caused environmental pollution due to mass production (Meadows and others, 1972). Population growth, industrialization and rapid growth of urban areas have had major impacts on the environment. Environmental problems such as air, water and soil pollution; the loss of fertile agricultural areas and woodlands; the decrease in biological diversities due to the urban population increase and the development of industry are experienced in all developed or less developed world countries (Bartone, C., and others, 1995; Serageldin and others, 1995b; Brown and Mitchell, 1998). As the effect of environmental problems reached beyond the borders it is accepted that a worldwide avert program is mandatory.

"Sustainable development" policies which target the protection of ecological systems have formed the basis of environmental policies of especially developed countries after the 1980s. Sustainable development policies were developed during the United Nations Conference on Environment and Development (UNCED) Earth Summit in Rio de Janeiro (1992) (Brundtland and others, 1991; Leitman, 1994; Karaman, 1999). Ecological approaches to planning which is considered a significant instrument of economic growth has been discussed for a long time (Isard, 1972; Kozlowski and Hughes, 1972; Rodgers, 1976).

Water, the main source of life on earth is under the threat of various types of pollution. These threats have been forceful in demonstrating the importance of the aquatic ecosystems, the economic value of water as a resource and the comprehensive planning and management of the drainage basins. Therefore, river basin planning whose borders are defined by natural resources has gained more importance than regional plans whose borders change with the socio-economical and technological development (Teclaff, 1996; Aydemir and Aydemir, 1998).

1.1 Aim of the Study and Discussion of the Problem

The sustainability of water resources has become vitally important for the future of the world. Therefore, sustainable development policies indicate the necessity of a basin planning and management in which the cooperation and coordination between the agents is established for the conservation of natural resources. In this study, it is aimed the improvement of the strategic decision making process for environmental benefit in a river basin system. For this reason, the relationships and conflicts between decision makers, the decision making process and water pollution are explored with the help of game theory.

In Turkey, there are a large number of institutions which are decision makers in planning and there are many plans which are prepared to serve different purposes. Again, there exist several regulations specially produced for drinking water basins. However, the concept of "river basin" as an integrated spatial planning unit is not recognized in the current planning system in Turkey even though specific river basins are defined by the Ministry of Energy and Natural Resources – the General Directorate of State Hydraulic Works (DSİ). The Regional Directorates of DSİ are not organized according to the borders of the basins. Some basins may be administered by more than one Regional Directorate. Besides, basins may include many municipalities, district, village and province. Despite the global developments about integrated basin planning and management, the approach to the planning and management of water resources has not been improved. Apart from the debates on the difficulties of the implementation of sustainable development policies, it is observed that sustainable development policies in Turkey are not being implemented.

In Turkey, approximately, a total number of 36 public agencies take part in the decision making process within a drainage basin (Daşöz, 1995). Decisions, taken by these agencies with respect to the use of land and water, affect the quality and sustainability of water as a natural resource. These agencies act under a legal structure comprised of 100 different laws and regulations which are related to the environment (Daşöz, 1995); this creates additional confusion in the planning practice. The absence of basin planning and management makes the solution of environmental problems difficult. Water-sharing among settlements, agriculture and industry is a crucial problem and the absence of planning causes over usage and the contamination of water. Industrial development and urbanization increase the consumption and the pollution of water. Besides, pollution is spread through the rivers. For this reason, the location of industry is important and this results in a severe conflict between the up-stream polluters and the ones who are affected by pollution down-stream. The question is who should pay the costs which have been incurred because of pollution.

In conclusion, a watershed is studied as a case to demonstrate the conflicts among decision makers. The Nilüfer Watershed within the borders of Susurluk Basin, which has been deeply affected by the increasing environmental pollution, is selected. Bursa, the third biggest industrial city of Turkey, is situated the fact that the DSİ has done two regular water pollution researches (DSİ, 1984 and DSİ, 2000) in this area was an important reason in the choice of the watershed as the study area. In addition, the Bursa 2020 Strategy Plan which has been put to force since 1998 has affected the choice.

Decision makers in the Nilüfer Watershed, their strategies, conflicts and environmental infrastructure of the settlements, industrial areas and industrial plants are examined. Most of the industrial facilities –both public and private- have no wastewater treatment plants. With no regard to regulations, they discharge wastewater onto surface water which shows that sustainable development policies are not applied. The inefficiency of authorities, which are monitoring pollution and which officially permit industrial activities; and their intension to accept economic development as a primary strategy are other significant problems. In the recent system of planning and management, decision makers do not primarily adopt the conservation of the environment. Additionally, the costs of the environmental infrastructure are not considered as criteria in terms of industrial actors' choices of location. Moreover, local governments are not capable of improving environmental infrastructure. In addition, municipalities which seek to increase their income, compete amongst each other for industrial investments.

In this thesis, it is argued that in a particular watershed, decision makers have no coordination between them but if they had such coordination, sustainability would be possible. Besides, in the current situation, the agents decide without considering environmental costs whereas they would choose different strategies if they took environmental costs into consideration. The present situation in which the players choose the best strategies and the second situation in which the agents consider environmental infrastructure costs are both discussed. The aim of this thesis, to improve the decision making process for sustainability in a watershed.

1.2 The Method

When there are many decision makers (players) as in the case of watershed, the rivalry between them increases deeply. Ministries and municipalities are usually in conflict with each other. Each decision maker would like to realize own strategies and plan decisions, and they cannot cooperate. Consequently, some environmental strategies cannot be achieved and it becomes difficult to protect the environment. Therefore, game theory is chosen as a method to resolve problems.

The study has four hypotheses;

1. The abundance of decision makers, who decide on environment and planning and who have no cooperation or coordination among them have caused surface water pollution to increase.

2. Decision makers have not been conforming to the present regulation of discharge, the sharing and usage of water as a natural resource is not sustainable.

3. Environmental infrastructure costs are not assessed in industrial investments in decisions of location and feasibility. The location strategy of the investor will change when environmental infrastructure costs are taken into consideration.

4. In the state of cooperation between the decision makers; it is possible that the agents acquire optimum profit and the environment is not damaged.

The first and the second hypotheses are explored in the case study. The third and the fourth hypotheses are explored by using game theory.

Game theory is a mathematical theory which aims to explain the interactive decision making process in situations with more than one decision maker (Luce and Raiffa, 1967; Myerson, 1991; Aumann and Hart, 1994). Players are assumed to behave rationally, so every player tries to maximize his/her payoffs. The game theory analyses the behaviour of the players, their strategies and searches for maximization of their own utilities. Emile Borel gave the first modern formulation of game theory for two-person games in 1921. Another important study was published about two-person, zero-sum games in 1928 and in 1937 by Von Neumann (Luce and Raiffa, 1967). Von Neumann and Morgenstern (1944) analyzed economic problems as games. This seminal book that was useful for social scientists as well as mathematicians and game theory has become important theoretical analysis in the social sciences (Rasmusen,1994; Fudenberg and Tirole, 1996). John Nash (1950, 1951, and 1953) made significant contributions to both non-cooperative game theory and to bargaining theory in cooperative game.

Game theory is divided into two main branches; non-cooperative games and cooperative games. Players can negotiate before the game and players know about what to do in the game if the game is cooperative (Binmore, 1996). On the other hand, if the game is non-cooperative, commitments are not available, unless allowed for by the rules of the game (Fudenberg and Tirole, 1996). Modern applications of game theory, in particular to social sciences, use mainly non-cooperative games, because non-cooperative games are better at defining real world situations. Players, actions, information, strategies, payoffs, outcomes and equilibrium are essential elements in a game (Rasmusen, 1994; Ritzberger, 2002). Furthermore, games are classified according to the number of participants; "two-person game" and "n-person game". In a two-player, zero sum game; one player wins whereas the other loses. Therefore this game is also called a strictly competitive game. On the other hand, non-zero sum games (non-strictly competitive) provide opportunities in which both of the players may win and lose, at the same time (Von Neumann and Morgenstern, 1944; Ritzberger, 2002). Therefore, non-zero sum games are a suitable real world situation as a model. For that reason, most games of interest in the social sciences are non-zero sum games.

There are essentially two ways to represent a game; extensive form, strategic (or normal) form. The extensive form shows what could happen during a playing of the game (Ritzberger, 2002). Namely, players make sequentially decisions. Therefore, extensive form is known to be more detailed than strategic form. In addition, extensive form shows each player's action (move). On the other hand, if a player has one move, strategic form is more useful for abstraction, and players make decisions, simultaneously in strategic form. In addition, players' moves are of two kinds; a personal move and a chance move. Strategic form games consider personal move because of the assumption of rationality (Von Neumann and Morgenstern, 1944; Luce and Raiffa, 1967; Vego-Redondo, 2003).

Information of players about the situation is another factor which affects players' choices (Luce and Raiffa, 1967). Games, in which each player knows exactly what has happened in previous moves, are called games with "perfect information". By contrast, games in which there is some uncertainty about previous moves are called games with "imperfect information" (Gardner, 1995; Hart, 1992). If every player knows the rules of game and payoff function, a game has complete information. (Vego-Redondo, 2003; Fudenberg and Tirole, 1996).

Rationality and common knowledge are basically assumed in the theory. Each player is assumed to be "rational" in the sense that, given two alternatives, he/she will always choose the best strategy. If every player knows the rules of a game, every player knows that every player knows it, and so on…ad infinitum that is called common knowledge (Luce and Raiffa, 1967; Rasmusen, 1994; Harshanyi, 1992). If there is no element of time in game, it is called a "static game". On the contrary, if time is analyzed in game, the game is a "dynamic game" (Fudenberg and Tirole, 1996). Games may be played "one-shot (once off)" or they can be "repeated" (Sorin, 1992). Decision making under certainty, risk, or uncertainty is significant for analysis (Luce and Raiffa, 1967; Harshani, 1992). Furthermore, players' information about the rules of a game determines the solution of a game. All of the concepts have been discussed and developed by game theorists for solutions of games.

The players, actions, and outcomes are collectively referred to as the rules of the game, and the modeler's objective is to use the rules of the game to determine the equilibrium. The solution of a game requires discussing the concept of equilibrium. Equilibrium is a set of the best strategies. In other words, in equilibrium, each player is playing the strategy that is a "best response" to the strategies of the other players. No one has an incentive to change his strategy given the strategy choices of the others (Gardner, 1995; www.gametheory.net).

The first important equilibrium concept is the dominant-strategy equilibrium. Dominant strategy equilibrium is a strategy profile consisting of each player's dominant strategy. Indeed, a dominant strategy solution exists when every player has a dominant strategy (Rasmusen, 1994; Aliprantis and Chakrabarti, 2000). However, some games have no dominant strategy. For that reason, dominant strategy equilibrium approach cannot be used in such games. Thus, the process of elimination is used to solve these different kinds of games. The process of elimination requires that all dominated strategies of all players are eliminated. In other words, a player's inferior strategies are dominated strategies. This process of elimination is called iterated dominance or iterated strict dominance. The solution of the dominant strategy and the iterative elimination of a dominated strategy are used to solve strategic form games (Fudenberg and Tirole 1996; Vego-Redondo, 2003). When strategies are undominated in a game, it could be solved by the Nash equilibrium approach.

The central concept of non-cooperative game theory is that of the strategic equilibrium (or Nash equilibrium) (Ritzberger, 2002). Nash (1951) defines equilibrium points and proves "a finite non-cooperative game always has at least one equilibrium point". The equilibrium of a dominated strategy solution is stronger than Nash equilibrium (Buck, 2004).

Commonly, strategies are determined by two characters; pure strategy and mixed strategy. A pure strategy defines a specific move or action that a player will follow in every possible attainable situation in a game (Selten, 1988). A pure strategy that is undominated by other pure strategies may be dominated by a mixed strategy. In addition, in a game without a pure strategy Nash equilibrium, a mixed strategy may result in a Nash equilibrium. Therefore, a mixed strategy provides a useful approach for games such as Matching Pennies Game. On the other hand, Nash equilibrium need not be the best combination of strategies; a pair of strategies has the highest payoffs, but it's not an equilibrium, absent "cooperation" behavior such as the Prisoner's Dilemma. Nash equilibrium has been developed by game theorists. Selten (1965) introduced the idea of refinements of the Nash equilibrium with the concept of (subgame) perfect equilibria. Harsanyi (1990) developed the Bayesian Nash equilibrium in games with incomplete information in 1967.

Game theory has been applied in many social science fields as a mathematical method; such as economy, political science, international relationship, law, military, sociology, psychology, and management sciences. Furthermore, game theory has been applied to the location problem of planning since 1960s. Stevens (1961) discussed the problem of location strategy and he used game theoretic approach in analysis. Isard and Reiner (1962) explore behaviours of industrialists who choose location for investment. Location alternatives are in an underdeveloped region, outside the country and in the capital city. Walter Isard (1967) studies game theoretic approaches in industrial agglomeration and he considered transportation costs.

Game theory has been used in environmental problems and the planning of natural resources since the 1990s. Water basin planning and the water-sharing problem among sectors (or countries) are based on these studies. Harshadeep (1995) applied cooperative game theory to the water-sharing problem in the Subernarekha River Basin, India. Freeman (2000) used a game theoretic approach, also water-sharing problems according to international law in the Tigris-Euphrates Basin. Kucukmehmetoglu (2004) discussed a coalition among countries of the Tigris-Euphrates Basin which used Shapley Value. Cooperation and coalition situations among agents are discussed for optimum usage of water and its sustainability in these studies. Nijkamp (1980) proposed negotiations between agents for solving externalities in environmental problems and he added game-theoretic strategies could be used for negotiations.

The problem of reducing of emission has been discussed by game theoretic perspective. The reduction of emissions is targeted amongst neighbouring countries through cooperation. Maler and Zeeuw (1998) consider an acid rain differential game in their paper. The Markov-perfect Nash equilibria of the acid rain differential game is explored in the paper. Barret (1998) emphasized negotiation to build a strategy for climate change. This study indicates that carbon dioxide emissions can be reduced by cooperation amongst countries. The purpose of the Ray's (2000) paper is the same. A simple environmental game between two neighboring countries which are emitting a pollutant is formulated in the paper.

1.3 Data

In this thesis, actors whose decisions affect the environment, the conflicts among them and decision making process were determined. An in depth analysis was made to understand the roles, preferences and attitudes of different players taking part within the watershed. Planning and Environmental Regulations were used to define the roles and strategies of the decision makers. Publications of the State Institute of Statistics (SIS), the Bursa 2020 Strategic Plan (1998), the Bursa Wastewater Master Plan (2002), the Bursa Environmental Report (2000), web sites of the Metropolitan Municipality, the Bursa Provincial Governor and the Organized Industrial Districts were examined to determine the basic data an socio-economic development, land use, and environmental infrastructure in the watershed. Additionally, interviews with several authorities such as the Bursa Metropolitan Municipality, the Provincial Directorate of Industry and Commerce, and the Provincial Directorate of Environment and Forestry were conducted.

The DSİ carried out pollution measurements in the Nilüfer Stream in 1979-1982 and 1999-2000. These pollution measurements taken at an eighteen year interval were compared to see the impact of the development that took place in the area. In the watershed, present land use and its effects on water pollution were examined. The sharing of the water, as a natural resource, between industry, agriculture and the settlements and their conflicts, were analyzed. The impacts of these sectors on water pollution and the existence of environmental infrastructures which prevent water from being polluted were determined.

The city of Bursa is one of those rare cities with a “strategic plan” in Turkey. This strategic plan called “Bursa 2020 Strategic Plan” was approved in 1998 by the Bursa Metropolitan Municipality, the Bursa Provincial Governor and the Ministry of Public Works and Settlement. The Strategic Plan is based on two principles; principles on preservation and principles on development. Strategies chosen for analysis in this study also take place in the strategic plan. In other words, this study will also question the applicability of these strategic decisions.

When planning and environment are the subject of discussion, it becomes more difficult to define the agents and their payoffs. In previous studies where the game theory was used it was observed that there was no problem determining the players (Stevens, 1961; Isard and Reiner, 1962; Maler and Zeeuw, 1998). For instance, in a war the enemies are defined and the main goal is victory with a minimum loss. Similarly, in a game among countries causing air pollution, the creators of the pollution are those countries, and there is no need for an analysis to determine this (Ray, 2000). However, Shubik (2002) indicates that in general, experimental works need pre-analysis before the application. In this study, a pre-analysis was required to determine payoffs of players. Land price, infrastructure participation fees, wastewater treatment cost of a small textile firm were explored in pre-analysis. The authorities of organized industrial districts and municipalities were interviewed to determine land price and infrastructure participation fees. An environmental engineering firm was questioned to determine wastewater treatment (both initial and operating) cost.

2. SUSTAINABLE DEVELOPMENT AND RIVER BASIN PLANNING

The link between the environment and economic development has discussed since 17th century (Leiss, 1970; Capra, 1995). However, environmental economics has again become an important area of study since the 1970s, because of increasing environmental degradation (Nijkamp, 1980). Consumption of natural resources has rapidly increased because of population growth and economic development. Between 1990 and 2025, the number of people who live in urban areas is expected to double to more than 5 billion people. Almost all of this growth will occur in the countries of the developing world (World Resource, 1996; Towards an Urban World, 1995). As recently as 1975, only over one third of the world's people lived in urban areas. By 2025, the proportion will have risen to almost two thirds (World Resource, 1996). Thus, optimum use of natural resources is vital for sustainability of economic development as well as human life.

Additionally, environmental problems have reached beyond borders; during the past century the world has come to understand that global and local, national, regional, rural and urban ecosystems and environmental conditions are all connected (Bartone and others, 1994; Serageldin and others, 1995b; Brown and Mitchell, 1998).

Sustainable development policies, which come with the economic growth and prioritize the protection of ecological systems, formed the basics of environmental policies of especially developed countries after the 1980s. Sustainable development policies also affect planning. There is no doubt that planning is the most effective instrument in terms of conservation of the environment and natural resources (Meadowcroft, 1999; Redclift, 1999; Voogd, 1994). Ecological approaches to planning, and the use and management of natural resources, became basic criteria of the planning concept. Thus, a discussion on the border of planning has started (Aydemir and Aydemir, 1998). Sustainable development policies indicate the necessity of a basin planning in which the cooperation and coordination between the agents is established for the conservation of natural resources.

This chapter aims to define the linkage between economy and the environment. Sustainable development policies are discussed both in the context of Turkey and the world in general. Water basin planning legislation and management, and their applications in the world and in Turkey are analyzed.

2.1 The Environment and Development

There is a multidimensional relationship between environment and economical development. Firstly, natural resources –environmental goods/ free commodities- are used for economical development which we need for the improvement of life quality. Furthermore, natural resources are not endless. The free commodity concept is an essential feature of environmental economic phenomena. Free commodities are assumed to have no price, because these commodities are not sold and bought on a normal market. This situation implies that in a normal competitive system of a market economy an over-use of environmental commodities will occur (Nijkamp, 1980; Isard, 1972; Batabyal and Nijkamp, 2004; Turner et al, 1994). Secondly, economic development causes environmental degradation such as water and air pollution and this leads to economic loses. On the other hand, poverty also causes environmental problems because of insufficient service and over consumption of resources (Cisneros, 1995; Serageldin and Cohen, 1995; Turner et al, 1994). According to Leitmann (1994), economic structure of countries shapes its environmental problems. For these reasons, the link between the environment and development is very strong.

Mankind has always struggled with nature; he has used nature and then has shaped it. The Free Online Dictionary (www.thefreedictionary.com) has three simple definitions of environment; the first definition is “the circumstances or conditions that surround one; surroundings”. The second definition is “the combination of external physical conditions that affect and influence the growth, development, and survival of organisms” and the third definition is “the complex of social and cultural conditions affecting the nature of an individual or community”. These definitions are different from each other. Indeed, the second definition is close to the concept of ecology which is defined in the same dictionary “the science of the relationships between organisms and their environments”. Broadly, “environment” is used to refer to the whole of the natural world –from ecosystem to biosphere- within which human beings and all other parts of the plant and animal world exist (Kışlalıoğlu and Berkes, 1994; Şişli, 1999).

The concepts of the environment and environmental economics have changed together with environmental problems since the 17th century. Human being stood over and above nature, and nature was there solely for man's use during these centuries. Scientists believed (such as Bacon, Descartes, Newton) that technological development could achieve welfare in society. This idea is frequently termed "anthropocentrism". An anthropocentric ethic argues that the human species are morally superior to non-human parts of nature (Leiss, 1970; Capra, 1995). The origins of environmental economics has emerged in the beginning of the 1900s in Victorian England. At that time, the older classical economic theories of Smith, Malthus and Ricordo were investigated again by economists. Neoclassic economists -Marshall was the leader of neoclassic school-, focused on the measurement of human satisfaction which resulted from the production and consumption of goods and services (de Steiguer, 1997).

Environmental science has independently advanced from ecology since the 20th century, because man activities have begun to impact the environment, negatively. Environmental problems require focus one's attention on an anthropocentric approach to the environment. On the other hand, it has been understood that technologic development could not solve environmental problems. New research about ecology shows that the environment is an open system, and man is part of this system. Thus, an eco-centric (or life-centered) approach to environment gains importance (Sessions, 1995; Kışlalıoğlu and Berkes, 1994; Şişli, 1999).

The relationship between ecology and spatial economy has been examined by regional scientists since the 1970s and it is still being discussed. (Isard, 1972; Kozlowski and Hughes, 1972; Rodgers, 1976, Hite and Laurent, 1972; Petrakis and Xepapadeas, 2000). Isard (1972) added the new concept of "ecology" in his book which is called "Ecologic-Economic Analysis for Regional Development". He developed the Economic-Ecologic Models for sub-national regions. Figure 2.1 illustrates how the model works.

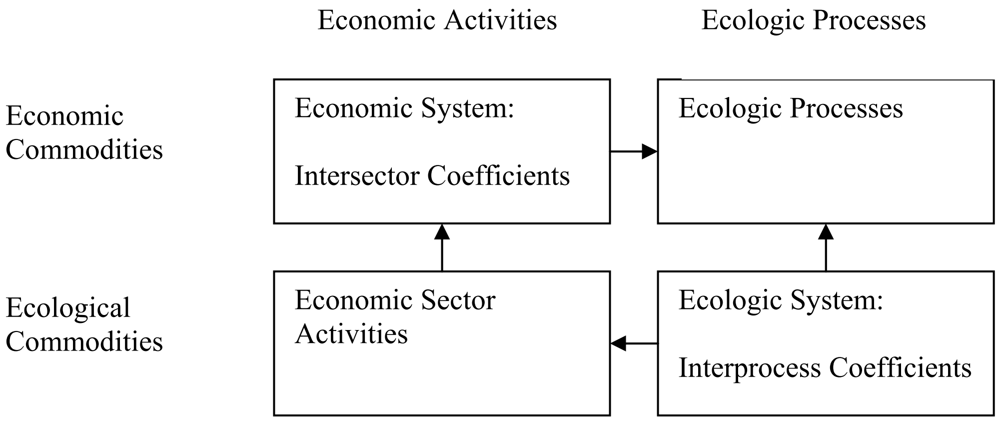

Figure 2.1 Schematic Representations of the Isard Economic-Ecologic Models (Isard, 1972)

Indeed, neoclassic economy contains some weaknesses and it causes increase in environmental problems. Firstly, the traditional measure for economic growth of countries or regions is income per capita. This measure may be a reasonable criterion for welfare in the case of a perfect competitive system characterized by full information and a fully operating price system, but it still neglects many essential elements of human life such as residential living conditions and the quality of working life (Nijkamp, 1980). Economic valuation of environmental goods and the economic costs of pollution have been discussed by environmental economists, and certain techniques have been developed for the measurement of the economic value (Pearce and et al., 2000). Secondly, externality arises when a non-market impact resulting from the consumption or production activity of one economic agent (a person, household, firm, state-run enterprise, etc.) affects the welfare of another economic agent. For example, untreated municipal sewage affects the market goods such as fish and drinking water, and non-market goods such as swimming and recreational fishing (Turgut, 1998; Turner and et al., 1994).

The thesis explores these two essential problems. For that reason, a river basin is chosen as a case study. Socio-economic development and increasing of water pollution are examined, together. Furthermore, externality is clearly observed in a river basin. Behaviours of actors in up-stream can negatively affect actors in down-stream.

2.2 Sustainable Development Policies

2.2.1 Environmental Policies in the World

In the 20th century, as a result of development policies, the human effect on the environment has reached dangerous levels. The arguments on environmental degradation and the consumption of natural resources and its dimensions in the 1970s started to be reflected in the environmental policies of the developed countries as well as on an international level. Many developed countries have enacted environmental legislation, especially about the protection of water since the 1970s.

The environmental crisis gave its first alarms in industrialized countries and especially in the urban areas in the 1960s. Publication of Rachel Carson's "Silent Spring", which was published in 1962, is accepted to be the beginning of the modern environmental era by many scientists (Cech, 2003; de Steiguer, 1997; Sessions, 1995). Rachel Carson was a biologist and her novel was about the risks posed by pesticides. Her book achieved public attention on environmental disasters which caused anthropogenic activities. The period between the 1960s and the 1970s was one of the most tumultuous eras in the developed world (such as the United States and European countries). Many studies were published about increases in population, economic growth, consumption habits and environmental degradation in the 1960s and the 1970s (Sessions, 1995; Doyle and McEachern, 1998). Furthermore, some big environmental accidents and disasters occurred such as; the mercury poisoning at Minamata Bay in Japan in 1959, oil pollution was caused by the stricken tankers Torrey Conyon in 1967, industrial accidents at Bhopal in India, which killed over 3000 people and injured many hundreds of thousands, Three Mile Island nuclear facility in the United States in the late 1970s, Flixborough in England in 1974 and Seveso in Italy in 1976, Chernobyl nuclear accident in the 1980s (Connelly and Smith, 1999; Garner, 2000).

Because of a rapid increase in population growth rates and the extinction of natural resources, consumption habits, life styles and production based economic systems have begun to be criticized. Historically, economic growth has clearly been linked to increasing consumption. However, some scientists (Hoyer and Nass, 2001) have argued that economic growth does not necessarily mean increasing consumption. In

1963, two economists, Harold Barnett and Chandler Morse, released a new book entitled "Scarcity and Growth: The Economics of Natural Resource Availability". In 1966, University of Colorado professor Kenneth Boulding published "The Economics of the Coming Spaceship Earth"; the principal subject of this essay was the decreasing availability of the world's natural resources, especially energy resources (de Steiguer, 1997). In 1968, Garrett Hardin published "the Tragedy of the Commons" and he described the human perspective that often leads to resource mismanagement and conflict. In his essay, the concept of competing demands on a resource, and the issue that personal gain often injures the common good are discussed (Cech, 2003; Hardin, 2000). The most influential research is "The Limits to Growth" which was studied by Meadows and friends for the Club of Rome, in 1972. This report argued that the post-war rate of economic expansion and population growth can not be sustained without exhaustion of global natural resources, irreparable environmental damage and an increase in poverty and malnutrition (Meadows and et al., 1972; Connelly and Smith, 1999).

The result of the increasing environmental problems, numerous publications and studies has helped the environmental issues to be discussed in public opinion since the 1960s. Environmental disasters in the period have made the dimensions of this threat more visible. The United Nation Conference on the Human Environment was the first important international meeting in Stockholm in 1972, focused on international cooperation for and on the environment (Doyle and McEachern, 1998). The conference theme was that environmental problems could be solved by science and technology. The United Nations Environmental Programme (UNEP) was established in the follow up to this meeting. The UNEP was set up specifically to address environmental issues. It plays a vital role in monitoring and coordinating international action (Uslu, 1993 ; Sönmez, 1995).

The United States Congress enacted several important legislations including the Clean Air Act in 1963, the Wilderness Act in 1964, the Endangered Species Preservation Act in 1966 and the National Environmental Policy Act in 1970 (Rodgers, 1976; Wolf, 1983; EPA, 1993). Many developed countries such as Canada and European Countries also enacted environmental protection regulation during this era (Garner, 2000; Couch and others, 1983). The European Economic Community (EEC) –established in 1957- was not originally set up with the intention of promoting environmental policy. Despite this, by 1967 the Community had begun to issue directives concerning environmental matters; and by 1973 it had developed environmental policy explicitly stated in the form of the First Environmental Action Programme (TUSIAD, 1990). The single European market required those standards within and among countries to be comparable so as to ensure equality of competition. Between 1973 –85 there was a significant increase in the European Union (EU) environmental legislation –120 directives, 27 decisions and 14 regulations, to be exact- covering a wide range of issues such as the quality of domestic and drinking water, air quality and the disposal of hazardous waste. The EU's legal competence to deal with environmental issues –The Single European Act- was marked in 1986 (Garner, 2000; Arts, 1994; Budak, 1997).

The concept of sustainable development has become more and more important because of the growing awareness of the global scale of the environmental impacts of economic development activities since the 1980s (Strigle, 2003; Bauriedl and Wissen, 2002). The term, "sustainability", which was used to explain some economic utility such as land value, has been used since the 18th century. The term was used by Adam Smith and Thomas Malthus. The 19th century scientists such as William Paley, Harriet Martineau, Henry George, Charles Darwin, Aguste Compte who made important contributions, are closely related to sustainability (Lumley and Armstrong, 2004). Despite the old research, the term became popular after 1987 when the report titled "Our Common Future" was published (more commonly known as the Brundtland Report). The Brundtland Report was prepared by the United Nations – The World Commission on Environment and Development (WCED), and influenced all countries' environmental policies (Doyle and McEachern, 1998). Despite consensus about some of the aspects of sustainable development, the concept itself is still being discussed. Sustainable development is defined variously, some definitions are seen below;

"sustainable development is a process in which economic, fiscal, trade, energy, agriculture, industrial -indeed, all policies- are designed to bring about economically, socially, politically, and ecologically desirable growth" (ul Haq, p 22, 1995), "sustainable development refers to a process in which the economy, environment and ecosystem of a region develop in harmony and in a way that will improve over time" (Loucks and Gladwell, 1999); and Lumley and Armstrong (p.376, 2004) adds "…the concept has been often to subsume a number of the following ideas; inter- and intra-generational equity, concern for the future, altruism, the conservation of nature, the protection of natural resources, balanced development.”

General definition of sustainability from the Brundtland Report is commonly accepted; “sustainable development is development which meets present needs without compromising the ability of future generations to achieve their own needs and aspirations…” (http://www.ace.mmu.ac.uk/ Brundtland_Report.html).

The concept of sustainable development is based on justification between current and future generations, and it aims to provide justification among the current generation for usage of natural resource. The Brundtland Report (1987) emphasizes the links between environmental degradation and patterns of economic development; it argues that environment and development policies must be integrated in all countries. Sustainability requires guaranteeing the permanence of reproduction process in two areas. One of them is the “reproduction of development”, and the other is “the self reproduction capacity” of natural resources (Greenhuisen and Nijkamp, 1994). However, it is clear that much additional work on this concept is still needed. Batabyal and Nijkamp (2004) indicate that the measurement criterion for judging sustainable development is vague.

In addition, Sachs (p.40, 1995) asks “sustainability, yes, but at what level? Where is the circle of use and regeneration to be closed”. Furthermore, sustainable development requires states to negotiate because of increasing Northern consumption levels, and the South’s desire for industrial development (Brown, 1996). How to provide justice among the generations and how to overcome the contradiction between developed countries/regions and less developed countries/regions is still a study subject (Strigle, 2003; Brown, 1996). Glasby (2003) specifies that the term “sustainable development” as commonly used, is a useful concept in environmental procedures, but we live in a markedly unsustainable world.

In 1992, the United Nations Conference on Environment and Development (UNCED) was organized in Rio de Janeiro. The Rio Earth Summit affects environmental policies in the direction of sustainable development and five agreements were signed; Rio Declaration, Agenda 21, Declaration on Forest

Principles, Convention on Climate Change, and Convention on Biological Diversity. Application problems of sustainable development were discussed in the Rio Earth Summit (Loucks and Gladwell, 1999; http://www.un.org). The conference indicates the practical aspect of the concept of sustainable development rather than the theoretical part, so Agenda 21 targets authoritative ideas on how sustainable development is put into practice (Sönmez, 1995). Furthermore, The Rio Declaration endorsed both the “polluter pays principle” and the “precautionary principle”, and it emphasized developing environmental information, increased public participation, and environmental impact assessment of development schemes (Hens and Nath, 2003; http://www.unep.org/Documents/).

The World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002, was attended by 9101 delegates from 191 governments. The WSSD Agenda included main issues such as water, health, rural and urban development, energy, science and technology, government (especially local government and authorities), climate, social responsibility, economics (http://www.johannesburgsummit.org). The WSSD reaffirmed Agenda 21 as the main pathway to sustainable development, and the WSSD also stressed the importance of partnerships between countries as well as between governments and civil society (Hens and Nath, 2003; http://www.worldsummit2002.org /index.htm).

The development of environmental policies in world is shown in Table 2.1.

During the ten years between Rio and Johannesburg, social awareness has been raised about sustainable development. The WSSD focused on implementation of sustainable development, and equal emphasis is also given to including carrying-capacity, technology-transfer, training and education, partnerships, financial means, and good management (Hens and Nath, 2003; Serageldin and others, 1995a). From Stockholm in 1972, to Rio in 1992, and finally to Johannesburg in 2002, sustainable development issues have been discussed and negotiated.

Table 2.1.The Development of Environmental Policies in the World (adapted from Hens and Nath, 2003; Bauriedl and Wissen, 2002)

1972

- United Nation Conference on The Human Environment, Stockholm.
- UNESCO Convention on the Protection of World Cultural and Natural Heritage.
- First Report of the Club Of Rome.

1973

- Convention on International Trade in Endangered Species, Flora and Fauna (CITES).

1976

- Convention on the Protection of the Mediterranean Sea Against Pollution

1977

- United Nations Water Conference, Mar del Plata, Argentina.

1979

- Convention on the Conservation of Migratory Species of Wild Animals
- The Geneva Convention on Long-Range Transboundary Air Pollution
- First World Climate Conference, Geneva

1982

- Stockholm + 10 Conference Organized by UNEP in Nairobi,

1985

- Vienna Convention on the Protection of the Ozone Layer

1987

- Montreal Protocol on Substances that Deplete the Ozone Layer
- The Report, Our Common Future, published by The WCED

1988

- The World Meteorological Organization and UNEP Establish the Intergovernmental Panel on Climate Change

1989

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

Table 2.1 The Development of Environmental Policies in the World (continued)

1990
- The Global Consultation on Safe Water and Sanitation, New Delhi

1991
- Establishment of the Global Environmental Facility with UNEP, UNDP and the World Bank as Partners.

1992
- UN Conference on Environment and Development (UNCED), Rio De Janeiro
- The International Conference on Water and the Environment (ICWE), Dublin
- Convention on the Protection of the Black Sea Against Pollution
- Framework Convention on Climate Change
- Convention on Biological Diversity

1994
- Interministrerial Conference on Drinking Water Supply and Environmental Sanitation, The Netherlands,

1996
- Habitat II Conference, Istanbul

1997
- The Kyoto Protocol

2000
- We The Peoples: The Role of The UN In 21st Century: Millennium Report
- The Cartagena Protocol on Biosafety

2001
- The Stockholm Convention on Persistent Organic Pollutants
- Fourth Ministerial Meeting of the WTO-Doha Declaration

2002
- International Conference on Financing for Development: Monterrey Consensus.
- UN World Summit On Sustainable Development (WSSD), Johannesburg

Environmental policies based on “polluter pays principle” and “user pays principle”, target reducing negative externalities by economic instruments such as fines and taxes. Sustainable development policies suggest that an “anticipate and prevent” strategy needs to be developed together with a “react and cure” strategy (Ertürk, 1996). However, if economic instruments use a single method, they could not efficiently solve environmental problems. Therefore, as emphasized in the Rio Declaration, other alternative methods which are based on the strategy of “anticipate and prevent”, should be improved (Glasby, 2003). Additionally, some concepts and methods have been developed and proposed; such as volunteering, cooperation, public-private incorporating, and improvement of the decision making process, technological innovation for implementation of sustainable development policies (Harrison, 2000; OECD, 1997; Schmidt, 2001; Albrecht, 2001).

The method of environmental impact assessment and strategic approaches to planning become more important. Besides, consumption habits in the world and the use of resources have been discussed; the importance of developing production technologies has been mentioned to reach less consumption of natural resources and to reduce waste. Recycling is supported. A voluntary approach is becoming more important together with taxation and fines. Higher consumer consciousness would force the producers to conform with environmental regulations. Parallel to the developments around the world, similar issues are being discussed in Turkey. However a strategic approach to planning and environment is not present in legal regulations and is applied only in a limited number of projects.

2.2.1.1 Environmental Impact Assessment

A method of environmental impact assessment (EIA) based on the strategies of “anticipate and prevent” and the EIA has been developed as an implementation instrument of sustainable development policies. The EIA method is “…an activity designed to identify and predict the impact on the biogeophsical environment on man’s health and well-being of legislative proposals, policies, programmes, projects and operational procedures and to interpret and communicate information about the impacts” (Munn, 1979). In other words, environmental impact assessment is “…an anticipatory environmental management tool which is designed to effect decisions about projects which might have significant effects on the environment…" (Wood and Jones, p 1237, 1997).

The United States National Environmental Policy Act (NEPA) is the first comprehensive environmental legislation that was enacted in 1969, and it consists of a significant new term, the Environmental Impact Assessment (EIA) (Rodgers, 1976; Wolf, 1983). The EIA has been a topic in the legislation of many countries, especially European countries, since the 1980s. In 1985, "the council directive investigation of environmental impacts of some public and private projects" for which the European Economic Community (EEC) was responsible, was published (Budak, 1997). In 1987, UNEP expressed the purposes and basis of the EIA as a recommendation for countries which are members of the UN (Keleş and Hamamcı, 1997).

The method of the EIA is a multi-criteria and cost-benefit analysis. Furthermore, the EIA requires a multi-discipline approach. The EIA is a method which enables one to evaluate the environmental impacts of different alternatives. Many techniques like overlays, checklists, matrices, networks / systems diagrams etc. are used. Monitoring and public participation after the implementation of a project is an indispensable part of the method (Arts, 1994; Ericson, 1994).

The EIA method has been used in land use planning as a decision making tool (Jones, 1983; Brachya, 1993; Wood and Jones, 1997), and the method has been developed for environmental planning. In recent years, especially within the EU, the EIA is used to evaluate for strategic decisions that called strategic environmental impact assessment (SEA). The SEA follows the same basic methodology as EIA, although it focuses on policies, plans and programs rather than on individual projects (Connelly and Smith, 1999). The SEA concept takes place in the 5th Environmental Action Plan which was prepared in 1992 (Balfors and Schmidtbauer, 2002).

According to Report of the 4th European Workshop on the SEA (Kleinschmidt and Wagner, 1997), the SEA provides a selection of alternatives so environmental authorities tend to focus on environmental quality. Additionally, the SEA calls for a closer cooperation between environmental and sectoral authorities than the EIA, so the SEA is a useful method that has been accepted especially for regional planning.

However, there is no agreement as to what kind of methods should be used in the SEA. Policy analysis or scenario techniques that are suitable for the SEA are suggested (Kleinschmidt and Wagner, 1997).

2.2.1.2 Strategic Planning

The concept of strategic planning develops in management science (David, 1993; Pettigrew and others, 2002). However, the concept is considered by urban and regional planners. Bilsel (p.10, 1998) defines strategic planning as "a period with physical, financial and institutional aspects during which different public institutions participate in order to make comprehensive decisions on strategical development targets aiming at mid or long terms". Strategic planning has been used, especially in England, since the 1960s, and systematic methods have been developed in British strategic planning such as the interrelated decision areas technique (Batey, 1983; Masser, 1983).

Planning is often short-term as with the five-year development plans followed by many countries. However, Barton and others (p. 71, 1994) emphasises that "environmental problems requires long-term strategic planning that is well-coordinated and that is endorsed by the many actors who shape urban development". For that reason, strategic planning was suggested as a tool for sustainable development in Rio and Johannesburg (Hens and Nath, 2003; Williams, 2002; Leitmann, 1994). In addition, creation of strategic vision and development of long-term strategies are proposed for urban environmental policies by the Organization for Economic Cooperation and Development (OECD), (OECD, 1990). Strategic Planning has been applied in many countries and cities (http://www.cityofseattle.net /planning/;http://www.scotland.gov.uk/library5/planning/rospc-00.asp)

Some techniques have been developed for strategic planning and management. The SWOTs (strengths, weaknesses, opportunities, threats) analysis and development scenarios are usually used for the determination and application of strategies (Williams, 2002; Ildırar, 2004; Bilsel, 1998; http://www.planware.org/strategy.html). One of the objectives is development of strategic thinking in this thesis. In the end of the thesis, a method that aims to improve strategic decision making process will be developed.

2.2.1.3 Innovations

Prevention of pollution before it occurs has been encouraged by newly improved techniques and forms of production. For instance, eco-innovation, re-design, product improvements which include less use of natural resources and cause less pollution, have been developed (Serageldin and others, 1995b; World Resource, 1996; Albrecht, 2001; Schmidt, 2001). Reduction of energy consumption is important both in an urban environment and in economy. Furthermore, the development of renewable energy technologies provides urban sustainability (Nijkamp and Pepping, 1998; Solsbery, 1997). Another innovation is recycling for optimum usage of natural resources. Development of recycle technologies and encouraging uses of recycle productions are part of the sustainable development polices (Schmidt, 2001).

Cooperation and co-ordination among actors -especially between the public and private sector- is important for the achievement of environmental policies (Marcus and et al., 2002; Beierle and Konisky, 2000). Marcus and et al. (p.347, 2002) claim that "companies would improve their environmental performance in order to enhance their public image" by voluntary approaches. When consumers prefer a product, which does not cause environmental degradation, competition among producers increases, positively. Therefore, the process of production and services are improved as in the case of Environmental Managment System -ISO 14000- (Gassner and Narodoslwsky, 2001).

In addition, planned areas such as organized industrial districts, eco industrial parks, industrial regions and technological parks are formed in order to solve environmental problems caused by industrialization efforts. When industry is gathered together in an area, environmental effects can be controlled and infrastructure costs can be reduced. This also makes it easier to cooperate (Şenlier and Albayrak, 2003; Deutz and Gibbs, 2004). Besides, it has been an important step for the conservation of the environment that environmental information systems could be improved by new technological facilities such as geographical information systems (GIS) (Uçkaç, 1999).

2.2.2 Environmental Policies in Turkey

These developments on environmental issues in the world have had an impact on Turkey also. The 1980s witnessed environmental regulations in Turkey. The Third Five-Year Development Plan (1973-1978) which was prepared after the 1972 Stockholm Conference mentioned environmental issues for the first time (Keleş and Hamamcı, 1997; Ertürk, 1996). The 1982 Constitution mentioned "environmental rights" that every citizen has a right to live in a healthy and balanced environment (article of 56th). Nevertheless, this right was restricted by the 65th section of the same law, which states that government is responsible for the prevention of pollution and the preservation of the environment as far as the budget allows it to (Turgut, 1998). Turkish Environmental Law (Law no: 2872) was enacted in 1983.

There have been laws which contained environmental issues such as Municipalities Law (1930, this law was reconsidered in 2004, new law number 5272), Protection of Common Health Law (1930), Hunting Law (1937), Forestry Law (1956), Aquatic Products Law (1971). However, most of the environmental legislations have been enacted after 1980s. For instance, Environmental Law (Law no: 2872, 1983), National Parks Law (Law no: 2873, 1983), Protection of Natural and Cultural Assets Law (Law no:2863, 1983), Coastal/Shore Law (Law no: 3621, 1990), Development Law (Law no: 3194, 1985), Tourism Incentives Law (Law no: 2634, 1982), Metropolitan Municipalities Law (Law no:3030, 1980, this law was reconsidered in 2004, new law number 5216) (Abacıoğlu, 1995; Özkaya, 1997; TUSIAD, 2002; www.rega.basbakanlik.gov.tr). Henceforth, some regulations have been enacted in accordance with the Environmental Law such as the Regulation of Air Pollution Control, 1986; the Regulation of Noise Control, 1986; the Regulation of Water Pollution Control, 1988; and the Regulation of Environmental Impact Assessment, 1993, (Abacıoğlu, 1995; www.rega.basbakanlik.gov.tr).

In the Fifth Five-Year Development Plan (1985-1989), principles of wiping out existing pollution, prevention of possible pollution in future and the most effective use of resources for future generations was considered (Keleş and Hamamcı, 1997; Ertürk, 1996). It can be observed that sustainable development policy is affected by the fifth plan. After that, the Ministry of Environment was established in 1991 (Keleş and Hamamcı, 1997). However the most significant study about the environment is the Seventh Five-Year Plan (1996-2000). In this plan, the following targets were named; preventive policies were considered as a priority, national environmental strategy and action plan were set, reorganization of institutional structure and environmental management were assessed. Following this plan, "the Action Plan for National Environmental Strategy" were prepared by the State Planning Organization and the Ministry of Environment in 1998 (Yaşamış, 2001).

Development of Turkish policy on the environment was also an outcome of the supranational connections and agreements. Turkey applied to become an European Union (EU) member state in 1959, and the Ankara Convention was made between Turkey and the EU on issues of membership and custom regulations in 1963. Hence, the Turkish economy and law would be developed in parallel to that of the EU states. Turkey applied for full membership to the EU in 1987, 19 commissions were formed to evaluate and develop different issues, among which was the environment commission (Budak, 1997; Yaşamış, 2001; Yenice and others, 2001; TUSIAD, 2002). From then on, Turkey signed many agreements with the United Nations (UN), EU, OECD and the World Bank. These institutions required ecological evaluations in every project that was to be funded or co-funded by them (Uslu, 1993). Turkey signed many international agreements concerning the environment such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973, the Convention on the Conservation of European Wildlife and Natural Habitats, 1983; the Convention Concerning the Protection of the World Cultural and Natural Heritage, 1983; the Convention for the Protection of the Mediterranean Sea Against Pollution, 1981; the Convention on the Protection of the Black Sea Against Pollution, 1992; the Ramsar Convention on Wetlands (http://www.cevre.org/Tcm/Sozlesmeler/).

In Turkey after the 1980s, we witness the formation of environmental legislation and gradual arrangements concerning environmental management. The Ministry of Environment and Forestry is responsible for environmental management. There are three permanent councils which work for the Ministry; Superior Environmental Council, Environment Council and Local Environment Council (Özdirek and et al., 1999). The Ministry of Environment joined with the Ministry of Forestry in 2004. However, the environmental management cannot be effective because of too many legal arrangements and institutions -100 laws, 36 institutes, existing of confusions and the absence of coordination between authorities, centralist structure, lack of sufficient staff and technical infrastructure in the Ministry of Environment and Forestry which is the central authority related to environmental issues (Daşöz, 1995; Karaman, 1999).

2.2.2.1 Environmental Impact Assessment in Turkey

Regulation of the Environmental Impact Assessment (EIA) was enacted in 1993, in Turkey. The Regulation has been reconsidered several times in 1997, 1999 and 2003. EIA period in Turkey is similar to the ones in the EU, and European standards were taken as criteria to form the Turkish EIA (Uslu, 1993; Başaran, 1999). The EIA Regulation consists of two lists. The first list shows the projects where EIA will be implemented. The second list shows the projects which will be evaluated before EIA can be applied. After evaluation, in case a project has important environmental influence then EIA would be implemented (Regulation of EIA, 2003). On the other hand, the Regulation of 1993 includes a third list about sensitive environmental areas which were cancelled in 1997.

The weak relationship between the process of EIA and planning negatively affects achievement of EIA. Especially, the EIA method could not measure cumulative impacts in industrial areas without master plans (Başaran, 1999; Özer and others, 1996). Therefore, the Ministry of Environment and Forestry has developed the strategic environmental impact assessment (SEA) to application on environmental plan decisions. Çanakkale is a chosen pilot study for environmental structure plan by the Ministry (Aydemir and Aydın, 2002). In addition, a draft regulation about the SEA has been prepared and discussed by the Ministry of Environment and Forestry (http://www.cedgm.gov.tr/taslak_scdyon.doc).

2.2.2.2 Strategic planning in Turkey

Although, strategic planing has not been defined in the Turkish planning system, strategic approach has been appropriated especially in metropolitan cities, recently. New Municipality Law (Law no: 5272, article 17, 38, 41, 2004) and Metropolitan Municipality Law (Law No: 5216, article 7, 18, 2004) consist of strategic plan approach. These laws consider to develop strategic plan of municipalities (population over 50 000), and the term of the strategic plan mentions the balance between the targets of municipalities and its budget. Nevertheless, relationship is not established between spatial planning and strategic plan.

On the other hand, Development Law (Law no: 3194, 1985) determines planning scale on 1/200 000 and 1/100 000 as environmental structure plans. Ünal (2003) defines these plans as strategic plans. The Ministry of Public Works and Settlement makes the plans if it is necessary. Furthermore, nowadays, the Ministry of Public Works and Settlement has developed provincial strategic plans which enclose provincial borders such as Bursa 2020 Province Strategic Plan (Bursa Strategic Plan, 1998). As few existing examples are looked over, it is seen that these do not have the management structures that strategic planning requires. There is no management model for national strategies to be applied regionally. For instance, Bursa 2020 Strategic Plan is prepared by the participation of the Ministry of Public Works and Settlement, the Bursa Metropolitan Municipality and the Bursa Provincial Governor and was approved by the Ministry of Public Works and Settlement. A separate institutional regulation was not made for preparing the strategic plan (Bademli, 2001).

2.2.2.3 Innovations in Turkey

Turkish industry is working towards global integration. Therefore global technological improvements are also followed by Turkey. Recent environmental legislation supports technologies which use less environmental resources and cause less pollution. For instance, according to "the Regulation for Packing Waste" which was passed in 2004 (http://www.cevre.gov.tr) packages used for industrial purposes should be recycled and deposit-returned to some extent. Environmental management system -ISO 14000- is applied by the industrial entrepreneurs on voluntary bases and is important in the preventive sense. Nevertheless companies with ISO 14000 certificates are a lot less in number than their counterparts in other countries (Tüzün, 1999).

In recent years supporting industrial developments with planned industrial areas have gained importance and three laws have been enacted. In 2000, the Law of Organized Industrial Districts (Law no: 4562); in 2001, the Law of Technology Development

Regions (Law no: 4691); and in 2002, the Law of Industrial Districts (Law no: 4737) (www.rega.basbakanlik.gov.tr). With these three laws, control of industrial waste, problems of locating plants and infrastructure expenses are expected to be settled.

2.3 River Basin Planning

All through history, cultural, social and economic centers were aware of the need to control water and use it to their advantage. Therefore, the using and sharing of water resources have been a fundamental topic in both national and international law. The Riparian Doctrine (also called the common law of water) was developed in the 6th century and provided the framework for water allocation throughout the Roman Empire (Cech, 2003). Moreover, one of the first "modern" environmental laws was, in many industrialized countries, a "water quality law" (Teclaff, 1996; Krairapanond and Atkinson, 1998). However, water will be one of the most important natural resources of the world in the future. Water use in 2025 is going to be shaped by several major driving forces; population increase, trade policies and global climate change (Le Moigne, 1995; Hens and Nath, 2003). The potential for international conflict over water is great. Some scenarios about water wars for the future are formulated (Cech, 2003). The fresh water resources of a nation will affect national economy, and it may shape the role of the nations in the world. Therefore, optimal use of water as a natural source, just distribution and its sustainability are important.

Although there is an abundance of water on earth, 97,4% of it has a high salt content and is not generally usable. Only about 0,6% of the total water volume on earth is freshwater in the liquid state -inland surface waters and ground waters- (Malkina-Pykh and Pykh,, 2003; World Resources, 1996). Furthermore, water resources are not distributed equally on earth. Ranges of river runoff per capita per year could be seen in Figure 2.2

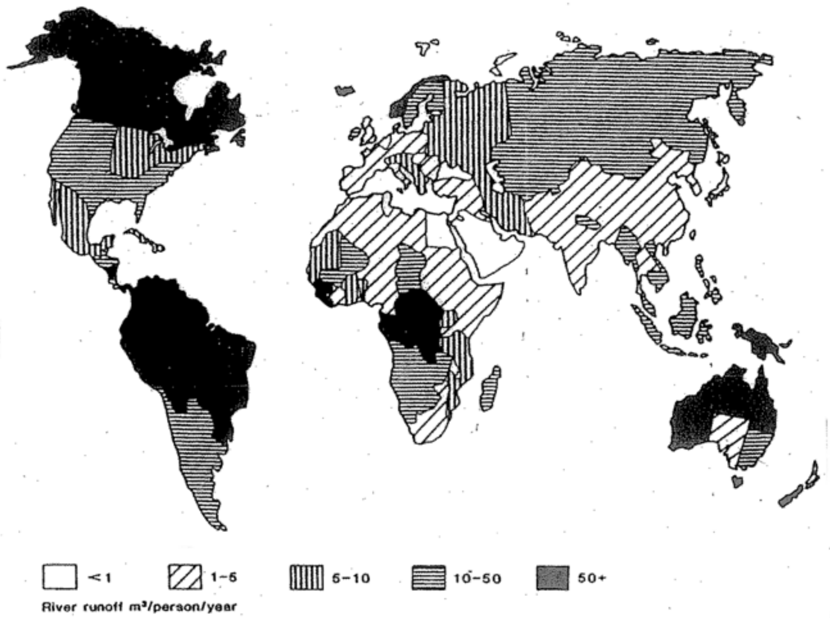

Figure 2.2 Ranges of River Runoff per Capita per Year on Earth (Loucks and Gladwell, p13, 1999)

Water resources are also key parts of sustainable development, and sustainable development can not succeed without sustainable water resource systems supporting that development (Hens and Nath, 2003; Loucks and Gladwell, 1999). Thus, river basin planning and river basin management, whose borders are defined by natural resources, have gained more importance as an ecologic approach (Teclaff, 1996; Aydemir and Aydemir, 1998). If natural protection is a goal, a regional or global approach to planning should be considered, not national (Krairapanond and Atkinson, 1998). Therefore, water basin approach at a regional level to planning has been developed in sustainable development policies.

Each river basin has its own sensitive and subjective problems. Climate, geology, topography, soils, flora and fauna all interact with the basin's waters, and if there is a change in any of these factors, either naturally or by human action, the watercourse system reacts (Teclaff, 1996; Cech, 2003). Therefore, planning and management should be held in the scale of the river basin with consideration of those characteristics of the river. For instance, Meşhur (1995) suggests that discharge standards should be determined according to their individual features.

Teclaff (p. 360, 1996) defines the river basin and watershed as "a river and all its tributaries (branches) make up a river system, and the area from which a river system drains is called the river basin. A basin is usually delimited on the surface by a natural boundary called the watershed or drainage divide". Cech (p.59, 2003) describes watershed as "the total land area that contributes water to a river is called a watershed (also called river basin, drainage basin, and catchments). Reimold (1998) classified management units of a water basin as basin, sub-basin, watershed, sub-watershed and catchment.

2.3.1 River Basin Planning in the World

Water resources have been planned and managed since ancient times such major basins as the Nile, the Tigris-Euphrates, the Indus, the Yellow and the Yangtze rivers. The first modern river management authorities were established in the early 19th century in the United States. The first legislation (the Flood Control Act) about the usage of the river was enacted in 1917 (Chech, 2003). The Tennessee Valley Authority (federal regional agency), which tries to improve transportation facilities, agricultural and irrigation facilities, flood control, reforestation, marketing of power, and industrial development of the basin, was established in 1933 (Wagner, 1972). Since 1960, river basin planning and management has taken place in many countries' planning legislations. Today, the concept of integrated water resources management is developed because of the cooperation among stakeholders.

By 1960, eight departments and some 40 agencies in the federal government were involved in some phase of water resource planning, and the Water Resource Planning Act enacted in 1965 in the United States (Don Maughan, 1972). Planning, development, and management of water and land resources took place under a federal system of government, and the responsibility for managing the water (and related land resources of river basins) is shared among federal, state and local governments and private enterprise in the United States (Smith, 1972).

Nowadays, in the United States, various watershed management approaches are in place to address small streams and major river and lake basins. Examples of watershed management organizations are the Great Lakes Commission, the Ohio River Valley Water Sanitation Commission and on a more local scale, the Anacostia River Restoration efforts in Washington, D.C. (Victory and Tennant, 1998). EPA (Environmental Protection Agency of the United States)'s vision for watershed approaches and builds upon the Office of Water "Watershed Protection Approach Framework", endorsed by senior EPA managers in 1991. Watershed approach is defined as "…is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow" by EPA (www.epa.gov/owow/watershed).

Development of water resource planning and legislation in Canada is similar to the United States. The Canada Water Act passed in 1970. This Act embodies the concept of an integrated approach to water management, and it was developed also within the Canadian system of shared jurisdiction between federal and provincial governments. The Great Lakes-St.Lawrence system is important for Canada and the United States, it is especially vital to Canada, and this region is threatened by the pressures of rapidly increasing urban areas and the growth of new industry. The Great Lakes-St.Lawrence system has been shared in harmony since the early 19^{th} century by Canada and the United States. They have signed series treaties, and established the International Joint Commission (Austin, 1972; Tinney and van Loon, 1972).

In the United Kingdom, river authorities have been established with broad powers to manage both the quality and quantity of rivers. Further east, in Germany, national legislation has established self-administration water associations for the management of the Emscher and Ruhr river basins. In France, six water agencies corresponding to the country's six large hydrographic regions have been created; they have been effective in developing and executing policy decisions to enhance water resources (Reimold, 1998). France updated its water legislation in 1964 and its model of basin administration which continues to gain adherents in Eastern Europe, the former USSR, southeastern Asia and Latin America. Furthermore, many metropolitan authorities have also developed their water managements like New York, London, Los Angeles, and Paris (Teclaff, 1996).

Projects for transfer of water across large regions, and even across continents were on the drawing board. They included the Pacific Southwest Water Plan to divert supposedly "surplus" water from northern California to the lower Colorado basin, the north American water and power alliance scheme to interlink river basins from

Alaska and Canada southward to Mexico and the Siberia project for a canal link between Siberian rivers and Soviet Central Asia (Teclaff, 1996).

The International Law Association (ILA) endorsed the integrated basin principle, closely followed by the International Law Institute in its Salzburg declaration of 1961. The most comprehensive and detailed elicitation of principles for cooperation of states in developing shared water resource was clearly illustrated in the ILA's Helsinki rules, adopted in 1966 conference (http://www.internationalwaterlaw.org / IntlDocs/Helsinki_Rules.htm;http://web.idrc.ca/es/ev-29787-201-1-DO_TOPIC). In 1977, in Argentina, the United Nations Water Conference resulted in an "action plan"; including recommendations targeted at meeting the goal of safe drinking water and sanitation for human settlements by 1990 (Cech, 2003).

The International Conference on Water and the Environment (ICWE) in Dublin in 1992 indicated that "freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment" and "water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels" (Malkina-Pykh and Pykh,, 2003). The ICWE reflected in Agenda 21 and river basin planning and managing are stressed for sustainability. After the Rio Conferences and the ICWE, the World Bank has developed a policy on sharing and conserving the resources of international rivers (Serageldin and others, 1995b). Ten years later, the water problem was at the top of the World Summit on Sustainable Development (WSSD) and integrated water basin management principle was agreed to be accepted until 2005 (http://www. johannesburgsummit. org/; http://www.un.org/events/wssd/statements/). The EU has announced that they have agreed upon the "water framework directive" (2000/60/EC) which was implemented in 2000 (Eroğlu, 2004, http://europa.eu.int /comm/ environment /wssd/water).

Today there is a trend towards an ecosystem approach that is considered some form of integration. The concept of integrated water resources management has developed especially river sustainability (Kirby and White, 1994; Toope and et al., 2003). Integrated water resources management includes a number of approaches: integration of water sources (mainly ground and surface water source), linkage of social and economic development, land and water uses within the context of watersheds, stakeholder participation in decision-making and involvement in protection planning and implementation, integration of water resources planning and management into the framework of national planning process, consideration of the needs of aquatic ecosystems for water, and prevention and reduction of pollutant discharges (Malkina-Pykh and Pykh,, 2003; Heathcote, 1998).

2.3.2 Planning System and River Basin Planning in Turkey

2.3.2.1 Administrative System

Administrative institutions in Turkey may briefly be classified under two groups; central administration and local authorities. "Central administration represents the organization that makes up the main administrative structure of the state. It takes and implements political, administrative and economic decisions about the general administration of the country" (www.mahalli-idareler.gov.tr). In addition, central administration is composed of two branches; central administrative organizations in Ankara and the provincial administration. "The provincial administration is comprised of provinces and districts established to take and implement decisions on behalf of the Centre. These units are headed by provincial and district governors" (www.mahalli-idareler.gov.tr). In other words, provincial administrations carry out their responsibilities in coordination with the main bodies of the Ministry and under the supervision of the respective Governors.

There are three types of local authorities in Turkey; special provincial administrations, municipalities, and villages. "Central administration exercises administrative guardianship over local authorities. Tutelage is exercised over the decisions, acts and omissions, organs, and personnel of local authorities" (www.mahalli-idareler.gov.tr ; Keleş, 1994).

Special provincial administrations are field administrations which are established to carry out tasks in the regions beyond municipal boundaries, within their respective provinces. Municipalities are a form of local authority, which are established to function in areas with dense population. It is possible to establish municipalities in the settlements of more than 5,000 inhabitants according to the Municipalities Law (Law no: 5272, 2004). A metropolitan municipality is a superior local body which is formed to regulate the entire metropolitan area. Reference law for the metropolitan municipalities is the Metropolitan Municipalities Law (Law no: 5216, 2004).

2.3.2.2 Planning System

Development Law (Law no:3194, 1985), which regulates the Turkish planning system, defines planning levels as regional plans and development plans. Furthermore, development plans divide into two major parts as master plans and implementation plans (Law no 3194, article 6, 1985). The State Planning Organization is responsible for setting regional plans in accordance with the socio-economic conditions of the region (Law no: 3194, article 8a, 1985). Nevertheless, no regional plans are being prepared except from a few such as The Southeastern Anatolia Project, The East Black Sea Region Project (www.dpt.gov.tr).

There are the regulations which include the rules of planning such as “the Regulation of Implementation for Helping Municipalities”, 1983; “the Regulation of Planning in Unplanned Areas”, 1985; “the Regulation for Plan Preparation”, 1985. The last regulation was reconsidered in 1999, 2000 and 2001 (www.rega.basbakanlik.gov.tr). However, there are confusions about scale, definition and the name of plans. “The Regulation for Plan Preparation” (1985) defines various plans types such as the environmental structure plan (1/200 000, 1/100 000, 1/50.000 and 1/25.000), metropolitan plan, revision plan, supplement plan, local plan (the Regulation for Plan Preparation, 1985). Furthermore, plans of scale 1/50 000, 1/25 000, 1/10 000, 1/5000 and 1/2000 are defined as master plans by the Bank of Provinces (1990).

1/200 000 and 1/100 000 scale plans which are called the environmental structure plans are prepared and approved by the Ministry of Public Works And Settlement. Ünal (2003) points out that “environmental structure plans are unique tools for application of sectoral development policies within the state’s spatial development plans”. Furthermore, environmental structure plans of 1/50 000 and 1/25 000 scale are prepared and approved by the Ministry of Public Works And Settlement. Master plans of 1/5000 and 1/2000 scale and implementation plans of 1/1000 scale are prepared and approved by municipalities or provincial governors (Ünal, 2003; Tunçer, 2001; Law no:3194, 1985; the Regulation for Plan Preparation, 1985).

If there is a higher scaled plan, the plan should be made according to that one but higher scaled plans are not obligatory. For this reason, when settlements have no environmental structure plans, master plans and implementation plans are prepared in local scale.

In addition, there are various plans which have special purposes in the Turkish planning system. Each plan might be made by different authorities, and this situation can cause confusion and conflict in planning. For example, the Ministry of Culture and Tourism makes “tourism development plans” and “conservation plans”. Furthermore, the Ministry of Environment and Forestry has authority to make “special environmental conservation plans”, “environmental structure plans” and “drinking water basin plans”. However, in reality, “drinking water basin plans” have not been prepared or actioned. Moreover, there are industrial development plans such as “organized industry districts plans”, “technological region development plans”, and “industrial development plans” (Ünal, 2003; Çubuk, 1999). Different types of the plans in the Turkish planning system and component authorities are shown in Figure 2.3

Preparation of 1/25 000 scaled environmental structure plan causes conflicts between the Ministry of Environment and Forestry, and the Ministry of Public Works and Settlement, and also between these ministries and municipalities. The Ministry of Environment and Forestry passed a legislation in 2000 and announced that it has the authority to conduct environmental structure plans. In the Regulation (article 4, 2000), environmental structure plan is defined as “1/25.000, 1/50.000, 1/100.000 and smaller scaled plans which are prepared to determine land use of housing, industry, agriculture, tourism, transportation etc. according to regional and national plan decisions”. Additionally, some responsibilities of the Ministry of Environmental and Forestry are classified as “determination of policy, plans and projects for the conservation of the environment, prevention of environmental pollution and improving the environment; improving environmental standards; monitoring and controlling; coordination of environmental authorities and institutes; and preparing environmental structure plans that achieve a balance between economic and ecological factors and the rational use of natural resources” (Law no: 4856, article 2, 2003).

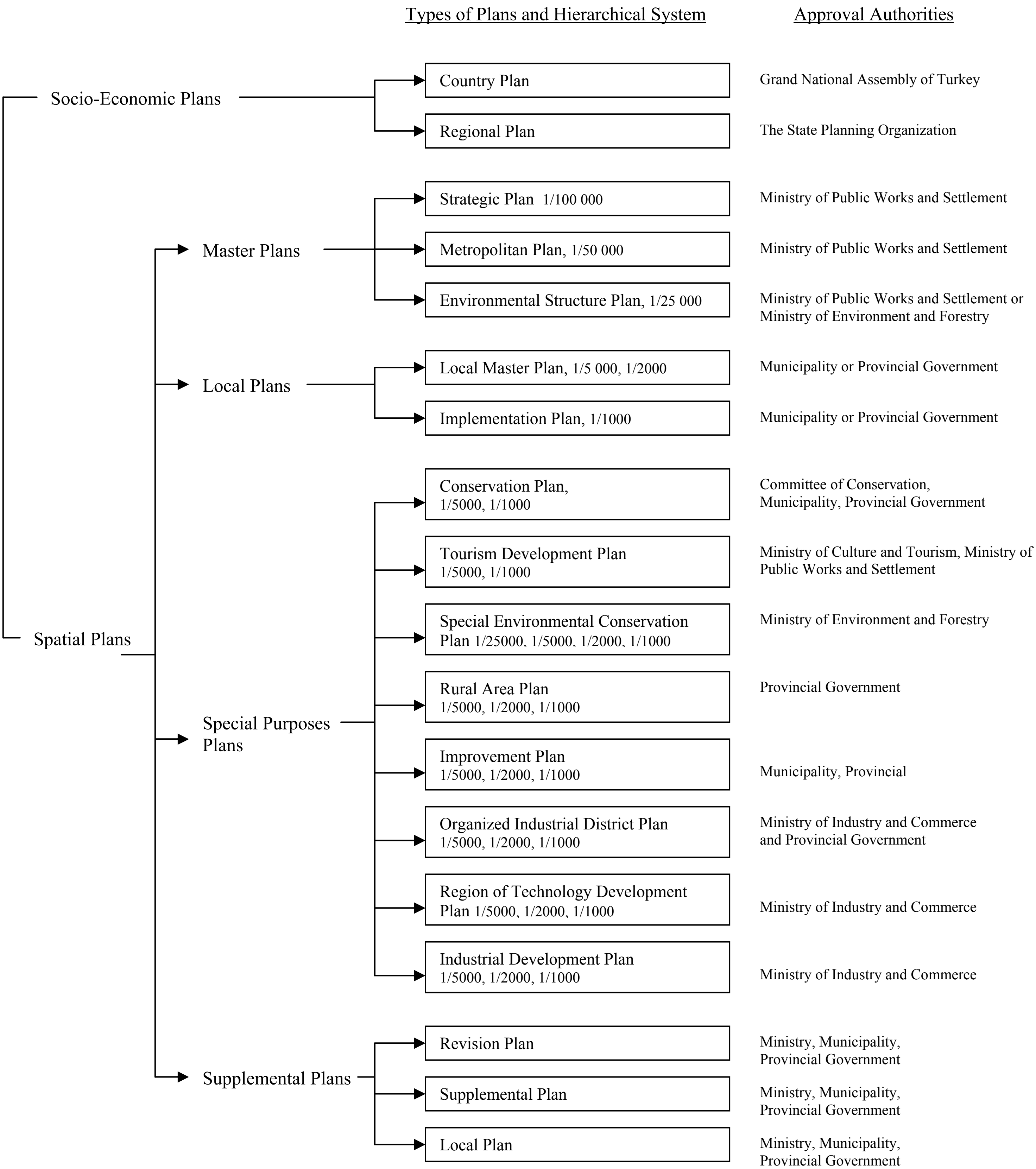

Figure 2.3 Types of the Plans in the Turkish Planning System and Approval Authorities (adapted from Ünal, 2003)

On the other hand, the Ministry of Public Works and Settlement that had been in charge for so many years, took legal action, and in 2001 broadened the definition of "environmental structure plan" within the renewal of the "Regulation for Plan Preparation", and the environmental structure plan is defined as "a plan that should provide balance among sectors like housing, industry, agriculture, tourism, transportation, urban, rural, and natural-cultural values" (Regulation for Plan Preparation, article 3, 1985). In addition, these plans should be made according to the decisions of a regional plan if a regional plan exists. With this new regulation, a new term was introduced to the environmental structure plans, "conservation and usage balance" which was not used before. In conclusion, terms like conservation of natural values and balance have started to be mentioned in planning legislations.

Metropolitan Municipalities make and approve plans of 1/25000 and 1/5000 scale (Law no: 5216, article 7-b, 2004). However, if a metropolitan area which consists of more than one municipality and a metropolitan municipality is not established, the Ministry of Public Works and Settlement is able to prepare an environmental structure plan. Furthermore, if a city grows beyond metropolitan municipality area, an environmental structure plan can be prepared by a provincial government, the metropolitan municipality, the Ministry of Public Works and Settlement, together. After that, the Ministry of Public Works and Settlement approves the environmental structure plan (Law no: 3194, articles 8 and 9, 1985). Usually administrative boundaries and metropolitan boundaries intersect. Because of this the Ministry of Public Works and Settlement holds the authority for planning although municipalities also have the right to do so. This situation causes conflicts but with the new regulation (Law no: 5216, 2004), Metropolitan Municipality boundaries can coincide with the city borders.

Master plans (1/5000, 1/2000) and implementation plans (1/1000) are defined in a hierarchical planning system. These plans are prepared and approved by municipalities within the municipality's borders, otherwise the provincial government prepares and approves implementation plans outside of the municipality's borders. Implementation plans have to coincide with master plans. As for district municipalities of a metropolitan municipality, they make their 1/5000, 1/2000 and 1/1000 scaled plans according to the bigger scaled plans and metropolitan municipalities have authorities to inspect their district municipalities (Law no: 3194, 1985; Law no: 5216, 2004; Regulation for Plan Preparation, 1985). However, the main problem in metropolitan area planning is the settlement that gains a sub-district status after the establishment of metropolitan municipalities. These sub-districts' municipality do their own 1/5000 and 1/1000 plans independent from the metropolitan municipalities according to Municipalities Law (Law no: 1580, 1930). This situation is changed new municipality law (Law no: 5272, 2004).

Furthermore, nowadays, the Government of Turkish Republic is studying a draft of a proposed law about public management structure and local management. Drafts of local management, development and urbanization laws are being discussed in the National Assembly. These laws are expected to prevent the authoritative complexities, and local management will gain importance. Plans for special purposes are expected to be abolished. The planning and management system of Turkey is being changed by these draft laws. These studies proposed to cancel provincial directorates of ministries whereas duties of these authorities will be transferred to municipalities and local authorities such as special provincial administrations. The General Directorate of Rural Services is being closed (Declaration of The Chamber of City Planners, 2003; Tanık and others, 2003; Dünya, 2004b; Dünya, 2004c).

2.3.2.3 River Basin Planning

In Turkey, there's a common misconception that the water resource is fairly abundant. Eroğlu (2004) defines the geographical location of Turkey as a semi-arid region. Conversely, as it is seen in above Figure 2.2 ranges of river runoff are not that high in comparison to world. Moreover, some writers (Şaylan and Kadıoğlu, 2004) claim that climate changes on a global scale would inevitably affect Turkey and in conjunction with the rain system, these changes would impact our water resources.

There is no water or river planning in the current planning system of Turkey. However, water basin development plans also take place within special purposed physical plans and special location plans. Ünal (2003) points out that these plans can be made on 1/5000, 1/2000 and 1/1000 scales by municipalities and provincial governments regarding the legislation rules. Still there are also no clarified arrangements for basin management, yet. However, the General Directorate of State Hydraulic Works (DSI) is a noteworthy institution which plans drinking water basins (together with the provincial governors). The DSİ was established in 1954, and it is organized on a regional scale. Besides, it is responsible for the production of energy, agricultural irrigation and the acquisition of drinkable water to cities whose population is over 100.000 (www.dsi.gov.tr). On the other hand, in rural areas, water supply for irrigation and drinking is provided by General Directorate of Rural Services. In addition, metropolitan municipalities are responsible for planning and investments concerning drinking water (Law no: 5216, 2004). Turkey consists of 26 different river basins which are defined by the DSİ that are shown below Figure 4.1.

The DSİ gives priority to the planning of water resources which are used for the production of drinking water and rivers on which dams are constructed for irrigation and production of energy. In addition, it has conducted research on rivers where water pollution is dense (www.dsi.gov.tr; DSİ, 2000). However, the Regional Directorates of DSİ are not organized according to the borders of the real hydrological basins. Some of the basins are managed by more than one Regional Directorate. Furthermore, river basins contain several administrative units (Başaran, 1997).

In fact, the current legislation refers only to the drinking water basin in Turkey. If rivers are not used for supplying drinking water, they may not be subject to planning. Drinking water basin plans are made by the DSİ and the Ministry of Environment and Forestry (Regulation of Water Pollution Control, article 5, 2004). Furthermore metropolitan municipalities can make drinking water basin plans (Law no, 5216, 2004). Moreover, standards of drinking water are determined by the Institute of Turkish Standards (TSE); classification of surface and ground waters are determined by the Ministry of Environment and Forestry; discharge limits are determined by the Ministry of Environment and Forestry, and the metropolitan municipalities. In conclusion, there are different authorities that are responsible for supplying drinking and domestic water, determination of the classifications, monitoring, controlling discharge, and basin plans.

In addition, the Ministry of Environment and Forestry is responsible for the protection of surface waters which are outside the borders of a metropolitan municipality. It determines quality guidelines of surface waters and their “protection zones”. This guidelines, which is regulated by the Regulation of Water Pollution Control (2004) and “protection zones” are the same for all surface waters in the country. The Regulation (2004) consists of a decision which restricts the pollution of inland surface waters which are sources of drinking and domestic water. Metropolitan municipalities also make basin protection plans within their own borders.

Although, river basin planning does not exist in the current Turkish planning system, there are a few projects which have a watershed approach. “The Southeastern Anatolia Project” is an important example of regional planning which is based on river system, but this plan is not made on a watershed scale. The project area covers 9 administrative provinces in the basins of the Euphrates, the Tigris and in Upper Mesopotamia. It was supervised by the State Planning Organization and then “The Southeastern Anatolia Project Regional Development Administration” was instituted in 1989. The project is identified as “a multi-sector and integrated regional development effort approached in the context of sustainable development.” The Southeastern Anatolia Project had originally been planned in the 1970s, consisting of projects for irrigation and hydraulic energy production on the Euphrates and the Tigris, but has transformed into a multi-sector social and economic development program for the region in the 1980s (www.dpt.gov.tr).

Another planning study of the State Planning Organization, which was made at the scale of river basin, is “Yeşilırmak Watershed Development Project” concerning regional problems such as flooding, erosion and environmental pollution. “Yeşilırmak Provinces Joint Public Services Union” which include the provinces in the geographical field of the project, was founded in 1997 (Yıldırım and others, 2001; http://www.dpt.gov.tr/bgyu/). In addition, Ergene River Environmental Structure Plans (1/100 000), and Sakarya Lake Basin Environmental Structure Plans (1/25 000) were developed by the Ministry of Environment and Forestry (http://www.cedgm.gov.tr/cdplanlari.htm). Furthermore, the DSİ prepares plans on river basins. “B. Menderes River Basin” was chosen a pilot region and “integrated basin management plan” was prepared by the DSİ (Eroğlu, 2004).

2.4 Conclusion

Optimal use of water as a natural source, just distribution and its sustainability are important for both present and future generations. On the other hand, environmental problems (i.e. surface water pollution and water-sharing problems) require planning at a regional and international level. Therefore, a water basin approach to planning is developed for optimum usage and the protection of a water resource.

Although Turkey is classified as having an insufficient natural water reserve, the Turkish planning system does not include basin plans. However, watershed development plans are classified under special purpose physical plans or special areas plans. The General Directorate of State Hydraulic Works (DSİ) is a noteworthy institution which plans consumption of water basins with the provincial governments. Moreover, metropolitan municipalities are responsible for planning and investments concerning drinkable water. Additionally, the Ministry of Environment and Forestry is responsible for the protection of surface waters which are outside the borders of the metropolitan municipality. The Ministry of Environment and Forestry and metropolitan municipalities determine the quality guidelines of surface waters.

Complexities are caused both by disagreements on the basin planning approach and many institutions authorized for the planning. According to Development Law (Law no: 3194, 1985), levels of planning in the Turkish planning system are listed as regional plans, environmental structure plans, master plans and implementation plans. The State Planning Organization is responsible for regional planning, but no regional planning was made apart from several sample plans. Therefore, environmental structure plans are physical plans on large scales which would bring policies and strategies down to spatial. On the other hand, environmental structure plans (1/25 000) can be prepared and approved by the Ministry Public Works and Settlements, the Ministry of Environment and Forestry and metropolitan municipalities.

A major problem in basin planning is that natural boundaries do not match with administrative boundaries. Even the Regional Directorate of State Hydraulic Works which is responsible for drinking water basins is not organized on a water basin level. Furthermore, a basin can be covered by more than one province, district and municipality. This also means many authoritative bodies concerning that basin. Thus, lack of basin and environmental management causes increasing environmental problems.

On the other hand, nowadays, the Government of the Turkish Republic is studying a draft of proposed law about local managements, public management and urbanization structure. Local authorities (metropolitan municipalities, provincial governors and special province authorities) will be authorized by new draft law about public management. Furthermore, metropolitan municipalities of borders will be expanded. However, unfortunately, basin planning and basin management approaches did not appropriate in the draft.

The watershed approach, strategic evaluation, and integrated water resource planning have not been developed in the current Turkish management and planning system. However, studies and implementations in the world are indicated to the obligation of a watershed approach to planning and integrated water resource management for the protection of water. Additionally, basin management by co-ordination and cooperation among stockholders should be resolved for sustainability. Therefore, the watershed approach and the strategic approach should be integrated in to the spatial planning system.

3. THE METHOD: GAME THEORY

3.1 Aim of Game Theory

Game theory is a branch of applied mathematics. The word "game" is inspired by parlor games such as chess and poker, or field games such as football and basketball. Rules of parlor games and players' behaviours are modified in the game theory. For instance, the act of bluffing in poker is quite similar posturing of nations about their military strength (Fudenberg and Tirole, 1996; Gardner, 1995). We make decisions every day about whether a situation is important or not. Game theory deals with the choices of people in the real world (Ray, 2000). Players would like to gain the best profit for themselves in the game theory. Therefore the theory is based on decision theory and utility theory (Ritzberger, 2002).

According to Selten (in introduction, 1988), most of the strategic decision problems occur in human life and they are quite complicated. Usually, rational solutions are not easily available. Selten (1988) defines game theory as follows; "a game is a mathematical model of a situation where several actors with different goals are engaged in strategic interaction. Game theory explores the nature and the consequences of rational behavior in games", and according to Rasmusen (p.9, 1994) "game theory is concerned with the actions of decision makers who are conscious that their actions affect each other". Möbius (p.2, 2004) explains "game theory is a formal way to analyze interaction among a group of rational agents who behave strategically". Game theorists emphasize "interactive decision" in a decision making process. Luce and Raiffa (1967) define the term interactive as a situation where "each player attempts to maximize her utility in a situation where her outcome depends not only upon her choice, but upon the choices of each of the other players; in turn, their choices are influenced by the choice they think she is going to make, for they too are attempting to maximize a function over which they do not have full control". Otherwise the game is a simple series of independent decision problems. Namely, decision makers act in an environment where other players' decisions influence their payoffs and every action has a reaction. Furthermore, the reaction is not programmed to be equal and opposite (Luce and Raiffa, 1967).

Myerson (1991) indicates that "conflict analysis" or "interactive decision theory" might be more descriptively accurate names for the subject. Another definition of game theory is "the study of rational behavior in situations involving interdependence" (McMillan, p.6, 1992). Rationality is basically assumed in the theory. Every decision maker chooses what is best for his/her and expects the best response. In short, game theorists try to understand conflict and cooperation by studying quantitative models and hypothetical examples.

3.2 Historical Background of Game Theory

Game theory is not a new model. Walker (1995) asserts the origin of the theory beyond 500 A.D. The Babylonian Talmud is a compilation of ancient law and tradition set down during the first five centuries A.D. which serves as the basis of the Jewish religious, criminal and civil law. One problem discussed in the Talmud is called the marriage contract problem. A man has three wives whose marriage contracts specify that when the man died they would receive the estate. In brief, the problem deals with sharing the estate amongst his wives. In 1985, it was recognized that the Talmud anticipates the modern theory of cooperative games (Walker, 1995).

First studies of games in economics literature on oligopoly pricing and production were the papers by Cournot in 1838, Bertrand in 1883, and Edgeworth in 1925. A natural generalization of the equilibria studies in specific models by Cournot and Bertrand, and it is the starting point for most economic analysis (Fudenberg and Tirole, 1996). Cournot discusses the special case of duopoly and utilizes a solution concept. Edgeworth proposed the contract curve as a solution to the problem of determining the outcome of trading between individuals in 1881. The concept of the core is a generalization of Edgeworth's contract curve (Kiannai, 1992). At the beginning of the nineteenth century, Zermelo asserted the first theorem of game theory that was about chess. He proved that chess is "strictly determined" (Hart, 1992).

Borel who was a French mathematician, studied a mixed strategy along with finding the minimax solution for two-person games in 1921. Von Neumann published papers about two-person, zero-sum games in 1928 and in 1937. They state that every two-person, zero-sum game with finitely many pure strategies for each player is determined (Luce and Raiffa, 1967). Besides these precursor studies, the book of the Theory of Games and Economic Behavior (Von Neumann and Morgenstern, 1944) is generally accepted as the first comprehensive academic study into game theory (Luce and Raiffa, 1967, Rasmusen, 1994; Fudenberg and Tirole, 1996). They proposed "minimax theorem" for the solution of two-person, zero-sum games in non-cooperative game theory. (Von Neumann and Morgenstern, 1944).

Game theory has attracted the attention of the business world since the late 1950s. The Ford Foundation and the University of Michigan sponsored a seminar on the "Design of Experiments in Decision Processes" in 1952. This was the first experimental economics / experimental game theory conference. On the other hand, after the world experienced an economic crisis in the 1970s, the game theory rapidly gained importance in economy during the 1980s. Game theoretic concepts have been applied to model the interactions of economic agents (Berkovitz and Dresher, 1959; Eichberger, 1993).

John Nash (1950a, 1950b, 1951 and 1953) made significant contributions to both non-cooperative game theory and to bargaining theory in cooperative game; "Equilibrium Points in N- Person Games" (1950a), "The Bargaining Problem" (1950b), "Non-cooperative Games" (1951) and "Two-Person Cooperative Games" (1953). Nash's contributions created significant approaches to how equilibrium could be achieved in the game theory, and Nash shared the 1994 Nobel Economy Prize with Harsanyi and Selten (Walker, 1995).

Nash's papers on the definition and existence of equilibrium (Nash,1950a and 1951) laid the foundations for modern non-cooperative game theory. At the same time, cooperative game theory reached important results in the papers by Nash (1950b) and Shapley (1953) on bargaining games. Aumann and Hart (1992) define the bargaining theory as a "bridge" between the non-cooperative and the cooperative game theory. Shapley (1953) helped the theory by his significant contribution "A Value for N Person Game". The notion of the "core" as a general solution concept was developed by Shapley. This solution is called the Shapley Value. The concept of core is used as balance (or coalition) in the cooperative game. Kannai (1992) describes the concept of core as "it is the set of all feasible outcomes (payoffs) that no player or group of participant (coalition) can improve upon by acting for themselves. Put differently, once an agreement in the core has been reached, no individual and no group could gain by regrouping”.

Selten (1965) introduced the idea of refinements of the Nash equilibrium with the concept of (subgame) perfect equilibria. Harsanyi (1990) developed the Bayesian Nash equilibrium in games with incomplete information in 1967. Bayesian Nash equilibrium is the cornerstone of many game theoretic analyses. Aumann (1974) proposed the concept of a correlated equilibrium and Myerson (1994) has developed this equilibrium concept. Kreps and Wilson (1982) extend the idea of a subgame perfect equilibrium to subgames in the extensive form that begin as information sets with imperfect information. They call this the extended idea of equilibrium sequential. Rubinstein (1982) considered a non-cooperative approach to bargaining in his paper “Perfect Equilibrium in a Bargaining Model”. Harsanyi and Selten (1988) produced the first general theory of selecting between equilibria. They provide criteria for selecting one particular equilibrium point for any non-cooperative or cooperative game.

If there is no element of a time in game, it is called a “static game”. On the contrary, if time is analyzed in game, the game is a “dynamic game” (Fudenberg and Tirole, 1996). Games may be played “one-shot (once off)” or they can be “repeated”. Sorin (p.72, 1992) explains differences between a “repeated game” and a “one-shot game”; “a repeated game is concerned with analysis of behavior in long-term interactions as opposed to one-shot situations. A repeated game results when a given game is played a large number of times and when deciding what to do at each stage, a player may take into account what happened at all previous stages”. Additionally, decision making under certainty, risk or uncertainty is significant for analysis. Furthermore, players’ information about the rules of a game determines the solution of a game. All of the concepts have been discussed and developed by game theorists for the solution of games.

3.3 Basic Concepts and Elements of Game Theory

Games have main basic elements such as players and strategies. Rasmusen (1994) has determined the essential elements as the players, actions, information, strategies, payoffs, outcomes and equilibria, and adds that a game’s description must include players, strategies and payoffs. On the other hand, Ritzberger (2002) determined three main ingredients; players, rules and outcomes.

Decision making with "complete information" or "incomplete information" determines game forms. On the other hand, games are divided into two parts; zero-sum and non-zero sum games. Solution of the game depends on determination of the rules.

3.3.1 Non-Cooperative and Cooperative Games

Non-cooperative games and cooperative games are two main branches of the game theory. Cooperative means a coalition of two or more individual players to act together with a common purpose (Myerson, 1991). In other words, coalition is emphasized and commitment is available in cooperative games. Players can negotiate before the game and players know what to do in the game if the game is cooperative (Binmore, 1996). The main discussion about a grand coalition in a cooperative solution is the kind of coalition among players and the sharing of the benefits by each player in a satisfactory way (Ray, 2000).

On the other hand, if the game is a non-cooperative game, commitments are not available, unless allowed for by the rules of the game. However, modern applications of game theory, in particular to social sciences, use mainly non-cooperative games, because non-cooperative games are better at defining real world situations. (Gardner, 1995; Ritzberger, 2002). Fudenberg and Tirole (p.xviii,1996) define "non-cooperative means that the players' choices are based only on their perceived self-interest, in contrast to the theory of cooperative games, which develops axioms meant in part to capture the idea of fairness". On the other side, they (1991) add that "non-cooperative does not mean that the players do not get along or that they always refuse to cooperate".

The situation of non-cooperative is different from decision making under uncertainty or risk. When a player makes decision under certainty, game can be a non-cooperative game (Luce and Raiffa, 1967). Harshanyi (p.671, 1992) defines decision making under certainty, risk, and uncertainty as "We speak of certainty when the decision maker can uniquely predict the outcomes of any action he may take. We speak of risk when he knows at least the objective probabilities associated with alternative possible outcomes. We speak of uncertainty when even some or all of these objective probabilities are unknown to him".

3.3.2 Games in Strategic (Normal) Form

Game theory is symbolized by extensive form and strategic form (also known as "normal form" or "matrix form") (Hart, 1992; Ritzberger, 2002). However, some authors specify a third form that is called characteristic function forms (Luce and Raiffa, 1967), coalitional forms (Vega-Redondo, 2003), or coalition function form (Gardner, 1995). Von Neumann and Morgenstern (1944) introduced the ideas of the extensive form and strategic form representations of a game. According to Ritzberger (2002), representation theory is based on game theory beside decision and utility theories.

The extensive form is a graphical representation of a sequential game. It provides information about the players, payoffs, strategies, and the order of moves. While extensive form could be called game tree, strategic form represents matrices. The game tree consists of nodes which are decision points. (www.gametheory.net, Vego-Redondo, 2003; Eichberger, 1993; Stanford Encyclopedia of Philosophy; Hart, 1992). According to Shubik (2002), in general, strategic form has been preferred in experimentation, because of its simple description.

All games have certain assumptions and game forms are determined according to these assumptions. For example, if a strategic form is used, players make a decision, simultaneously. If a player has one move, strategic form is more useful for abstraction, and players make decisions, simultaneously in strategic form. However, games can be played sequentially. In sequential games, players take turns. Game tree consists of nodes (choice) and branches (different options). For this reason, if a game consists of moves, it is represented with extensive form. In addition, players' moves are of two kinds; a personal move and a chance move. Strategic form game considers personal move because of the assumption of rationality (Von Neumann and Morgenstern, 1944; Luce and Raiffa, 1967).

Furthermore, if the set of players (n) and all the strategy set (S_i) are finite, the game is called a finite game. In general, a strategic form game is assumed to be finite (Ritzberger, 2002). A game in normal form has three elements (Luce and Raiffa, 1967; Fudenberg and Tirole, 1996; Dutta, 1999);

i) the finite set of n players,

ii) the pure strategy space S_i, for each player,

iii) linear payoff function $u_i(s)$ represents the expected utility payoff of player i

Strategic form game is symbolized with " Γ ". Although some authors (Selten, 1988; Vega-Redondo, 2003) denote strategic form game as "G", others (Hart, 1992; Ritzberger, 2002) use " Γ " symbol. Formally, a strategic form game (Von Neumann and Morgenstern, 1944; Ritzberger, 2002;) is any " Γ " of the form as given in Definition 3.1.

A strategic form game; $\Gamma = (n, (S_i)_{i \in n}, (u_i)_{i \in n})$ **(3.1)**

In general, rationality and common knowledge are basic assumptions in a normal form game (Luce and Raiffa, 1967; Rasmusen, 1994; Harshanyi, 1992);

- Rationality; each player is assumed to be "rational" in the sense that, given two alternatives, he will always choose the better strategy.
- Common knowledge; if every player knows the rules of the game, every player knows that every player knows it, and so on…ad infinitum that is called common knowledge.

Harshanyi (p. 671, 1992) discusses the concept of rational behaviour and he says "rational behavior is not a descriptive concept but rather a normative concept. It does not try to tell us what human behaviour is in fact like, but rather tells us what it would have to be like in order to satisfy the consistency and other regularity requirements of perfect rationality".

3.3.3 Rules of the Games and Information

Expectations or preferences are determined to be a players' decision. At the same time, players' information about the situation is another factor which affects players' choices. In other words, the information of players determines the rules of the game (Gardner, 1995). The players, actions, and outcomes are collectively referred to as the rules of the game, and the modeler's objective is to use the rules of the game to determine the equilibrium (Rasmusen, 1994). In addition, rules of the game which specify who can do what and when technically determine the "game form" (Ritzberger, 2002).

The behaviour of players depends on the opponent's action, and then the player needs to know what the opponent knows about the game and her behaviour. There are two main types of factors determining a player's decisions. One is her expectation or preferences; the other is her information about the situation. (von Neumann and Morgenstern, 1944; Luce and Raiffa, 1967). Therefore, the information of the players determines the rules of the game.

Games, in which each player knows exactly what has happened in previous moves, are called games with "perfect information". Mycielski (p.42, 1992) defines perfect information as "…at each time only one of the players moves, that the game depends only on their choices, they remember the past, and in principle they know all possible futures of the game." By contrast, games in which there is some uncertainty about previous moves are called games with "imperfect information"(Gardner, 1995). Examples of games of perfect information are chess, checkers, hex, nim, go, because each player can observe what happened in previous moves. In contrast, poker, bridge, kriegsspiel are games of imperfect information (Hart, 1992). Another description of perfect information, if player's information set has just one node (move), a player has perfect information, if there is more than one node, a player has imperfect information (Mycielski, 1992; Myerson, 1991; Vajda, 1966).

Table 3.1 Information Categories (Rasmusen, p.45, 1994)

Information categories	Meaning
Perfect	Each information set is a singleton
Certain	Nature does not move after any player moves
Symmetric	No player has information different from other players when he moves, or at the end nodes
Complete	Nature does not move first, or his initial move is observed by every player

Rasmusen (p.10, 1994) defines that "nature is a pseudo-player who takes random actions at specified points in the game with specified probabilities". For instance, in OPEC game, oil producers are players. Passive individuals like the consumers who react predictably to oil price changes without any thought of trying to change anyone's behaviour, are not players, but environmental parameters (Rasmusen, 1994).

Games can be complete information or incomplete information games. The term of the complete information is defined as "a game is one of complete information if all factors of the game are common knowledge. Specifically, each player is aware of all other players, the timing of the game, and the set of strategies and payoffs for each player"(www.gametheory.net). On the other hand, a game might be "complete information game" and "imperfect information game" at the same time. In addition, the main assumption of the non-cooperative game is that it studies games of complete information (Vego-Redondo, 2003; Fudenberg and Tirole, 1996). Fudenberg and Tirole (1996) examine games and its solution in their book as "static games of complete information", "dynamic games of complete information", "static games of incomplete information", and "dynamic games of incomplete information".

3.3.4 Players

Players are the participants in a game that includes one or more decision makers; a decision is made by an individual or a group. However, a group behaves like an individual, and each individual decision maker is referred to as a player (Luce and Raiffa, 1967). In other words, "players are the individuals who make decisions" and "each player's goal is to maximize her utility by choice of actions." (Rasmusen, p. 10, 1994). On the other hand, the number of players in a game is a basic question. Games are classified according to the number of participants. If a game has two players, it is called a "two-person game". If a game has "n" participants, game is called an "n-person game" (von Neumann and Morgenstern, 1944). In general, a player is denoted by i, number of players are denoted by "n", and set of players is symbolized by "n_i".

Two-person games play a central role in the whole theory of games. Generally, two-person games are formulated and they have become popular such as the Prisoners Dilemma, the Battle of the Sexes, the Stag Hunt, the Hawk-Dowe, the Matching Pennies, the Rock Paper Scissors etc. Ritzberger (2002) explains Stackelberg leader-follower game in an economic problem. This is a duopoly game between two firms; a leader firm and a follower firm. Moreover, the game may have more than two players. The first player is the leader firm and other "n" firms ($n > 2$) are follower firms. The leader chooses its output level first. Then followers hear about the leader's choice. Finally, all followers simultaneously choose their output levels and market forces determine the price.

On the other hand, n-person games and its solutions are a vast area in the theory (Nash, 1950a; Shapley, 1953; Rapoport, 1970). Von Neumann and Morgenstern (1944) indicate that “n-person game” is based on the principle of coalition. Nash (1950a) explores equilibrium points in n-person game, and Nash and Shapley (1950) study the solution of a three-person game. They formulated the three-person poker game and analyzed players’ behaviors.

3.3.5 Strategies and Payoffs

Strategy may be defined as a “comprehensive plan of action” (www.gametheory.net). Commonly, strategies have two characters; pure strategy and mixed strategy. Nevertheless, Selten (1988) defines four strategies; local strategy, behavior strategy, pure strategy and mixed strategy. He (1988) defines that “a pure strategy is a special behaviour strategy”. In other words, a pure strategy defines “a specific move or action that a player will follow in every possible attainable situation in a game” (www.gametheory.net). On the other hand, there are many situations in which a player’s best behaviour is to randomize when making his/her choice as in the case of mixed strategy such as the Matching Pennies Game (Hart, 1992). Selten (p.4, 1988) defines a mixed strategy as “a probability distribution over a set of pure strategies”. In other words, moves are chosen randomly from the set of pure strategies.

Pure strategy is denoted π_i and the set of all pure strategies of player i is denoted $\prod_i$ by Selten (1988). On the other hand, some writers (Rasmusen, 1994; Ritzberger, 2002) symbolized the pure strategy by s_i and the set of the pure strategies by S_i.

- Player i’s strategy set or strategy space $S_i = \{ s_i \}$
- S_i is the set of pure strategies available to player i, $s_i \in S_i$ of all players $i=1,....,n$, and the set of all pure strategies of player i is denoted by n_i (Ritzberger, 2002; Selten, 1988; Rasmusen, 1994).

Goals and preferences of players are described as a utility function and every player wants to maximize his/her utility (Dutta, 1991). Rasmusen (1994) indicates that the term of payoff is used for both the actual payoff and the expected payoff in literature, and he (p. 13, 1994) defines it a “the expected utility player i receives as a function of the strategies chosen by himself and the other players”.

- $u=(u_1,....u_n) : S \rightarrow R^n$ is the (expected) payoff function. **(3.2)**

There is an outcome in the game and this outcome depends on the strategies chosen by each of the players, a phenomenon that is called strategic interdependence. Even a bad strategy can win if the opponent chooses a worse one (Gardner, 1995).

A two-person game in a strategic form of the m x n matrix may symbolically be represented as in Table 3.2. For games with only two players, the normal form can be represented by two matrices. Player 1’s pure strategies are identified with the rows of the matrices and player 2’s pure strategies are identified with the columns of the matrices. This is often called a bimatrix game. Additionally, player 1 controls the rows and player 2 controls the columns. Matrices simply show the outcomes, represented in terms of the players' utility functions, for every possible combination of strategies that the players might use (Vego-Redondo, 2003; Eichberger, 1993; Stanford Encyclopedia of Philosophy**,** 2004).

A matrix game is a two player game such that (Aliprantis and Chakrabarti, p. 44, 2000):

- Player 1 has a finite strategy set S_1 with m elements,
- Player 2 has a finite strategy set S_2 with n elements, and
- The payoffs of the players are functions $u_1 (s_1, s_2)$ and $u_2 (s_1, s_2)$ of the outcomes $(s_1, s_2) \in S_1 \times S_2$

The matrix game is played as follows: at a certain time player 1 chooses a strategy $s_1 \in S_1$ and simultaneously player 2 chooses a strategy $s_2 \in S_2$, and once this is done each player i receives the payoff $u_i (s_1, s_2)$.

Table 3.2 Two-Person Game in a Strategic Form

		Player 2					
		S_{21}	S_{22}	...	S_{2j}	...	S_{2n}
	S_{11}	ϕ_{11}	ϕ_{12}	...	ϕ_{1j}	...	ϕ_{1n}
	S_{12}	ϕ_{21}	ϕ_{22}	...	ϕ_{2j}	...	ϕ_{2n}
	.	.	.				.
Player 1	.	.	.				.
	.	.	.				.
	S_{1i}	ϕ_{i1}	ϕ_{i2}	...	ϕ_{ij}	...	ϕ_{in}
	.	.	.				.
	.	.	.				.
	.	.	.				.
	S_{1m}	ϕ_{m1}	ϕ_{m2}	...	ϕ_{mj}	...	ϕ_{mn}

The outcome is associated with $(S_{1i,} S_{2j})$ by ϕ_{ij} that results from these choices. The outcome $(S_{1i,} S_{2j})$ of a game is the set of interesting elements that the modeler picks from the values of actions, payoffs, and other variables after the game is played out (Rasmusen, 1994).

3.3.6 Equilibrium

The solution of a game requires discussing the concept of equilibrium. Equilibrium is a set of the best strategies. In other words, in equilibrium, each player is playing the strategy that is a "best response" to the strategies of the other players. No one has an incentive to change his strategy given the strategy choices of the others (www.gametheory.net). Gardner (p.55, 1995) defines equilibrium as " the strategy that is a best response to the strategies of the other players".

Formally, player i's best response or best reply to the strategies S_{-i} chosen by other player is the strategy S^*i that yields her the greatest payoff. The best response is strongly best if no other strategies are equally good and weakly best otherwise. In addition, "an equilibrium $S^* = (S^*_1,\ldots\ldots, S^*_n)$ is a strategy profile consisting of a best strategy for each of the n players in the game" (Rasmusen, p.15, 1994).

Rasmusen (1994) emphasizes the differences in the concept of equilibrium in game theory and in other areas of economics. He (p.15, 1994) indicates "in a general equilibrium model, for example, an equilibrium is a set of prices resulting from optimal behaviour by the individuals in the economy. In game theory, that set of prices would be the equilibrium outcome, but the equilibrium itself would be the strategy profile –the individuals' rules for buying and selling- that generated the outcome"

The concept of equilibrium has been discussed and developed by game theorists. Nash (1950a and 1951) proved "every finite n-person game has an equilibrium point (in mixed strategies)". After that Khun demonstrated that "every finite n-person game of perfect information has an equilibrium point in pure strategies" in 1953 (Hart, 1992; Selten, 1988). Gardner (1995) defines pure and mixed strategy equilibrium as "an equilibrium in which every player plays a pure strategy. It is called a pure strategy equilibrium whereas an equilibrium in which at least one player plays a mixed strategy is called a mixed strategy equilibrium".

Several refinements of Nash equilibrium (perfect equilibria, proper equilibria for strategic form, and subgame perfect equilibria, sequential equilibria, for extensive form) have been developed and discussed to analyze models (Selten, 1965; Harsanyi, 1990; Harsanyi and Selten, 1988).

3.3.7 Solutions of Two-Person Games

3.3.7.1 Zero Sum Games

In a two-player zero sum game; what one player wins is what the other loses. The term "zero-sum" is used because it is possible to choose the zeros and units of the two utility functions so that they always sum to zero (Luce and Raiffa, 1967). Therefore this game is also called strictly competitive game (Ritzberger, 2002) or a constant sum game (Gardner, 1995). Formalization is given in Definition 3.3 (Ritzberger, 2002).

A (finite or infinite) game is strictly competitive if it is a two-player game; $\Gamma = (S_1 \times S_2, u_1 \times u_2)$ satisfying

$$u_1(s) \leq u_2(s') \text{ if and if only } u_2(s) \geq u_2(s') \text{ for all } s, s' \in S \qquad \textbf{(3.3)}$$

In other words, if the payoffs of two players sum to the same constant for all strategy combinations, a strictly competitive game occurs. By the expected utility hypothesis the constant is arbitrary, so it can be normalized to zero.

$$u_1(s) + u_2(s) = 0 \text{ for all } s \in S \qquad \textbf{(3.4)}$$

Von Neumann and Morgenstern (1944) analyzed the solution of two-person, zero-sum games in non-cooperative game theory. They proposed “minimax theorem” for solution of two-person, zero-sum games in non-cooperative game theory. The first proof of the minimax theorem was given by von Neumann in 1928. Minimax theorem says that “a player should choose probabilities in order to guarantee that her expected payoff in the game can never be less than her security level whatever the opponent may do” (Binmore, 1996). In other words, the strategies selected by the theory must have the property that the resulting utility is the maximum entry in its column and the minimum entry in its row (Von Neumann and Morgenstern,1944).

In general, linear programming approach is used in two-person, zero-sum games (Vajda, 1966; Luce and Raiffa, 1967). The concept of transitivity is used in the problem of decision under uncertainty in two-person, zero-sum games (Ritzberger, 2002). For instance, if A is preferred in the paired comparison (A,B) and B is preferred to the paired in the paired comparison (B,C), then A is preferred in paired comparison (A,C), and this holds for all possible triples of alternatives A, B and C. Luce and Raiffa (1967) emphasize the importance of the concept of transitivity which is used to solve a two-person game.

Zero sum games always have a solution. On the other hand, equilibrium concept is used to solve the non-zero sum games (Buck, 2004). In general, zero sum games can not represent real life situations, because one player wins and other player loses. However, both of the players may win or lose, at the same time. Therefore, most games of interest in the social sciences are non-zero sum games.

3.3.7.2 Non-Zero Sum Games

In a two-player, zero sum game; one player wins whereas the other loses. On the other hand, non-zero sum games provide opportunities in which both of the players may win and lose, at the same time. Therefore, non-zero sum games are a suitable real world situation as a model. For that reason, most games of interest in the social sciences are non-zero sum games. The analysis of non-zero sum games (non-strictly competitive) is inherently different from that of zero sum games. Players cannot achieve mutual benefit by cooperation in strictly competitive games whereas such mutual gain is always a possibility in non-strictly competitive (non-zero sum) games (Luce and Raiffa, 1967).

The special game is known as the Prisoner's Dilemma which is a two-person and non-zero sum game. The popular game is also a non-cooperative game (Luce and Raiffa, 1967; Vego-Redondo, 2003) and its scenario goes as follows; two suspects are arrested and they are being held in separate cells in jail with no way to communicate with one another. Therefore, they cannot communicate and come to an agreement. Each of the suspects is confronted with two choices; either to confess to the crime or not. If they both confess to the crime then they will both go to jail for 3 years. If they both do not confess then they will both go to jail 1 year. If one confesses and the other does not, then the confessor will receive maximum punishment (10 years) and the other player will be free (0). Prisoner's Dilemma payoffs are seen below (Table 3.3) in strategic form. Payoffs are identified with the negative of prison years.

Table 3.3 Prisoner's Dilemma

		Player (prisoner) 2	
		Confess	Not Confess
Player (prisoner) 1	Confess	**-3**, **-3**	**0**, -10
	Not Confess	-10, **0**	-1, -1

In the Prisoner's Dilemma, we know that confess is a dominant strategy. Namely, "confess" is the best strategy for each player, independently of what her opponent does. Despite the fact that strategies of "not confess" are better "agreement" for both, rational players will always choose "confess". Thus, they will both end up with 3 years in prison instead of 1 year. Prisoner's Dilemma is a symmetric game and it has a dominant strategy equilibrium (confess, confess), and equilibrium payoffs are (-3, -3).

3.3.7.3 Dominance

Dominance approach is used to solve two-person games (von Neumann and Morgenstern, 1944; Vego-Redondo, 2003). The first important equilibrium concept is the dominant-strategy equilibrium. Rasmusen (p.16, 1994) implies that "the strategy S^*_i is a dominant strategy if it is a player's strictly best response to any strategy the other players might pick, in the sense that whatever strategy they pick, her/his payoff is highest with S^*_i" and he (p.17, 1994) adds that "a dominant strategy equilibrium is a strategy profile consisting of each player's dominant strategy".

Mathematically, a strategy s_i of player 1 in a matrix game is said to (Aliprantis and Chakrabarti, p.44, 2000);

- dominate another strategy s_j of player 1 if

$$u_1 (s_i, s) \geq u_1 (s_j, s) \qquad \textbf{(3.5)}$$

- strictly dominate another strategy s_j of player 1 if

$$u_1 (s_i, s) > u_1 (s_j, s) \qquad \textbf{(3.6)}$$

for each strategy s of player 2.

Indeed, a dominant strategy solution exists when every player has a dominant strategy. However, some games have no dominant (i.e., uniformly best) strategy. For this reason, dominant strategy equilibrium approach cannot be used for solving these games. Thus, the process of elimination is used to solve these kinds of games. In other words, player's inferior strategies are dominated strategies. For instance, solution of the two-player game with dominance approach is seen in the below matrix (Table 3.4).

Table 3.4 A Strategic Form Game with no Dominant Strategy

		Player II		
		A	B	C
Player I	X	2, 7	2, 0	2, 2
	Y	7, 0	1, 1	**3, 2**
	Z	4, 1	0, 4	1, 3

In this matrix, player I and II have three pure strategies: X, Y, Z and A, B, C, respectively. Strategy Y gives Player I a strictly higher payoff than Z does. That means, strategy Z is strictly dominated. Thus, a "rational" player I should not play Z. Furthermore, if player II knows that player I will not play Z, then C is a better choice than B. Finally, if player I knows that player II knows that player I will not play Z, then player I knows that player II will play C or A, and so player I should play Y. In conclusion, we reach the result that only the profile (Y, C) may (or should) be played, because it is the unique outcome.

This process of elimination is called iterated dominance or iterated strict dominance (Fudenberg and Tirole, 1996; Ritzberger, 2002). Some authors use the term "strong" instead of "strict" such as strong equilibrium or strongly dominant.

In a normal form game $\Gamma = (S, u)$ a pure strategy $s_i \in S_i$ of player i $(=1,\ldots,n)$ is strictly dominated if there is another strategy $s'_i \in S_i$ such that

$$u_i(s_{-i}, s'_i) > u_i(s_{-i}, s_i), \text{ for all } s_{-i} \in S_{-i} \tag{3.7}$$

A strategy $s_i \in S_i$ is undominated if it is not strictly dominated, and it is admissible if it is not weakly dominated (Rasmusen, 1994).

The dominant strategy solution and iterative elimination of dominated strategy solution concepts are used to solve strategic form games. When strategies are undominated in a game, it could be solved by the Nash equilibrium approach.

3.3.7.4 Nash Equilibrium

The central concept of non-cooperative game theory is that of the strategic equilibrium (also known as Nash equilibrium or non-cooperative equilibrium) (Binmore, 1996; Hilas and Kohlberg, 2002). The concept of strategic equilibrium was suggested by von Neumann and Morgenstern (1944), but it was first defined by Nash. Von Neumann and Morgenstern (1944)'s book contains a theory of n-person games which is called cooperative, and the theory is based on an analysis of the interrelationships of the various coalitions. However, Nash (p.286,1951) asserts that "our theory, in contradistinction, is based on the absence of coalitions in that it is assumed that each participant acts independently, without collaboration or communication with any of the others" and he (p.288, 1951) defines equilibrium points and proves "a finite non-cooperative game always has at least one equilibrium point".

In other words, in a Nash equilibrium each agent plays the best response to the equilibrium strategies of the other agents (Eichberger, 1992). Vego-Redondo (p.44, 2003) defines a more detailed the theorem; "in every game where there is any finite number of players and these players have only a finite number of pure strategies available, some Nash equilibrium (possibly in mixed strategies) always exists".

If a game has a dominant strategy, it has also Nash Equilibrium. In other words "every dominant strategy equilibrium is a Nash equilibrium, but not every Nash equilibrium is a dominant-strategy equilibrium" (Rasmusen, p.24, 1994). Hence, it is obvious that the equilibrium of a dominated strategy solution is stronger than Nash equilibrium. Buck (2004) illustrates this situation below. According to Figure 3.1, if a game consists of a dominant strategy, a game can be solved by dominance (Iterated Elimination of Dominated Strategies-IEDS) and Nash equilibrium approaches.

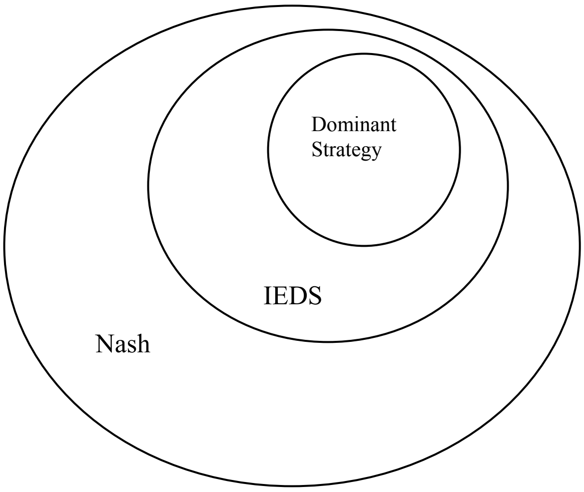

Figure 3.1 Dominant Strategy Equilibrium and Nash equilibrium (Buck, 2004).

A strategy profile s^* is a pure strategy Nash equilibrium of game if and only if (Möbius, 2004),

- $u_i(s_i^* , s^*_{-i}) \geq u_i(s_i , s_{-i}^*)$, for all players i and all $s_i \in S_i$ **(3.8)**

A pure strategy Nash equilibrium is strict if (Möbius, 2004),

- $u_i(s_i^* , s^*_{-i}) > u_i(s_i , s_{-i}^*)$, **(3.9)**

The Battle of the Sexes and the Matching Pennies are famous two-person games which cannot be solved by a dominance approach. The Battle of the Sexes, which is given in the matrix below (Table 3.5), has two pure strategy equilibria. A husband and wife have agreed to attend a rare entertainment event in the evening. Unfortunately, the husband prefers the boxing match while the wife prefers the opera. They must decide simultaneously and without communication which event to attend. A different pure strategy equilibrium is preferred by each player. Thus, this game cannot be solved by a dominance approach. On the other hand, a mixed strategy equilibrium also exists. Vego-Renondo (2003) shows a third mixed-strategy Nash Equilibrium in the Battle of the Sexes game.

Table 3.5 Battle of the Sexes Game

		Wife	
		Boxing	Opera
Husband	Boxing	**3, 1**	0, 0
	Opera	0, 0	**1, 3**

Although, The Battle of the Sexes has two pure strategy equilibria, the Matching Pennies has no pure strategy equilibrium. The story of the Matching Pennies is as follows; players 1 and 2 simultaneously announce heads or tails. If the announcements match (heads-heads or tails-tails), then player 1 gains a util and player 2 loses a util. If the announcements differ, it is player 2 who wins the util and player 1 who loses. Namely, matching pennies game is strictly competitive.

Table 3.6 Matching Pennies Game

		Player 2	
		Heads	Tails
	Heads	1, -1	-1, 1
Player 1	Tails	-1, 1	1, -1

A pure strategy that is undominated by other pure strategies may be dominated by a mixed strategy. In addition, in a game without a pure strategy Nash equilibrium, a mixed strategy may result in a Nash equilibrium. Therefore, a mixed strategy provides a useful approach for the Matching Pennies (Fudenberg and Tirole, 1996). In other words, every simultaneous move game has a Nash equilibrium in mixed strategies. The concept of Nash equilibrium has been developed by game theorists. Selten (1965) introduced the idea of refinements of the Nash equilibrium with the concept of (subgame) perfect equilibria. Harsanyi (1990) developed the Bayesian

Nash equilibrium in games with incomplete information in 1967. R. J. Aumann proposed the concept of a correlated equilibrium in 1974.

3.4 Applications of Game Theory to Social Sciences

Game theory has been applied in many social science fields as a mathematical method such as economy, political science (on both the national and the international level), international relationship, law, military, sociology, psychology, evolutionary biology, computer science and management sciences. After the publication of von Neumann and Morgenstern's (1944) book, game theory has become an increasingly important approach for theoretical analysis in the social sciences. Luce and Raiffa (1967) indicate that "game theory is one of the first examples of an elaborate mathematical development centered solely in the social sciences" and they suggested that the theory needed attention from social scientists.

Game theoretic concepts have been widely used in economy. The other application area is military. Game theory is analyzed in decision making under uncertainty, or a non-cooperative situation. Therefore, the theory has been used in war scenarios, war tactics, attack and defense etc. (Thomas, 1966; Fain and Philips, 1966). O'neill (1994) indicates international relations theorists have often used 2 x 2 matrices in war scenarios. Furthermore, political choice problem; voting is studied in political science (Banks, 2002). Walker (1995) referred to the researches of Shapley and Shubik as the earliest applications of game theory to political science. For instance, the method of "Shapley Value" was used to determine the power of the members of the UN Security Council.

Game theoretic approach has also been used in biology. Evolutionary game models are also commonly utilized within the learning literature. Some advanced contributions were publicated in 1950s. Originally game theory was developed as a theory of human strategic behaviour based on an idealized picture of rational decision making. However, evolutionary game theory does not rely on rationality assumptions but on the idea that the Darwinian process of natural selection drives organisms towards the optimization of reproductive success (Hammerstein and Selten, 1994).

3.4.1 Game Theory and Planning

Although game theory applications in planning are limited in number, they are very important studies on location problem in spatial planning (Stevens, 1961; Isard and Reiner, 1962; Isard, 1967; Isard and Smith, 1967). Stevens (1961) explored the possibility of location strategy in game theory. His paper entitled "An Application of Game Theory to a Problem in Location Strategy", deals with the strategic problem of two competitive sellers' location along a line. Hotelling formulation was used to solve this problem as a simple two-person, zero-sum game. Indeed, space and location problems are topics in economy. Space is a source of market power. For this reason, economy interested in spatial problem such as transportation costs, location of consumer, neighbour companies. These studies are often called "location models", which originated in the work of Hotelling in 1929 (Vega-Redondo, 2003).

Another research that was based on decision theory and location problem was published by Isard and Reiner (1962). The objective of this paper (p.25, 1962) was "to present a concrete illustration of how these new ideas and approaches in decision making can be used for the projection of behavior". They explore behaviours of industrialists who choose location for investment. Location alternatives are defined such as underdeveloped region, outside the country and in the capital city.

Walter Isard (1967) studied game theoretic approaches in industrial agglomeration. His paper "Game Theory, Location Theory and Industrial Agglomeration" considered transportation costs such as Webarian location problem. Isard explores the location of a large-scale steel plant in alternatives of three regions which desire to promote an industrial agglomeration. The selection procedure is an alternating leader-follower procedure. Industrial agglomeration is a classical problem in location theory and regional science. However, Isard (1967) emphasized the game element must also be a basic component of modern-day agglomeration theory and he (p. 10, 1967) says "it is essential that we understand fully both the conflict and cooperative elements present in the interdependent decision situation associated with any given agglomeration problem".

Location models have been developed by economists, regional scientist and game theorists. Gabszewich and Thisse (1992) designed the model to describe spatial competition among firms. In this model, a population of consumers is spread out over a geographical area, while firms selling a homogeneous product are located in the same space. Firms defined as players, and prices and/or location determined strategies in this model. Bagwell and Wolinski (2002) studied industrial organization and game theory.

Game theory, which explains the uncertain situation that many decision makers are in, will affect planning discipline in a positive way. Nijkamp (1980) proposed negotiations between agents for solving externalities in environmental problems and he added that game-theoretic strategies could be used for negotiations. He indicates min-max models that the compromise solution for conflicting objectives is based on conflicting strategies from game theory. Nijkamp (1980) adds "especially in an interactive framework the min-max approach is very appropriate for environmental decision models". He applied the model as a multidimensional approach to environmental planning.

3.4.2 Game Theory and Environmental Problems

Game theoretic approaches have been used in environmental economics since the 1960s. Hardin (2000) published a paper called "the Tragedy of the Commons" in 1968. This famous paper deals with "freedom in a commons brings ruin to all", and he applied the Prisoners' Dilemma to the problem of population growth and natural resources. After that, the model of the tragedy of the commons is referred to for explanation in many environmental goods problems, and the concepts of the game theory are used in environmental economy such as cooperation, rationality, choice problem, and utilities (Connelly and Smith, 1999; Benson, 2000). On the other hand, game theory applications to environmental problems such as the reduction of emissions, water-sharing problems and sustainable development have vastly spread since the 1990s. Not only environmental scientists but also regional scientists and politicians have become interested in these environmental problems. Ray (2000) points out that environmental problem such as the transfrontier pollution are often multilateral, and pollution affects all the agents. It is a classical environmental problem in economy. The abundance of the agents in environmental problems requires interactive decision making, so the game theory is used for the solution of such multilateral problems.

Maler and Zeeuw (1998) examined the costs of emission reductions and the damage to the soil due to the depletion of the acid buffers. Co-operation between countries is important because of transboundary externalities, and the outcomes will depend on cooperation. The acid rain differential game is formulated and Markov-perfect Nash equilibria solution concepts are derived. The theory is used to analyze the acid rain differential game for sulphur between Great Britain and Ireland.

The purpose of Ray's (2000) paper also relates to emission reduction problems. A simple environmental game between two neighbouring countries which are emitting a pollutant is formulated; and the correlated equilibrium for emission levels explores. Ray (p.5, 2000) indicates "reducing emission reduces the environmental damage cost, but increases the abatement cost. So the countries have to consider the total cost of emission". Ray (2000) discusses the correlation in a non-cooperative situation and proposes coalition-proof correlated equilibrium for environmental games.

Verhoef and Nijkamp (2000) have studied the spatial dimensions of environmental policies for transboundary externalities. The performance of taxes both with and without optimal policy coordination is considered, and a spatial price equilibrium approach is used in the study. Carraro and Topa (1995) also have analyzed taxation, industrial organization and environmental innovation by game theoretic approach. The paper shows that firms' innovation decisions are not simultaneous because of new technology costs, and there exists socially optimal timing of innovation. These incentives have to account for the presence of asymmetric information.

Krawczyk (1995) has analyzed the dynamic game between the management of effluents (Regional Council) and some polluting firms. In the game, polluters are the "followers", whereas the Council is the "leader". The polluters are supposed to be myopic and small; the Regional Council is interested in promoting production, collecting taxes, and in a clean environment. Yeung's (1995) paper also deals with pollution management in the industrial sector. In his paper, the industrial sector chooses the level of investment to maximize net income and the government imposes a tax and uses the tax proceeds for pollution abatement operations. The (subgame perfect) feedback Nash equilibrium is used for a solution in the differential game.

Barret (1998) discusses international environmental agreements by game theoretic approach. In the study, international agreements are described as a process (pre-negotiation, negotiation, ratification, implementation and renegotiation) and the process has an outcome. Some important conventions on climate change such as the Kyoto Protocol, and the Montreal Protocol are observed for analyzing behaviours of signatories. Barret (1998) argues that the minimum participation level on treaty for equilibrium, and emphasizes the importance of negotiation which can build an optimum strategy for climate change problem among polluter countries.

Sharing problem of a river as a natural resource is the main study area in environmental planning and regional science (Dinar and Wolf, 1994; Kucukmehmetoglu and Guldman, 2002; Rogers, 1993; Rogers, 1969). Harshadeep (1995) applied cooperative game theory to the water resources problem in Subernarekha River Basin, India. The increasing demands of agricultural, industrial, domestic water and a shortage of water resources are the main problems in the Subernarekha River Basin. The model determines the recommended sizes of the dams and canals, optimal cropping patterns, and a level of conservation. Freeman (2000) used the game theoretic approach, also for a water-sharing problem according to international law in Tigris-Euphrates Basin. Game theory and expected utility theory are used to solve the water-sharing conflict among Turkey, Syria and Iraq. Other research is about the Tigris-Euphrates River using game theory by Kucukmehmetoglu (2004). In the paper, coalition among agents is discussed and satisfying the level of each country is demonstrated by using Shapley Value.

3.5 Conclusion

In this chapter, game theory is examined, and applications of game theory in planning and environmental problems are analyzed. In general, game theory is analyzed in "interactive decision making process" with more than one decision maker. That is to say, decision makers act in an environment where other players' decisions influence their payoffs and every action has a reaction. Moreover, game theory analyzes conflicts and cooperation among agents.

The cooperation of agents to maximize their benefits is a subject examined by the game theory. It can be criticized in game theory for the agents to cooperate in order to achieve maximum payoff, so in planning this cooperation would end positively for public interest. In recent years, the use of game theory for sharing natural resources

and diminishing pollution is useful for achieving optimum balance for players' benefits; this way the environment would also benefit.

Problems that are subjects in the game theory and the concepts such as player, strategy, conflict, utility, and cooperation are similar to those of planning. Therefore, game theoretic approach will make it easier for the agents to cooperate if the conflicts in the planned area are clearly defined. It is possible to achieve cooperative bargaining solutions where all agents are winners. Furthermore, decision making under uncertainty or decision making in non-cooperative situation is a useful approach to planning problems. Actually, the best response for all players is also the target of planning. In other words, sustainable development of a river basin depends on bargaining where all agents are winners.

In general, two-person or three-person games are used in problems of planning and environment. Additionally, non-zero sum games are more suitable for planning and environmental analysis, because one player win does not require that others lose. Furthermore, payoffs of both the winner and loser cannot be equal. Therefore, non-zero sum game is more appropriate for the planning decision making process.

Basic elements should be determined in a game such as player, information, strategies, payoffs, outcomes and equilibrium. The determination of game elements will require another analysis, because we do not know which players make which decisions and how they affect each others' strategies. Decision making processes determine the form of the games and it helps to understand individual behaviour. Thus, we can interpret a player's move as cooperative or non-cooperative. Public institutions are also making decisions about environment and planning, so we have to discuses the concept of "expected utility" and "best response", because each decision maker wants to maximize his/her payoffs. In conclusion, the game theory can be used by regional scientists and urban planners as an effective approach in decision making problem solving. Terms and approaches used in the game theory make it easier to analyze the problems in planning and increases analytical skill.

4. CASE STUDY: DETERMINATION OF DECISION MAKING PROCESS IN THE NILUFER WATERSHED

Environmental policies have been developed as a result of increasing environmental problems; new environmental policies affect planning disciplines. Urbanization and industrialization create an increasing demand for fresh water. Therefore, water-sharing problems cause conflicts among sectors or countries. The water-sharing problem and carrying-capacity of water basins have been discussed by planners and environmental engineers. Over use of water and pollution are vital problems in a drainage basin for sustainability. Therefore, sustainability of a drainage basin requires drainage basin planning and management. Hence, a watershed is chosen as a case study area. This watershed is the most polluted part of the river.

In this chapter, the first and second hypotheses of this thesis are explored. The first hypothesis is defined in the first chapter as “the abundance of decision makers, who decide on environment and planning and who have no cooperation and coordination among them cause surface water pollution to increase”. Therefore, first of all, decision makers who make decisions about the environment and planning are determined. The relationships of the central government and local authorities are examined, hierarchically. After that the strategies of decision makers are defined and how one strategy affects other strategies is explored. The behaviour of decision makers and the decision making process are examined. Players’ preferences and priorities are explored, and their effects on water pollution are discussed.

The second hypothesis is defined as “decision makers have not been abiding by the present regulation of discharge, and the present sharing and usage of water as a natural resource is not sustainable”. The pollution of the Nilüfer Stream is examined, and existence of wastewater treatment plants (both industrial and domestic) in the Nilüfer Watershed is explored. Decision making process in planning and permitting process for industry are searched in this chapter.

The results of these surveys are used to develop a game theoretic model. Consequently, the concept of conflict, competition and cooperation among players are discussed according to the game theory.

4.1 Definition of the Susurluk River Basin

4.1.1 Natural and Administrative Borders

The Susurluk River Basin stretches over 22 399 km^2 (8648 mi^2) northwest of Anatolia. The Susurluk and other river basins of Turkey are shown in Figure 4.1. These borders of the river basins are determined by the General Directorate of State Hydraulic Works (DSI). However, some borders as defined by the DSİ are not always compatible to the existing hydrological borders. The Susurluk River Basin is surrounded by the Sakarya River Basin in the east, the Marmara Sea Basin in the north, the Aegean Sea Basin in the west and the Gediz River Basin in the south (Geographic Map of Turkey, 2004; DSI, 2000).

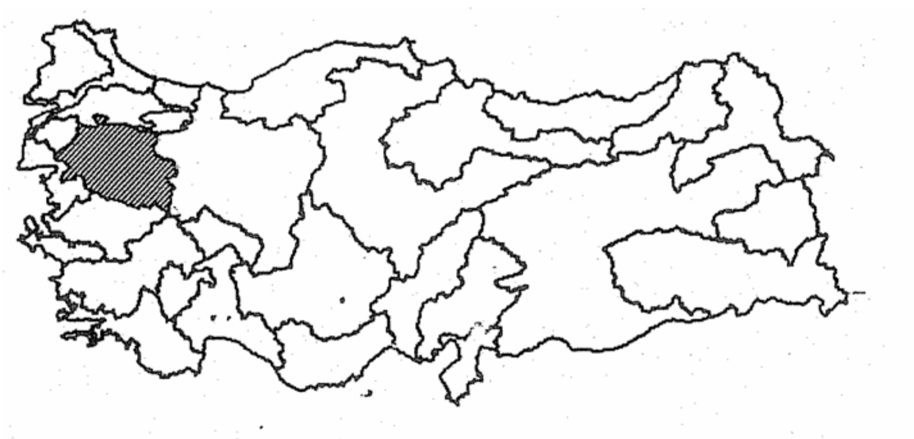

Figure 4.1. The Susurluk River Basin and the other River Basins in Turkey (DSI, p 2, 2000)

As the map of Figure 4.1 illustrates, the Susurluk River Basin is the one of the biggest river basins in Turkey. The Susurluk River Basin has 22 399 km^2 (8648 sq.mile) area. Reimold (1998) classifies watershed management units such as basin (1000-10 000 sq.mile), subbasin (100-1000 sq.mile), watershed (10-100 sq.mile), subwatershed (1-10 sq.mile) and catchment (0.05-0.50 sq.mile). According to the classification, the Susurluk River Basin is a “basin”, and Reimold (1998) suggests state, multi-state or federal planning authority for the management of this type basin. On the other hand, local government or multi-local government is suggested for a watershed and subwatershed scale.

The highest mountains are located in the east and the south of the Susurluk River Basin; Uludağ (Great Mountain) (2543 m), Tepedağı (2012 m), Eğrigöz Mountain (2081 m), Akdağ (2089), and Ulus Mountain (1773 m). There are few plains that are located in the north of the basin. The most significant surface waters are the Nilüfer Stream, the Orhaneli Stream, the Emet Stream, the Mustafa Kemal Paşa Stream, the Simav Stream, the Bombay Stream, the Kille Stream, the Atnos Stream, the Üzümcü Stream, the Koca Stream (DSI, 2000; Geographic Map of Turkey, 2004). Additionally, there are two wetlands (Manyas and Apolyont) in the basin; they are covered by Ramsar Convention (protected wetlands that are bird habitats). These wetlands are administrated by the Ministry of Environment and Forestry (Bursa Environmental Report, 2000).

Although usage of these streams is generally similar (such as domestic, industrial and agricultural usage), each stream has a different pollution level (Environmental Problems of Turkey, 1991; DSI, 2000). Moreover, the use of water supply coupled with poor planning decisions will cause different environmental problems on each stream. Therefore, restriction of a case study area is a necessity. In addition, if the Susurluk River Basin is analyzed as a whole system, the determination of a decision maker becomes difficult. Restriction of a case study area provides the practice for analysis of players, strategies and decision making processes.

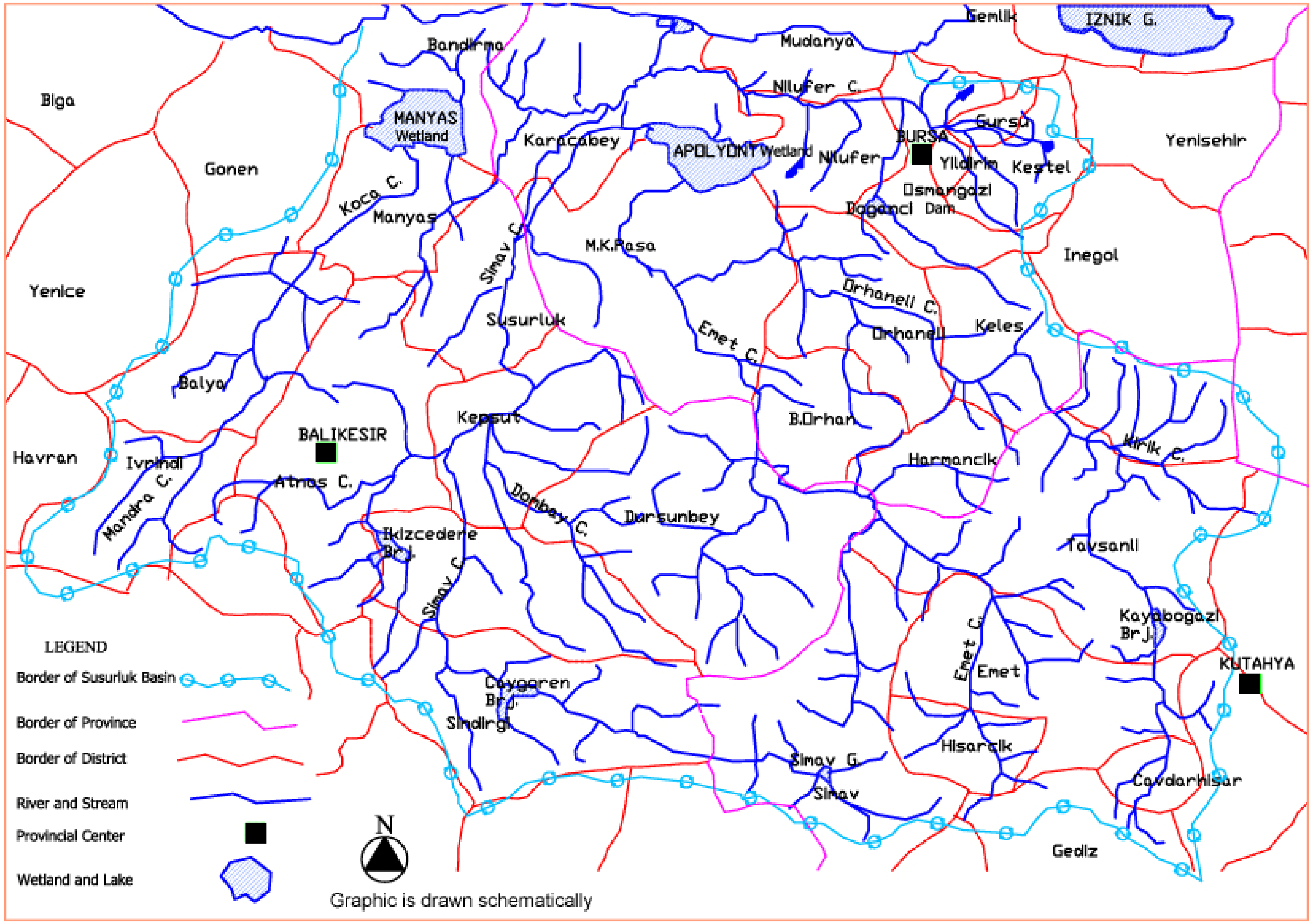

Figure 4.2 The Susurluk River Basin and Jurisdictional Boundaries (DSI, p.3, 2000)

Three provinces (Bursa, Balıkesir, Kütahya) are located in the Susurluk River Basin. However, the administrative borders of the provinces and the natural border of the river basin do not overlap. Hence, some of the districts and municipalities of the provinces are outside of the river basin. The Susurluk River System and jurisdictional boundaries are given in Figure 4.2.

28 district municipalities, 1 metropolitan municipality (Bursa), and 91 sub-districts municipalities (totally 120 municipalities) are located in the Susurluk River Basin (SIS, 2002a). The River Basin's natural borders are determined by the General Directorate of State Hydraulic Works, but the Regional Directorate of State Hydraulic Works' are not organized in accordance with the natural basin borders. The Susurluk River Basin lies under the administration of two different Regional Directorates of State Hydraulic Works which are; the 1st Regional Directorate (administration area within the borders of Bursa, Kocaeli and Yalova Provinces), and the 25th Regional Directorate (administration area within the borders of Balıkesir and Çanakkale Provinces) (DSI, 2000).

4.1.2 Socio-Economic Development

The Susurluk River Basin is in the south of the Marmara Region which is the most developed region in Turkey. Bursa is the biggest city which is located north of the river basin. Bursa has been known as an agricultural and commercial center since the Ottoman Empire, and industry has grown rapidly since the 1960s. According to the data of the State Institute of Statistics Prime Ministry Republic of Turkey's (SIS), Bursa is the third biggest industrial city according to the number of companies and workers in Turkey, and it is the fourth city that pays highest value-added tax (SIS, 1993; SIS, 2002a). The second most important city in the Susurluk River Basin is Balıkesir where in addition to agriculture, animal husbandry, and industry has developed in recent years. Forestry and mining have developed in Kütahya which is the mountainous area in the south of the basin.

The north of the basin comprises plains and flat places, and is close to the sea port. Consequently, agriculture, industrialization and urbanization have developed in the north. Forestry and mining have developed in the mountainous south. In conclusion, the north is more developed than the south. The Susurluk River Basin has been polluted as a consequence of industrial and mining activities, and urbanization. However, the north of the basin is more polluted than the south (Environmental Problems of Turkey, 1991; DSI, 2000).

4.2 Determination of the Nilüfer Watershed

The Nilüfer Stream Watershed is chosen as the case study area. Although a water basin should be taken as a whole to study, a river basin's single branch is taken as a case study area in order to simplity the analysis. The selected area for the case study has approximately 1000 sq.mile, so it can be defined as a subbasin. However, in this study, the term "watershed" is prefered. The concept of the watershed is defined as "the land area that dains into a stream; or, the elevated boundary line separating drainage basins" in the Glossary of Environmental Terms (Yıldırım and Berkmen, 1991).

The selected watershed contains most of the Susurluk River Basin's environmental problems. The Nilüfer Stream is more polluted than other streams, because of the big industrial city: Bursa (Environmental Problems of Turkey, 1991; Eroğlu, 2004). The length of the Nilüfer Stream is approximately 168 km and it is the branch of the Susurluk River that flows through the city of Bursa.

On the other hand, the Orhaneli Stream and the Emet Stream are polluted because of mining in Kütahya, the Mustafa Kemal Paşa Stream and the Simav Stream are polluted because of agricultural facilities, Manyas Wetland and Apolyont Wetland (covered by Ramsar Convention) have lost their biological diversity (DSI, 1984; DSI, 2000). These surface waters are left outside the study area, but the Nilüfer Stream has also the same environmental problems. Therefore, the case study area represents typical environmental problems of the Susurluk River Basin. The Nilüfer Watershed, an arm of the Susurluk River Basin is shown in Figure 4.3. As it is clearly seen the natural borders of the river basins do not correspond with administrative borders, namely the provincial borders or the district borders.

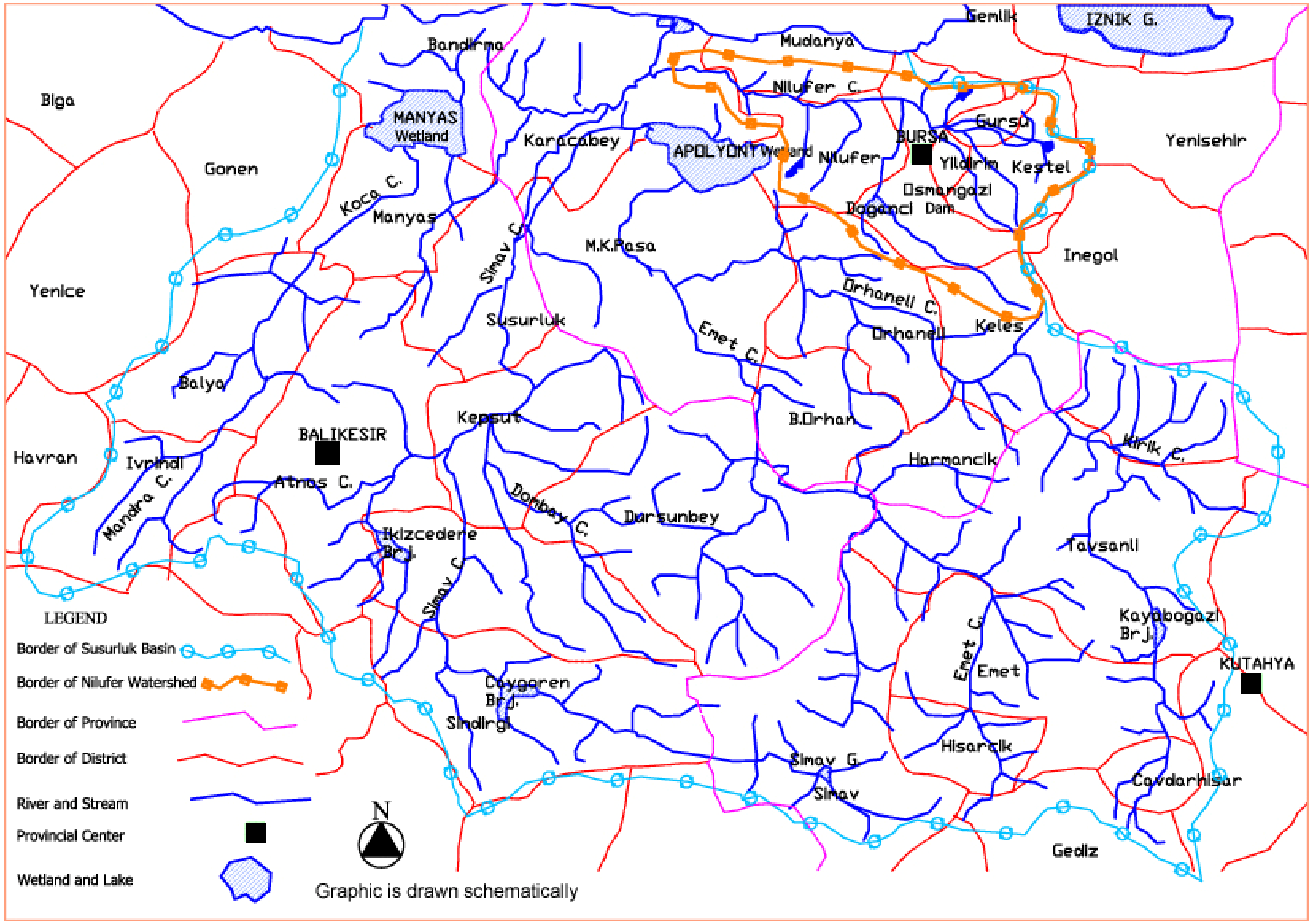

Figure 4.3 The Nilüfer Watershed in the Susurluk River Basin (adapted from DSI, 2000; Geographical Map of Turkey, p 20, 21, 40, 41, 2004; Başaran and Bölen, 2004)

The Nilüfer Stream is the most polluted water in the Susurluk River Basin. Thus, special plans and projects are developed to clean and protect it. Furthermore, there are several authorities who measure pollution periodically in the Nilüfer Stream (such as the Regional Directorate of DSI, Uludag University, and the Bursa Metropolitan Municipality). That is the biggest reason for choosing the Nilüfer Watershed. Lastly, a shortage of water and pollution cause an increase in conflicts and competition among decision makers in the watershed. These conflicts and competition provide a clear definition of the decision making process.

The borders of the Susurluk Basin are determined by the General Directorate of DSI. However, the Nilüfer Watershed does not have officially defined borders. Thus, the borders had to be determined with the help of topographic data. Although the river basin borders depend on climate, geology, topography, soils, flora and fauna, surface water and ground water (Teclaff, 1996, Oktay and others, 1997), in this study, only topography and surface water were taken into consideration. The geographical location of the Nilüfer Stream sub-basin is seen in Figure 4.5, and representation of the three dimensional topography in Figure 4.4.

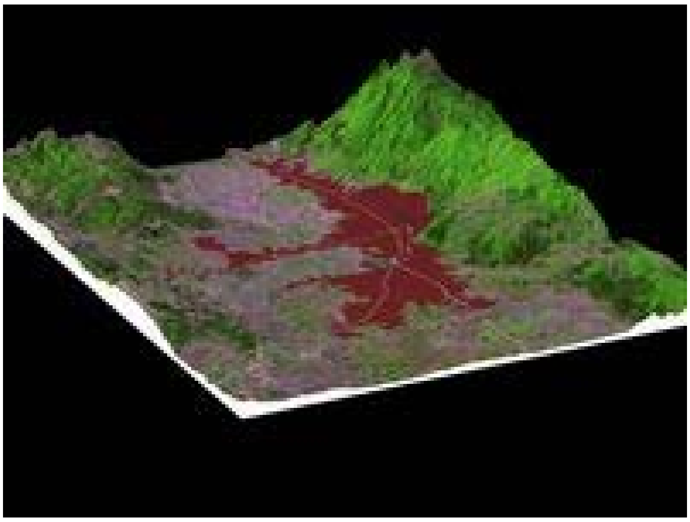

Figure 4.4. Representation of the Three Dimensional Topography of the Watershed (http://www.bursa-bld.gov.tr/index1.html)

A river's course is generally divided into three parts –the upper, middle, and lower courses, each of which have their own particular physical characteristic (Malkina-Pykh and Pykh, 2003). The Nilüfer Stream has also three parts; an up-stream part, a middle part and a down-stream part. The Nilüfer Stream springs from Mount Tepel in Kestel district and it flows in the direction of the north-west in a narrow valley (DSI, 1984; Geographical Map of Turkey, 2004). Many branches join from Mount Uludağ and the south-west side of the valley. This part is called the up-stream in this study. After that, the Nilüfer Stream flows through the narrow valley, and then directs to the west at the end of Bursa Plain and passes through the city of Bursa. This part is called the middle part. After Cakırkoy Plain, the stream flows within a wide valley and joins the Simav Stream which flows to the Marmara Sea. This part is the down-stream of the Nilüfer Stream.

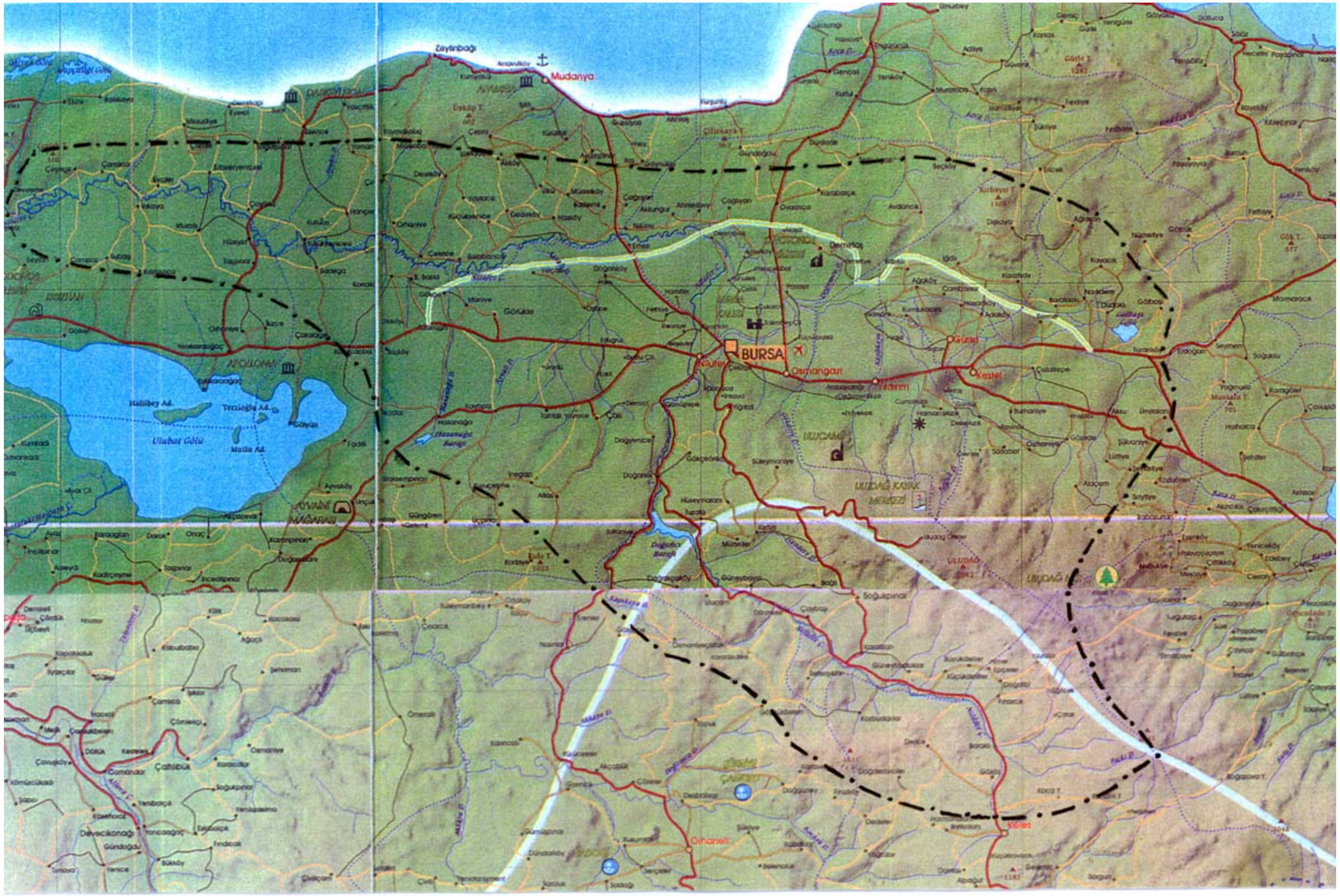

Figure 4.5. Geographical Map of the Nilüfer Watershed (adapted from Geographical Map of Turkey, p 20, 21, 40, 41, 2004)

4.3 Land Use and Environmental Infrastructure in the Watershed

4.3.1 Settlements

The Nilüfer Stream and Mount Uludag determine the macroform of Bursa city. Mount Uludag sharply borders the south of Bursa. Therefore, urban growth is in the north, the easth and the west. Settlements are located alongside the Nilüfer Stream. The boundaries of the Bursa Province do not correspond to the natural boundaries of the Nilüfer Watershed. However, the Bursa Province contains all of the Nilüfer Watershed. Some of the Bursa districts are outside the watershed. Although the Province of Bursa has 17 districts and 38 sub-districts, there are only 10 districts (3 of them metropolitan municipality) and 11 sub-districts in the watershed.

There has been an increase in the population growth rate within the area due to industrial development since 1960s. In 2000, population of the Bursa Province was over 2 million and the annual population growth rate was 2,86 % between 1990 and 2000 (Figure 4.6).

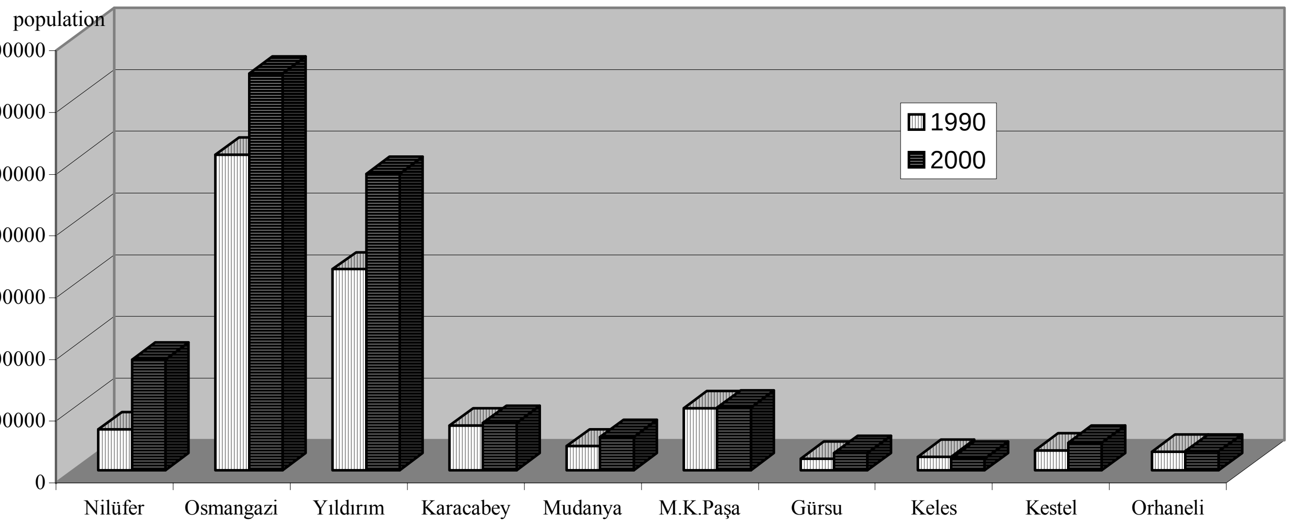

Figure 4.6 Population Growth in the Nilüfer Watershed's Districts (1990-2000), (adapted from SIS, 2002a)

The annual population growth rate of the metropolitan area, which contains 3 districts, is 3.59 %. The population density in the province is 204 persons per square km. While the population density in Nilüfer district, which is one of the three districts of Bursa Metropolitan Municipality, is 371 persons/sq.km, and 1085 persons/sq.km in Osmangazi district, it is 7504 persons in Yıldırım. 465 out of a total of 719 villages in the province have populations below 500, and it is observed that most of the villages have a low population (SIS, 2002a). These facts show that Bursa's center is under the pressure of urbanization.

According to the Bursa 2020 Strategic Plan (1998), population has increased in the east (Kestel and Gürsu) and the north (Demirtaş) of the Bursa city because of industrilazation. However, the Bursa 2020 Strategic Plan (1998) restricts the growth in the east and the north, because these areas have fertile agricultural land. Furthermore, water pollution caused in these areas is carried along to the city of Bursa by the Nilüfer Stream.

Migration is both from the rural area of Bursa and the rural areas of other regions because of industrialization. According to the Bursa Environmental Report (2000), 52262 persons (total population of 4%) moved to another place in Bursa between 1985 and 1990. That means migration from rural areas of Bursa to the inner city of Bursa. Migration have caused unplanned urbanization, unhealthy residential areas, and the destruction of green areas. Additionally, transportation is the main problem in Bursa city (Bursa, 2003).

The population growth projections show the number of people who are expected to live in the metropolitan area in 2020. Three population growth projections are made for Bursa metropolitan area by the Metropolitan Municipality. The first projection is made for environmental infrastructure and it shows that 2.26 million people will live there. The second projection is made for transportation, and it predicts that the population will decrease 1.81 million (Report of Wastewater Master Plan, 2002). Lastly, the third projection that is made for the Bursa 2020 Strategic Plan estimates that 2.8 million people will live in the Bursa Metropolitan Municipality and 3.3 million people will live in the metropolitan area. It is said that approximately 3.3 million people are expected to live in the Nilüfer Stream Watershed in 2020 (Bursa 2020 Strategic Plan, 1998).

Clean water demand depends on population growth. For this reason, domestic wastewater also increases. The Water and Sewage Administration of the Bursa Metropolitan Municipality, which is responsible for water supplies and environmental infrastructure, continues its work with the possibility that its authority will be enlarged beyond the metropolitan municipality borders (Report of Wastewater Master Plan, 2002). There are sewerage systems in all the settlements that have a municipal government, but septic tanks are used in villages. Local Agenda 21 - Action Plan of the Blue Nilüfer (1997) that was prepared by Bursa Metropolitan Municipality claims that leachate waters do not cause ground water or soil pollution because of small dosage.

Urban population is significantly higher than rural population. Therefore, it can be interpreted that domestic wastewater of rural areas do not affect the environment as much as the domestic wastewater of urban areas. The population of urban and rural areas is given in Figure.4.7.

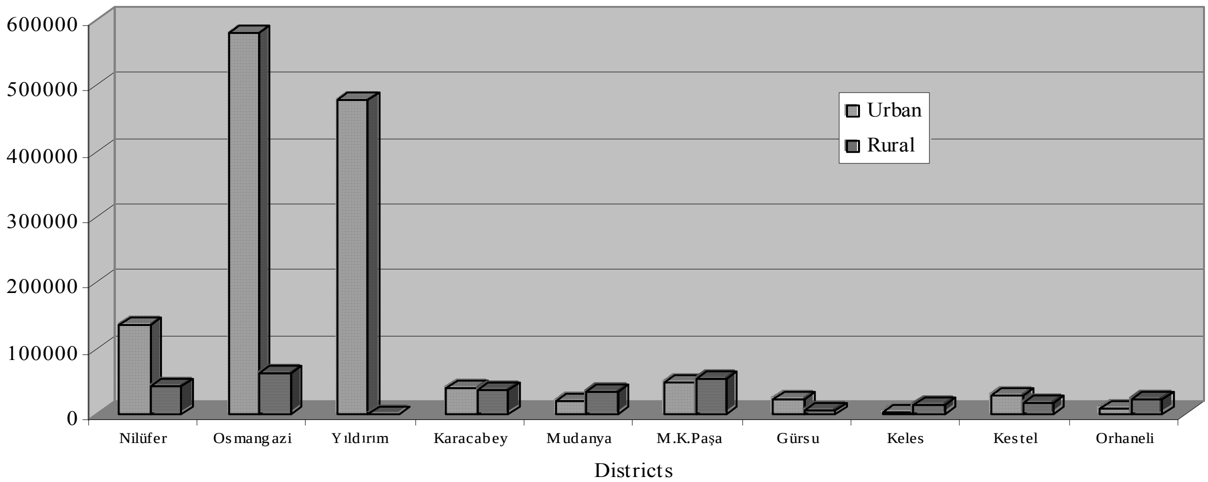

Figure 4.7 Populations of Urban and Rural Areas in the Watershed, 2000 (adapted from SIS, 2002a)

The domestic wastewaters of Bursa, Kestel, Demirtaş and Görükle have caused pollution in the Nilüfer Stream that is emphasized by the Action Plan of Blue Nilüfer (1997). None of the settlements have a wastewater treatment plant except the Bursa metropolitan city. The Bursa metropolitan city, which has more population density in the watershed, has only a common treatment system for domestic wastewater, and the Bursa Metropolitan Municipality has received the European Bank Credit to develop and rehabilitate two current treatment plants and sewerage systems. Unfortunately, the others settlements' domestic wastewaters are discharged directly into the Nilüfer Stream or its branches (Report of Wastewater Master Plan, 2002, Bursa Environmental Report, 2000; Bursa 2020 Strategic Plan, 1998). Land use of the Nilüfer sub basin is given in Figure 4.8.

The other important environmental problem is the sanitary landfill of domestic solid waste. Its leachate causes ground water pollution. The domestic solid waste of settlements of Bursa and Demirtas has been stored in sanitary landfills. Leachate is collected by drainage canals. Collected leachate waters are treated and then discharged to the sewerage system. On the other hand, unfortunately, domestic wastes of other settlements spill out imprudently onto the natural environment. Moreover, Gürsu solid waste dump site is close to an irrigation canal. Therefore, the surface water and the ground water are polluted (Action Plan of Blue Nilüfer, 1997).

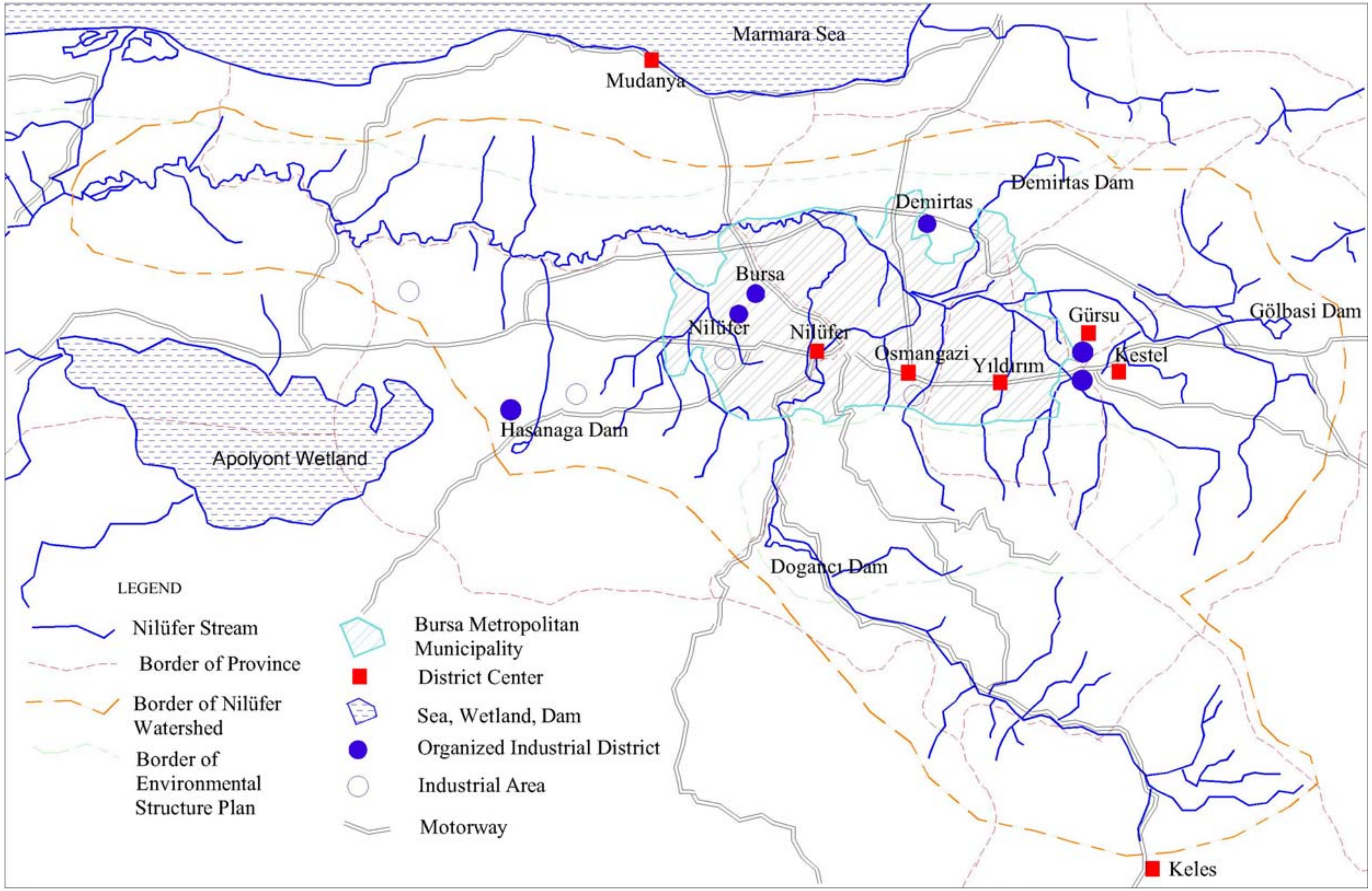

Figure 4.8 Land Use in the Nilüfer Watershed (Başaran, 2003; Başaran and Bölen, 2004)

4.3.2 Industry

Bursa has tried to integrate with world trade (especially the textile sector) since the Ottoman period (Bursa Metropolitan Municipality, 2003). Small companies were developed after the 1950s, and two big public textile factories were established in Bursa. The Bursa Organized Industrial District (BOSAB) was the first Organized Industrial District of Turkey established in 1961. The government has encouraged industrial development with “The South-East Marmara Development Project”. The main objective of the project was to decentralize industry and population from Istanbul. Due to the low land prices and low wages, proximity to Istanbul, and transportation facilities, industries have developed rapidly in Bursa since the 1960s, and not only in the textile but also automotive and food sectors (Bursa Province, 1982).

Today, Bursa is the third largest industrial city in Turkey. The number of employee shows this situation. In central Bursa, the share of industrial sector was 51%, the service sector was 45%, and agriculture was 4% (Bursa 2020 Strategic Plan, p.67, 1998). Municipalities, which have industrial facilities are economically developed, whereas undeveloped areas with geographical barriers have no industry. Gross national income share and development per capita by districts of Bursa are given in Table 4.1. As the table show, the District Municipalities of the Metropolitan Municipality (Nilüfer, Osmangazi, and Yıldırım) have the highest percentage of gross national product in the watershed. The districts of Mustafa Kemal Paşa and Karacabey follow these districts. The south of the watershed, which has mountainous areas, has not developed economically.

Table 4.1 Gross National Income Share and Development Index in the Districts of Bursa (www.bursa.gov.tr)

Districts of Bursa	Gross National Income Share per Capita (%)	Development Index
Nilüfer *	1.08	15
Osmangazi *	0.77	27
Yıldırım *	0.48	48
M.K.paşa**	0.29	85
İnegöl	0.27	92
Gemlik	0.26	95
Karacabey* *	0.25	101
Orhangazi	0.18	134
Mudanya **	0.12	154
Gürsu ***	0.08	232
Yenişehir	0.08	233
Kestel ***	0.07	252
İznik	0.07	270
Orhaneli***	0.04	370
Keles***	0.03	426
Harmancık	0.02	502
Büyükorhan	0.02	503

* Districts of the Metropolitan Municipality
** These districts in the down-stream of the Nilüfer Watershed.
*** These districts in the up-stream of the Nilüfer Watershed.
Other dirticts are not located in the watershed

There are 6 organized industrial districts and 2 industrial areas in the watershed (see in Figure 4.8). There are 2 more organized industrial districts and 9 industrial areas that are under construction. The BOSAB, which is located in the Metropolitan Municipality, has 176 firms and 35 000 workers. Nevertheless, a common wastewater treatment plant was built in 1998 (www.bosab.org.tr). The Demirtaş Organized Industrial District (DOSAB), which is located outside the Metropolitan Municipality, was established legally in 1990 in the watershed. However, industrialization has developed in this region since 1968, because a great investor is (called Tofaş Automotive) located in this area.

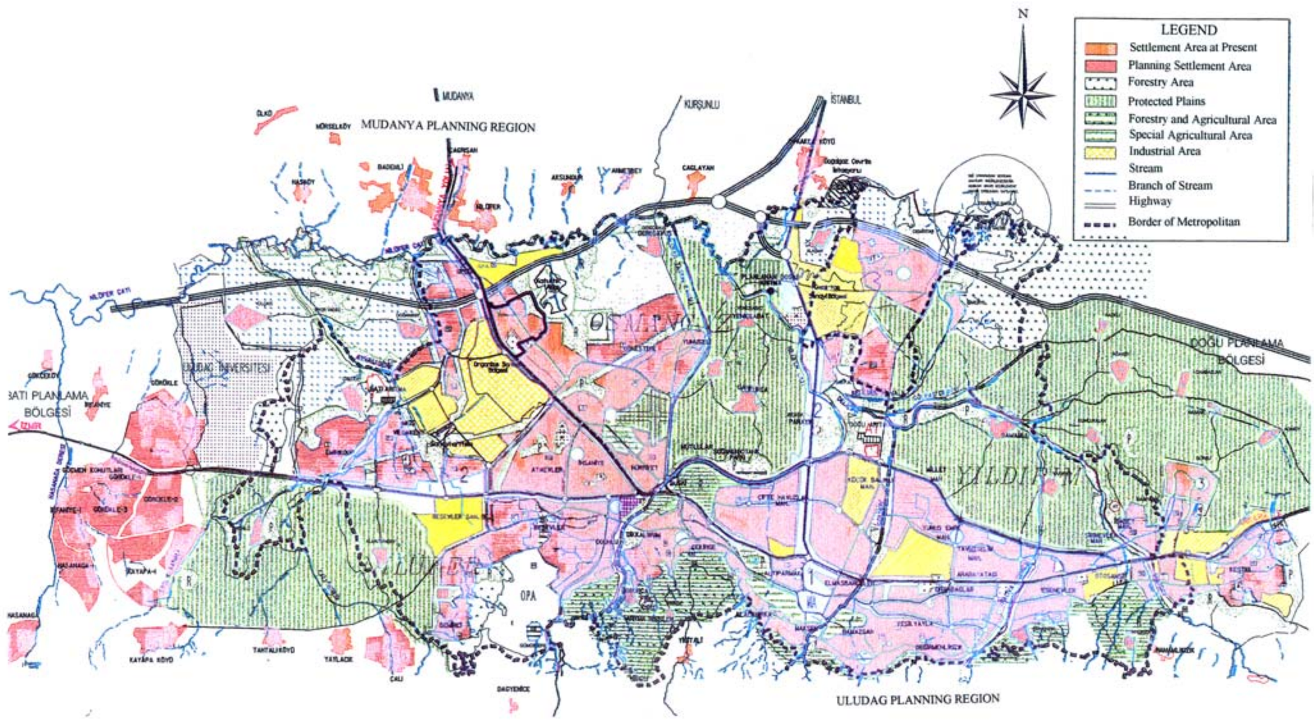

Figure 4.9 Land Use in the Bursa Metropolitan Municipality (Report of Bursa Wastewater Master Plan, 2002)

87

GIBB – İMECE – TABAR ORTAK GİRİŞİMİ / *JOINT VENTURE*

1 0 1 2 3 4 5 Kilometre

Today, 26 000 workers work in the Demirtaş Organized Industrial District. It has no wastewater treatment plant (www.dosab.com.tr). The existence of common wastewater treatment plants in Organized Industrial Districts is given in Table 4.2.

Table 4.2 The existence of Common Wastewater Treatment Plants in the Organized Industrial Districts, (adapted from Başaran and Bölen, 2004; Bursa Environmental Report, 2000, Dünya, 2004a)

	Organized industrial districts	Establishment date	Number of companies	Common wastewater treatment plant
1	Bursa	1963	171	Exsit-1998
2	Demirtaş	1990	255	Building
3	Nilüfer	2001	116	Non-existent
4	Gürsu	2001	59	Non-existent
5	Hasanağa	2003	32	Non-existent
6	Kestel	2004	170	Non-existent

There are many factories – 89 leather and 69 textiles- which are separately located in Bursa. These factories only remove some of the solids from the waste water before it is discharged into the Nilüfer Stream (Action Draft of Blue Nilüfer, 1997). The Bursa Master Plan, which was appoved in 1995, restricted the spatial expansion of these factories. Additionally, moving the leather industy from the inner city to the outside of metropolitan area is decided by the Bursa Strategic Plan. The organized industrial district is being built for leather firms that move from center to industrial area (Bursa 2020 Strategic Plan, 1998; Bursa Metropolitan Municipality, 2003).

On the other hand, there are textile plants in Kestel and Gürsu which are located on the up-stream. The Kestel Municipality and the Barafaki Sub-District Municipality have planned new industrial areas (Kestel 190 ha, Barafaki 130 ha) in the up-stream (Bursa 2020 Strategic Plan, 1998). Although Kestel has domestic wastewater treatment, it does not work efficiently. The Cooperative, which aims to build a common wastewater treatment plant for industrial and domestic wastewater of Gürsu, Barafaki and Kestel, was established by the Bursa Provincial Government (Action Plan of Blue Nilüfer, 1997). Furthermore, the industrial area of Kestel was accepted to be an organized industrial area in 2004, but it has no environmental infrastructure (Dünya, 2004a).

The Bursa Environmental Report (2000) determines that 588 plants are established in Bursa Province (Table 4.3). 50 % of the plants are textile and leather industries which are in need of fresh water and they cause water pollution. 58,5 % of the establishments in Bursa Province do not have a wastewater treatment plant. Both public and private companies in Bursa Province and their individual wastewater treatment plants are given in Table 4.3.

Table 4.3 Private and public companies' wastewater treatment plants in Bursa, 1998 Bursa Environmental Report, p.71, 2000

Sectors	**Number of companies**			**Number of companies which have insufficient wastewater treatment**		
	Sum	Public	Private	Sum	Public	Private
Food	205	8	197	187	8	179
Textile	128	2	126	59	-	59
Paper	3	-	3	-	-	-
Leather	162	-	162	58	-	58
Petrol	12	-	12	-	-	-
Chemistry	5	-	5	5	-	5
Cement, soil	13	-	13	-	-	-
Fertilizer	2	1	1	2	1	1
Mine	10	-	10	10	-	10
Glass	2	-	2	-	-	-
Energy	2	2	-	-	-	-
Metal	4	1	3	-	-	-
Forest	16	-	16	-	-	-
Machine, automotive	24	-	24	23	-	23
SUM	588	14	574	344	9	335

On the other hand, the Action Plan of Blue Nilüfer (1997) determined that 254 plants are discharged to the Nilüfer Stream or the sewerage system of Bursa city. Most of the plants have no wastewater treatment system that is known. Due to the increasing production costs, the existing ones are not working effectively (Bursa Metropolitan Municipality, 2004; Bursa Environmental Report, 2000). According to SIS data (1998), there were only three plants which had discharge licences in Bursa in 1992. Therefore, many factories are discharged without treatment to surface water in the watershed. Furthermore, some factories' wastewaters pump up ground water and that causes ground water pollution (www.buski.gov.tr). The quantity of industrial effluent and its discharge destinations are given in Table 4.4.

Table 4.4 Quantity of industrial effluent and its discharge destinations in Bursa, 1992 (adapted from SIS, 1998)

Sewerage System	6 946 738 m^3/year
Sea	9 386 592 m^3/year
Lake	2 138 000 m^3/year
River	14 387 086 m^3/year
Land	18 800 m^3/year
Septic tanks	240 374 m^3/year
Sum	33 626 375 m^3/year

Another main problem is the lack of environmental inventory. The Bursa Metropolitan Municipality and the Provincial Directorate of Environment and Forestry emphasize that industrial investors do not declare the correct information about the quantity of wastes (Bursa Environmental Report, 2000; Report of Wastewater Master Plan, 2002).

In recent years, unplanned industrial areas around Bursa are increasing. As planned industrial areas are fully occupied and price of industrial land is high, investors choose settlements where land is cheaper. Industrial companies are willing to be close to these settlements, thus they choose to be close to Bursa (Bursa 2020 Strategic Plan, 1998). As industrilization increases, conflicts on the use of natural sources such as agricultural land and fresh water rise between industry and agriculture. Districts of the city consider industry as a step towards development and progress; therefore they want industrial terrains within their territory.

4.3.3 Agriculture

Although the number of people employed in agriculture is low, Bursa is one of the major agricultural cities in Turkey according to agricultural income. Agricultural products have always been considered important for the economy of Bursa city because of fertile lands. The income of Bursa from different sectors in Turkey is given in Table 4.5. While Bursa is the third city in the manufacturing sector, she is the thirteenth city in the agricultural sector.

Table 4.5 Bursa's Income from some Sectors in Turkey (www.bursa.gov.tr)

Sectors	Share of Bursa Province (%)	Rank within Turkey
Manufacture	5.9	3
Construction	3.4	4
Commerce	2.4	5
Mining	2.5	8
Agriculture	2.2	13

The industrial and service labour forces are increasing in contrast to the agricultural labour force which is decreasing (SIS, 1993; SIS, 2002a). When sector share is analyzed on a metropolitan level, an increase in agriculture has been observed since 1970. In 1970, the share of agriculture was 30% - 40% in the districts and in 1990 this value decreased to 20%- 25% (Bursa 2020 Strategic Plan, 1998). Despite this fact improvement in irrigation possibilities, technological innovation, and marketing have increased the agricultural products and the income gained from them. The increase in agricultural products, which is given in Figure 4.10, depends on the development of agricultural industries. Bursa has over seventy factories which produce agricultural products such as fruit juice, and tomato sauce.

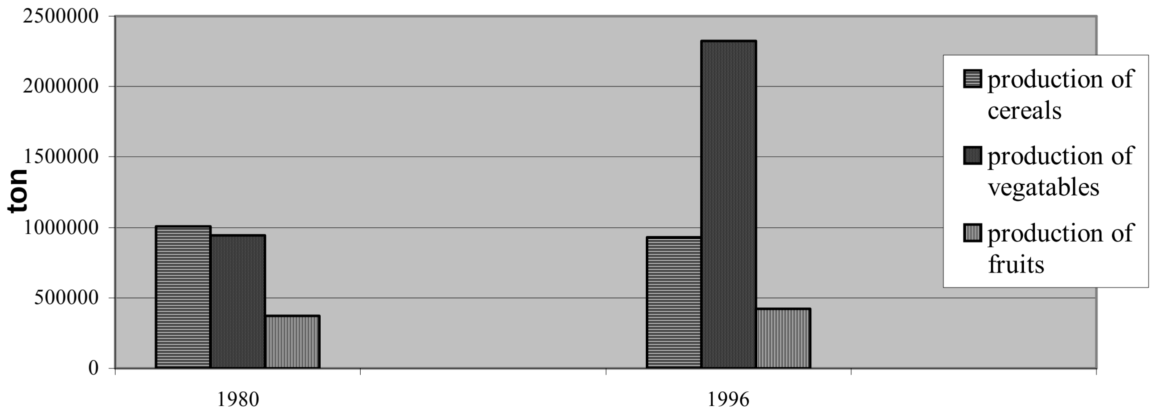

Figure 4.10 Increasing Agricultural Products in Bursa (1980 – 1996), (SIS, 1982; SIS, 1998)

The Karcabey district, which is located down-stream, has the highest number of agricultural products (except fruit) in the watershed. Additionally, the plains of Bursa and Çakırköy, which are located in the middle part, are very fertile. If they have efficient irrigation, there can be three harvests a year. However, the Nilüfer Stream cannot be used for irrigation because it is polluted (Bursa Environmental Report, 2000). The thirty-five percent of agricultural lands in Bursa have irrigation possibilities. There are two dams and two ponds (Demirtaş Dam, Gölbaşı Pond, Burcun Pond, Hasanağa Dam see in Figure 4.8) and four new irrigation projects. However, the Plains are being negatively affected by urbanization and industrialization (Bursa Environmental Report, 2000; Bursa 2020 Strategic Plan, 1998). Furthermore, each plain has wealthy ground water resource, and they are threatened by industrialization.

On the other hand, the most important pollutant, besides the settlements and industries in the watershed, is agricultural facilities. Chemical pollution and pesticides are not measured in the watershed, but the General Directorate of State Hydraulic Work research (DSI, 2000) indicated that the irrigation water which rejoins the water cycle system is already polluted.

4.4 Usage of Water in the Nilüfer Watershed

According to the surveys (DSI, 1984; DSI, 2000), consumption of fresh water has increased in the watershed due to industrial development and population growth. It can be stated that supplying fresh water and sharing it among domestic, agricultural and industrial usage are two main problems in the watershed. The consequences of the economic impact of existing water pollution in the watershed are very interesting. The first problem is supplying clean water and providing it to all sectors. This problem is solved in a short time and in a particular way. There is one point on which all stakeholders agree; that is the protection of the dam which provides potable water for Bursa city. The ground water is reserved for industrial use and ponds are built for agricultural use. The treatment expense of industrial and domestic wastewater is saved. On the other hand, according to SIS data (2002b), 30% of the agricultural land of Bursa was being irrigated by the stream and its branches.

There are dams, ponds and water channels which have been under construction since the 1970s. 6 irrigation projects, 1 pond (Gölbaşı), 1 dam in order to supply drinking water in 1985 (Doğancı 1) and 2 dams for irrigation (Hasanağa, İznik) were built by the Directorate of State Hydraulic Works in 1979. Pollution of the Nilüfer Stream creates an increasing demand on ground water. A shortage of fresh water causes competition among settlements, industry and agriculture. There was a conflict between industry and agriculture because of ground water usage in Demirtaş. Therefore, the Demirtaş dam was built for irrigation purposes. As a result, the ground water of Demirtaş can only be used for industrial plants. Flood control of surface water and changing the direction of the stream are two of the projects that are applied by the Directorate of State Hydraulic Works in the watershed. Dams and canal projects for irrigation are especially considered for the other branch of the Susurluk basin (Emet, Orhaneli) (DSI, 1984; DSI, 2000).

Table 4.6 Usage of Ground Water in the Bursa Plain (DSI, 2000)

	Purpose of the ground water usage	**Quantity of usage hm^3/year**	**Percent of usage %**
Bursa Metropolitan Municipality	Domestic	33	28
Industries	Industrial	36	31
Villagers	Irrigation	43	36
Demirtaş Subdistrict Municipality	Domestic + industrial	6	5
SUM		118	100

28 % of the ground water is provided for the Bursa Metropolitan Municipality for drinking and domestic water, 31% is supplied for the industrial waters, 36% is used for irrigation, and 5% is provided for the Demirtaş Sub-District Municipality for drinking and industrial water (see Table 4.6). Although the Regional Directorate of State Hydraulic Works does not give new permission for the usage of ground water, the usage of ground water is increasingly illegal (Bursa Environmental Report, 2000); according to the same Report, the increase of new industries in up-stream (Gürsu district) causes negative environmental effects such as water pollution.

4.5 Water Pollution in the Nilüfer Stream

Some physical, chemical, and bacteriologic parameters are used for the determination of water pollution. For instance, color, temperature, total dissolved solids are physical parameters. Chemical parameters divide into two parts such as organic and inorganic parameters. Biochemical oxygen demand and chemical oxygen demand are organic chemical paremetres, whereas hardness, Ph, iron, manganes, sulfhate, and orthophosphate are inorganic chemical parameters (Uslu, 1993). These parameters indicate water pollution levels. According to the Regulation of Water Pollution Control (2004), high qualified 1st class waters; drinking water can be used for recreational, fishing and other purposes. 2nd class less polluted water can be used as drinking water after a treatment, as well as fishing, recreational watering, and in all activities which do not require 1st class water. 3rd class polluted water can be used as industrial waters (excluding textile and food industries) after a suitable treatment method. 4th class polluted waters cannot be used for any purpose. On the other hand, the classification and protection of surface waters are not sufficient according to the Regulation of Water Pollution Control. Pollution parameters are measured in a water resource according to the Regulation. However, pollution should be evaluated not only for water resource but also for whole drainage basin (Baykal and et al., 1997).

4.5.1 Regulations of Effluent Standards

There are three authorities that control wastewater quality standards in the watershed. The Regulation of Water Pollution Control was accepted by the Ministry of Environment and Forestry in 1988. This Regulation was reconsidered in 2004. The effluent (wastewater discharge) standards for domestic and industrial discharges have been determined in the Regulation of Water Pollution Control (2004). Industrial effluent standards are identified according to sectors (such as textile, food, mining etc.). According to the Regulation (2004), all wastewater discharges –industrial and domestic- have to suit these standards, but the Metropolitan Municipalities’ areas are exceptions.

Secondly, the effluent standards of the Bursa Metropolitan Municipalities are determined by the Regulation of Metropolitan Municipalities Wastewater Discharge (The Regulation of Water Pollution Control, 2004). Standards are divided into two parts; pretreatment (discharge to a sewerage system) and disposal in nature in accordance with the Regulation. The Metropolitan Municipalities can accept a low quality of pretreatment standard because they aim to build a wastewater treatment plant at the end of the sewerage system. Thirdly, effluent standards are controlled by Aquatic Products Law (Law no, 1380, 1973). Effluent standards are high according to this Law, because it evaluates water quality by taking only aquatic life into consideration. The Ministry of Agriculture and Rural Affairs evaluates all surface water according to Aquatic Products Law. All three authorities can give “discharge licenses” to an investor according to their regulations.

On the other hand, the General Directorate of State Hydraulic Works (DSI) is another authority that responds to conserve ground water and drinking water basin (Law no: 167, 1960; http://www.dsi.gov.tr/mission.htm). It has no effluent standards or effluent regulation, but it can regulate drinking water basins.

The Bursa Metropolitan Municipality, the Provincial Directorate of Environment and Forestry, the Regional Directorate of State Hydraulic Works, the Provincial Directorate of Agriculture and Rural Affairs, and the University of Uludag have studied the water pollution in the Nilüfer Stream. Additionally, the Provincial Directorate of Health has also analyzed stream water for public health. However, these studies are not coordinated. In this study, the surveys of the DSI are used.

4.5.2 Analyses of Pollution of the Nilüfer Stream

The General Directorate of State Hydraulic Works (DSI) has observed the water quality in the Nilüfer Stream between 1979 and 1982; a study called “Research of Water Resource Pollution in Bursa Region” was published in 1984. This study includes only physical and chemical parameters. Bacteriologic parameters and fertilizers were not measured, because the DSI and the Ministry of Health could not be coordinated (DSI, 1984). Parameters were evaluated as the lowest value, the highest value and average value, but the water quality was not classified. The second survey is between 1998 and 1999 which is called “Water Quality Management in

Susurluk River Basin" (2000). The second survey contains more sampling points, and more water pollution parameters than the first. Additionally, results of the measurements were classified according to the Water Pollution Control Regulations (2004) in the second one.

Although four (N1, N2, N3, N4) sampling points were chosen in the first survey (1984), there were twenty-one sampling points in the second research (2000). Thus the results of four (4) stations can be compared. These stations are shown in Figure 4.11. The "N1" station is before the Doğancı Dam that supplies drinking and domestic water to the Bursa metropolitan area. The "N2" station is after the Bursa residential area. The "N3" station is after industrial and residential areas which are up-stream. The "N4" station is at the end of the Bursa metropolitan area. The last measurement point (N4) shows cumulatively the pollution of up-stream and middle stream. After the last sampling point (N4) polluted stream flows down stream through the agricultural areas.

As the survey (DSI, 1984) results of the years 1979-1982 are investigated, it is possible to say that the surface water used to flow quite clean from the spring to Bursa; but quantity of suspended solids, ammonium nitrogen, iron was seen take over standard values because of erosion and structure of solids (see Table 4.7). Although Bursa has a domestic wastewater treatment system, the pollution in the surface water started mainly due to the Bursa sewerage wastewaters. After the domestic wastewater discharge to the surface waters, the water quality became 4^{th} class according to the physical parameters (DSI, 1984). First survey shows that the quantity of ammonium nitrogen, nitrate, biochemical oxygen demand, and orthophosphate increases from N1 to N2 (Table 4.7). These values indicate the negative effects of the Bursa domestic wastewater (DSI, 1984).

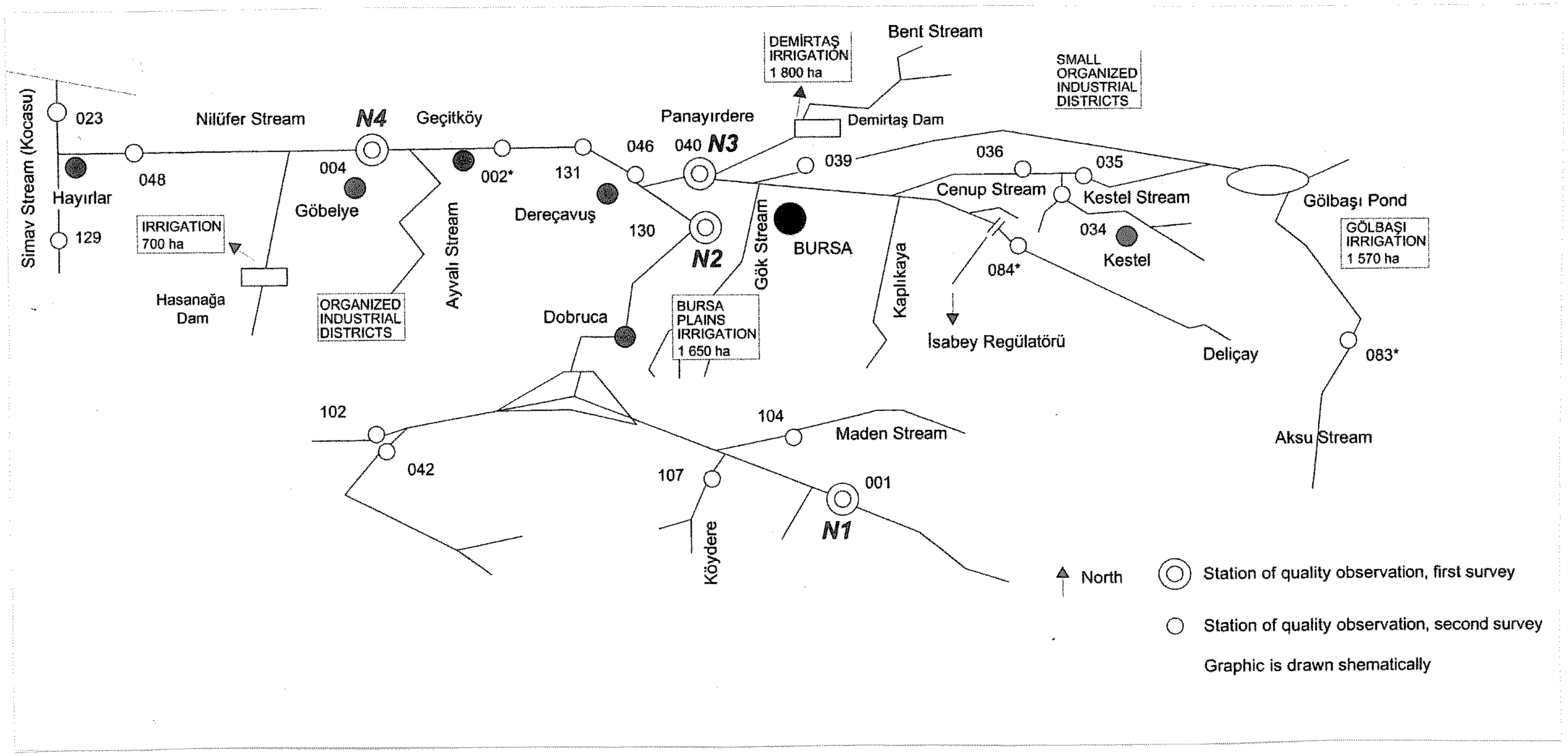

Figure 4.11 Stations of Water Quality Observation, First and Second Survey (adapted from DSI, 1984 and DSI, 2000.)

Table 4.7 The Values of Measured Parameters, 1st Survey (adapted from DSI, 1984 and Regulation of Water Pollution Control, Table 1, 2004)

Parameters of water quality		Unit	Sampling Points			
			N1	N2	N3	N4
A-Physical and Inorganic Chemical Parameters						
Q	Stream flow	m^3/sn	8,256	3,16	15,66	24,68
T	Water temperature	^oC	12,6	15,2	13,3	15,6
pH	-	-	8,2	8,2	7,9	7,8
EC	Electrical conductivity	µmhos/cm	388	461	539	573
TDS	Total dissolved solids	mg/l	299	441	-	-
SS	Suspended solids	mg/l	61	108	148	160
Cl	Chloride	mg/l	3,2	6,3	29,0	30,7
NH_3-N	Ammonium nitrogen	mg/l	0,45	2,7	5,68	3,37
NO_2-N	Nitrite	mg/l	0,009	0,278	0,30	0,297
NO_3-N	Nitrate	mg/l	0,36	0,482	0,786	0,78
DO	Dissolved oxygen	mg/l	10,3	10,3	7,2	5,8
SO_4	Sulfate	mg/l	-	-	-	-
Na	Sodium	mg/l	4,7	-	-	-
B- Organic Parameters						
M-Al	Total alkalinity	mg/l $CaCO_3$	168,7	209	201,1	217,6
P-Al	Phenolphthalein	mg/l $CaCO_3$	6,9	10,1	2,34	3,26
pV	Permanganate value	mg/l	2,19	8,6	9,98	15,6
BOD_5	Biochemical oxygen demand	mg/l	1,5	3,8	11,4	12,8
TH	Total hardness	mg/l $CaCO_3$	172	185	181	200
o-PO_4	Orthophosphate	mg/l	0,057	0,88	0,656	1,0
COD	Chemical oxygen demand	mg/l	-	37,8	53,6	58,2
C- Inorganic Parameters						
Fe	Iron	mg/l	1,97	-	-	-
Mn	Manganese	mg/l	0,03	-	-	-
K	Potassium	mg/l	1,1	-	-	-
Ca	Calcium	mg/l	40,8	-	-	-
Mg	Magnesium	mg/l	20,2	-	-	-
B	Boron	mg/l	-	-	-	-
D- Bacteriologic Parameters						
	Fecal Coliform	EMS/ mg/l	-	-	-	-
	Total Coliform	EMS/ mg/l	-	-	-	-

Before the N3 sample point, industrial wastewater of Demirtaş, Kestel, Gürsu and one of the main collectors of Bursa sewerage system, and main irrigation discharge channel of Bursa plain join the Nilüfer Stream. The quantity of ammonium nitrogen, nitrate, and orthophosphate were measured over the standards in N3 whereas biochemical oxygen demand values were not measured high. This situation can be explained by industrial wastewaters which contain heavy metals and toxic matters (DSİ, 1984).

Finally the wastewater of the BOSAB is discharged to the Ayvalı stream which is the branch of the Nilüfer Stream before the N4 sample point. The Ayvalı Stream's natural flows are dried up, so only industrial wastewaters flow in summer time. The measured value of chemical oxygen and orthophosphate in N4 point shows industrial pollution. After the N4 point, the Nilüfer Stream is used for agricultural facilities. However the Nilüfer stream is not suitable for irrigation and animal husbandry according to the value of ammonium nitrogen, biochemical oxygen demand, orthophosphate, and chemical oxygen (DSI, 1984).

The survey (DSI, 2000) results of the years 1998-1999 show no significant difference in the water quality of the stream from the Doğancı Dam which supplies fresh water to Bursa. The sampling point "001"(N1 in the first survey) shows that surface water is 2nd water quality according to A and B parameters, and 3rd water quality according to D parameter. The changing of water quality according to A (physical), B (organic) and D (microbiological) parameters are given in Figure 4.12.

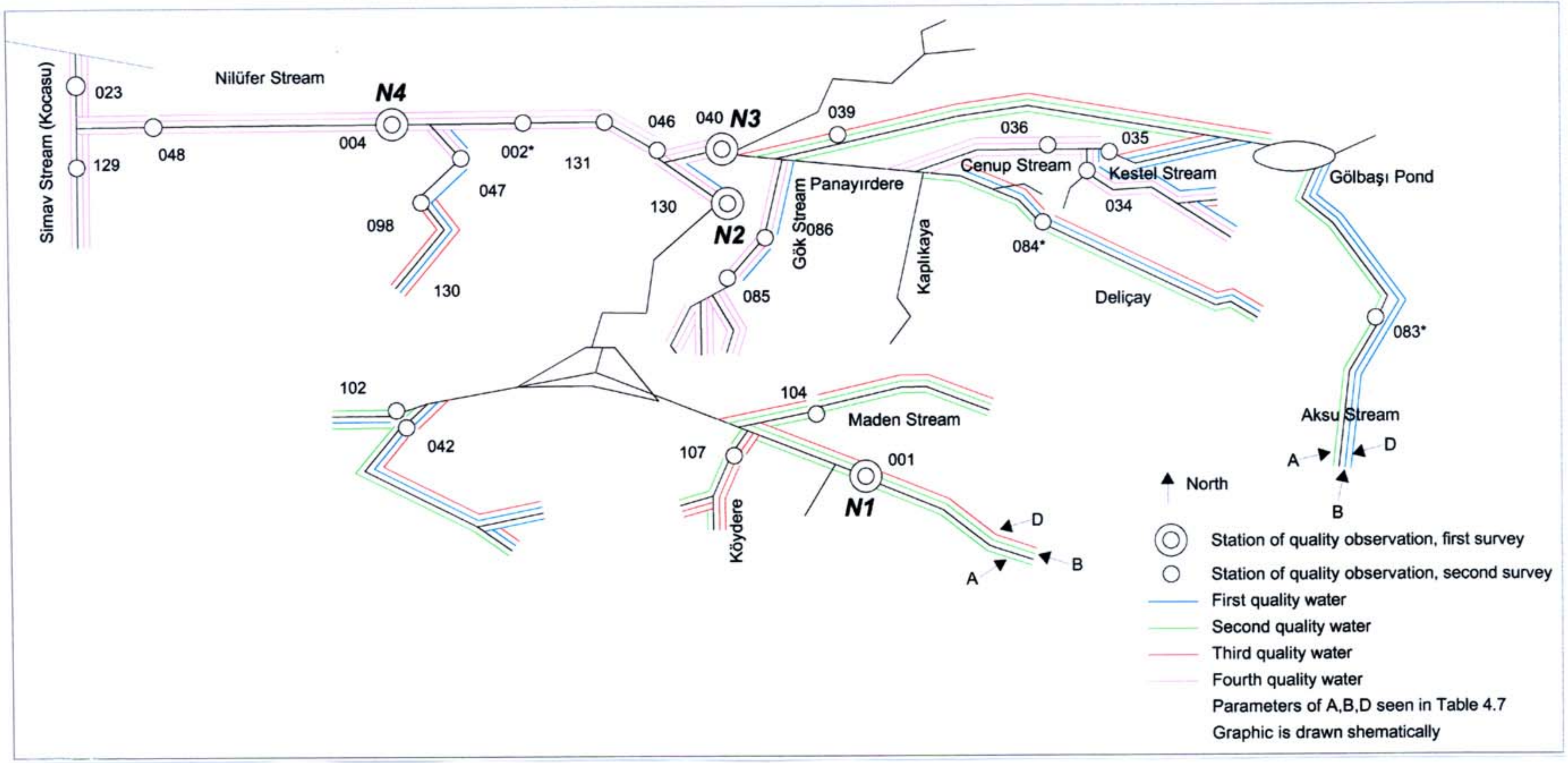

Figure 4.12 The Quality of Water in the Watershed (DSI, p.102, 2000)

After the Bursa sewerage discharge to the stream the water quality becomes 4th class according to A and B parameters, and 2nd class according to D parameter in the N2-130 sampling points. When the waters do not leave the dam, the stream seems like a wastewater channel. When the industrial wastewater joins the stream, the water quality moves beyond the 4th class in the stations 040 and 004 (N3 and N4 in the first survey) according to the A, B and D parameters. After the 040 sampling point stream seems like a wastewater channel every season (DSI, 2000).

It is compared pollution values taken at eighteen year intervals to see the impact of the developments that took place in the area. Results of both surveys are classified according to the Regulation of Water Pollution Control, and the Quality Criteria of Inland Water (see in Table 4.8).

Table 4.8 Changing the Classification of the Nilüfer Stream Water (adapted from Başaran, 2003; Başaran and Bölen, 2004; DSI, 1984; DSI, 2000, Regulation of Water Pollution Control, Table 1, 2004)

Station	**T**	**pH**	**TDS**	**Cl**	**NH_3-N**	**NO_2-N**	**NO_3-N**	**DO**
N1	1-1	2-3	1-1	1-1	x-2	2-4	1-1	x-1
N2	1-1	2-1	1-2	1-2	x-4	4-4	1-1	x-1
N3	1-1	1-4	x-2	2-2	x-4	4-4	1-1	x-2
N4	1-1	1-1	x-2	2-3	x-4	4-4	1-1	x-2
	BOD5	**o-PO_4**	**SO_4**	**Fe**	**Na**	**T-coli**	**CN**	**COD**
N1	1-2	x-2	x-1	3-3	x-1	x-2	x-1	4
N2	1-4	x-4	x-1	x-3	x-3	x-1	x-4	2-4
N3	3-4	x-4	x-1	x-3	x-1	x-2	x-4	2-4
N4	3-4	x-4	x-1	x-3	x-3	x-1	x-4	2-4

x ; the parameters were not measured between 1979 and 1982.
First value is classification in 1984 and second value is classification in 2000.

The results of the surveys indicate that the pollution rate is increasing in the Nilüfer Stream except for the Doğancı Dam. It is possible to say that biological balance is totally destroyed in the stream, as well as biological diversity. The Nilüfer stream is the most polluted part of the Susurluk River System. Dissolved oxygen value was measured as zero in most of the sampling points in second survey. The Nilüfer stream has become an open channel which carries the wastewater of Bursa through the Simav Stream to the Marmara Sea. In conclusion, the whole region suffers deeply from water pollution (DSI, 1984; DSI, 2000).

4.6 Planning Process in the Nilüfer Watershed

4.6.1 Decision Making Process

There are many authorities which make decisions on planning and environmental issues in the watershed. These decision makers (both central administration and local authorities) and the hierarchical relationships between are given in Figure 4.13

All provincial directorates and regional directories are coordinated by the Local Environment Council (see in Figure 4.13). The council applies decisions of the Ministry of Environment and Forestry. The Provincial Governor is the president of the Council, and all provincial authorities of ministries, the mayor of the metropolitan municipality, the chamber of industry, the chamber of agriculture and the Provincial Gendarmerie Command are members of the Council (Law no: 4856, 2003). Furthermore, ministries are coordinated by the Superior Environmental Council.

There are abundant authorities for monitoring, controlling and permitting. For example, if industrial investments are located in a metropolitan municipality area, the Metropolitan Municipality controls them with the exception of food sectors which are controlled by the Ministry of Health, and the Ministry of Agriculture and Rural Affairs. If industrial investments are outside the borders of the Metropolitan Municipality, the Ministry of Environment and Forestry, and the Ministry of Health control them. Controlling contains many processes such as environmental impact process, opening license, discharge license, emission license etc. Decision makers according to industrial location alternatives are given in Figure 4.14.

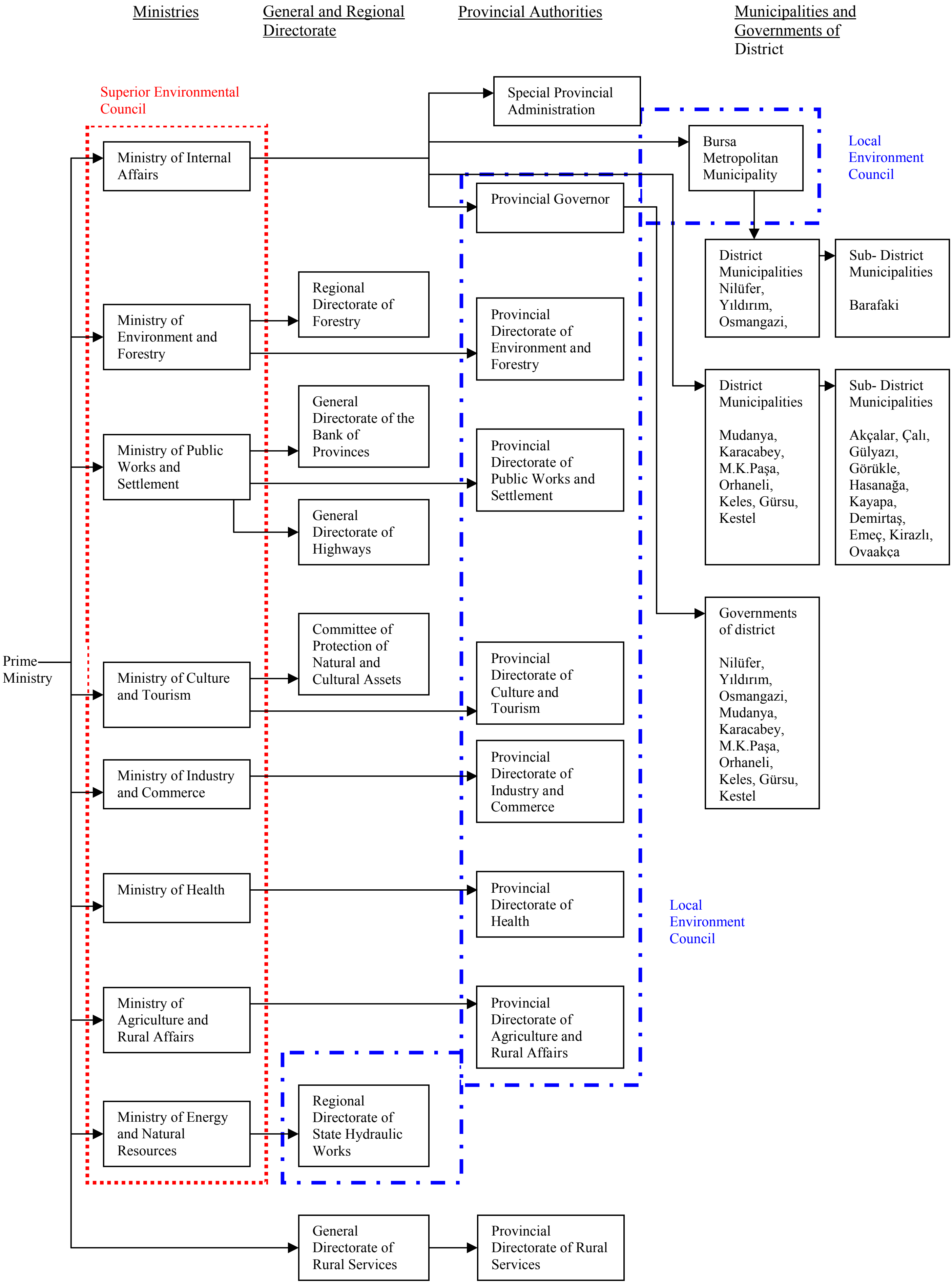

Figure 4.13 Public Authorities and their Relationships (Başaran, 2003; Başaran and Bölen, 2004)

The Regulation of Unhealthy Establishment (1995) classifies industrial plants as first, second, and third class. According to this classification; first class plants within the borders of a metropolitan municipality would receive their operational permits from the metropolitan municipality, otherwise they would receive it from the Ministry of Health. Second and third category plants would receive their licences from district municipalities, if they locate in district municipalities borders; otherwise they would get them from the Provincial Directorate of the Ministry of Health. The Commission of Unhealthy Establishment Licence (opening licence) includes members from the Provincial Directorate of Environment and Forestry, the Governor of District, District Municipality, other members that the Ministry of Health finds necessary (Regulation, 1995).

A discharge license is supplied by the metropolitan municipality if the plant is within city boundaries or by the Ministry of Environment and Forestry if otherwise. In particular areas inspected by the Ministry of Agriculture and Rural Affairs, discharge licences are supplied by the Ministry of Agriculture and Rural Affairs (Regulation of Water Pollution Control, 2004; Law no:5216, 2004; Law no:1380, 1973).

The Regulation of Industrial Air Pollution Control (2004) divides industrial plants into two categories; A and B. A category receives permits from the Ministry of Environment and Forestry while B category is permitted through the Provincial Directorate of Environment and Forestry, and the Provincial Government. Furthermore, according to the Regulation of EIA (Regulation, 2003), plants are classified into two categories. The first category is evaluated by the Ministry of Environment and Forestry while the second category is evaluated by the Provincial Directorate of Environment and Forestry, and the Provincial Government.

In 2004, the Law on Metropolitan Municipalities was reorganized (Law no:5216, 2004). It anticipated that with this law the Metropolitan Municipality of Bursa will enlarge its area of coverage. This way several organized industrial districts (Demirtaş, Batı, Gürsu and Leather Organaized Industrial Districts) and industrial areas will come under the authority of the Bursa Metropolitan Municipality (Bursa Metropolitan Municipality, 2004). This situation will effect the decision making process and will also strengthen the Bursa Metropolitan Municipality as the planning body.

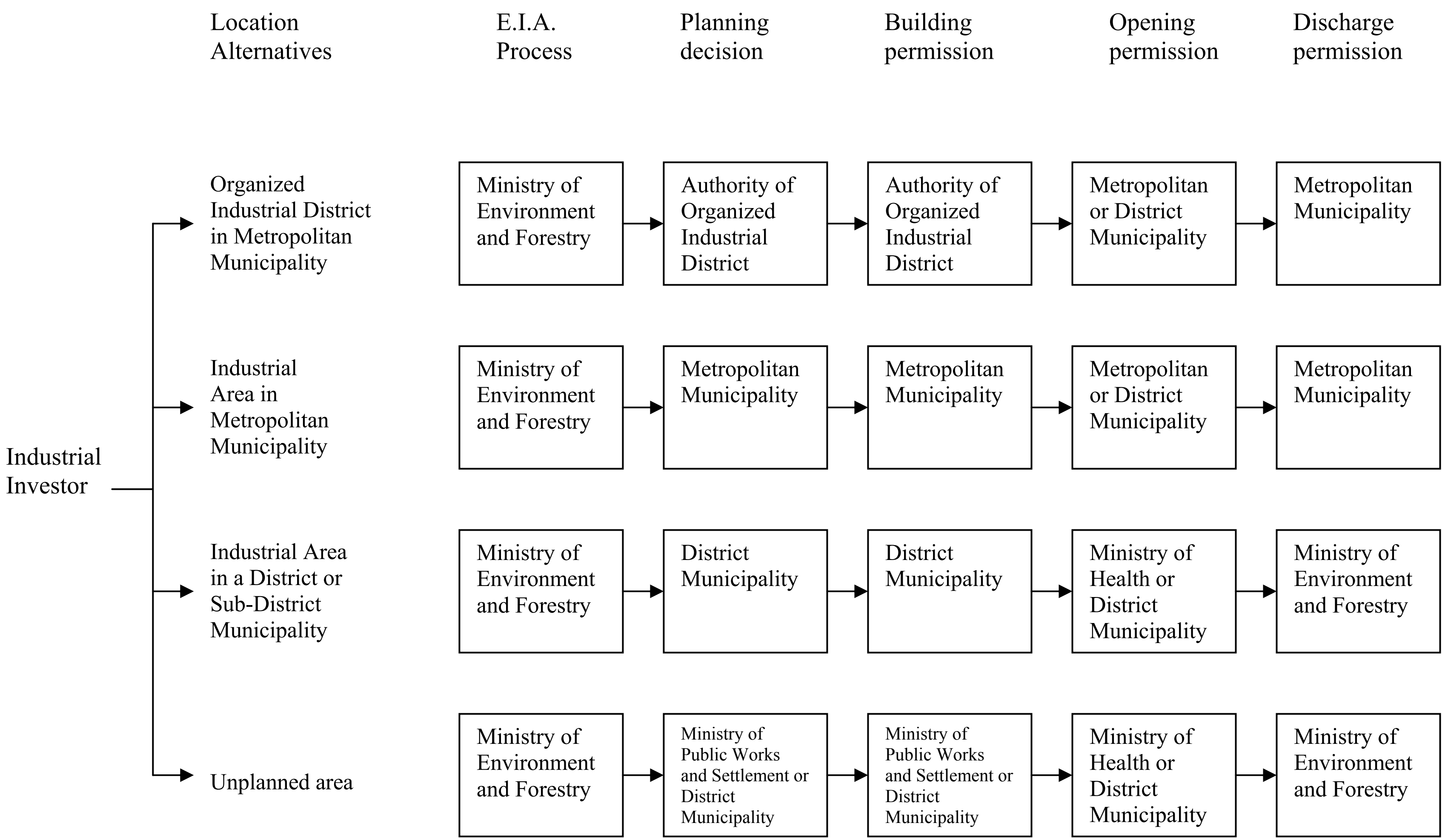

Figure 4.14 Decision Makers according to Industrial Location Alternatives

The Ministry of Public Works and Settlement, is also responsible for preparing and approving "environmental structure plans" on 1/25 000 scale (Law no: 3194, 1985). The Ministry of Environment and Forestry and Metropolitan Municipalities are other authorities which respond to the environmental structure plans. Implementation plans are prepared and approved by the district municipalities and the provincial government (Law no: 2872, 1983; Law no: 4856, 2003; Law no: 5216, 2004). The Bursa Metropolitan Municipality was established in 1987 and it contains three districts. Decision makers who decide about land use planning, and their authority areas are shown in Figure 4.15.

Besides all these different authorities, the Ministry of Culture and Tourism, the Ministry of Agriculture and Rural Affairs and the Ministry of Energy and Natural Resources have authority for preparing master plans. There are many archeological and natural sites in the watershed –there are 10 natural preserved areas-, so the Ministry of Culture and Tourism responds to land use decisions in these areas. The part of the Nilüfer Stream which is inside the Metropolitan Municipalities is a preserved area (Bursa Environmental Report, 2000; Law no: 2872, 1983). In addition, industrial areas such as organized industrial districts or industrial regions are planned by the Ministry of Industry and Commerce (Regulation of Industrial Regions, 2004).

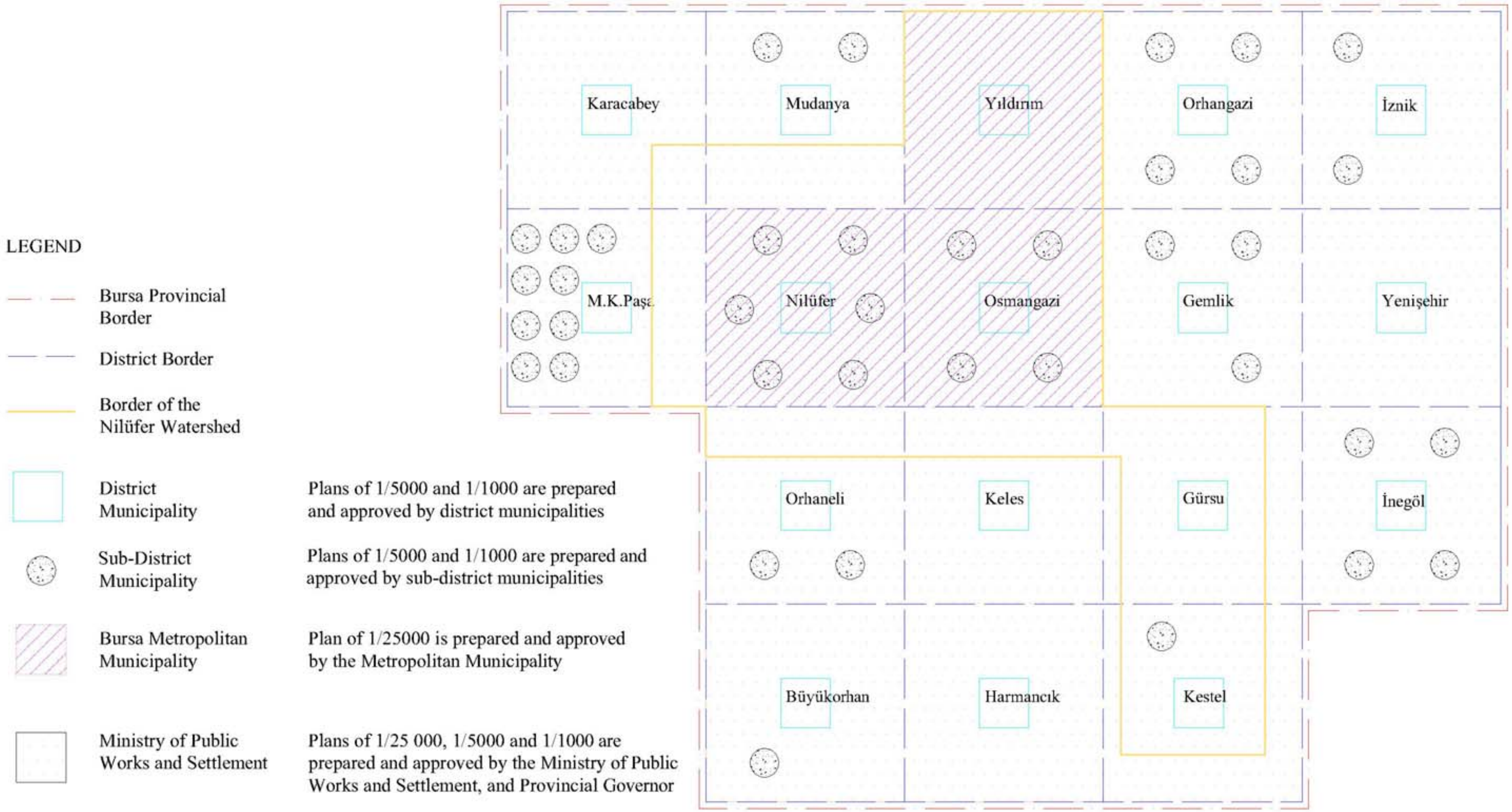

Figure 4.15 Decision Makers about Land Use Planning and their Authority Areas (Başaran, 2003; Başaran and Bölen, 2004)

4.6.2 Strategic Planning Decisions

The first master plan (1/25 000) for Bursa's city centre was made in 1976. In 1992, 1/25000 scaled Coastal Plan which covers the Nilüfer Stream bank up to the seafront and the surroundings of Gemlik were approved. In 1993, 1/25000 scaled Uludağ Environmental Structure Plan was approved. This plan covers Uludag National Park, forests and the settlements around it (Bursa 2020 Strategic Plan, 1998). These plans were prepared and approved by the Ministry of Public Works and Settlement. These planning areas are not under the authority of the Metropolitan Municipality.

The Bursa 2020 Strategic Plan was prepared together by the Bursa Province Government, the Ministry of Public Works and Settlement, and the Bursa Metropolitan Municipality. Bursa is one of the cities which went through a strategical planning experience. This strategic plan of 1/100 000 scale covers the whole provincial boundaries of Bursa and was approved by the Ministry of Public Works and Settlement in 1998. While this plan was being prepared, a "master development planning office" was established within the Bursa Metropolitan Municipality. Representatives of the economic sectors were consulted to establish sector based distinctions. The Chamber of Industry, Chamber of Commerce, diverse ministries, non-governmental organizations (NGOs) and city council of Agenda 21 were contacted (Bademli, 2001). The Bursa Municipality has set its geographical information system during the strategic planning process.

The principles of Bursa 2020 Strategic Plan (1998) are divided into the principles of protection and the principles of development (see in Table 4.9). In the planning phase, natural datas, industry, trade and services, population, technological infrastructure and transportation sectors were taken into account. Determination and evaluation were made in four steps: Turkey and East Marmara Region (1/250 000), Bursa Metropolitan Region (1/100 000), Bursa Metropolitan Area (1/25 000), and Metropolitan Municipality (1/5000). The target is set for 2020 for regularity plans but 2005 is designated for short term plans.

Table 4.9 Principles and Strategies of Bursa Strategic Plan (adapted from Bursa 2020 Strategic Plan, 1998)

Protection Principles To protect all agricultural lands that have high fertility • To protect the plains of Bursa, M.Kemalpaşa, Karacabey, Yenişehir and İnegöl, • To ensure the agricultural lands that have irrigation facilities, • To protect the forestry, • To protect the water basins, dams and ponds which are used for drinking water and irrigation purposes, • To protect the important natural, archeological and urban areas,
Development Principles • Development areas should not destroy agricultural areas, • Expected population should be evenly distributed, • Sub-centers should be developed, and population should be decentralized, • Industry should be developed in organized industrial districts, and organized industrial districts should be located in unfertile agricultural areas, • Special regions should be planned for polluting industy and environmental preventive measures should be taken, • Common wastewater treatment has to be built in organized industrial districts, • Organized industrial districts should be supported by new small and medium industrial regions, • Service sector should be developed, • Local planning decisions on a parcel scale should not be made about industry and settlement, • Application strategies should be developed for the tourism sector, • Population growth should be restricted in historical protection areas.

The Metropolitan Region, which is determined in the Bursa 2020 Strategic Plan (1998), is divided into five planning regions; Inegol Planning Region, M.Kemalpaşa-Karacabey Planning Region, İznik-Orhangazi Planning Region, Yenişehir Planning Region, and Metropolitan Area Planning Region. Decisions are developed for each planning region. In addition, the Metropolitan Area Planning Region, which contains most of the watershed, is also divided into six planning regions such as Mudanya-Gemlik Planning Region, East Planning Region, West Planning Region, Uludağ and Alaçam Planning Region, North Planning Region, and Centeral Area Planning Region.

Detailed decisions were made on these planning areas according to main strategies. According to these decisions, the city will expand towards the west. Moreover, the leather industry, which is located in the centre, will be moved to an organized industrial district for leather on the west side. It is emphasized that environmental problems increase with the decisions of district municipalities concerning industry; it is decided that industry should be located in organized industrial districts. Industrial activity will not be allowed by local planning decision. New industrial areas will not be allowed in Kestel and Gürsu but the existing ones will be rehabilitated. It is pointed out that the organized industrial districts in Bursa and Demirtas will establish their common wastewater treatment plants.

In the Bursa 2020 Strategic Plan (1998), cooperation among the different agencies is mentioned but a solid management system is not mentioned. It is well known that the cooperation was achieved between the Bursa Metropolitan Municipality and the Provincial Government. However, the conflicts came into existence between these two and the Ministry of Public Works and Settlement in approval process of the Strategic Plan. The Ministry of Public Works and Settlement is a unique authority to approve the strategic plans. Bademli (2001) criticizes this situation and emphasizes that an independent agency should be producing strategical plans. On the other hand, the new Metropolitan Municipality Law gives the Metropolitan Municipalities an authority for the strategic plans (Law no:5216, 2004).

Bursa Metropolitan Municipality (Bursa, 2003) indicates the problem of cooperation among authorities. Coordination on environment issues is the main target among municipalities, the Provincial Directorate of Health, the Provincial Directorate of Agriculture and Rural Affairs, private sectors and Local Agenda 21. However, the Provincial Directorate of Environment and Forestry are outside of this coordination.

Bursa is a member of the World Health Organization (WHO) Healthy Cities Network, so the Bursa Metropolitan Municipality has some strategies such as the strategy of improving quality of life and environment, and the strategy of sustainability of an ecologic system. Moreover, the strategy of protecting the Nilüfer Stream considered in Local Agenda 21 (Bursa, 2003). Improving environmental infrastructure and municipal wastewater treatment is another strategy. Hence, the Bursa Metropolitan Municipality is using World Bank credit for the environmental infrastructure of Bursa city (www.buski.gov.tr). In addition, improvement of the Nilüfer Stream water quality is targeted by the Wastewater Master Plan (2002) and the Action Plan of Blue Nilüfer (1997).

Industrial development versus protection of environment is the biggest conflict in the watershed at the moment. For this reason, the Bursa 2020 Strategic Plan involves protective and development principles. According to the Bursa Strategic Plan, density in the city centre will be diminished and Bursa will expand towards the west. At the same time, industrial development towards the up-stream is restricted in the plan. As a result of the aforementioned reasons, leather industries and dyehouses are scheduled to be moved to an organized industrial district at the watershed away from the city centre. Improving environmental infrastructure and municipal wastewater treatment is also the main strategy. It is a very important problem that pollution is carried by water and local authorities are not willing to take responsibility for the cost of the pollution. The Metropolitan Municipality does not want to be held responsible for water pollution caused by up-stream industrial plants. The same situation is the case for the down-stream areas of the watershed. This shows that the basin should be considered and treated as a whole to overcome these problems. All agents are linked and the decision of one would influence the other and vice versa.

4.6.3 Decision Makers and their Strategies

There are 8 local units of central authorities and 21 municipalities that decide on planning and environmental issues in the watershed (see in Figure 4.13); 6 local units (provincial directorate of ministries) and 1 Regional Directorate of State Hydraulic Works, 1 Provincial Authority (Bursa), 1 Metropolitan Municipality (Bursa), 3 District Municipalities within of Metropolitan Municipality (Nilüfer, Yıldırım, Osmangazi), 4 District Municipalities (Keles, Gürsu, Mudanya, Karacabey) and 13 Sub-District Municipalities. There is no unique decision maker among official authorities (such as government and municipalities). There are several players who affect the decision making process in the watershed such as private enterprises and residents. Moreover, NGOs, the news media, the scientific and engineering community should be accepted as key actors (Bartone and others, 1994).

Planning and Environmental Legislations are examined to understand the roles and strategies of the authorities. The strategies of public authorities are formulated according to the publications in which ministries and local administrations explain their plans, programs and goals. In addition, the local authorities and the directors of the organized industrial districts were interviewed to determine the conflicts among them. The results of the analysis are seen below in Table 4.10. There is no doubt that every player has many strategies but they are chosen that affects the environment.

All players have strategies about environment and planning such as land use decision, waste water standard and discharge permitting etc. Some strategies conflict with the other players' strategies. Public authorities' roles are defined by laws and public agencies are all acting on behalf of the public benefit. However, they may not always take public benefit into consideration. For instance, the Regional Directorate of State Hydraulic Works trys to use surface water as drinking water whereas municipalities allow it to be used for industrial facilities, because they strive to increase industrial incomes. Furthermore, when players have the same strategies, it may cause conflicts. For example, authorities (the Ministry of Reconstruction and Settlement, the Ministry of Environment and Forestry and the Metropolitan Municipality) aim to prepare environmental structure plan, so they have conflict with each others.

Table 4.10 Roles of Public Authorities, Strategies and Conflicts in the Watershed (adapted from Başaran, 2003)

PLAYERS	ROLES	STRATEGIES	CONFLICTS
Bursa Metropolitan Municipality	Urban services and metropolitan area planning (Law no: 5216, 2004)	(1) to develop life quality (2) to increase municipality income (3) to solve environmental problems	(1) With the Ministry of Environment and Forestry and the Ministry of Agriculture and Rural Affairs about the “discharge standard” and “discharge permission”. (2) Concerning the protection of water resources, the Ministry of Environment and Forestry who has the authority to prepare special plans, the Ministry of Public Works and Settlement, the Ministry of Culture and Tourism and municipalities have conflicts,
District Municipalities of Metropolitan Municipality	Urban services and Land use planning (Law no: 5216, 2004)	(1) to develop of life quality (2) to increase municipality income (3) to solve environmental problems	(1) The conflicts increase when the Metropolitan Municipality and their district municipality belong to different political parties. They generally contradict and do not conform with planning decision.
District Municipalities	Urban services and land use planning (Law no: 5272, 2004)	(1) to develop life quality (2) to increase municipality income (3) to solve environmental problems	(1) Between municipalities that are willing to develop their industrial activities and agencies that prepare special purpose plans. (such as environment, housing, industry), (2) With the Ministry of Health concerning 2nd class "working licenses" for industrial plants, (3) Municipalities have conflicts concerning the responsibility of the pollution treatment costs.
Sub-District Municipalities	Urban services and land use planning (Law no:1580, 1930; Law no: 5272, 2004)	(1) to develop of life quality (2) to increase municipality income (3) to solve environmental problems	(1) There are authorization problems between sub-district municipalities and the Metropolitan Municipality especially when sub-district municipalities are within the metropolitan borders. Sub-district Municipalities want to act independently, so they do not follow the decision of master plans of metropolitan municipality.

Table 4.10 Roles of Public Authorities, Strategies and Conflicts in the Watershed (continue)

Ministry of Environment and Forestry and Provincial Directorate	To protect environment and natural resource, to improve environment, Environmental planning (Law no: 2872, 1983; Law no: 4856, 2003)	(1) to protect environment and natural resources (2) to develop standards of environmental quality (3) to monitor (4) to develop waste management systems	(1) With municipalities that avoid environmental infrastructure expenses, (2) With the Ministry of Public Works and Settlement concerning environmental master plan, (3) With municipalities concerning the "working licenses" for new investments with the environmental impact assessment process, (4) With the Ministry of Agriculture and Rural Affairs concerning the soil pollution, (5) With the Metropolitan Municipality and the Ministry of Agriculture and Rural Affairs concerning discharge standards, (6) With the Ministry of Industry and Commerce who does not oblige industries for developing infrastructure in the Organized Industrial Districts.
1st Regional Directorate of State Hydraulic	To plan surface and ground water resources, management and development (www.dsi.gov.tr)	(1) to supply drinking water (2) to develop dams and ponds	(1) With all the players who cause pollution, concerning the protection of water sources.
Ministry of Agriculture and Rural Affairs, and Provincial Directorate	To develop agricultural lands (Law no: 1380, 1973; Regulation of Protected of Agricultural Lands, 2005)	(1) to increase agricultural income (2) to develop harvest health standards	(1) With the municipalities that give housing and industrial permission for the agricultural lands, (2) With the Metropolitan Municipality and the Ministry of Environment and Forestry concerning "discharge criteria".
Ministry of Industry and Commerce and Provincial Directorate	To develop industry and commerce (Law no 4562, 2000)	(1) to increase industrial income (2) to develop product standards and encourage exportation	(1) The Ministry of Industry and Commerce which supports and builds Organized Industrial Districts, under the pressure of the municipalities concerning the location for Organized Industrial Districts.
Ministry of Public Works and Settlement, and Provincial Directorate	To define construction standards and planning in outlying municipalities areas (Law no:3194, 1985)	(1) to define and development construction, (2) to monitor (3) to develop of settlements	(1) With the Ministry of Environment and Forestry concerning environmental structure plans, (2) With the municipalities that do not follow environmental structure plans.

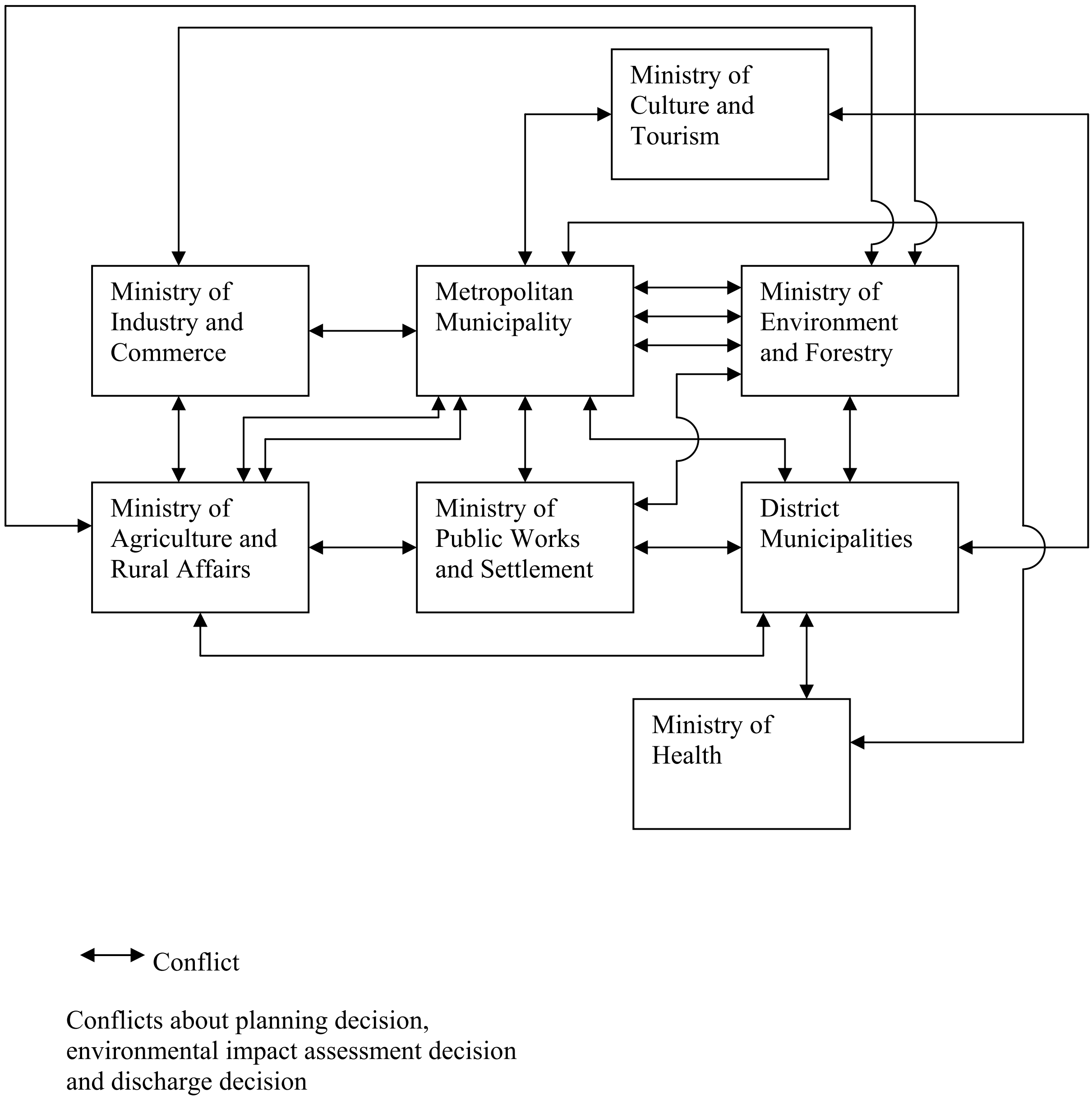

Figure 4.16 Conflicts among Authorities Regarding the Decision Making Process

It is indicated in Table 4.10 that there are conflicts among official agencies. Figure 4.16 ilustrates conflicts between decision makers.

Most obvious conflicts are about authority in preparing plans, and they are competing to be the approving authority. Moreover procedures related to discharge permits, emission permits and working licences have a complex decision making process. As we see in Table 4.10 and in Figure 4.16, conflicts among the public authorities occur at three levels. The first level of conflicts is between the central authorities (ministries) and the local authorities (municipalities). Municipalities want to have an affect on the decisions of central authorities, because they target rapid economic development. The second level of conflicts is among the central authorities. There are many authorities with the same power; they do not want to share it, and they do not want to lose it. The third level of conflicts is among local authorities because of competition among municipalities. However, the number of conflicts increases on decisions of the Metropolitan Municipality and the Ministry of Environment and Forestry. This situation is defined in Figure 4.16.

Land is expensive in the city centre; entrepreneurs tend to look for land outside, but yet still close to the centre. This increases the demand for industrial land within the boundaries of district municipalities and this situation brings with it the demand for housing. These district municipalities are competing with each other for more income so they can give permit to industry even though they do not fulfil the environmental legislation.

In 2004, with the revision of the law on municipalities, the Bursa Municipality is expected to enlarge its area of authority. If this happens, nearby industrial areas will be in the borders of the Bursa Metropolitan Municipality. This will effect the decision making process in a positive way. The Metropolitan Municipality will be the only decision making authority. Still, even then it is possible that industry grows unplanned outside the new area of coverage.

4.6 Conclusion

There are 45 authorities who make decisions on the environmental issues and planning in the watershed. It has been observed that there is a non-cooperative situation in the watershed, because a watershed planning and management system does not exist. All of them have their own tasks and each develop its strategy according to its own task. This situation has threatened the sustainability of water as a natural resource. These results confirm the first hypothesis of this study.

Environmental infrastructure in the Nilüfer Watershed is not even sufficient to fulfil the needs of its present population. There are sewerage systems in all the settlements that have municipality, but cesspools are used in villages. Furthermore, none of the settlements have wastewater treatment plants except the Bursa metropolitan area. Unfortunately, domestic wastewaters of other settlements are discharged directly into the Nilüfer Stream or its branches. The Bursa Organized Industrial District has only wastewater treatment plant. Approximately 588 plants are established (as of 2000) in Bursa Province, and 58,5 % of establishments –neither private sector nor public sector- do not have a wastewater treatment plant. Due to the increasing product costs, existing ones are not working effectively. Therefore, it can be proposed that authorities who are in charge of inspecting water pollution do not fulfil their duties. The second hypothesis is verifed according to these results.

Bursa is one of the rare cities in Turkey that has a strategic plan. However, despite the plan, cooperation among actors cannot be established and pollution cannot be prevented. Increasing pollution in the Nilüfer Stream stands as a proof. Therefore, new methods should be developed that confirm to the strategic plan and the determination of new strategies. One of the main reasons for not applying these strategies is conflicting benefits among agents and sectors. For this reason game theory can be used as an analysis method for the decision making process as this theory focuses on maximizing the benefit for all sides. Game theory can also be used to question the success of strategies beforehand and to develop effective strategies.

5. APPLICATION OF GAME THEORY TO THE DECISION MAKING PROCESS IN THE WATERSHED

We defined many decision makers who make decisions on environmental issues and planning in the Nilüfer watershed in the previous chapter. Moreover, some strategies of the decision makers are in conflict with each other and this situation negatively affected the environment. In this chapter, the interactive decision making process of these actors in the watershed by using a game theoretical approach is going to be examined. It is clear that there is a major conflict between industrial development and conservation of the environment in the watershed. We would like to reflect this dilemma in the application. Therefore, industrial location strategies and environmental protection strategies are selected, and two-person, non-cooperative games are analyzed.

The third and fourth hypotheses of this study are explored in this chapter. The third hypothesis claims "environmental infrastructure costs are not assessed in location decisions of industrial investments and feasibility. The strategy of location of the investors changes when environmental infrastructure costs are taken into consideration", and the fourth hypothesis asserts "in the state of cooperation between the decision makers. It is possible that the agents acquire optimum profit whereas the environment is not damaged". Two games are modeled to verify these hypotheses. The first game (Game I) represents present condition and decision making process, and the second game illistruates ideal situation in the Nilüfer Watershed. Games are played between the Bursa Metropolitan Municipality and a small scale textile enterprise.

5.1 Formulation of the Scenario: Industrial Location Decisions

The number of decision makers (players) is reduced by using a scenario in this study. Decision makers are called players. Although, there are many studies about solution of “n player games” in game theory (Von Neumann and Morgenstern, 1944; Nash, 1950a; Shapley, 1953; Rapoport, 1970), “two player games” are more explanatory for our study, because simplification is going to be useful for analyzing the decision making process. Scenarios are especially used in experimental studies such as war, politics, and economic problems (Shubik, 2002; Thomas, 1966; Fain and Philips, 1966; O’neill, 1994).

Different scenarios can be constituted to formalize the conflicts among players. For example, a scenario can explore the conflicts about land use decisions between the Ministry of Environment and Forestry and the Bursa Metropolitan Municipality. Although, the Ministry of Environment and Forestry has the authority to prepare the environmental plan for the watershed, the Bursa Metropolitan Municipality is the most important decision-maker about land use in the watershed. Another scenario suggestion can be the agriculture master plan which explores the conflicts between the Ministry of Agriculture and Rural Affairs and the Bursa Metropolitan Municipality. The water usage problem may be a topic in another scenario where the conflict of sharing fresh water among settlement, industry and agriculture is explored.

Municipalities plan new industrial areas, because they would like to increase their industrial income, and they provide incentives to investors regarding working permit and building permit. Consequently, decisions about industrial location and decisions about the environmental protection in the watershed are analyzed in this study. Thus, our scenario (game) relates to industrial location and its environmental costs. The first player is the Bursa Metropolitan Municipalities who is a leader player in the watershed, and the second player is an industrial enterprise who causes water pollution. In addition, the Bursa Metropolitan Municipality is represented by Player A, and industrial enterprise is represented by Player B. Furthermore, we prefer to define player A as she, and player B as he. Both players have finite pure strategies. A pure strategy is defined in the third chapter as “a specific move or action that a player will follow in every possible attainable situation in a game” (www.gametheory.net).

The results of the case study showed that there is no cooperation and co-ordination among players in the watershed. In addition, decision makers do not act appropriately according to the environmental legislation; economic development is priority for them. Therefore, our games are non-cooperative games. Games represent strategic form (matrix form). Time dimension is omitted, so our games are static games.

Two situations are represented by two games; present situation and ideal situation. Players have finite strategies and perfect information, and games are completed information games. Nash equilibrium is explored for solutions in both games. According to Nash (1951) “a finite non-cooperative game always has at least one equilibrium point”, and in a Nash equilibrium each agent plays the best response to the equilibrium strategies of the other agents. In other words, Nash equilibrium indicates the best decision for every player in non-cooperative situations (Eichberger, 1992).

These games are related to location problems, but they are different from Hotelling or Webarian location models (Stevens, 1961; Isard, 1967; Gabszewich and Thisse, 1992; Vega-Redondo, 2003). These location models deal with the best location for economy, whereas our model explores the best location for both economy and environment.

5.2 Aims of Games

Effluent standards and permission process change according to industrial location in the watershed. Furthermore, most of the factories have no wastewater treatment plant, and public authorities do not close the factories. For that reason, two games are modelled. Present condition and decision making process between the Bursa Metropolitan Municipality and a small industrial enterprise are illustrated in the first game (Game I). Players make decisions without considering environmental costs. Both players have this information, and each player knows what the other player knows. Under these circumstances, land price, infrastructure participation fee and permission process are important criteria for industrial enterprise.

On the other hand, ideal situation is represented in the second game (Game II), so players act with consideration of environmental costs. Namely, it is assumed that all public authorities apply environmental regulations and act, legally. Therefore, payoffs of players in the second game are determined by considering land price, infrastructure participation fee and permission process. Consequently, payoffs of strategies are not the same in Game I and Game II.

Both players would like to maximize their payoffs according to game theory. Games aim to analyze interactive decision making process and to evaluate strategies according to payoffs. Which strategies provide high gain payoffs? We are analyzing the effects of environmental costs on the behaviour of players, and we are going to explore which strategies are the best according to the decision makers. Furthermore, certain strategies may be best for a player, but these strategies can negatively impact on environment. Moreover, when players consider environmental costs, they may change their decisions. Additionally, the best strategies of Game II can be different from Game I. On the other hand, if players make a bargain, possibilities of increasing of payoffs are searched. The answers to these questions are discussed in the results of games.

5.3 Determination of Strategies and Rules

5.3.1 Strategies

The Bursa Metropolitan Municipality (player A), who puts decisions into practice in the watershed, makes a decision about land use and environmental infrastructure. On the other hand, industrial enterprise is another agent who determines industrial development and causes increasing industrial pollution. Industrial enterprises are assumed to be footloose small and medium scale textile enterprises which are sensitive to costs and control advantages provided by different location.

Strategic decisions in the Bursa 2020 Strategic Plan (1998) (Table 4.9) and common strategies of players (Table 4.10) in the watershed are discussed in the fourth cheapter. However, more descriptive and detailed information about these strategies are needed. Two basic topics are indicated in the Bursa Strategic Plan; environmental protection and economic development. Therefore, these two essential approaches are considered to determinate strategies of player A. First, player A would like to increase industrial income. Second, she would like to prevent industrial water pollution.

Definition of strategies proceeds as follow. The planning of newly organized industrial districts and industrial areas are suggested in the Bursa 2020 Strategic Plan, and the Bursa Metropolitan Municipality would like to increase industrial income, so the first strategy of player A (S_{A1}) is determined as "to plan new industrial areas in the watershed".

The Bursa Strategic Plan (1998) targets environmental protection and the reduction of industrial water pollution. In addition, the Bursa Metropolitan Municipality has developed certain protection strategies and projects for surface water pollution. The major projects are the improvement of the Bursa sewer system and the municipal wastewater treatment plant. Furthermore, the Bursa Metropolitan Municipality aims to develop a sewerage system outside the metropolitan area (Report of Wastewater Master Plan, 2002). Thus, the second strategy (S_{A2}) is determined as "developing environmental infrastructure and monitoring-inspection systems in industrial areas in the watershed".

The Bursa Strategic Plan (1998) proposes to direct industrial investments to organized industrial districts, because it has provision to control industrial pollution. Therefore, the third strategy (S_{A3}) of player A is determined as "to direct new industrial investments to organized industrial districts". The Bursa Metropolitan Municipality is also planning to move the industrial (especially the leather and textile factories) sector from the central area to the organized industrial districts (Bursa Strategic Plan, 1998; Bursa Metropolitan Municipality, 2003). Hence, the forth strategy (S_{A4}) of player A is determined as "to move industries from the inner city and the Bursa plain direct them to organized industrial districts". For this reason, a newly leather organized industrial district has been built down-stream. However, organized industrial districts have not yet solved their environmental infrastructure problems. To illustrate, the Bursa Organized Industrial District (BOSAB) was constructed in 1961, and the common wastewater treatment plant was built in 1998 (Bursa Environmental Report, 2000; web site of BOSAB). There are 6 organized industrial districts in the watershed, and they do not have a common wastewater treatment plant except the Bursa Organized Industrial District.

On the other hand, most of the factories do not have individual wastewater treatment plants. Moreover, most of the factories that have treatment systems do not use them effectively because they have increased production costs (Bursa Environmental Report, 2000; Bursa Metropolitan Municipality, 2004). Therefore, the fifth strategy (S_{A5}) of player A is defined as " to cancel working permits of plants which have unacceptable effluent standards".

Another problem is the spread of pollution into down-stream. The Bursa Metropolitan Municipality is negatively affected by the up-stream pollution, so "preventing a new polluting industry in the up-stream" is emerging as another strategy (S_{A6}). There are four municipalities on the up-stream (Gürsu, Kestel, Orhaneli, Keles), and the Municipality of Gürsu and Keles which are located to close Bursa city. The Municipalities of Gursu and Keles have targeted industrial development within their area. On the other hand, the stream is mainly polluted in the Bursa Metropolitan Municipality area, and down-stream settlements (Karacabey and Mustafa Kemal Paşa) do not use the stream for domestic purposes or irrigation. To sum up, it can be proposed that there is a conflict between up-stream's municipalities and the down-stream's municipalities about the use of surface water.

In addition, the Ministry of Environment and Forestry is responsible for "discharge permit" outside the Bursa Metropolitan Municipality borders (Regulation of Water Pollution Control, 2004). Moreover, the Ministry of Environment and Forestry has higher wastewater standards than the standards of the Bursa Metropolitan Municipality do (Regulation of Water Pollution Control, 2004; Regulation of Metropolitan Municipalities Wastewater Discharge, 1998). However, the Ministry of Environment and Forestry does not have enough personnel and sufficient budget for monitoring and inspection. Under these circumstances, behaviours of municipalities gain importance. Municipalities prefer to increase their income; so they are easier on handing out permits for industrial investments. Therefore, there is a competition among the municipalities in the watershed to enlarge their industrial areas, and because of this competition, agricultural areas are being lost.

In conclusion, 6 pure strategies are determined for player A (Bursa Metropolitan Municipality);

S_{A1} – to plan new industrial areas in the watershed,

S_{A2} - to develop environmental infrastructure and monitoring-inspection systems in industrial areas in the watershed,

S_{A3} - to direct new industrial investments to organized industrial districts,

S_{A4} -to move industries from inner city and Bursa plain and direct them to organized industrial districts,

S_{A5} – to cancel working permit of plants that have unacceptable effluent standards,

S_{A6} – to prevent the up-stream from the polluting industry.

Indeed, the Metropolitan Municipality has no authority outside of the metropolitan borders. However, the Metropolitan Municipality who is the lead player can put pressure on the Ministries or the Provincial Government to the planning decisions. For instance, in the sixth strategy (S_{A6}), player A has developed the strategy for outside the Metropolitan Municipality. The possibility of pressure is assumed in this strategy.

On the other hand, industrial enterprise, which is represented by player B, would like to minimize his investment cost and operating expense, so he chooses cheaper land that can be permitted easily. Indeed, there are many factors that effect industrial location on a macro level (such as proximity of market, proximity of raw material, and proximity of labour force, etc.) (Bölen, 2003). However, it is assumed that player B evulated these location factors and then he decided to locate in the watershed. Thus, industrial location alternatives on a micro level are explored in games. In addition, it is certain that infrastructure conditions are the same in all waterhed (such as transportation facilities, supplying of electricity and fresh water facilities). Bölen (2003) indicates that land price, infrastructure facilities and the provision of local incentives gain importance for industrial location on a micro level.

Conclusionally, industrial location alternatives of a small textile company in the watershed are accepted as strategies of player B. Which location alternative is more advantageous for industrial enterprise? The answers to these questions are discussed below determination of payoffs of player B. Player B (industrial enterprise) has 7 pure strategies related to location;

S_{B1} –to locate in the organized industrial districts of the Bursa Metropolitan Municipality where the infrastructures are completed,

S_{B2} –to locate in the organized industrial districts of the Bursa Metropolitan Municipality where the infrastructures are incomplete,

S_{B3} -to locate in the organized industrial districts in the up-stream,

S_{B4} -to locate in the organized industrial districts in the down-stream,

S_{B5} –to locate in the industrial area in the up-stream district or sub-district municipality,

S_{B6} –to locate in the industrial area in the down-stream district or sub-district municipality,

S_{B7} –to locate outside the municipalities of metropolitan and districts in the up-stream area,

6 x 7 matrixes are used in both games in this study. Indeed, this matrix size is big for an experimental study. Shubik (2002) suggests using 2 x 2 matrixes in experimental games. He (p. 2333, 2002) says "the 2 x 2 matrix game has been a major source for the provision of didactic examples and experimental games for social scientists with interests in game theory". However, it is clear that some large matrix application. For instance, Stevens (1961) uses the 5 x 5 matrix in location model. All basic strategies of player A and B are evaluated in our model. Equilibrium points are explored, but what is important to us is which strategies are more preferable. On the other hand, a large matrix can be used in strategic form with pure strategy. Furthermore, Shubik (2002) specifies that if a matrix has considerable regularities (continuous payoff functions), the use of a large matrix is suitable. Same player and same strategies are used in both games.

5.3.2 Rules

Both the games are two-person, non-cooperative games. Player A has 6 strategies, and player B has 7 strategies, so the games are finite games. Nash equilibrium is explored in the games for solution.

There exist uncertainties that affect enterprises' behaviour. It is possible to have hidden goals as well as the obvious ones in the determination of strategies. For instance, increasing municipality incomes is a necessity for better service, and increasing the income is a dominant strategy. There is another strategy which is more dominant, but not spoken aloud, such as collecting more votes in the next election. Such hidden goals are considered in the determination of the strategy if they have the possibility of leading to important environmental decisions. For example, the municipality's environmental policies can change together with the change of the mayor after the next election. Furthermore, the permission process of industrial investment can be harder or easirer according to the behaviour of municipalities.

The second uncertainty is about the effluent standards. The effluent standards change according to the location of investment. The Bursa Metropolitan Municipality is the authority inside the Metropolitan Municipality borders, and the Ministry of Environment and Forestry is the authority outside the Bursa Metropolitan Municipality borders. The Bursa Metropolitan Municipality has two different effluent standard types which are called the pretreatment standards and the standards of the disposal in nature (Regulation of Metropolitan Municipalities Wastewater Discharge, 1998). There are some differences between discharges in sewer systems and natural areas. For example, plants may discharge more polluted wastewater to the sewer than to the natural area. On the other hand, some surface waters are accepted as a sewer by the Bursa Metropolitan Municipality. If a plant is in the organized industrial district, it may discharge more polluted wastewater than it would to the sewer of the city because the organized industrial district has common wastewater treatment plant.

Effluent standards are important for industrial enterprise, because of investment and operating costs of wastewater treatment plant. Despite the existence of a large body of environmental legislation, most of the plants do not have a wastewater treatment plant, or if they do, they do not work. This situation creates unjust competition among investors. Thus, it is obvious that industrial enterprise makes decisions under uncertainy. Municipalities permit industrial investment easily, but if municipalities alter their strategies, plants may be closed by municipalities. Therefore, some assumptions are accepted in the games, so making a decision under certainty is provided. In addition, both games are assumed as perfect information games. Games, in which each player knows exactly what has happened in previous moves, are called games with "perfect information" (Gardner, 1995; Ritzberger, 2002; Mycielski, 1992; Myerson, 1991).

In Game I, municipalities would like to increase industrial income, so they try to extend industrial areas. On the other hand, industrial enterprise has this information. Namely, player B knows that his plant will not be closed even if he does not conform to the effluent standards. Therefore, industrial enterprise does not consider environmental costs, so land price and permission process are the most important criteria for player B.

In Game II, It is all players conform to laws and plans assumed that each of the players knows the opponent's information and rules in both game. If every player knows the rules and payoff function of a game, a game is a complete information game, so Game I and Game II are "complete information games". Moreover, the main assumption of the non-cooperative game is that it studies games of complete information (Vego-Redondo, 2003; Fudenberg and Tirole, 1996). Furthermore, a strategic form game considers a personal move because of the assumption of rationality. In addition, if a strategic form is used, players make decisions, simultaneously. Therefore, we accept that players make personal moves and make decisions simultaneously and the games are one-shot and static games.

Game I and Game II are non-zero sum games. In general, non-zero sum games represent real life situations better than zero-sum games. In the zero-sum games, one player wins and other player loses (Luce and Raiffa, 1967; Ritzberger, 2002). However, both of the players may win or lose, at the same time. Furthermore, the amount of loss or gain does not need to be equal. Therefore, most games of interest in the social sciences are non-zero sum games.

5.3.3 Payoffs

Associated with every possible game played there is a certain outcome for each of the different players. Payoff magnitudes, which are real numbers, are interpreted as utilities (Vega-Renondo, 2003). Generally, in many of the experiments with matrix games the payoffs have tended to be money, but some other measurement units are also used such as distance unit, time unit. However, in most experimental work, frequently, pre-analysis is made to obtain individual measures before the experiment (Shubik, 2002).

When we have a look over the previous studies, it is observed that money and distance units are used symbolically to determine payoffs. For example, Stevens (1961) describes a simple linear market, forty units long, with possible locations five points spaced equally along it. He explores the best location for each seller who would like to decrease transportation costs and extend marketing. Assume that the price for both sellers I and II is $1 per unit. In short, Stevens (1961) determined the payoffs by money and distance. Maler and Zeeuw (1998) use the values of sulphur emit (ton) per year and total area of countries for determination of payoffs. On the other hand, in some decision problems, it is not possible to measure payoffs with money or distance. Isard and Reiner (1962) discuss that one component of an outcome vector might measure profit, another prestige, a third life-expectancy, etc. They (1962) suggest adopting a three way classification such as +1, 0, -1 (satisfactory, neutral and unsatisfactory or win, draw and lose or increased assests, unchanged assets and decreased assest). The method of taxonomy is used as another technique for measurement of utility. For example, “4” is used for the most desired outcome and 1 for the least desired (Shubik, 2002).

Nijkamp (1980) has analyzed seven alternative plan decisions’ preference for interest groups in a cement factory which has important environmental impacts. He has used a “multidimensional scaling method” in his analysis. These alternatives are to be judged on the basis of various evaluation criteria. Three main criteria have been distinguished, economic, social and environmental and these three main criteria have been subdivided into thirteen criteria. These 13 subcriteria were evaluated in one matrix for seven decision alternatives, in other matrix they were evaluated from interest groups’ point. Matrix includes only qualitative information based on ordinal figures varying from 1 to 4. Element 1 means a high positive impact while element 4 means a very negative impact. In the last matrix, plan decisions were based on ordinal figures varying from 1 to 7. These ordinal numbers reflect the most desirable (1) or the least desirable (7) plans.

5.4 Data for Determination of Payoffs

In this study, firstly, a pre-analysis method is used like Shubik’s (2002) taxanomy method. Strategies were evaluated by qualitative scores that were measured on a plus (+) and minus (-) scale. More plus signs indicate the higher payoff and more minus signs the lower payoff. However, we needed a more descriptive method for determination of payoffs. Secondly, in our study, Nijkamp’s (1980) qualitative evaluation method is used to determine payoffs. For Player A strategies were classified as increased assets, unchanged assets and decreased assets, as for Player B some values like land prices, environmental costs were assessed to determine which would be preferred. Symbolic payoffs were set according to the results. However in this study, payoffs change according to the preference of the other player. In other words, an interactive decision making process is analyzed.

5.4.1 Data for Game I

Land prices in the city centre have risen because of the shortage of industrial areas. Therefore, industrial enterprises prefer to locate close to urban areas (Bursa Strategic Plan, 1998). We have interviewed the authorities of organized industrial districts and municipalities (2005) in the watershed to determine land prices and infrastructure participation fees. Enterprises have to pay infrastructure costs in certain organized industrial districts, and these costs affect the decisions of player B. Infrastructure participation fees are different from environmental infrastructure cost, they include transportation, green areas, common areas etc. The infrastructure participation fees and land prices of industrial areas are shown in Table 5.1.

As shown in data (Table 5.1), land prices in industrial areas change from 40 \$ to 150 \$. The Bursa Organized Industrial District (BOSAB) has the highest infrastructure cost, because the BOSAB is unique organized industrial district where the infrastructure is completed. The Demirtaş Organized Industrial District (DOSAB), which locate outside the border of the Metropolitan Municipalty, has the highest land price and it has second high infrastructure costs. Environmental infrastructure has developed in the DOSAB. In addition, the municipalities’ industrial areas are cheaper than organized industrial districts because of the competition among municipalities and due to the diversity of the land supplied by the municipalities.

Table 5.1 Land Prices and Infrastructure Participation Fees in the Watershed

Industrial areas and year of establishment	Location	Common wastewater treatment plant	Land prices ($ / m^2)	infrastructure participation fees ($ / m^2)
Bursa O.I.D.* (1961)	Metropolitan Municipality	Exist	125	34, 54
Nilüfer O.I.D. (2001)	Metropolitan Municipality	Non existent	50-90	5
Batı O.I.D. (2003)	Down-stream	Non existent	40-50	Non existent
Demirtaş O.I.D. (1990)	Up-stream	building	150	10,15
Ketsel O.I.D. (2004)	Up-stream	Non existent	80	9
Gürsu O.I.D. (2001)	Up-stream	Non existent	80-110	3,54
Deri O.I.D	Down-stream	Non existent	-	Non existent
Kestel Municipality	Up-stream	Non existent	80	Non existent
Karacabey Municipality	Down-stream	Non existent	60	Non existent
Unplanned area	Up-stream	Non existent	40	Non existent

* O.I.D; Organized Industrial District

Besides, infrastructure participation fees also vary in this region. In organized industrial districts, fees are high but in some industrial terrains there is no fee at all. Furthermore, as municipalities are willing to attract industry to their areas, they simplify the procedures and keep planning new industrial areas. Organized industrial districts in the watershed area are indeed what once district municipalities developed; these received an “organized” status later. Moreover, unplanned land around organized industrial districts and industrial areas are heavily under the threat of industry. On this kind of land, local development plans are valid and industrial plants can only be permitted by these. Regarding personal interviews with organized industrial district and municipality officials, it became clear that lands within the metropolitan municipality borders are more expensive than those either in up-stream area or in the watershed. The lowest value for land is on the west side at down-stream.

Furthermore, permission process in industrial areas is easier than in organized industrial districts. Industrial enterprises are concerned about the abundance of bureaucracy in the organized industrial districts. In fact, a similar process is followed in other industrial plants but as the municipalities wish to attract industry in their areas, they ease the permission process. Unplanned areas (see in Table 5.1) are close to industrial areas of municipalities, but an environmental structure plan (or master plan) has not been developed for these areas. Therefore, local planning decisions are developed in these areas by municipalities.

Some of the Organized Industrial Districts and industrial areas in Table 5.1 are used as a sampling area for the determination of player B's payoffs. For example, the Bursa Organized Industrial District is chosen for the first strategy (S_{B1} –to locate in the organized industrial districts of Bursa Metropolitan Municipality where the infrastructures are completed), and the Nilüfer Organized Industrial Districts are selected for the second strategy (S_{B2} –to locate in the organized industrial districts of Bursa Metropolitan Municipality where the infrastructures are incomplete). Gürsu Organized Industrial District is used as sampling area to determine the payoffs of the third strategy (S_{B3} -to locate in the organized industrial districts in the up-stream), and Batı Organized Industrial District is used as sampling area to define the fourth strategy (S_{B4} -to locate in the organized industrial districts in down-stream).

All these industrial areas have different land price and infrastructure participation fee, and it is assumed that industrial enterprise prefers the cheapest land. These criteria are ordered from the least preferable (7) to the most preferable (1) like Nijkamp (1980) models (see in Table 5.2). A qualitative preferences index is formed to consider land prices, infrastructure participation fees and permission precess. This index table is shown to be the initiative preference of player B. For instance, the Bursa Organized Industrial District has the highest land price and infrastructure participation fee, so player B does not prefer this district. This situation is symbolized as "7". At tha same time, player B does not alter an Organized Industrial Districts because of the permission process (3).

Table 5.2 A Qualitative Preference Index for Player B in Game I

Strategies	Location	Permission process index	Land price/ infrastructure participation fee index	Index of preferences
S_{B1}	Bursa Organized Industrial District	3 (the worst)	7 (the worst)	6 (the worst)
S_{B2}	Nilüfer Organized Industrial District	3 (the worst)	5	4
S_{B3}	Gürsu Organized Industrial District	2	6	5
S_{B4}	Batı Organized Industrial District	2	3	3
S_{B5}	Up-stream municipality area	1 (the best)	4	3
S_{B6}	Down-stream municipality area	1 (the best)	2	2
S_{B7}	Unplanned area in up-stream	1 (the best)	1 (the best)	1 (the best)

Payoffs are determinated according to the index of preferences. For example, permission process in municipalities' industrial areas is easier than organized industrial district. When organized industrial districts are the least preferable (3) areas, industrial areas are preferable (2) areas for player B. Furthermore, unplanned areas are more preferable (1) alternatives according to permission precess. Namely, the number 1 indicates the best choice of player B. The Bursa Organized Industrial District is the worst choice according to land price, participation fee (7) and permission process (3). Gürsu Organized Industrial District follows it according to land price and participation fee (6), but permission process is preferable (2). Conclusionally, strategies ordered from the most preferable (1) to the least preferable (6) strategies in pereferences index in the last column.

5.4.2 Data for Game II

In the second game, players will consider both economic benefit and environmental cost. The Bursa Metropolitan Municipality would like to increase industrial income, but she knows that this choice increase her environmental cost. Similarly, player B considers land price, infrastructure participation fee, permission process and environmental cost, together. Wastewater treatment costs are considered to determine payoffs of player B. Wastewater treatment plant costs change according to the location of administrative units, due to effluent standards. The Bursa Metropolitan Municipality has two types of effluent standards; pretreatment standard and standard of disposal to the nature. For instance, if a factory is inside the Bursa Metropolitan Municipality and its discharges to sewerage, the discharge dose of chemical oxygen demand (COD) should not exceed 800 mg/l (Regulation of Metropolitan Municipalities Wastewater Discharge, Table 1, 1998). If a factory discharges to stream or is located outside the Metropolitan Municipality, the discharge consantration of chemical oxygen demand (COD) should not exceed 350 mg/l for textile sector (Regulation of Water Pollution Control, Table 10.1, 2004).

For example, it is assumed that a small scale textile plant has 1200 m^3/day discharge. This plant's wastewater treatment plant construction price is 106 000 € and operating price is 20 € /month in the Bursa Metropolitan Municipality. On the other hand, for the same plant's wastewater treatment plant, the construction price is 148 000 € and the operating price is 30 € /month outside the Bursa Metropolitan Municipality. If the plant is located in the organized industrial districts of the Bursa Metropolitan Municipality, its costs will decrease depending on the chemical oxygen demand discharge consantration of general wastewater treatment plant of the organized industrial district (Arge, 2004).

When players consider environmental and development legislation, permission process are eaiser in organized industrial district than unplanned areas. Therefore, preferences of player B on permission process will change. A qualitative preferences index and payoffs of player B are seen in Table 5.3.

Table 5.3 – A Qualitative Preference Index for Player B in Game II

Strategies	Permission process index	Land price and infrastructure participation fees index	Wastewater treatment plant cost index	Index of preferences
S_{B1}	1	7	1	1
S_{B2}	1	5	2	2
S_{B3}	1	6	3	3
S_{B4}	1	3	3	4
S_{B5}	2	4	4	6
S_{B6}	2	2	4	5
S_{B7}	3	1	4	7

Three index columns in the Table 5.3 are evaluated to determinate the preferences index of player B. The industrial investor's choices are displayed according to wastewater treatment plant costs. Thus in order to minimize environmental infrastructure costs, Player B would prefer first strategy (S_{B1} –to locate in the organized industrial districts of the Bursa Metropolitan Municipality where the infrastructures are completed) then the other strategies. Furthermore, the seventh strategy (S_{B7} –to locate outside the municipalities of metropolitan and districts in the up-stream area) is worst strategy for player B. Conclusionally; preferences index is determined according to the three indexes for player B. When the first strategy of player B is the most preferable (1), the seventh strategy is the least preferable (7) according to preferences index.

5.5 Determination of the Payoffs in Game I

5.5.1 Payoffs of Player A in Game I

In Game I, players do not think about environmental costs. For that reason, payoffs do not reflect environmental costs. Two basic criteria are evaluated when payoff values are determinated. First, the strategy of player A realizes which depends the decision of player B. For example, player A plans to direct new industrial investments to organized industrial districts (S_{A3}), when player B prefers to locate to an organized industrial district (S_{B1}, S_{B2}, S_{B3}, or S_{B4}), the strategy of player A realizes. On the other hand, if player B chooses to locate outside of the organized industrial district (S_{B5}, S_{B6} or S_{B7}), the strategy of player A (S_{B1}, S_{B2}, S_{B3}, or S_{B4}) does not realize. Second, it is explored which strategy causes an increase or a decrease in income. For instance, if player B prefers to locate inside the Metropolitan Municipality (S_{B1} or S_{B2}), the industrial income of player A rises. On the other hand, if player B prefers to locate outside the Metropolitan Municipality (S_{B3}, S_{B4}, S_{B5}, S_{B6}, or S_{B7}), the industrial income of player A decreases.

Two criteria and outcomes are shown below in Table 5.4. Outcomes are arranged from maximum to minimum value such as (20), (10), (0), (-10), and (-20) for player A. Sum of outcomes gives payoffs.

Table 5.4 The Strategies Evaluation Criteria in Game I

	Criteria	Outcomes
1	Strategy fulfilled	20
	Strategy unfulfilled	-20
2	Industrial income increased	10
	Industrial income not increased	0
	Industrial income decreased	-10
	Costs increased	-10

Indeed, payoffs may change according to opponent's choice. For example, the strategy of player A may realizes (20), but player A may lose industrial income (-10), at the same time. Consequently, the payoff of player A is the calculated sum of the outcomes such as (20) + (-10) = 10. The choice of player A and the alternatives of player B's decisions are shown in Table 5.5 for Game I.

It is illustrated in Table 5.5., when player A chooses her first strategy (S_{A1} – to plan new industrial areas in the watershed), if player B prefers strategy of S_{B1} and S_{B2}, the first strategy of player A (S_{A1}) realizes (20), and the industrial income of player A increases (10), so the payoffs of player A will be 30 units. On the other hand, if player B chooses one of the S_{B3}, S_{B4}, S_{B5}, S_{B6}, the strategy of player A (S_{A1}) realizes (20), but the industrial income of player A does not increase (0), because player B has not chosen an area inside the Metropolitan Municipality, so the payoffs of player A will be 20 units. Otherwise, if player B chooses the S_{B7}, strategy of player A (S_{A1}) does not realize (-20), because player A would like to extend the industrial areas in the watershed whereas player B has preferred to locate outside the industrial areas. Moreover, the industrial income of player A does not increase (0), so the payoffs of player A will be -20 units.

Table 5.5 Payoffs of Player A in Game I

Player A	Player B	Realization of strategy	Industrial income, increase/decrease	Increasing cost	Payoff
S_{A1}	S_{B1}	20	10	0	30
	S_{B2}	20	10	0	30
	S_{B3}	20	0	0	20
	S_{B4}	20	0	0	20
	S_{B5}	20	0	0	20
	S_{B6}	20	0	0	20
	S_{B7}	-20	0	0	-20
S_{A2}	S_{B1}	20	10	-10	20
	S_{B2}	20	10	-10	20
	S_{B3}	20	0	-10	10
	S_{B4}	20	0	-10	10
	S_{B5}	20	0	-10	10
	S_{B6}	20	0	-10	10
	S_{B7}	-20	0	0	-20
S_{A3}	S_{B1}	20	10	0	30
	S_{B2}	20	10	0	30
	S_{B3}	20	0	0	20
	S_{B4}	20	0	0	20
	S_{B5}	-20	0	0	-20
	S_{B6}	-20	0	0	-20
	S_{B7}	-20	0	0	-20
S_{A4}	S_{B1}	20	10	0	30
	S_{B2}	20	10	0	30
	S_{B3}	20	-10	0	10
	S_{B4}	20	-10	0	10
	S_{B5}	-20	-10	0	-30
	S_{B6}	-20	-10	0	-30
	S_{B7}	-20	-10	0	-30
S_{A5}	S_{B1}	-20	0	0	-20
	S_{B2}	-20	0	0	-20
	S_{B3}	-20	0	0	-20
	S_{B4}	-20	0	0	-20
	S_{B5}	-20	0	0	-20
	S_{B6}	-20	0	0	-20
	S_{B7}	-20	0	0	-20
S_{A6}	S_{B1}	20	10	0	30
	S_{B2}	20	10	0	30
	S_{B3}	-20	0	0	-20
	S_{B4}	20	0	0	20
	S_{B5}	-20	0	0	-20
	S_{B6}	20	0	0	20
	S_{B7}	-20	0	0	-20

When player A chooses the second strategy (S_{A2} - to develop environmental infrastructure and monitoring-inspection systems in industrial areas in the watershed), the expense of player A rises except outside unplanned areas, because player A plans to develop environmental infrastructure only in industrial areas. For that reason, when player B chooses the strategy of S_{B1} and S_{B2}, player A wins (20) units, and player B alters the strategy of S_{B3} and S_{B4}, player A gains (10) units, and player B prefers the strategy of S_{B7}, player A loses (-20) units.

While player A chooses her third strategy (S_{A3} - to direct new industrial investments to organized industrial districts), if player B selects S_{B1} and S_{B2}, industrial income of player A increases (10), and the goal of player A realizes (20), so the payoff of player A will be 30 units. If player B chooses the strategy of S_{B3}, S_{B4}, the industrial income of player A does not increase (0), because player B has not chosen an area inside the Metropolitan Municipality. However, the goal of player A realizes (20), because player B has chosen an organized industrial district, so the payoff of player A will be 20 units. On the other side, if player B chooses S_{B5}, S_{B6}, and S_{B7}, the industrial income of player A does not increase (0), in addition, the goal of player A does not realize (-20), because player B does not prefer to locate in Organized Industrial District, so the payoff of player A will be (-20) units.

After player A chooses her fourth strategy (S_{A4} -to move industries from the inner city and the Bursa plain direct them to Organized Industrial Districts), if player B prefers to locate in the Metropolitan Municipality (S_{B1} and S_{B2} strategies), the industrial income of player A increases (10), and the goal of player A realizes (20), so the payoff of player A will be (30) units. When player B chooses to locate in an organized industrial districts (S_{B3} and S_{B4} strategies), the industrial income of player A decreases (-10), because player B moves from the inner city to outside the Metropolitan Municipality. However, the goal of player A realizes (20), because player B prefers to an organized industrial districts, so the payoff of player A will be 10 units. If player B selects other strategies (to locate outside an organized industrial districts and outside the Metropolitan Municipality, S_{B5}, S_{B6}, and S_{B7}), the industrial income of player A decreases (-10), in addition, the goal of player A does not realize (-20), so the payoff of player A will be -30 units.

Indeed, it is assumed that players do not act legally in Game I, so the factories, which have unacceptable effluent standards, will not be closed. Thus, although player A defined the fifth strategy (S_{A5}) as "to cancel the working permits of plants that have unacceptable effluent standards", her fifth strategy (S_{A5}) will not realize. Therefore, when player A chooses the fifth strategy (S_{A5}), player B decides whatever his strategies, income does not change for player A (0), and her strategy does not realize (-20), so the payoff of player A will be -20 units

The sixth strategy (S_{A6}) of player A is determined as "to prevent the up-stream from the polluting industry". When player B chooses the strategies of location in up-stream (S_{B3}, S_{B5} and S_{B7}), the factories should be closed. However, players know that these factories will be not closed. Namely, if player B chooses the strategies of location in up-stream (S_{B3}, S_{B5} and S_{B7}), player A will not close these factories, so the industrial income of player A does not increase or decrease (0), and the goal of player A does not realize (-20), consequently the payoff of player A will be -20 units.

On the other hand, if player B prefers the strategies the location in the Metropolitan Municipality (S_{B1} and S_{B2}), the industrial income of player A increases (10), so the payoff of player A will be 30 units. If player B selects the strategies of location in down-stream (S_{B4}, S_{B6}), the industrial income of player A does not increase or decrease (0), so the payoff of player A will be 20 units.

5.5.2 Payoffs of Player B in Game I

Player B and player A make decisions without regard to environmental costs in Game I. For that reason, the payoffs of player B are determined according to land price, infrastructure patticipation fee and permission process in Game I. To sum up, player B prefers the cheapest land and the easiest permission process because of maxsimization of payoffs.

Preferences index of player B is formed in Table 5.2. The payoffs of player B are determined according to the index. For instance, the first strategy is the least preferable for player B, so the payoff of the first strategy has the lowest value (5). On the contrary, the seventh strategy is the most preferable strategy, so the payoff of the seventh strategy has the highest value (30). Payoffs are ordered from “5”, “10”, “15”, “20”, 25” to “30”.

Table 5.6 Payoffs of Player B in Game I

Strategies	Location	Index of preferences	Payoff
S_{B1}	Bursa Organized Industrial District	6	5
S_{B2}	Nilüfer Organized Industrial District	4	15
S_{B3}	Gürsu Organized Industrial District	5	10
S_{B4}	Batı Organized Industrial District	3	20
S_{B5}	Up-stream municipality area	3	20
S_{B6}	Down-stream municipality area	2	25
S_{B7}	Unplanned area in up-stream	1	30

Some of the strategies of player A may cause an increase in land prices. For example, when player A directs new industrial investment to organized industrial districts, land prices may increase there, or if industrial facilities are forbidden in the up-stream, land prices may decrease. In spite of the fact that the payoffs of player B are assumed constant whatever the strategies of player A are. However, the payoffs of player A change according to the choices of player B in Game I. The payoff matrix of player A and player B are shown in Table 5.7.

Table 5.7 Payoff Matrix for Game I

		Player B						
		S_{B1}	S_{B2}	S_{B3}	S_{B4}	S_{B5}	S_{B6}	S_{B7}
Player A	S_{A1}	30, 5	30, 15	20, 10	20, 20	20, 20	20, 25	-20, 30
	S_{A2}	20, 5	20, 15	10, 10	10, 20	10, 20	10, 25	-20, 30
	S_{A3}	30, 5	30, 15	20, 10	20, 20	-20, 20	-20, 25	-20, 30
	S_{A4}	30, 5	30, 15	10, 10	10, 20	-30, 20	-30, 25	-30, 30
	S_{A5}	-20, 5	-20, 15	-20, 10	-20, 20	-20, 20	-20, 25	-20, 30
	S_{A6}	30, 5	30, 15	-20, 10	20, 20	-20, 20	20, 25	-20, 30

Player A’s pure strategies are represented by the rows of the matrix (player A is the “row player”) and player B’s pure strategies are represented by the columns of the matrix (player B is the “column player”). The left entry is Player A’s pay off and the right, player B’s.

5.6 Equilibrium of Game I

Both of the players know each other's payoffs and they would like to choose the best strategy for themselves. Players do not make an agreement before Game I, so Game I is a non-cooperative game. Player A makes a decision and after player B chooses his stategy.

Maximum payoffs are the results of the choices that are indicated with bold characters in Table 5.8. When player A chooses the S_{A1} (to plan new industrial areas in the watershed), player B will prefer the S_{B7} (to locate outside the municipalities in up-stream) which has maximum payoff, so player B wins "30", and player A loses "-20". While player A chooses the S_{A2} (to develop environmental infrastructure in the watershed), player B selects the S_{B7} strategy, again, because it maximizes his payoff. Thus, player B wins "30" unit whereas player A loses "-20" unit. When player A chooses the S_{A3} (to direct new industrial investments to organized industrial districts), player B will prefer the S_{B7}, again. Thus, when player B wins "30" units, player A loses "-20" units. When player A chooses the S_{A4} (to move industries from inner city and Bursa plain and direct them to organized industrial districts), player B prefers the S_{B7} strategy, again. Thus, player B wins "30" but player A will loses "-30". After player A chooses her fifth strategy (S_{A5}, to cancel working permits of plants that have unacceptable effluent standards), player B prefers his seventh strategy (S_{B7}), again. Similarly, when player A chooses her sixth strategy (S_{A6}, to prevent the up-stream from the polluting industry), player B prefers his seventh strategy (S_{B7}).

Table 5.8 Nash Equilibriums in Game I.

		Player B						
		S_{B1}	S_{B2}	S_{B3}	S_{B4}	S_{B5}	S_{B6}	S_{B7}
Player A	S_{A1}	**30**, 5	**30**, 15	**20**, 10	**20**, 20	**20**, 20	**20**, 25	**-20, 30**
	S_{A2}	20, 5	20, 15	10, 10	10, 20	10, 20	10, 25	**-20, 30**
	S_{A3}	**30**, 5	**30**, 15	**20**, 10	**20**, 20	-20, 20	-20, 25	**-20, 30**
	S_{A4}	**30**, 5	**30**, 15	10, 10	10, 20	-30, 20	-30, 25	-30, **30**
	S_{A5}	-20, 5	-20, 15	-20, 10	-20, 20	-20, 20	-20, 25	**-20, 30**
	S_{A6}	**30**, 5	**30**, 15	-20, 10	**20**, 20	-20, 20	**20**, 25	**-20, 30**

The five pairs of strategies (S_{A1},S_{B7} ; S_{A2},S_{B7} ; S_{A3},S_{B7} ; $S_{A5}S_{B7}$ and $S_{A6}S_{B7}$) have maximum payoffs for both players in a non-cooperative situation. In short, there are five Nash equilibriums in Game I, as it is shown in Table 5.7. Player A loses 20 units while player B wins 30 units in Nash equilibrium points. Consequently, in Game I, whatever strategies player A chooses, she always loses (-20). On the other hand, player B wins maximum benefit (30).

Indeed, if players made an agreement before the game, they would win, together. For instance, if player A chose the first strategy (S_{A1} – to plan new industrial areas in the watershed) or sixth strategy (S_{A6} – to prevent the up-stream from the polluting industry), and player B chose the sixth strategy (S_{B6} –to locate in the industrial area in the down-stream district or sub-district municipality), player A would gain "20" units instead of "-20". However, player B won "25" units instead of "30". Furthermore, if location in unplanned areas can be prevented, player A can increase her payoff.

5.7 Determination of the Payoffs in Game II

In Game II, players consider land price, infrastructure participation fee, permission process and environmental cost, together. Namely, the difference between the first and the second game is that environmental costs are evaluated as a third criterion in the latter. In addition, all polluting companies have to build wastewater treatment plants; organized industrial districts have to finish environmental infrastructure in accordance with environmental legislation and strategic plan decisions in Game II. All players have to consider environmental regulations and standards. Hence, in Game II, it is assumed that all authorities and municipalities act legally and they apply environmental policies such as discharge standards. Therefore, in Game II, environmental costs affect the payoffs of players

5.7.1 Payoffs of Player A in Game II

According to the choices of player B, industrial income of player A inceases or decreases, and /or environmental costs of player A increases or deceases. Criteria and outcomes are shown below (Table 5.9). Outcomes are arranged from maximum to minimum value such as (20), (10), (0), (-10), and (-20) for player A.

Table 5.9 The Strategies Evaluation Criteria in Game II

	Criteria	Outcomes
1	Strategy fulfilled	20
	Strategy unfulfilled	-20
2	Industrial income increased	10
	Industrial income not increased	0
	Industrial income decreased	-10
	Costs increased	-10
3	Environmental costs increased	-10
	Environmental costs not increased	0
	Environmental costs decreased	10

First of all, player A makes a decision, after that player B alters his strategy. The payoffs of player A are assessed according to Table 5.9. Player A has increased industrial income (10), and decreased environmental cost (10), together. The payoffs of player A are calculated in Table 5.10.

As see in Table 5.10, when player A chooses her first strategy (S_{A1} – to develop new industrial areas in the watershed), if player B prefers the strategy of S_{B1} and S_{B2}, the first strategy of player A (S_{A1}) realizes (20), and the industrial income of player A increases (10), but the environmental cost also rises (-10), so the payoffs of player A will be "20" units. If player B chooses one of the S_{B3}, S_{B4}, S_{B5}, or S_{B6}, the strategy of player A (S_{A1}) realizes (20), but the industrial income of player A does not increase (0). In addition, the environmental cost of player A increases (-10), if player B prefers the strategies S_{B3}, S_{B5}, S_{B7}. Thus, when player B chooses the S_{B3} and S_{B5}, player A wins "10" units. If player B prefers the strategies S_{B4} or S_{B6}, player A wins "20" units. On the other hand, if player B chooses the strategy S_{B7}, player A loses "-30" units.

Table 5.10 Payoffs of Player A in Game II

Player A	Player B	Realization of strategy	industrial income, increase/ decrease	Increasing cost	environmental costs, increase/ decrease	Payoff
S_{A1}	S_{B1}	20	10	0	-10	20
	S_{B2}	20	10	0	-10	20
	S_{B3}	20	0	0	-10	10
	S_{B4}	20	0	0	0	20
	S_{B5}	20	0	0	-10	10
	S_{B6}	20	0	0	0	20
	S_{B7}	-20	0	0	-10	-30
S_{A2}	S_{B1}	20	10	-10	-10	10
	S_{B2}	20	10	-10	-10	10
	S_{B3}	20	0	-10	-10	0
	S_{B4}	20	0	-10	0	10
	S_{B5}	20	0	-10	-10	0
	S_{B6}	20	0	-10	0	10
	S_{B7}	-20	0	0	-10	-30
S_{A3}	S_{B1}	20	10	0	-10	20
	S_{B2}	20	10	0	-10	20
	S_{B3}	20	0	0	-10	10
	S_{B4}	20	0	0	0	20
	S_{B5}	-20	0	0	-10	-30
	S_{B6}	-20	0	0	0	-20
	S_{B7}	-20	0	0	-10	-30
S_{A4}	S_{B1}	20	10	0	-10	20
	S_{B2}	20	10	0	-10	20
	S_{B3}	20	-10	0	-10	0
	S_{B4}	20	-10	0	0	10
	S_{B5}	-20	-10	0	-10	-40
	S_{B6}	-20	-10	0	0	-30
	S_{B7}	-20	-10	0	-10	-40
S_{A5}	S_{B1}	20	-10	0	10	20
	S_{B2}	20	-10	0	10	20
	S_{B3}	20	0	0	10	30
	S_{B4}	20	0	0	0	20
	S_{B5}	20	0	0	10	30
	S_{B6}	20	0	0	0	20
	S_{B7}	20	0	0	10	30
S_{A6}	S_{B1}	20	10	0	-10	20
	S_{B2}	20	10	0	-10	20
	S_{B3}	-20	0	0	-10	-30
	S_{B4}	20	0	0	0	20
	S_{B5}	-20	0	0	-10	-30
	S_{B6}	20	0	0	0	20
	S_{B7}	-20	0	0	-10	-30

After player A chooses her second strategy (S_{A2} - to develop environmental infrastructure and monitoring-inspection systems in industrial areas in the watershed), player B decides on any of his strategies except S_{B7}, the expense of player A increases (-10). On the other hand, if player B prefers the seventh strategy (S_{B7}), the second strategy of player A (S_{A2}) does not realize (-20), because player A plans to develop environmental structure only in industrial areas in the second strategy (S_{A2}) while player B did not prefer an industrial area as a location. Thus, if player B chooses the strategies of S_{B1} and S_{B2}, player A wins “10” units, if player B chooses the S_{B5} and S_{B6}, player A wins “10” units, if player B chooses the S_{B3} and S_{B4}, player A wins “10” units. On the other hand, if player B prefers the strategy of S_{B7}, player A loses “-30” units.

When player A chooses her third strategy (S_{A3} - to direct new industrial investments to organized industrial districts), if player B selects S_{B1} and S_{B2}, the industrial income and the environmental costs of player A increase, and the goal of player A realizes (20), so the payoff of player A will be “20” units. If player B chooses the strategy of S_{B3}, the industrial income of player A does not increase (0), but the goal of player A realizes (20). However, the environmental cost of player A increases (-10), so the payoff of player A will be “10”. If player B chooses the strategy S_{B4}, the industrial income and the environmental cost of player A does not increase (0), but the goal of player A realizes (20), so the payoff of player A will be “20” units. On the other hand player A loses, when player B chooses one of the strategies S_{B5}, S_{B6}, and $S_{B7.}$

If player A alters her fourth strategy (S_{A4} -to move industries from the inner city and the Bursa plain and direct them to organized industrial districts), and if player B prefers the strategies S_{B1} and S_{B2}, both the industrial income and the environmental cost of player A increases (10; -10), and the goal of player A realizes (20), so the payoff of player A will be “20” units. If player B chooses S_{B3}, the industrial income of player A decreases (-10), and the environmental cost increases (-10), but the goal of player A realizes (20), so the payoff of player A will be “0” units. If player B chooses S_{B4}, the industrial income of player A decreases (-10), but the goal of player A realizes (20), so the payoff of player A will be “10” units. On the other hand player A loses, when player B chooses one of the strategies S_{B5}, S_{B6}, and $S_{B7.}$

When player A chooses her fifth strategy (S_{A5} – to cancel the working permits of plants that have unacceptable discharge standards), if factories close in the Metropolitan Municipality, player A would decrease her industrial income (-10), but the goal of player A realizes (20), and environmental cost decreases (10), so the payoff of player A will be "20" units. If factories close outside the border of the Metropolitan Municipaliy, the income of player A does not decrease (0), but the fifth strategy of player A realizes (20). Additionally, the environmental costs of player A increase, when player B selects one of the strategies S_{B1}, S_{B2}, S_{B3}, S_{B5}, S_{B7}. Hence, when player B chooses the strategies S_{B3}, S_{B5}, S_{B7}, the payoffs of player A will be "30" units.

When player A chooses the sixth strategy (S_{A6} – to prevent the up-stream from the polluting industry), if player B prefers the strategies S_{B1} and S_{B2}, the industrial income of player A increases (10), but the environmental cost increases (-10). However the sixth strategy of player A realizes (20), so the payoff of player A will be "20" units. If player B chooses S_{B3}, S_{B5}, and S_{B7}, the industrial income of player A does not increase (0), and the goal of player A does not realize (-20), and the environmental cost increases (-10), so the payoff of player A will be "-30" units. If player B selects the strategies of S_{B4}, S_{B6}, the industrial income of player A does not increase (0). Furthermore the environmental cost of player A does not increase or decrease (0), because player B chooses to locate down-stream. Pollution in down-stream does not effect to player A. therefore, the payoff of player A will be "20" units.

5.7.2 Payoffs of Player B in Game II

Player B's payoffs are determined by land price, infrastructure contribution fees and the permission process as well as environmental costs in the second game. In Game II, the environmental cost of player B, the wastewater treatment plant's initial investment and operating cost were primary concerns. Player B's environmental costs depended upon the chosen land and cost of wastewater treatment plant. The cost of wastewater treatment plant differs depending on discharge criteria; discharge criteria differ in the watershed, this affects the cost of treatment plant. These criteria evaluated, and pereferences index formed in Table 5.3. According to Table 5.3, the first strategy is the most preferable strategy (1) for player B whereas the seventh strategy is the least preferable strategy (7). Payoffs of player B are determined in Table 5.11 according to preferences index in Table 5.3.

Table 5.11 Payoffs of Player B in Game II

Strategies	Location	Index of preferences	Payoffs
S_{B1}	Bursa Organized Industrial District	1	30
S_{B2}	Nilüfer Organized Industrial District	2	25
S_{B3}	Gürsu Organized Industrial District	3	15
S_{B4}	Batı Organized Industrial District	4	20
S_{B5}	Up-stream municipality area	6	7
S_{B6}	Down-stream municipality area	5	10
S_{B7}	Unplanned area in up-stream	7	5

In Game II, environmental issues play an important role; industrial plant cannot be activated unless the necessary legislative requirements are fulfilled. Therefore developing environmental infrastructure becomes more important than land prices for Player B in the long term.

The process would not change because of attitudes of organized industrial district administrations or municipalities. The permission process is expected to be shorter in organized industrial districts. Establishing industrial plants for unplanned areas by local planning decisions would be the most difficult option. Additionally, environmental costs also affect player A and B's payoffs in Game II. Thus when player A enlarges its industrial land, she is also aware that her environmental cost will increase. Similar to this is the fact that player B knows he has to act according to effluent standards; otherwise the plant will not be permitted to function. Therefore environmental costs become important for player B, because they affect long term costs. Due to effluent standards, the best option for player B is strategy S_{B1} in an organized industrial district with completed infrastructure within a metropolitan municipality area.

According to Table 5.11, Land price in strategy S_{B1} -location in an organized industrial district which has a completed infrastructure in the Metropolitan Municipality- is higher than the other strategies whereas environmental costs are lower than the others. On the other hand, if player B chooses the strategy of location "outside the municipalities and organized industrial districts in the up-stream" (S_{B7}), land price decreases whereas environmental cost increase. In general, outside the planning areas where there are agricultural lands and plants built with a local planning decision on a parcel. Effluent standards are determined according to stream for this reason environmental costs are high. We believe that if players consider environmental law and regulations, the permission process in industrial areas is easier than in unplanned areas. Therefore, while the first strategy of player B (S_{B1}) has maximum payoff, the seventh strategy of player B (S_{B7}) has minimum payoff.

The choices of player A affect the payoffs of player B in Game II. For example, when player A chooses the second strategy (S_{A2}), she is expected to develop the sewerage system in the watershed. Thus, if factories locate outside the Metropolitan Municipality, they can discharge into the sewerage system instead of natural areas. In consequence, player B reduces environmental costs when he chooses the strategies S_{B3}, S_{B4}, S_{B5}, S_{B6}. Player B's payoffs add up to "5" units.

On the other hand, when player A selects the fifth strategy (S_{A5}), if player B does not conform to effluent standards, his plant will be closed, so the payoffs for player B will be "0". Similarly, when a player chooses the strategy S_{A6}, the plant will be closed if player B prefers to locate up-stream and the payoffs will be "0".

Payoff matrix of player A and Player B are shown in Table 5.12.

Table 5.12 Payoff Matrix for Game II

		Player B						
		S_{B1}	S_{B2}	S_{B3}	S_{B4}	S_{B5}	S_{B6}	S_{B7}
Player A	S_{A1}	20, 30	20, 25	10, 15	20, 20	10, 7	20, 10	-30, 5
	S_{A2}	10, 30	10, 25	0, 20	10, 25	0, 12	10, 15	-20, 5
	S_{A3}	20, 30	20, 25	10, 15	20, 20	-30, 7	-20, 10	-30, 5
	S_{A4}	20, 30	20, 25	0, 15	10, 20	-40, 7	-30, 10	-40, 5
	S_{A5}	20, 0	20, 0	30, 0	20, 0	30, 0	20, 0	30, 0
	S_{A6}	20, 30	20, 25	-30, 0	20, 20	-30, 0	20, 10	-30, 0

5.8 Equilibrium of Game II

Players, their strategies and rules are the same in both Game I and Game II. Both players know each other's payoffs and they behave rationally so they would like to choose the best strategy. Players do not make an agreement before Game II, so Game II is a non-cooperative game. Firstly, player A makes a decision and after that player B makes a decision.

If player A chooses the strategy S_{A1}, player B chooses the strategy S_{B1}, because he would like to win maksimum payoff, so player A wins "20" and player B wins "30". Namely, player B chooses to locate in the organized industrial district of the Metropolitan Municipality where the infrastructures are completed; while the industrial incomes of player A increases, so both of them maximize their payoffs.

When player A chooses the strategy of S_{A2}, player B chooses the strategy of S_{B1}, again. Player A wins "20" while player B wins "30". If player A chooses the strategy S_{A3}, player B chooses the strategy of S_{B1}, again. Player A wins "20" while player B wins "30". Similarly, if player A chooses the strategy of S_{A4}, player B will choose the strategy of S_{B1}, so player A wins "20" and player B wins "30".

After player A chooses the strategy of S_{A5}, whatever player B chooses, the payoffs will be "0". Therefore, player B may choose one of all the strategies. If player A chooses the strategy S_{A6}, player B will choose the strategy S_{B1}, so player A wins "20" while player B wins "30". The preferences of players as indicated in bold characters are shown in Table 5.13.

Table 5.13 Nash Equilibriums in Game II

		Player B						
		S_{B1}	S_{B2}	S_{B3}	S_{B4}	S_{B5}	S_{B6}	S_{B7}
Player A	S_{A1}	**20, 30**	**20,** 25	10, 15	**20**, 20	10, 7	**20**, 10	-30, 5
	S_{A2}	10**, 30**	10, 25	0, 20	10, 25	0, 12	10, 15	-20, 5
	S_{A3}	**20, 30**	**20,** 25	10, 15	**20**, 20	-30, 7	-20, 10	-30, 5
	S_{A4}	**20, 30**	**20,** 25	0, 15	10, 20	-40, 7	-30, 10	-40, 5
	S_{A5}	**20, 0**	**20, 0**	**30, 0**	**20, 0**	**30, 0**	**20, 0**	**30, 0**
	S_{A6}	**20, 30**	**20**, 25	-30, 0	**20**, 20	-30, 0	**20**, 10	-30, 0

There are eleven equilibrium points (Nash equilibrium) in Game II (see in Table 5.13). The four pairs of the strategies (S_{A1},S_{B1}), (S_{A3},S_{B1}), (S_{A4},S_{B1}), (S_{A6},S_{B1}) that have maximized their payoffs. When player B chooses a location in an organized industrial district which has a completed infrastructure, player B wins the highest payoff. The other seven equilibrium points indicate the choices of player B, when player A selects the strategy of S_{A5}.

Seven other equilibrium conditions in Game II happen in case player A chooses to cancel working permits of plants that have unacceptable effluent standards (S_{A5}). All options are the same for player B. If he does not act according to effluent standards, his plant will be closed down. Indeed, ideal situation is modelled in Game II. Therefore, the S_{A5} strategy might not be classified as a strategy as it is information. For player A, closing down his industrial plant in up-stream or prevention strategies would increase her payoff. Industry in up-stream does not cause to increase the industrial income of player A. Furthermore, it causes to increase the environmental cost of Player A. Therefore, when the plants are closed down in up-stream, the environmental cost of player A decreases. Nevertheless at this point, the industrialist's benefit is zero.

5.9 Results of Games

In Game I, present situation is modeled. The players do not consider environmental costs in the decision making process. For this reason, environmental costs are neglected in the determination of players' payoffs. Player B's choices affect Player A's payoffs, but Player A's choices do not affect Player B's payoffs in Game I. Player B's payoffs are determined by the price of the chosen land, the contribution fee for infrastructure and the permission process. Accordingly, the highest payoff for Player B is the strategy of choosing a place outside industrial areas in Game I. For this reason, whichever strategy Player A chooses, Player B would choose to locate outside the municipalities in the up-stream (S_{B7}).

Nash equilibrium is sought in both games. There are five Nash equilibriums in the first game. In Game I matrix, when player B chooses a place in the Metropolitan Municipality area, player A increases its industrial income. As for player B, the best option is choosing land out of industrial areas (S_{B7}) when the participation fee and process of receiving permits are considered. The worst option for player B is being located in an organized industrial district with full infrastructure within municipality borders (S_{B1}). Therefore, in Game I, whichever strategy player A chooses, his choice for land is out of industrial areas (S_{B7}). Furthermore, player A always loses (-20) and player B always wins (30) under these circumstances. This shows that the environmental protection strategies of player A will not be successful. Indeed, Player A would not be willing to employ these strategies. For instance, player A would not want to develop environmental infrastructure in the entire watershed area because the industrial entrepreneur chooses places unplanned areas (outside the organized industrial districts and outside industrial areas of municipalities), so Player A cannot benefit. It would be more profitable for Player A to develop infrastructure only in her area rather than the whole watershed. In the current situation, conflict between two players would continue in any case and it creates an unsustainable condition.

Player A would not want to move industries from inner city, because if Player B were to move outside the metropolitan municipality area, her income would decrease. Player B, on the other hand, would think that his plant would not be closed, thus he will choose a place outside industrial organized districts. Therefore conflicts between the industrial investors and the Bursa Municipality arise, countinuously.

In reality, if players bargained before the game or if player A could barricade location at unplanned areas of up-stream, player A could increase her payoffs. For example, if player A prefered to develop new industrial areas in the watershed (S_{A1}), and player B chose to locate in the industrial area in the down-stream district or sub-district municipality (S_{B6}), player A would win “-20” units instead of “20” units. However, if this arrangment constituted, player B won “25” units instead of “30” units. Moreover, when player A prefers to prevent the up-stream from the polluting industry (S_{A6}), if player B chooses the sixth strategy (S_{B6}) again, player A wins “-20” instead of “20” and player B wins “25” instead of “30”. Additionally, when player A chooses the sixt strategy (S_{A6}) and player B chooses the sixth strategy (S_{B6}), the sub-strategy of the Metropolitan Municipality concerning development on the west side will realize. However, player B does not choose an organized industrial district for location, he prefers to locate an industrial area of municipalities in down-stream.

In Game II, land prices and infrastructure participation fees are the same for player B as in Game I. Nevertheless the permission process has changed. As it is presumed that all acts according to present laws and legislations, the permission process is the same in all industrial areas. In the second game, there are eleven Nash equilibriums. In four of these S_{A1},S_{B1}; S_{A3},S_{B1}; S_{A4},S_{B1}; S_{A6}, S_{B1}, both players benefit. When player B takes environmental costs into account, the most beneficial strategy for him would be to choose a location in an organized industrial district within the Bursa municipality area; then his profit would be at its maximum (20). Nevertheless all environmental costs will increase for player A together with industrial income as player B chooses a place within her territory. For this reason she cannot have maximum benefit (30) but she will still benefit. Player A would benefit in any case so she appropriates all of the strategies.

Furthermore, Player A wins much more in Game II than in Game I. This would also mean that Player A would also agree with four strategies that are good for environmental protection. Both players would benefit if they act according to legislation. On the other hand, there is only one organized industrial district with a fully completed infrastructure in the watershed. When other organized industrial districts' infrastructures are completed, there will be more choices for Player B.

5.10 Conclusion

In this chapter, the interactive decision making process of players in the watershed have been analyzed by the help of game theory. Two non-cooperative and two-player games are modelled here in order to evaluate their behaviours thoroughly. Industrial development and industrial land use decision are the main problem in the watershed according to the Bursa Strategic Plan. Therefore, the environmental protection strategies of the Bursa Metropolitan Municipality and the location strategies of a small industrial entrepreneur are analyzed by game theory.

Cooperation is not observed among the players in the watershed, therefore the decision making processes are defined as non-cooperative. In the current situation it is clear that players do not consider environmental legislation and plan decisions. Thus two game matrices are determined. In other words, as players do not act according to environmental legislation, environmental costs are not taken into consideration in the decision making process in Game I. On the other hand, in Game II, analysis is based on players' acting in accordance with environmental legislation and according to the plan decisions. Thus in the second game matrix, environmental costs are taken into account when players' payoffs are designated. After these assumptions, in both games players make decisions under certainty and they are supplied with perfect information. Both games are complete information games. Games are non-zero sum games.

When the best strategy pairs are evaluated in both the games, we see that the best strategies of players and payoffs are changed. The Metropolitan Municipality losses "-20" units in the first game while she gains "20" units in the second game according to Nash equilibriums. This situation confirms the third hypothesis of this study for player A. Namely, when players consider environmental cost, they change the strategies. Furthermore, the Metropolitan Municipality wins much more, and considers environment, at the same time. In addition, the Metropolitan Municipality can increase her payoffs by bargaining in the first game. However, sustainable development is impossible in Game I. On the other hand, co-ordination and cooperation among agents are assumed in the second game. It can be defined this assumption as a bargaining or agreement between players. The result of the second game indicates players can increase their payoffs and at the same time, sustainability is possible. The second game verifies the fourth hypothesis. The fourth hypothesis of the study deal with cooperation among decision makers, it claims that if cooperation is possible, the agents acquire optimum profit and the environment is not damaged.

According to the Game II matrix, player A can finish the infrastructures of organized industrial districts in her boundaries and can create more options for player B. Moreover, with these equilibrium conditions, the environment will be polluted less and water pollution can be controlled. If players are convinced to act according to the environmental legislation, industrialists demand for an organized industrial district with completed infrastructure will increase. Then it will also be possible to protect the environment. In short, Game I is more profitable than Game II for player A. Moreover, sustainable development is possible in Game II.

6. GENERAL CONCLUSIONS AND FURTHER SUGGESTIONS

Environmental problems caused by human activities have reached the point of threatening the natural balance of the earth. Increasing world population, and industrialization cause diminishing natural resources and pollution to the extent of endangering human life. In the second part of this study, we have studied economic growth its relationship to the environment as well as developing environmental policies together with their impacts on Turkey. Besides natural resources being used as an input in economic growth, negative externalities show the close relationship between the economy and the environment. Environmental economy and environment concept have been discussed since the 17th century but increases in environmental problems require different approaches to these concepts. In the 20th century, environmental science has grown separate from ecology and a system approach was introduced to environmental concept. Human desire to dominate nature and the hopes of technology solving environmental problems, this human-centric approach, is forging its way in environment-centric theories.

Environmental problems and disasters after the efforts of industrialization in the 1960s have led to scientific studies; consequently the limits of growth have become the issue of debates. It has become an obligation to find a balance between economic growth and the protection of the environment. In the 1970s, developed countries started to form legislations in order to protect the environment. Conferences and agreements, especially with the contributions of UN and other supranational bodies, have helped to put the environment on the agenda all around the world. In the 1980s, sustainable development policies in balance with environmental protection became a significant issue. The sustainability principle was based on “polluter pays principle” and also on “anticipation and preventions”. It offers cooperation on social levels and voluntary effort. As a result of this principle, methods like the environmental impact assessment, strategic planning and strategic environmental impact assessment are being developed. These developments on environmental issues have an impact on planning science. Planning is an effective tool for obtaining a continuous growth but without efficient management it will not succeed. Water basin planning and its management is a worldwide accepted approach in the sustainability of natural water resources.

These developments also have positive impacts in Turkey. Although Turkey set up its environmental legislation in the 1980s, environmental legislations still continue to be prepared. In fact, there are many laws with effective sanctions about the environment and many institutions as decision makers; yet, an influential environment management is still not present. The Ministry of Environment and Forestry shares many of its authorities with other ministries and organizations; thus it cannot function efficiently. Basin planning as a special purposes plan is defined in the body of current planning law. The Ministry of Environment and Forestry, the General Directorate of State Hydraulic Works, metropolitan municipalities can plan water basins. The management problem cannot be solved with these plans which apply only for drinking water. All three of the authorities mentioned above are organized at basin level. A water basin can be under the authority of more than one ministry or institute. The State Planning Organization is also authorized to prepare basin planning, apart from the other three. Their approach is closer to the global one in planning but unfortunately, the quantities of the plans they have prepared are only a few in number.

As a result of the second chapter; the necessity of planning on basin scale and management for the sustainability of water is inevitable. However, this system is not institutionalized in Turkey, yet. Besides, diverse institutions or ministries holding power for environment and planning create complicated decision making phases for water basin planning. Lack of regional plans and not adopting a strategic approach in planning make it difficult to plan and manage water basins.

In the third chapter, the interactive decision making process among the decision makers is evaluated. Game theory approach was used to analyze the decision making process of actors in a water basin. The main principles of game theory are examined by considering the decision making process in planning. The theory is based on conflicting decision makers and their aim in maximizing benefits. It has elements like players, strategies, payoffs, information and equilibrium. Although there are games with many players; a game with two players reflects the basic form of the theory. A game with two players was the most suitable for this study. Despite the fact that there are more players in the decision making process about environment and planning; a two-person game was the most convenient in analyzing the attitudes of players efficiently. In its broadest sense, each player has numerous strategies and there is a value that they would benefit from each strategy. The most important assumption in the game is that the players are acting rationally which means that they choose their strategies according to what their opponent will choose.

Game theory is separated into two main branches as; cooperative and non-cooperative games. The social sciences usually focus on non-cooperative game cases. Nevertheless it is expected that players increase their benefits in the case of cooperation or bargaining. In Turkey, there are many actors in environmental issues and planning and it is well known that these actors do not act in cooperation. As a result of this, non- cooperative games are used in modeling. Besides these games are non- zero sum games. This means that if a player benefits, the other one does not necessarily lose and the amount of benefit and loss need not be equalized. On the contrary, the aim is that both players would win. In this sense, a non-sum zero game explains the decision making process in planning more explicitly.

Games are represented in strategic form in our models. Many factors are avoided in order to simplify the model. Modelled games in this study and analysis of a static situation, where a time period is avoided, and is played only once. Players act rationally; personal attitudes are important and there is no luck factor playing role. Information players have are important for the decision making process. The process of decision making varies due to risk factors and indefinite situations. The decision making process is also affected by players' awareness of the other's strategies, information and benefits. The pair of the best strategy is named as equilibrium in the finite game. It is accepted that dominant strategy is the most beneficial strategy for players. However each game does not have a dominant strategy but Nash states that a game which has two players, non-cooperative, non-zero sum and finite pure strategy has at least one equilibrium. Nash equilibrium shows the best strategy pair of players.

In the fourth chapter, a water basin is determined as a case study for game theory to be applied in a real decision making process. Two primary hypotheses are studied in the fourth chapter. The first one is on actors and their relationships in the watershed area. This hypothesis can be summarized as "water pollution is caused by too many decision making actors, their lack of coordination and cooperation". Therefore, the decision making actors in a water basin, their relations and conflicts with each other, the decision making process, strategies developed by each and their role are evaluated in this part. The second hypothesis is about the water pollution and the usage of water in the watershed. This second hypothesis is explained as "decision makers have not been acting properly according to the present regulation of discharge, sharing and usage of water is not sustainable as a natural resource." Therefore, natural water resources and their use are researched in along whit this hypothesis as well as environmental infrastructure and refinement facilities in the watershed area.

There are districts, towns and villages in the watershed area which are not a part of Bursa city. According to the 2000 census, the population in Bursa is more than 2 million people and immigration to the city continues. An estimated population for 2020 is 3.3 million. Urbanization results in destroying agricultural areas. The Bursa Metropolitan Municipality is working on the necessary infrastructure work and the healing of the present system. Furthermore, the city of Bursa has common wastewater treatment plant. Although there is a sewerage system in the surrounding towns and villages, sewage is dumped directly into the Nilüfer Stream.

Besides settlements, industrial plants also discharge their wastewater into the Nilüfer Stream without treating it first. Organized industrial districts were formed according to district municipality decisions; later they became organized industrial districts. Therefore they are not as organized as would be expected from organized industrial districts and their infrastructure systems are not sufficient. 58.5% of industrial plants within the city borders of Bursa discharge their wastewater without treating it. Furthermore, there is no environmental inventory on this, thus the discharge amounts of industry are not precisely known. Diverse institutions are in charge of planning industrial districts, permits and inspection of their discharges. These subjects create conflicts between the Metropolitan Municipality, ministries and other local authorities.

When social and economic characteristics of population are the case, there is an increase in industry and service sectors while there is a decrease in agriculture. Contrary to this agricultural income of the city increases which has always been an important income for Bursa. Although agricultural land has been destroyed and the

Nilüfer Stream cannot be used for irrigation anymore, an increase in agricultural income can be explained by the use of technological facilities and the growth of industry based on agriculture.

Water pollution values were measured in the Nilüfer Stream by the DSI in 1979-1982 for the first time and later in 1998-1999. These measurements show that the stream's water is completely polluted and cannot be used for any purpose apart from the part Doğancı dam stands which supplies Bursa's drinking water. The main problems in the watershed are fresh water supply and conflicts in sharing the water apart from water pollution. This problem has been solved for short term but the solution is not sustainable. Doğancı dam is being protected. Ground water reserves are allocated for industrial use. Lakes and ponds were formed for agricultural use. The Nilüfer Stream is not used and is being polluted.

The management system in the watershed involves the Bursa Metropolitan Municipality, 10 district municipalities, 11 sub-district municipalities. Apart from the municipalities, the provincial governor of Bursa, the provincial directors of ministries are active in the region. There are 45 authorities in the watershed. Among these are the local environmental council which is appointed for coordination; it represents the government and provincial governor. The leading actor in the watershed is the Metropolitan Municipality of Bursa. However, especially with the master plans, the Metropolitan Municipality is in conflict with the ministries, mainly with Ministry of Public Works and Settlement. As for the application of these plans the Bursa Metropolitan Municipality conflicts with district municipalities.

A plan which covers the watershed area has not been prepared but several large scaled plans within the Bursa city border were prepared by the Ministry of Public Works and Settlement. The Bursa 2020 Strategic Plan, which was approved in 1998, is one of the first strategic plan experiences in Turkey. The Bursa Strategic Plan which was prepared by the Bursa Metropolitan Municipality, the Ministry of Public Works and Settlement and the Provincial Governor of Bursa was approved by the Ministry of Public Works and Settlement. This plan involves the development of industry and the preservation of environment. It also points out that these subjects are themes of the major conflicts in the city. Bursa was divided into sub-regions and different strategic decisions were made for each sub-region in line with the main strategy. One of the main strategies is to lead industry in organized industrial districts in order to control their environmental impacts and to protect agricultural land.

Bursa is growing towards the west and new industrial areas will be organized here. Industry is dense on the up-stream and polluted water is carried down to the watershed which creates a major problem. On the other hand, industry trends to develop at up-stream areas, because of proximity to Bursa city. The district municipalities support and try to attract industry for growth and for more income. The Bursa Metropolitan Municipality refuses to take responsibility for the pollution in the up-stream area which is carried down to its area by the Nilüfer Stream. For this reason planning areas and population in this area are restricted. Similarly, pollution from the up-stream and city of Bursa are carried down to agricultural lands in down-stream. Moreover, the metropolitan area is developed towards this part. This problem shows the importance and necessity of basin scaled planning. Water basins are ecological systems and decisions for one spot can affect the whole basin. In the Strategic Plan, it is assumed that organized industrial districts and individual plants will construct their own wastewater treatment plants. Somehow, how this will occur is not mentioned. On the other hand, the Bursa Metropolitan Municipality plans to construct sewerage systems outside its administration area.

As a result of the case study, lack of coordination among many decision makers in the watershed is observed. These official decision makers do not cooperate and moreover conflict with each other in the planning and permitting process. Authority chaos and competition among these parties cause applications of environmental decisions to become impossible. Moreover, the results of water pollution analysis in the Nilüfer Stream, which were conducted again after 18 years, show that pollution has increased. These results justify the first hypothesis. None of the settlements' domestic wastewater is treated except for Bursa city and many industrial plants discharge into the Nilüfer Stream in the watershed area; these show that environmental legislations are not applied, discharge standards are not fulfilled. These plants, which are not supposed to be functioning, are active and moreover what is more disturbing is that not only private industrial plants act but also public industrial plants. Water sharing and water pollution causes conflict between them. All these results show that sustainable development criteria are not present in the watershed area. This supports our second hypothesis.

The management and planning systems need to be set in order to solve problems and overcome conflicts in the watershed. Strategic decisions need to be made considering the watershed basin scale. Authority and responsibility in planning and environmental legislations should be redefined and reorganized. It will be possible to enlarge the Bursa Metropolitan Municipality borders but new borders without scientific background will not solve problems, on the contrary they can lead to new ones.

In the last chapter of this thesis, the decision making process in the Nilüfer Watershed is studied by the game theory. The location choice of a small scale textile plant is analyzed versus the Bursa Metropolitan Municipality's industrial and environmental strategies. The result of the case study shows that water pollution as an outcome of industrial activity in the watershed stands as an important environmental problem. In the Bursa Strategic Plan, planning industrial areas, the location choice of entrepreneurs and preventing industrial based water pollution are stated. For these reasons, an interactive decision making process between the Metropolitan Municipality and an industrial entrepreneur is modelled as a two player game.

In the fifth chapter, last two hypothesis of this thesis are evaluated. It is already known that actors do not function according to environmental legislation and discharge standards at the moment. The third hypothesis is "actors decide without considering the present environmental infrastructure; however if they do their strategies would change". Both players' most beneficial strategy will change. Two games are modelled for demonstration of the third hypothesis. In the first game, the first case is when both players decide to neglect the environmental costs and the second case is when they decide to consider environmental costs. Their decisions are evaluated accordingly. The fourth hypothesis is "in the state of cooperation between the decision makers; it is possible that the agents earn optimum profit whereas the environment is not damaged". Therefore, for both players, best strategy pairs are analyzed in the sense that whether these are in accordance with environment and at the same time, change in their benefits and impact of these on the environment are discussed.

In both games, players' strategies and the rules of the games are alike. Players decide in cases of non-cooperation but they know each other's strategies and the results of these. The Metropolitan Municipality (player A) has 6 pure strategies and the industry investor (player B) has 7 pure strategies. The Metropolitan Municipality's strategies are chosen from the Strategic Plan of Bursa. Investor's strategies are the location alternatives in the watershed. This way, the Bursa Strategic Plan's applicability is also questioned.

In the modelling stage, strategy payoffs are defined symbolically and separately for each game. In the first game, determining payoffs of player A, industry income rise or decrease is a criteria; player B's payoffs are land price, infrastructure participation fee and permit supplying process were considered in determination. In the second game, environmental costs are added. Environmental costs for the industrial investor are defined as construction and operation costs of wastewater treatment plant for a textile company. These costs differ according to the chosen location.

Nash equilibrium was looked for in both games. In the first game, free from the Metropolitan Municipality's strategy, player B always chooses the same strategy (S_{B7}). The investor chooses the unplanned areas which are close to industrial areas of district municipalities and organized industrial districts. This type of land is cheap, she does not have to pay any participation fee and it is easy to obtain a permit. There are five Nash equilibrium points with which players gained maximum payoffs. However, the Bursa Metropolitan Municipality's strategies are not beneficial when player B chooses S_{B7}. Namely, player A loses "-20" units, while player B wins "30" units.

In short, the Metropolitan Municipality always loses, so that means that strategies of the Bursa Strategic Plan will failed. If the Metropolitan Municipality can barricade the strategy of location on unplanned areas (or two player made an agreement), player B chooses to locate in the industrial area in the down-stream municipalities (S_{B6}), player A wins "20" units instead of "-20", and player B wins "25" units instead of "30". Certainly, the Bursa Strategic Plan consists of the strategy of "local planning decisions should not be made about industry and settlement". Furthermore, preference of the strategy of S_{B6} provides the western expansion of the Bursa metropolitan area. Indeed, this choice reflects the present situation. If player B prefers to locate down-stream, both agents will win, even if they do not consider environmental costs. However, this situation is not sustainable in the long term because of environmental degradation.

In the second game, the first strategy S_{B1} (to locate in the organized industrial districts of the Bursa Metropolitan Municipality where the infrastructures are completed) is always beneficial for player B. Because this way he can minimize environmental costs and can receive the licence more easily although he will have to pay more for the land and for the participation fee. In this game (Game II) player A will win “20” units at five of her strategies out of six. Player B would win “30” units if he chooses S_{B1} but unless he fulfils discharge standards his plant will be shut down.

If we evaluate best strategy pairs according to environment in both games, we notice that in Game I, the Metropolitan Municipality will not adopt strategies which are important to protect the environment; such as directing industry towards organized industrial districts, and development of infrastructure as they are not beneficial. Besides, an industrial investor is not willing to choose land in industrial areas. This makes it difficult to get environmental issues under control.

In Game II, player A will benefit if she chooses 5 out of 6 strategies, this means that the Metropolitan Municipality will apply the strategies in the Strategic Plan. If the industrial investor chooses a location in an organized industrial district with no infrastructure problem, she will minimize her contribution to water pollution. Briefly, the best strategy pairs in Game II are also positive for the environment. Besides, if the industrial investor chooses a place in an organized industrial district with full infrastructure, this will set an example and create compatibility so other organized industrial districts will speed up completion of their infrastructure systems.

In short, it is obvious that players choose different strategies when they consider environmental costs. When equilibrium points are compared, benefits of players do not change in either of the games. Thus, if players take environmental costs into consideration they will receive maximum benefit and they will also protect nature. This justifies the fourth hypothesis.

In conclusion, all four hypotheses are justified by case study and modelling study. In fact, players’ decisions on acting according to environmental legislation can be considered bargaining. As a result of this, it is proven that both players will win and industrial impacts on environment can be controlled.

The main outcome of the thesis will open new directions in the planning process and to open the discussion for the use of game theory in planning. A non-cooperative, two-person game is used in this study for an explanation of the decision making process. Nevertheless, cooperative games and n person games are also the main topics in the game theory. A game theoretic approach will make it easier for the agents to cooperate if the conflicts in the planned area are clearly defined. It is possible to achieve cooperative bargaining solutions where all agents are winners. Actually, this is the goal of planning because sustainable development of the river basin depends on bargaining where all agents are winners. Therefore, cooperative game with two-person or n-person will be used next studies. Coalition among two person/n person is a useful approach for planning discipline and an environmental management model. Furthermore, new scenarios will be developed about planning and environmental problems. Dynamic and repeated game can be modeled next studies.

REFERENCES

Abacıoğlu, M., 1995. Çevre Kanunu ve Çevre Sağlığı Mevzuatı, (The Environmental Law and Legislation of Environmental Health), Seçkin Yayınevi, Ankara

Action Plan of the Blue Nilüfer, 1997. Mavi Nilüfer Eylem Planı, Yerel Gündem 21, Bursa Büyükşehir Belediyesi (Local Agenda 21, Bursa Metropolitan Municipality).

Albrecht, S.M., 2001. Forging New Directions in Science and Environmental Politics and Policy: How Can Co-Operation, Deliberation and Decision Be Brought Together, *Environment, Development and Sustainability*, Kluwer Academic Publishers, **3**:323-341.

Aliprantis, C.D., and Chakrabarti, **S.K**., 2000. Games and Decision Making, Oxford University Press.

Arapkirlioğlu, K., 2003. Ekoloji Ve Planlama, (Ecology and Planning), *Planlama Dergisi,* TMMOB Şehir Plancıları Odası*,* **1**:4-8.

Arge, 2004. The Estimation of Wastewater Treatment Systems for A Small Textile Industrial Factory in Bursa. Arge Environmental Technologies Coo. Ltd., Istanbul.

Arts, J., 1994. Environmental Impact Assessment: From Ex Ante To Ex Post Evaluation, Issues In Environmental Planning, *European Research In Regional Science 4*, pp.145-163, Eds. Voogd, H. Published By Pion Ltd.

Aumann R.J. and Heifetz, A., 2002**.** Incomplete Information, *Handbook of Game Theory with Economic Applications*, Volume 3, Chapter 43, pp1665-1686, Ed. Aumann and Hart**.** Elsevier Science Pub.

Aumann, R. J. and Hart, S. 1992. Preface, *Handbook of Game Theory with Economic Applications,* Ed. Aumann and Hart**,** Volume 1, Elsevier Science Pub.

Aumann, R.J., 1974. Subjectivity and Correlation in Randomized Strategies, Game Theory in Economics, *The International Library of Critical Writings in Economics 5,* Ed. Rubinstein, pp85-114, Edwar Elgar Publishing, 1990.

Austin, J., 1972. Canadian Water Policy: History, Problems and Recent Developments, *Water Management, Basic Issues*, pp77-84, OECD.

Authorities of Organized Industrial Districts, 2005. Personal Interview

Aydemir, Ş., and Aydın, M., 2002. Stratejik Çevresel Değerlendirme ve Türkiye'deki Uygulaması, (Strategic Environmental Assessment and Its Application in Turkey), pp.165-170, *10. Ulusal Bölge Bilimi/Bölge*

Planlama Kongresi, 17-18 Ekim 2002, ITU Mimarlık Fakultesi, Istanbul

Aydemir, Ş., Aydemir, S. E., 1998. Bölge ve Bölge Planlamada Örgütlenmenin Yeniden Yapılanması, (Reconstruction of Organization in Region and Regional Planning), pp1-6, *8. Ulusal Bölge Bilimi/Bölge Planlama Kongresi,* İTÜ Mimarlık Fakültesi, 24-25 Eylül, Istanbul

Bademli, R., 2001. Bursa İl Planı Deneyimi, Raci Bademli ile Söyleşi, (Experience of Bursa Province Plan, Interview with Bademli), *Planlama Dergisi,* TMMOB Şehir Plancıları Odası*,* **2001/1-2**, 12-21.

Bagwell, K., and Wolinski, A., 2002. Game Theory and Industrial Organization, *Handbook of Game Theory with Economic* Applications, Volume 3, Chapter 49, pp 1853-1893/ Ed. Aumann and Hart**.** Elsevier Science.

Balfors, B., and Schmidtbauer, J., 2002. Swedish Guidelines for Strategic Environmental Assessment for EU Structural Funds, *European Environment*, **12**, 35-48.

Bank of Provinces of Technical Contract, 1990**.** İller Bankası Teknik Şartnamesi, İller Bankası Yayını, Ankara

Banks, S.J., 2002. Strategic Aspects of Political System, *Handbook of Game Theory with Economic* Applications, Volume 3, Chapter 59, pp 2205-2227/ Ed. Aumann and Hart**.** Elsevier Science.

Barret, S., 1998. On the Theory and Diplomacy of Environmental Treaty-Making, *Environmental and Resource Economics*, **11** (3-4), 317-333, Kluwer Academic Publishers.

Bartone, C., And Others., 1994. Toward Environmental Strategies for Cities, *Urban Management Programme,* The World Bank, Washington, DC,

Başaran, A., 1997. Marmara Bölgesi Su Havzalarının Sürdürülebilirliği ve Plan Sınırları Projesi, (Project of Sustinability of Water Basin in the Marmara Region and Determination of Plan Borders, unpublished project), Danışman, Prof. Dr. Fulin Bölen, İTU. Fen Bilimleri Enstitüsü, Yüksek Lisans Projesi.

Başaran, A., 1999. Çevresel Etki Değerlendirmesi Yönteminde Planlama Boyutu: Aşağı Meriç Havzası (Edirne) Örneği, (Dimension of Planning in Environmental Impact Assessment Method; the Meric River Basin Case Study, unpublished Master of Science Thesis) *Y. Lisans Tezi*, Danuşman, Prof. Dr. Fulin Bölen, İTÜ Fen Bilimleri Enstitüsü.

Başaran, A., 2003. Determination of Agents and their Strategies in River Basin according to Game Theory, *ERSA 43 Rd Congress Of European Regional Science Association,* 27-30 August 2003, University Of Jyvaskyla, Finland.

Başaran, A., and Bölen, F., 2004. Sürdürülebilir Planlama İçin Nilüfer Çayı Alt havzasında Bir Yöntem Araştırması (A Method Research for Sustainable Planning in the Nilüfer Stream Watershed), *11. Ulusal Bölge Bilimi/Bölge Planlama Kongresi,* 21– 23 Ekim, 2004, Trabzon

Batabyal, A.A., and Nijkamp, P., 2004. The Environment in Regional Science: An Eclectic Review, *Regional Science*, **83**, 291-316.

Batey, 1983. Systems Analysis in Urban Policy-Making and Planning ed. Michael Batty, Bruce Hutchinson, *NATO Advanced Research Institute on Systems Analysis in Urban Policy-Making and Planning*, New York : Plenum Press.

Bauriedl, S. and Wissen, M., 2002. Post-Fordist Transformation, the Sustainability Concept and Social Relations with Nature: A Case Study of the Hamburg Region, *Journal of Environmental Policy & Planning*, John Wiley & Sons, Ltd., **4**:107-121.

Baykal, B.B. et al., 1997. İstanbul'un İçmesuyu Kaynaklarında Su Kalitesinin Yeni Bir Sınıflandırma Yaklaşımıyla Değerlendirilmesi, (A New Assessment Approach for İstanbul's Drinking Water Resources), pp137-144, *Su Kaynaklarının Korunması Ve İşletilmesi Sempozyumu*, 2-3 Haziran, 1997, İSKİ, İstanbul

Beierle, T.C. and Konisky, D.M., 2000. Values, Conflict, and Trust in Participatory Environmental Planning, *Journal of Policy Analysis and Management*, vol.19, no. 4, 587-602.

Benson, J. 2000. Environmental Goods and the Problem of Cooperation, Environmental Ethics an Introduction with Readings, Introduction 3, pp49-66, Ed.John Benson, Published By Routladge.

Bilsel, S.G., 1998. Alt-Bölge Planlamasında Stratejik Planlama Yaklaşımı (III), (Strategic Planning Approach to Sub-Region Plans-III), pp7-17, *8. Ulusal Bölge Bilimi/Bölge Planlama Kongres*i, I.T.U., 24-25 Eylül, Istanbul.

Binmore, K., 1996. Essays on Game Theory / John F. Nash, Jr., Ed. Binmore, (Introduction by Ken Binmore), Edwar Elgar Publishing Ltd.

Bölen, F., 2003. İstanbul'da Büyük Sanayi Kuruluşlarının Mekez Dışına Yerleşme Süreci: 1970lerdeki Yer Değiştirme Kararlarına Bugünden Bakış (Decentralization of Industrial Investments in İstanbul), pp7-18, Prof.Dr.Yücel Ünal'a Armağan, ITU Mimarlık Fakültesi, Şehir ve Bölge Planlaması Bölümü.

Brachya, V., 1993. Environmental Assessment in Land Use Planning in Israel, *Landscape and Urban Planning*, Elsevier Science Publishers, **23,** 167-181.

Brown, J.W., 1996. North-South Cooperation for Sustainability, Chapter 14, pp227-239, *Building Sustainable Societies, A Blueprint for a Post-Industrial World*, ed. DC. Pirages.

Brown, L.R. and Mitchell, J., 1998. Building of a New Economy, *Report of Worldwatch Institute for Sustainability*, pp.277-309, Translated By Eser, İ., Publication of TEMA Foundation, Publication No- 23, Istanbul.

Brown, L.R., 1994. River Basin Development to Sustain Megacities. pp11-21, *Integrated River Basin Development,* Ed. Kirby, C. and White W.R. HR Wallingford Ltd. and Institute of Hydrology, John Wiley & Sons Ltd.

Brundtland Report, 1991. Ortak Geleceğimiz, (Our Common Future, the World Commission on Environment and Development), Türkiye Çevre Sorunları Vakfı Yayını, Çev. Çorakçı, Üçüncü Baskı, Oxford University Press.

Buck, A.J., 2004. An Introduction to Game Theory with Economic Applications, http://courses.temple.edu/economics/Game%20Outline/index02.htm, (full text online).

Budak, S., 1997. Avrupa Topluluğu'nun Çevre Politikası ve Türkiye'nin Uyum Sorunu (Environmental Policies of European Union and Adaptation Problem of Turkey, PhD Thesis), *Doktora Tezi*, İ.Ü. Sosyal Bilimler Enstitüsü, Istanbul.

Bursa 2020 Strategic Plan Report, 1998. Bursa 2020 Strateji Planı Raporu, Bursa Büyükşehir Belediyesi, Bayındırlık ve İskan Bakanlığı, Bursa Valiliği.

Bursa Environmental Report, 2000. Bursa İl Çevre Durum Raporu, Bursa İl Çevre Müdürlüğü ve Bursa Valiliği, Özkan Yayınevi, Bursa.

Bursa Metropolitan Municipality, 2003. Bursa Dericiler Bölgesinin Kent İçinde Boşaltacakları Alanın Kente Kazandırılması Projesi, (Project of Urban Renewal for Bursa City Center (Leather İndustrial Area), pp359-366, Bursa Büyükşehir Belediyesi APK Daire Başkanlığı Kentsel Gelişme Müdürlüğü, *Kentsel Dönüşüm Sempozyumu, TMMOB Şehir Plancıları Odası*, 11-13 June, Istanbul

Bursa Metropolitan Municipality, 2004. Interview with Planning Department.

Bursa Province, 1982. Bursa İli, Türkiye İl İl: Dünü, Bugünü, Yarını, (Bursa Province Provinces of Turkey; Yesterday, Today, Tomorrow) Yurt Ansiklopedisi, cilt 3, pp1612-1746, Anadolu Yayınları.

Bursa, 2003. Bursa Kent Sağlık Gelişim Planı 2003-2007, Dünya Sağlık Örgütü, Sağlıklı Kent Projesi, (Healty Development Plan of Bursa City 2003-2007, World Heath Organization (WHO), Project of Healty City), Bursa Büyükşehir Belediyesi.

Burström, F. and Korhonen,J., 2001. Municipalities and Industrial Ecology: Reconsidering Municipal Environmental Management, *Sustainable Development*, **9**:36-46

Capra, F., 1995. Deep Ecology a New Paradigm, *Deep Ecology for the 21st Century, Ed. George Sessions*, chapter 2, p19-25, Shambhala Publications.

Carraro, C., and Topa, G., 1995. Taxation And Environmental Innovation, *Control and Game-Theoretic Models of The Environment*, Ed. Carraro and Filar, Annals of The International Society of Dynamic Games, Boston, **2**:109-140.

Chech, V.T., 2003. Principles of Water Resources, History, Development, Management and Policy, John Wiley & Sons, Inc.

Cisneros, **H.G**., 1995. Urban Poverty and Urban Environment, The Human Face of the Urban Environment, Environmentally Sustainable Development Proceedings Series No:6, pp7-10, Ed. Serageldin and others, *Second*

Annual World Bank Conference on Environmentally Sustainable Development, September 19-21, 1994, Washington, D.C.,

Connelly, J. and Smith, G., 1999. Politics and the Environment from Theory to Practice, Routledge Publisher, London.

Couch and others, 1983. Environmental Impact Assessment in Canada, *Environmental Impact Assessment,* pp,41-57, Ed. PADC, NATO ASI Series, Behavioral and Social Sciences No: 14, Martinus Nijhoff Publishers, Boston.

Çubuk, M., 1999. İmar Mevzuatından Şehircilik Mevzuatına, Türk Şehirciliğine Sistematik Bir Yaklaşım Denemesi, (A Systematic Approach to Turkish Urbanization) MSÜ, Şehir ve Bölge Planlama Bölümü.

D.S.İ, 1984. Bursa Bölgesi Su Kaynakları Kirlilik Araştırması, 1979-1982, (Survey of Water Resource Pollution in Bursa Region,1979-1982), Devlet Su İşleri Genel Müdürlüğü, Ankara.

D.S.İ., 2000. Susurluk Nehri Havzasında Su Kalitesi Yönetimi, 1998-1999, (Water Quality Management in the Susurluk River Basin, 1998-1999), Devlet Su İşleri Genel Müdürlüğü, Ankara.

Daşöz, H.İ., 1995. Çevre Yönetimimizin Hukuksal ve Kurumsal Yapısı Üzerine Değerlendirmeler, (Evolutions of Legislative and Institutional Structure of Environmental Management in Turkey),*Yeni Türkiye Dergisi*, Çevre Özel Sayısı, **5**:260-266.

David, F.R., 1993. Concepts of Strategic Management, New York : Macmillan

de Steiguer, J. E., 1997. The Age of Environmentalism, The Mcgraw-Hill Companies, Inc. U.S.A.

Declaration of the Chamber of City Planners, 2003. Kamu Yönetimi Temel Kanunu Tasarısı Taslağı Hakkında Şehir Plancıları Odasının Görüş ve Önerileri, (Discussion and Suggestions of the Chamber of City Planners about Draft of A Proposed Law of Public Management) *Planlama Dergisi,* TMMOB Şehir Plancıları Odası, **2**:56-60.

Deutz, P. and Gibbs, D., 2004. Eco-Industrial Development and Economic Development: Industrial Ecology or Place Promotion, *Business Strategy and the Environment,* **13**:347-362.

Dinar, A., and Wolf, A., 1994; Middle East Hydropolitics and Equity Measures for Water-Sharing Agreements. *Journal of Social, Political & Economic Studies*, **19(1):**69-63.

Don Maughan, W., 1972. Recent Developments in Water Management Policy of the United States Government, p 47-56, *Water Management, Basic Issues*, OECD.

Doyle, T., and McEachern, D., 1998. Environment and Politics, Routledge Introductions to Environment Series, Publishing by Routledge.

Dünya, 2004a. Dünya Gazetesi, *Bursa Eki*, (The Dünya Newspaper, *Additional Magazine: Bursa)*, 10.08. 2004.

Dünya, 2004b. Dünya Gazetesi, Kamu Yönetimi Kökten Değişiyor, (The Dünya Newspaper, Fundamental Change in Public Managment). 16.07.204

Dünya, 2004c ; Dünya Gazetesi, İl Özel İdarelerinin Yetkileri Genişletiliyor, (The Dünya Newspaper, Authorities of Special Provincial Administration), 24.06.2004

Dutta, K.P., 1999. Strategies and Games, Theory and Practice, MIT Press,

Eichberger, J., 1992. Nash Equilibrium and Learning, *Recent Developments in Game Theory,* Ed. Creedy, Borland, Eichberger, Edwar Elgar Publishing Limited.

Eichberger, J., 1993. Game Theory for Economists. (First Buplication in 1952), San Diego:Academic Press

Environmental Legislation, 2004; Çevre Mevzuatı, Lebib Yalkın Yayınları, İstanbul

Environmental Problems of Turkey, 1991. Türkiye'nin Çevre Sorunları, Ed. Ural, Türkiye Çevre Sorunları Vakfı Yayını, Ankara.

Ericson, P.A., 1994. A Practical Guide to Environmental Impact Assessment, San Diego:Academic Press, San Diego.

Eroğlu, V., 2004. Türkiye'de Su Yönetimi Ve Su Kirlenmesi Kontrolü, (Water Management and Water Pollution Control in Turkey), *9. Endüstriyel Kirlenme Kontrolü Sempozyumu,* 2-4 Haziran, 2004, İstanbul

Ertürk, H., 1996. Çevre Bilimlerine Giriş, (Introduction to Environment Science) Uludağ Üniversitesi Güçlendirme Vakfı Yayını, 2. Baskı, Bursa.

Fain, W.W. and Phillips, J.B., 1966. Applications of Game Theory to Real Military Decisions, Ed. Mensch, pp.363-372, *Theory of Games, Techniques and Applications, NATO Scientific Affairs Committee,* Toulon, 29th June-3rd July, 1964, The English University Press Ltd.

Freeman, K. S., 2000. Water Politics and National Security in the Tigris-Euphrates River Basin, *Phd Thesis*, the University of Alabama (wwwlib.umi.com/dissertations).

Fudenberg D. and Tirole, J. 1996. Game Theory, the MIT Press, Fifth Printing (First Printing In 1991).

Gabszewich, J.J., and Thisse, J.F., 1992. Location, *Handbook of Game Theory with Economic Applications*, Volume 1, Chapter 9, pp 281-303, Ed. Aumann and Hart**.** Elsevier Science.

Gardner, R. 1995. Games for Business and Economics, John Wiley&Sons, Inc.

Garner, R., 2000. Environmental Politics, Britain, Europe and the Global Environment, Contemporary Political Studies, Second Edition, St. Martin's Press.

Gassner, J. and Narodoslawsky, M., 2001. International Legal Instruments and Regional Environmental Protection, *Environment, Development and Sustainability*, **3**:185-198.

Geographical Map of Turkey, 2004. Türkiye Coğrafya Atlası, D.B.R. Press, İstanbul

Glasby, G.P., 2003. Sustainable Development: The Need for a New Paradigm, *Environment, Development and Sustainability* **4,** 333-345. Kluwer Academic Publishers.

Greenhuisen M., Nijkamp, P., 1994. Sürdürülebilir Kenti Nasıl Planlamalı, Çev. Duruöz, *Toplum Ve Bilim*, **64-65**,129-139.

Hammerstein,P., and Selten, **R.** 1994. Game Theory and Evolutionary Biology, *Handbook of Game Theory with Economic Applications,* Volume 2, Chapter 28, pp926-993, Ed. Aumann and Hart**.** Elsevier Science.

Hardin, G., 2000. The Tragedy of the Commons, *Environmental Ethics an Introduction with Readings,* Reading *7*, pp185-196, Ed. Benson, Published By Routladge

Harrison, N.E., 2000. Constructing Sustainable Development, Published by State University of New York Press

Harsanyi, J.C. and Selten R., 1988, A General Theory of Equilibrium Selection in Games, Cambridge Mass., MIT Press.

Harsanyi, J.C., 1967. Games with Incomplete Information Played by Bayesian Players, *Game Theory in Economics*, pp38-84, Ed. Ariel Rubinstein, Edwar Elgar Publishing, 1990.

Harsanyi, J.C., 1992. Game and Decision Theoretic Models in Ethics, *Handbook of Game Theory with Economic Applications*, Volume 1, Chapter 19, pp669-709, Ed. Aumann and Hart**.** Elsevier Science.

Harshadeep, 1995. Comprehensive Multi-Objective River Basin Planning: Fuzzy and Game Theoretic Approaches (Case Study: India), *Phd Thesis*, Harvard University (wwwlib.umi.com/dissertations).

Hart, S., 1992. Games in Extensive and Strategic Forms, *Handbook of Game Theory with Economic Applications*, Volume 1, Chapter 2, pp19-40, Ed. Aumann and Hart, Elsevier Science.

Heathcote, I.W., 1998. Integrated Watershed Management, Principles and Practice, John Wiley & Sons, Inc.

Hens, L. and Nath, B., 2003. The Johannesburg Conference. *Environment, Development and Sustainability* **5,** 7-39. Kluwer Academic Publishers.

Hillas, J. and Kohlberg, E. 2002. Foundations of Strategic Equilibrium, *Handbook of Game Theory with Economic Applications,* Volume 3, Chapter 42, pp1597-1664, Ed. Aumann and Hart**,** Elsevier Science.

Hite, J., and Laurent, E.A., 1972. Environmental Planning: an Economic Analysis, Applications for the Coastal Zone*,* Cooperation with the Conservation Foundation and the Coastal Plans Regional Commission, Praeger Publishers, New York..

Hoyer, K.G., and Naess, P., 2001. The Ecological Traces of Growth: Economic Growth, Liberalization, Increased Consumption and Sustainable Urban Development, *Journal of Environmental Policy & Planning,* **3**, 177-192.

Ildırar, M., 2004. Bölgesel Ekonomik Büyüme: Türkiye İçin Bir Strateji Önerisi, (Regional Economic Growth: A Strategy Suggestion for Turkey) pp 92-98, *11. Ulusal Bölge Bilimi/Bölge Planlama Kongresi*, 21-23 Ekim, KTU Trabzon.

Isard W. and Reiner T.A., 1962. Aspects of Decision-Making Theory and Regional Science. *Papers and Proceedings of the Regional Science Association*, **9**: 22-33.

Isard, **W.** 1967. Game Theory, Location Theory and Industrial Agglomeration. *Papers of the Regional Science Association*, **18**:1-11.

Isard, W., 1972. Ecologic-Economic Analysis for Regional Development, the Free Press, New York.

Isard, W., and Smith, T.E. 1967. Location Games: with Applications to Classical Location Problems, *Papers of the Regional Science Association* **19**: 41-76,

Jones, M.G., 1983. Environmental Impact Assessment at the Planning Level: Two Systems, *Environmental Impact Assessment,* pp. 21-37, Ed. PADC, NATO ASI Series, Behavioral And Social Sciences No: 14, Martinus Nijhoff Publishers, Boston.

Kannai, Y., 1992. The Core and Balancedness, *Handbook of Game Theory With Economic Applications*,Volume 1, Chapter 12, pp355-393, Ed. Aumann and Hart**.** Elsevier Science.

Kadıoğlu, M. and Şaylan, L., 2004. Küresel İklim Değişimi ve Su Kaynaklarımız, (Change of Global Climate and Water Resources in Turkey) *İstanbul ve Su Sempozyumu,* 8-9 Ocak 2004, TMMOB Mimarlar Odası, İstanbul Büyükkent Şubesi, Taşkışla, İstanbul

Karaman, Z.T., 1999. Küresel Yönetim Stratejilerinde Çevre Ideolojisinin Yeri Ve Uluslararsı Etkileşim, (The Environment Ideology in Global Management Strategies) pp1-14, *3. Ulusal Çevre Mühendisliği Kongresi,* 25-26 Kasım, Izmir.

Keleş, R. and Hamamcı, C., 1997. Çevrebilim, (Environmental Science), 2.Baskı, Imge Kitabevi, Ankara

Kiper, P., et al, 1995. Mevcut Planlama Pratiğimizin Çevre Duyarlı Kent Planlama Yaklaşımları Açısından İrdelenmesi, (Analysis of Present Planning Practice in Turkey in Comparison with the Approaches of City Planning Considering Environment) 92-103, *Planlamaya Ve Tasarıma Ekolojik Yaklaşım,* MSÜ, Şehir Ve Bölge Planlama Bölümü.

Kirby, C. and White W.R., 1994. Integrated River Basin Development, HR Wallingford Ltd. and Institute of Hydrology, John Wiley & Sons Ltd.

Kışlalıoğlu, M., and Berkes, F., 1994. Ekoloji Ve Çevre Bilimleri, (Ecology and Environmental Sciences), 2. Baskı, Remzi Kitabevi Yayını, İstanbul.

Kleinschmidt, V. and Wagner, D., 1997. Report of 4th European Workshop on Strategic Environmental Assessment, ed. Kleinschmidt and Wagner, founded by Environmental Ministry of the State of Brandenburg, Federal Environmental Agency and European Commission.

Kozlowski J. and Hugles, J.T., 1972. Threshold Analysis, the Architectural Press, London.

Krairapanond, N., and Atkinson, A., 1998. Watershed Management in Thailand: Concepts, Problems And Implementation, *Regulated Rivers: Research & Management*, **14,** 485-498, John Wiley & Sons, Ltd.

Krawczyk, J.B., 1995. Management of Effluent Discharges: A Dynamic Game Model, Control and Game-Theoretic Models of the Environment, Ed. Carraro and Filar, *Annals of the International Society of Dynamic Games*, **2**:

Kreps, D., and Wilson, R. 1982. Sequential Equilibria, Game Theory in Economics, Ed. Ariel Rubinstein, *the International Library of Critical Writings in Economics 5,* Edwar Elgar Publishing, pp152-183, 1990.

Küçükmehmetoğlu, M., 2004. Sınırları Aşan Sularda Ülkelerin Su Tutma Kapasitelerinin Çoklu Dönemler Arası Kaynak Nakli İçin Kullanımı, Etkileri Ve Ülkeler Arası Koalisyona Tesirleri: Fırat Ve Dicle Havzaları Modeli, pp. 165-182, *11. Bölge Bilimi/Bölge Planlama Kongresi*, K.T.Ü., 21-23 Ekim, Trabzon.

Kucukmekmetoglu, M., and Guldmann, J.M., 2002. International Water Resources Allocation and Conflicts: The Case of the Euphrates and the Tigris. *42nd European Congress Of The Regional Science Association,* 2002, Dortmund, Germany (CD-Rom).

Kuismin, H.O., 1998. Environmental Issue Area and Game Theory, *the Environmentalist* **18**, 77-86, Kluwer Academic Publishers.

Law No 4562, 2000. Law of Organized Industrial Districts (Organize Sanayi Bölgeleri Kanunu), Official Gazette Date 15.4.2000, No: 24025.

Law No 4691, 2001. Law of Technology Development Regions, (Teknoloji Geliştirme Bölgeleri Kanunu), Official Gazette Date 06.07.2001, No: 24454.

Law No 4737, 2002. Law of Industrial Regions, (Endüstri Bölgeleri Kanunu), Official Gazette Date 19.01.2002, No: 24645.

Law No: 1380, 1971. Aquatic Products Law, (Su Ürünleri Kanunu), Official Gazette Date 04.04.1971, No: 13799.

Law No: 167, 1960. Ground Waters Law, (Yeraltı Suları Kanunu), Official Gazette Date, 23.12.1960, No: 10688.

Law No:1580, 1930. Municipality Law, (Belediye Kanunu), Official Gazette Date, 03.04.1930, No: 1471.

Law No: 2863, 1983. Protection of Natural and Cultural Assets Law, (Kültür ve Tabiat Varlıklarını Koruma Kanunu), Official Gazette Date 23.7.1983, No: 18113.

Law No: 2872, 1983. Environment Law, (Çevre Kanunu)**,** Official Gazette Date 11.08.1983, No: 18132.

Law No: 3194, 1985. Development Law, (İmar Kanunu), Official Gazette Date 9.5.1985, No: 18749.

Law no: 4856, 2003. Law of Duties Ministry of Environment and Forestry, (Çevre ve Orman Bakanlığı Teşkilat ve Görevleri Hakkında Kanun), Official Gazette Date 8.5.2003, No: 25102

Law No: 5216, 2004. Metropolitan Municipality Law, (Büyükşehir Belediyesi Kanunu)**,** the Official Gazette Date, 23.7.2004**,** No: 25531.

Law No: 5272, 2004. Municipality Law, (Belediye Kanunu), Official Gazette Date 24.12.2004, No: 25680.

Law No: 6200, 1953. The General Directorate of State Hydraulic Works's Establisment Law, (Devlet Su İşleri Kuruluş Kanunu), Official Gazette Date 25.12. 1953, No: 24454.

Le Moigne, G., 1995. Overview, Sharing and Conserving Common Resources: Water Supply and Water Resources, the Human Face of The Urban Environment, Environmentally Sustainable Development Proceedings Series No:6, pp108-111 Ed. Serageldin, I. and others, *Second Annual World Bank Conference On Environmentally Sustainable Development*, September 19-21, 1994, Washington, D.C.,

Leiss, W., 1970. Utopya Ve Teknoloji: Insanın Doğaya Egemen Olması Konusunda Düşünceler (Utopia and Technology), *Yerleşim Ve Çevrebilim Sorunları*, pp.31-46, Uluslararası Sosyal Bilimler Dergisinden Seçmeler -2, Çev. Ejder, N., Türk Sosyal Bilimler Derneği, Ed. Keleş, R., 1984, Ankara.

Leitmann, J., 1994. Rapid Urban Environmental Assessment, Urban Management Programme, UNDP/ UNCHS/World Bank, Washington D.C.

Loucks, D.P., and Gladwell, J.S., 1999. Sustainability Criteria for Water Resource Systems, International Hydrology Series, Cambridge University Press, Cambridge.

Luce R.C., and Raiffa H., 1967. Games and Decisions : Introduction and Critical Survey, (Seventh Printing, First Publishing in 1957), John Wiley & Sons, Inc.

Lumley, S., and Armstrong, P., 2004. Some of the Nineteenth Century Origins of the Sustainability Concept. *Environment, Development and Sustainability* **6,** 367-378, Kluwer Academic Publishers.

Maler, K.G., and Zeeuw, A.D. 1998. The Acid Rain Differential Game, *Environmental and Resource Economics* **12**:167-184, Kluwer Academic Publishers.

Malkina-Pykh, I.G., and Pykh, Y.A., 2003. Sustainable Water Resources Management, WIT Press, Southampton, UK

Marcus, A., and others, 2002. Business-Government Cooperation in Environmental Decision-Making, *International Journal of Corporate Sustainability, Corporate Environmental Strategy*, **9 (4):**345-355.

Masser, 1983. Systems Analysis in Urban Policy-Making and Planning ed. Michael Batty, Bruce Hutchinson, NATO Advanced Research Institute on Systems *Analysis in Urban Policy-Making and Planning*, New York : Plenum Press.

Mcmillan, J. 1992. Games, Strategies, and Managers, New York: Oxford University Press

Meadowcroft, J., 1999. Planning for Sustainable Development: What Can Be Learned From The Critics?, Ed. Kenny and Meadowcroft, *Planning Sustainability* **1**:12-38.

Meadows, D.H., and others, 1972. Limits of Growth, Universe Books, New York.

Meşhur, M., 1995. Çevre Duyarlı Planlama, (Environmental Approaches to Planning) *Yeni Türkiye Dergisi*, Çevre Özel Sayısı, **5,** 279-295.

Möbius, M.M., 2004. Motivation and Decision Theory, Lecture Notes I-II, February

Munn, 1979. Environmental Impact Assessment**,** SCOPE Report 5, 2nd edition, John Viley Publication**.**

Mycielski, J. 1992. Games With Perfect Information, *Handbook Of Game Theory With Economic Applications*, Volume 1, Chapter 3, pp 41-68, Ed.Aumann and Hart**.** Elsevier Science.

Myerson, R. B., 1991. Game Theory : Analysis Of Conflict , Harvard University Press.

Myerson, R. B., 1994. Communication, Correlated Equilibria and Incentive Compatibility, *Handbook Of Game Theory With Economic Applications*, Volume 2, Chapter 24, pp 828-847, Ed. Aumann and Hart**,** Elsevier Science.

Nash, J.F., 1950a. Equilibrium Points in N- Person Games, *Essays On Game Theory*, Ed. Binmore, pp9, E. Elgar, 1996

Nash, J.F., 1950b. The Bargaining Problem, *Essays on Game Theory*, Ed. Binmore, pp1-8, E. Elgar, 1996

Nash, J.F., 1951. Non-Cooperative Games, *Essays on Game Theory*, Ed. Binmore, pp9, E. Elgar, 1996

Nash, J.F., 1953. Two- Person Cooperative Games, *Essays on Game Theory*, Ed. Binmore, pp34-46, E. Elgar, 1996

Nash, J.F., and Shapley, L.S., 1950. A Simple Three-Person Poker Game, *Essays on Game Theory*, Ed. Binmore, pp10-21, E. Elgar,1996

Nijkamp, P. and Pepping, G., 1998. A Meta-analytical Evaluation of Sustainable City Initiatives, *Urban Studies*, **35** (9):1481-1500.

Nijkamp, P., 1980. Environmental Policy Analysis, Operational Methods and Models, John Wiley & Sons Ltd. New York.

O'neill, B., 1994. Game Theory Models of Peace and War, *Handbook Of Game Theory With Economic Applications*, Volume 2, Chapter 29, pp 995-1031, Ed. Robert J. Aumann and Sergiu Hart**.** Elsevier Science.

OECD, 1990. Environmental Policies for Cities in the 1990s, OECD Publications.

OECD, 1997. Sustainable Development, OECD Policy Approaches for the 21st Century, OECD Publications

Oktay, F.Y. and others, 1997. Su Havzası Koruma Sınırlarının Belirlenmesinde Jeolojik Faktörlerin Önemi: Büyükçekmece Havzası Örneğinde

İrdelenmesi, (Geological Factors for Determination of Water Basin Boundaries) p31-40, *Su Kaynaklarının Korunması ve İşletilmesi Sempozyumu*, 2-3 Haziran 1997, İSKİ, İstanbul.

Özdirek, M., and others, 1999. Çevre Yönetiminde Kurumsal Yapı, (Institutional Structure in Environmental Management) *Ulusal Çevre Mühendisliği Kongresi,* Çevre Mühendisleri Odası, 25-26 Kasım, İzmir.

Özer, A.Ö., and others, 1996. Plancı Gözüyle Kalkınma, Çevre Ve Çevresel Etki Değerlendirmesi, (Planner Approach to Development, Environment and Environmental Impact Assessment), Şehir Plancıları Odası, Ankara.

Özkaya, E., 1997. İmar Kanunu Şerhi ve Mevzuatı, (Development Law and Legislation), Seçkin Yayınevi.

Pearce, D., and others, 2000. Economic Valuation of Environmental Goods. *Environmental Ethics an Introduction with Readings*, Reading 5, pp171-180, Ed. John Benson, Published By Routladge

Pettigrew, A., and others, 2002. Handbook of Strategy and Management, ed.Pettigrew, Thomas, Whittington, Oaks, Calif., Sage Publications, London

Petrakis, E., and Xepapadeas, A., 2000. Location Decisions, Environmental Policy and Government Commitment, pp115-125, *Spatial Economy and Ecology the Interaction between Economics and the Natural Environment*, 4 Advanced in Ecological Science, ed. N.Georgantzis, I.S.B. Tarrazona, WIT Press.

Rapoport, A., 1970. N-Person Game Theory: Concepts and Applications, Ann Arbor: University Of Michigan Press

Rasmusen, E., 1994. *Games And Information : An Introduction To Game Theory*, Second Edition, (First Publication In 1989), Cambridge.

Ray, I. 2000. Game Theory and the Environment: Old Models, New Solution Concepts, Games & Environment, *Journal of Economic Literature*, (www.core.uc.be/climneg/pdf/climneg-climbel _wp27.pdf)

Redclift, 1999; Pathways to Sustainability: Issues, Policies and Theories, *Planning Sustainability*, Ed. Kenny and Meadowcroft, Chapter 3, pp67-77, published by Routledge

Regulation of Environmental Impact Assessment, 2003. (Çevresel Etki Değerlendirmesi Yönetmeliği), The Ministry of Environment and Forestry, Official Gazette Date 16.12.2003, No: 25318

Regulation of Environmental Structure Plan, 2000. (Çevre Düzeni Planlarının Yapılması Esaslarına Dair Yönetmelik), the Ministry of Environment, the Official Gazette Date 04.11.2000, No: 24220

Regulation of Industrial Air Pollution Control, 2004. (Endüstriyel Kaynaklı Hava Kirliliğinin Kontrolü Yönetmeliği), the Ministry of Environment and Forestry, the Official Gazette Date 7.10.2004, No: 25606

Regulation of Industrial Regions, 2004. (Endüstri Bölgeleri Yönetmeliği) The Official Gazette Date 16.12.2004, No: 25672

Regulation of Metropolitan Municipalities Wastewater Discharge, 1998. (BUSKİ Atıksu Deşarj Yönetmeliği), Bursa Metropolitan Municipality, Decision Number, 49-3

Regulation of Protected of Agricultural Lands, 1998. (Tarım Arazilerinin Korunması ve Kullanılmasına Dair Yönetmelik), the Ministry of Agriculture and Rural Affairs, the Official Gazette Date 25.03.2005, No: 25766.

Regulation of Unhealthy Establishments, 1995. (Gayri Sıhhi Müesseseler Yönetmeliği), the Ministry of Health, the Official Gazette Date, 26.9.1995, No: 22416.

Regulation of Water Pollution Control, 2004. (Su Kirliliği Kontrol Yönetmeliği), the Ministry of Environment and Forestry, the Official Gazette Date 31.12.2004, No: 25687

Regulation for Plan Preparation, 1985. İmar Planı Yapılması ve Değişikliklerine Ait Esaslara Dair Yönetmelik, the Ministry of Public Works and Settlement, the Official Gazette Date 02.11.1985, No: 18916.

Reimold, R.J., 1998. Watersheds-an Introduction, ed. Robert J. Reimold, *Watershed Management, Practice, Policies, and Coordination*. Chapter 1, pp1-5.

Report of Bursa Wastewater Master Plan, 2002. (Bursa Atıksu Master Plan Raporu), Water and Sewage Administration of Bursa Metropolitan Municipality, Consortium of GIBB-Imece-Tabar.

Ritzberger, K. 2002. Foundations of Non-Cooperative Game Theory, Oxford University Press.

Rodgers, Jr.J.L., 1976. Environmental Impact Assessment, Growth Management and the Comprehensive Plan, Cambridge, Massachusetts: Ballinger Publishing Company.

Rogers, P., 1969. A Game Theory Approach to the Problems of International River Basin. *Water Resource Research*, **5**(4), 749-760.

Rogers, P., 1993. The Value of Cooperation in Resolving International River Basin Disputes, *Natural Resources Forum*, May: 117-131.

Rubinstein, A., 1982. Perfect Equilibrium in a Bargaining Model, Game Theory in Economics, Ed. Ariel Rubinstein, pp 430-444, *The International Library Of Critical Writings In Economics 5,* Edwar Elgar Publishing, 1990.

Sachs, W., 1995. Global Ecology and the Shadow of "Development", ed. George Sessions, chapter 36, pp428-444

Samuelson, L., 1992. Subgame Perfection, *Recent Developments in Game Theory*, Ed. Creedy, Borland, and Eichberger, Edwar Elgar Publishing Limited

Schmidt, W.P., 2001. Strategies for Environmentally Sustainable Products and Services, *Corporate Environmental Strategy*, vol.8, no.2 , pp118-125.

Selten, R., 1988. Models of Strategic Rationality. *Series C: Game Theory, Mathematical Programming and Operations Research*, Kluwer Academic Publish.

Şenlier, N., and Albayrak, A.N., 2003. Endüstriyel Ekoloji: Planlamaya Ekolojik Yaklaşım, (Industrial Ecology: Ecological Approach to Planning), *Planlama Dergisi*, **1**:26-29.

Serageldin, I. and Cohen, A.M. (Ed.), 1995. The Human Face of the Urban Environment, A Report to the Development Community, Environmentally Sustainable Development Proceedings Series No:5, *Second Annual Conference On Environmentally Sustainable Development*, September 19-23, 1994, Washington, D.C.,

Serageldin, I. and others, 1995a. The Business of Sustainable Cities, the World Bank, *Environmental Sustainable Development Proceedings Series No: 7*, Washington D.C.

Serageldin, I. and others, 1995b. The Human Face of the Urban Environment, Environmentally Sustainable Development Proceedings Series No:6, *Second Annual World Bank Conference on Environmentally Sustainable Development,* September 19-21, 1994, Washington, D.C.,

Sessions, G., 1995. Ecocentrism and Anthropocentric Detour, *Deep Ecology for the 21st Century*, chapter 17, p156-183, Shambhala Publications.

Shapley,L.S., 1953. A Value for N-Person Games, In Contributions to the Theory of Games, *Annals of Mathematics Studies*, pp2-28, Ed.Khun, H. and Tucker, A.W., Princteton University Press.

Shubik, M., 2002. Game Theory and Experimental Gaming**.** *Handbook of Game Theory with* Economic Applications, Volume 3, Chapter 62, pp2329-2348, Ed. Robert J. Aumann and Sergiu Hart**.** Elsevier Science.

SIS (D.İ.E.), 1982. 1980 Tarımsal Yapı ve Üretim: Bursa (Agricultural Structure and Production, Bursa), Yayın no 985, Devlet İstatistik Enstitüsü Yayınları, Ankara.

SIS (D.İ.E.), 1993. 1990 Yılı Nüfüs Sayımı, Nüfusun Sosyal ve Ekonomik Yapısı, (1990 Census of Population, Social and Economic Characteristics of Population), Yayın No: 1577, Devlet İstatistik Enstitüsü Yayınları, Ankara.

SIS (D.İ.E.), 1998. Ekonomik ve Sosyal Indeks, Bursa 1992 Çevre İndeksi, 1996 Tarım İndeksi, (Economic and Social Index, Bursa Environmental Index for 1992, Bursa Agricultural Index for 1996), Number of Publication 2144, Devlet İstatistik Enstitüsü Yayınları, Ankara.

SIS (D.İ.E.), 2002a. 2000 Yılı Nüfüs Sayımı, Nüfusun Sosyal ve Ekonomik Yapısı, (2000 Census of Population, Social and Economic Characteristics of Population), Yayın no 2718, Devlet İstatistik Enstitüsü Yayınları, Ankara.

SIS (D.İ.E.), 2002b. 1997 Köy Envanteri, Bursa ili (1997 Inventory of Village, Bursa Province), Yayın no 2598, Devlet İstatistik Enstitüsü Yayınları, Ankara.

Şişli, M.N, 1999. Çevre Bilim-Ekoloji, (Environmental Science-Ecology), 2. Baskı, Gazi Kitabevi, Ankara

Smith, J.R., 1972. United States Water Policy, pp41-46, *Water Management, Basic Issues,* OECD.

Solsbery, 1997. Sustainable Development, *OECD Policy Approaches for the 21st Century*, chapter 7, pp89-100, OECD Publications

Sönmez, N., 1995. Ortak Geleceğimiz, Sthockholm 1972-Rio 1992 Ve Sonrası, (Our Common Future, Sthockholm 1972-Rio 1992 And After) *Yeni Türkiye Dergisi*, Çevre Özel Sayısı, **5**, 194-209.

Sorin, S., 1992. Repeated Games with Complete Information, *Handbook of Game Theory With Economic Applications*, Volume 1, Chapter 4, pp72-104, Ed.Robert J. Aumann and Sergiu Hart**.** Elsevier Science.

Stanford Encyclopedia of Philosophy, http://plato.stanford.edu/entries/game-theory/#bas, (full text online)

Stevens, **B.H.** 1961. An Application of Game Theory to a Problem in Location Strategy. *Papers and Proceedings of the Regional Science Association*, **7**:143-157.

Strigle,W.A., 2003. Science, Research, Knowledge and Capacity Building, *Environment, Development and Sustainability* **5:** 255-273, Kluwer Academic Publishers.

Tanık, H.B., and others, 2003. "Yerel Yönetimler Yasa Tasarısı" Üzerine…(Discussion about Draft of a Proposed Law of Local Management), Planlama Dergisi, TMMOB Şehir Plancıları Odası, **4:**47-58.

Teclaff, L.A., 1996. Evolution of the River Basin Concept in National and International Water Law, *Natural Resource Journal*, **36** (2):359-391.

Thomas, C., 1966. Some Past Applications of Game Theory to Problems of the U.S. Air Force, Theory of Games, Techniques and Applications Ed. Mensch.A., pp.250-266, *NATO Scientific Affairs Committee*, Toulon, 29th June-3rd July, 1964, The English University Press Ltd.

Tinney, E.R., and Van Loon, R.J., 1972. Canadian Federal Water Resources Policy, pp 85-97, *Water Management, Basic Issues*, OECD.

Toope, J. S. et al., 2003. Managing and Allocating Water Resources: Adopting the Integrated Water Resource Management Approach, ed. Alsharhar and Wood, *Water Resources Perspectives: Evaluation, Management and Policy, Developments in Water Science* ***50***:1-8, Elsevier.

Towards an Urban World, 1995. Urbanization and Development Assistance, Ed. Tannerfeldt, Swedish International Development Agency, Stockholm

Tunçer, M., 2001. Türkiye'de Bölge-Kent Planlaması ve Kentsel Tasarım Uygulama Sorunları ve Görüşler, (Regional-Urban Planning in Turkey and Application Problems of Urban Design), p63-78, *Dünya Şehircilik Günü, Şehir Plancıları Odası, Geleceği Planlamak*, Ankara

Turgut, N., 1998. Çevre Hukuku (Environmental Law), Savaş Yayınevi, 1. Baskı, Ankara.

Turner, R. K. et al, 1994. Environmental Economics, an Elementary Introduction, Published by Pearson Education Limited.

TUSIAD, 2002. Avrupa Birliği Çevre Mevzuatında Uyum Süreci, (Adaptation Process in Environmental Legislation of E.U.) Türk Sanayicileri ve İş

Adamları Derneği, Yayın No TÜSİAD-T/2002-9/331, Lebib Yalkın Yayınları.

Tüzün, **H.T.,** 1999. Türkiye'de EN ISO 14000 Belgeli Kuruluşlar, (Institutions have EN ISO 14000 Certificate in Turkey), *Ulusal Çevre Mühendisliği Kongresi, Çevre Mühendisleri Odas*ı, 25-26 Kasım, İzmir.

Uçkaç, Ş., 1999. Çevre Bilimlerinde Uzaktan Algılama ve Coğrafi Bilgi Sistemleri, (Environmental Science and Geographical Information Systems), *Ulusal Çevre Mühendisliği Kongresi, Çevre Mühendisleri Odası*, 25-26 Kasım, İzmir.

Ul Haq, M., 1995. Introduction, Are Cities Sustainable? The Human Face Of The Urban Environment, Environmentally Sustainable Development Proceedings Series No:6, pp21-23, Ed. Serageldin and Others, *Second Annual World Bank Conference on Environmentally Sustainable Development*, September 19-21, 1994, Washington, D.C.,

Ünal, Y., 2003. Türk Şehir Planlama Hukuku, (Turkish City Planning Law), Yetkin Yayınları, Ankara.

Uslu, O., 1993. Çevresel Etki Değerlendirmesi (Environmental Impact Assessment), Türkiye Çevre Vakfı Yayını, Ankara.

Vajda, S, 1966. An Introduction to Linear Programming and the Theory of Games, Second Edition (First Publication In 1960), London.

Van Damme, E., 2002. Strategic Equilibrium, *Handbook Of Game Theory With Economic Applications*, Volume 3, Chapter 41, pp1521-1589, Ed. Robert J. Aumann and Sergiu Hart**.** Elsevier Science.

Vega-Redondo, F. 2003. Economics and the Theory of Games. Cambridge University Press.

Verhoef, E.T., and Nijkamp, P., 2000. Spatial Dimensions of Environmental Policies for Transboundary Externalities: A Spatial Price Equilibrium Approach, *Environment and Planning*, **32** (11):2033-2055

Victory, A.H., and Tennant, P.A., 1998. The Case for River Basin Management, ed. Robert J. Reimold, *Watershed Management, Practice, Policies, and Coordination,* Chapter 11, pp221-234.

Von Neumann, J., Morgenstern, 1944. Theory of Games and Economic Behavior, Princeton University Press

Voogd, H., 1994. The Environment as an Object of Planning, *Issues in Environmental Planning,* Ed. H. Voogd, European Research in Regional Science 4, Published By Pion Limited. London

Wagner, A.J., 1972. Programmes of the Tennessee Valley Authority, p 109-122, *Water Management, Basic Issues*, OECD.

Walker, P., 1995. An Outline of the History of Game Theory, http://william-king.www.drexel.edu/top/class/histf.html (full text online).

Williams, P.M., 2002. Community Strategies: Mainstreaming Sustainable Development and Strategic Planning, Sustainable Development **10**, 197-205, John Wiley&Sons, Ltd.

Wolf, C. P., 1983. The U.S. Model of Environmental Impact Assessment, *Environmental Impact Assessment,* pp. 21-37, , Ed. PADC, NATO ASI Series, Behavioral And Social Sciences No: 14, Martinus Nijhoff Publishers, Boston.

Wood, C. And Jones, C.E., 1997. The Effect of Environmental Assessment on UK Local Planning Authority Decisions, *Urban Studies*, **34**(8):1237-1257.

World Resource, 1996. World Resource, A Guide to the Global Environment 1996-97, Habitat II, *The UN Conference On Human Settlements*, Oxford University Press

Yaşamış, F.D., 2001. Avrupa Birliği, Türkiye Ve Çevre, (European Nation, Turkey and the Environment), *8 Kasım Dünya Şehircilik Günü, 5. Türkiye Şehircilik Kongresi,* pp 235- 266, 7-9 Kasım, 2001, Ankara.

Yenice, Z.F., and Others, 2001; AB ve Türkiye'de Çevre ve Planlamaya İlişkin Politika ve Uygulamaların Sürdürülebilirlik Kavramı Çerçevesinde İrdelenmesi, (In EU and Turkey, Politics and Applications of Planning and Environment; the Concept of Sustainability), *8 Kasım Dünya Şehircilik Günü, 5. Türkiye Şehircilik Kongresi*, pp 267-282, 7-9 Kasım, 2001, Ankara.

Yeung, D.W.K., 1995. Pollution-Induced Business Cycles: A Game Theoretical Analysis, Control and Game-Theoretic Models of the Environment, Ed.Carlo Carraro and J.A. Filar, (2):319-336, *Annals of the International Society of Dynamic Games*, Boston.

Yıldırım and Berkmen, 1991. Glossary of Environmental Terms, IULA Environmental Series, Istanbul

Yıldırım and others, 2001. Development of a Basic GIS Database for the Yesilırmak Watershed Province Using Satellite Images and other Data, *Turkish Journal Of Earth Sciences,* **10** :133-141, TUBITAK

http://www.cityofseattle.net/planning, 2004

http://www.scotland.gov.uk/library5/planning/rospc-00.asp, 2004.

http:// web.idrc.ca/es/ev-29787-201-1-DO_TOPIC, 2004.

http://europa.eu.int/comm/ environment /wssd/water, 2004. Web site of European Union.

http://www.bosb.org.tr., 2004. Web Site of the Bursa Organized Industrial District.

http://www.nonprofits.org/npofaq/03/22.html, 2004.

http://www. pawatersheds.org., 2004.

http://www.ace.mmu.ac.uk/ Brundtland_Report.html, 2004.

http://www.bayindirlik.gov.tr., 2004. Web Site of the Ministry of Public Works and Settlement.

http://www.btso.org.tr., 2004. Web Site of the Chamber of Bursa Commerce and Industry.

http://www.bursa.gov.tr., 2004. Web Site of the Bursa Provincial Governor.

http://www.bursa-bld.gov.tr., 2004. Web Site of the Bursa Metropolitan Municipality.

http://www.buski.gov.tr., 2004. Web Site of Water and Sawage Admistration of Bursa Metropolitan Municipality.

http://www.cevreorman.gov.tr, 2005. Web Site of the Ministry of Environment and Forestry.

http://www.dosab.com., 2004. Web Site of the Demirtaş Organized Industrial District.

http://www.dpt.gov.tr., 2004. Web Site of the State Planning Organization.

http://www.dsi.gov.tr., 2004. Web Site of the General Directorate of State Hydraulic Works.

http://www.epa.gov/owow/watershed, 2004.

http://www.gametheory.net, 2004.

http://www.internationalwaterlaw.org /IntlDocs/Helsinki_Rules.htm, 2004.

http://www.johannesburgsummit.org, 2004.

http://www.mahalli-idareler.gov.tr., 2004. Web Site of the Interior Ministry

http://www.mises.org/journals, 2004. Periodicals of the Ludwig von Mises Institute

http://www.osbuk.org., 2004. Web Site of Superior Committee of Organized Industrial Districts.

http://www.planware.org/strategy.html, 2004.

http://www.rega.basbakanlik.gov.tr., 2005. Web Site of Official Gazette

http://www.sanayi.gov.tr, 2004. Web Site of the Ministry of Industry and Commerce.

http://www.tarim.gow.tr., 2004. Web Site of the Ministry of Agriculture and Rural Affairs.

http://www.thefreedictionary, 2004.

http://www.un.org/events/wssd/statements., 2004. Web Site of the United Nation

http://www.unep.org/Documents, 2004.

http://www.worldsummit2002.org /index.htm, 2004.

CURRICULUM VITALE

PERSONEL DETAILS

Name, Surname	ARZU BAŞARAN UYSAL
Date of Birth	1972
e-mail	a_basaran@yahoo.com

EDUCATION AND QUALIFICATION

Ph.D.

2000 -	I.T.U. Institute of Science and Technology, Department of Urban and Regional Planning, Adviser, Prof. Dr. Fulin Bölen
Thesis	A Method for Sustainable Development in the River Basin: Game Theory

M.Sc.

1996-1999	I.T.U. Institute of Science and Technology, Department of Urban and Regional Planning, Adviser, Prof. Dr. Fulin Bölen
Project	Project of Water Basin and Plan Boundaries in the Marmara Region,
Thesis	Dimension of Planning in Environmental Impact Assessment Method; the Meric River Basin Case Study
1995-1996	I.T.U. Department of Foreign Language – Preparing of English

B.Sc.

1990-1995	Istanbul Technical University, Department of Urban and Regional Planning
Project	Gemlik-Armutlu 1/1000 Implementation Development Plan

2005	ISO 9000:2000 Quality Management System (advanced), Turkish Standard Institutions (TSE)
2004	ISO 9000:2000 Quality Management System, Foundation of MES Education
1999	Programme of Environmental Impact Assessment Method, A.U. S.B.F. Ernst Reuter Centre of Settlement and Urban Research and Application

PAPER

2005	*Analyze of Strategic Decisions by Game Theory in a Watershed (*Bir Su Havzasında Stratejik Kararların Oyun Teorisi İle Analizi*),* 8 Kasım Dünya Şehircilik Günü 29. Kolokyumu, 7-9 November, 2005, Taşkışla, İstanbul.
2005	*A Method for Strategic Decision Making in a Watershed: Game Theory*, 45th Congress of the European Regional Science Association, Vrije Universiteit, Amsterdam, Holland, 23-27 August 2005.

2004	*A Method Research for Sustainable Planning in the Nilüfer Stream Watershed* (Sürdürülebilir Planlama İçin Nilüfer Çayı Alt Havzasında Bir Yöntem Araştırması*)*, 11.National Regional Science/Regional Planning Congress, 21– 23 October, 2004, Trabzon
2003	*Determination of Agents and their Strategies in River Basin according to Game Theory,* ERSA 43 rd Congress of European Regional Science Association, 27th-30th August 2003, University of Jyvaskyla, Finland
2000	*Environmental Impact Assessment, Planning and Industrial Investment in Turkey, Çorlu Case*, ERSA 13th European Advanced Studies Institute Regional Science Summer Institute 2000, 2nd-8th July, 2000, İ.T.Ü. Taşkışla, İstanbul.

WORK EXPERIENCE

2005- **Istanbul Metropolitan Municipality**
Position Urban Planner (M.Sc.)

- Istanbul 1/100 000 Strategic Plan, Department of Housing and Quality of Life

1997- 2004 **URBAN Environmental Consultant Ltd.**
Position Partner of the company

- Consulting about Environment and Development Legislation for industrial enterprise
- Environmental impact assessment reports
- Pre-research for environmental impact assessment
- Consulting about "Unhealthy Establishment Permit" (the Istanbul Metropolitan Municipality and the Ministry of Health), "Emission Permit" (the Ministry of Health and the Ministry of Environment and Forestry), "Discharge Permit" (the Istanbul Metropolitan Municipality and the Ministry of Environment and Forestry), "Working Permit" (the Ministry of Works and Social Security).

1996 –1997 **Yapı Üretim Organizasyon, Inc.**
Position Urban Planner

- Yoncaköy Housing Area Project (1000 house-200 ha) Implementation Plan, Istanbul
- Erguvankent Housing Area Project (450 hause-130 ha) Implementation Plan, Istanbul
- İkitelli Organized Industrial District Implementation Plan (500 ha), Istanbul

1994 – 1995 **Bahçeşehir Marketing and Commerce, Inc. (T.C. Emlak Bank)**
Position Technical Infrastructure Services Department

2000 KOSGEB (Istanbul Small Companies Development Centre), Participated as an educator on seminar about the method of environmental impact assessment for industrial entrepreneurs.