Ali Hakan GÖÇMEN

AN ANALYSIS
ON THE ECONOMIC VALUE
OF WATER
Master's Thesis

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Eskişehir, 2017

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Department of Economics
Supervisor: Asst. Prof. Sevilay KÜÇÜKSAKARYA

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ÖZET

SUYUN EKONOMİK DEĞERİ ÜZERİNE BİR ANALİZ

ALİ HAKAN GÖÇMEN

İktisat Anabilim Dalı
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İnsanoğlunun hayatta kalma güdüsü, büyük ölçüde doğal kaynakların yeterli miktarlarda ve uygun kalitede mevcut olmasına bağlıdır. Fakat genellikle insanlar, sürdürülebilir yolla çarkı sürekli çevirmek yerine bu temel kaynakları tahrip etmeyi tercih etmektedirler. Şüphesiz, yaşamın ana kaynağı olan su bu süreçte en fazla tehdit altında olan kaynaktır. Büyüme ve kalkınma amaçlı insan uygulamaları durumu içinden çıkılmaz hale getirmekte ve iklim değişikliği, kirlilik, giderek artan nüfus ve açlığı karşılamak için artan talep (yoksullardan ziyade zenginlerin açlığı) ile birleştiğinde su kıtlığına neden olmaktadır. İyi bilindiği üzere, iktisat kıt kaynakların sınırsız ihtiyaçlar ve arzular karşısında dağıtımı ile ilgilenen bir bilimdir. Dolayısıyla, su ekonomik değerine göre yönetilmelidir.

Bu çalışma, suyun ekonomik değerini tüm yönleriyle sunmayı ve su kaynaklarının sürdürülebilir bütünleşik yönetimi için politikalar sağlamayı amaçlamaktadır. Bu çalışmada, suyun değeri açısından tarihsel diyalektik bakış açısı, suya yönelik tehditler ve genel olarak su kaynaklarının değerini gösteren ekonomik araçlar incelenmiştir. Ayrıca, su kaynakları hakkında önemli uluslararası değerlendirmeler de sunulmuştur. Buna ek olarak, su kaynaklarının güncel ulaşılabilirlik ve kıtlık durumları bu kaynakların korunması ve verimli kullanılması için farkındalık yaratmak amacıyla analiz edilmiştir. Bu bağlamda, bu çalışma Türkiye için özgün bir literatür oluşturmaya katkıda bulunmaktadır.

Anahtar Sözcükler: Suyun değeri, Ekonomik değer, Ekonomik enstrümanlar, Bütünleşik su yönetimi, Su kıtlığı.

ABSTRACT

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Survival instinct of human beings largely depends on availability of natural resources in adequate amounts and sufficient quality. However, people mostly prefer to destroy these fundamental resources instead of spinning the wheel continuously in a sustainable way. Undoubtedly, water which is main source of life is the most threatened resource in this process. Human practices for growth and development make the situation worse and cause water scarcity when associated with climate change, pollution, ever-increasing population and demand for meeting hunger (not for the poor, but for the rich). It is well known that economics is a science interested in allocation of scarce resources against unlimited needs and desires. Hence, water should be managed in accordance with its economic value.

This study aims to present economic value of water in all its aspects and to provide policies for sustainable integrated management of water resources. Historical dialectic perspective for value of water, threats to water and economic instruments which generally give the value of water resources are examined in this study. Also, prominent international considerations about water resources are given. Moreover, current conditions of water resources in terms of both availability and scarcity are analyzed to raise awareness for protection and efficient use of these resources. In this respect, this study contributes to create an original literature for Turkey.

Keywords: Value of water, Economic value, Economic instruments, Integrated water management, Water scarcity.

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30.05/2017

ETİK İLKE VE KURALLARA UYGUNLUK BEYANNAMESİ

Bu tezin bana ait, özgün bir çalışma olduğunu; çalışmamın hazırlık, veri toplama, analiz ve bilgilerin sunumu olmak üzere tüm aşamalardan bilimsel etik ilke ve kurallara uygun davrandığımı; bu çalışma kapsamında elde edilemeyen tüm veri ve bilgiler için kaynak gösterdiğimi ve bu kaynaklara kaynakçada yer verdiğimi; bu çalışmanın Anadolu Üniversitesi tarafından kullanılan "bilimsel intihal tespit programı"yla tarandığını ve hiçbir şekilde "intihal içermediğini" beyan ederim. Herhangi bir zamanda, çalışmamla ilgili yaptığım bu beyana aykırı bir durumun saptanması durumunda, ortaya çıkacak tüm ahlaki ve hukuki sonuçlara razı olduğumu bildiririm.

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LIST OF ABBREVIATIONS

AIMCS : Antalya Infrastructure Management and Consulting Services Inc.

AWWD : Antalya Water and Wastewater General Directorate

AWSA : Ankara Water and Sewerage Authority

BAU : Business as Usual

BRICS : Brazil, Russia, India, China, and South Africa

C&C : Command and control

CESCR : United Nations Committee of Economic, Social and Cultural Rights

EIA : Environmental Impact Assessment

EIE : General Directorate of Electric Power Resources Survey and Development Administration

FAO : Food and Agriculture Organization of the United Nations

GIS : Geographical Information System

GWP : Global Water Partnership

HEPP : Hydroelectric Power Plant

ICWE : International Conference on Water and the Environment

IMF : International Monetary Fund

IWRM : Integrated Water Resources Management

OECD : Organization for Economic Co-operation and Development

O&M : Operation and Maintenance

SHW : State Hydraulic Works

TSI : Turkish Statistical Institute

UN : United Nations

UNCED : UN Conference on Environment and Development

UNESCO : United Nations Educational, Scientific and Cultural Organization

UNICEF : United Nations International Children's Emergency Fund

USA : United States of America

WEF : World Economic Forum

WFD : European Water Framework Directive

WHO : World Health Organization

WMO : World Meteorological Organization

WRI : Water Resources Institute

WRM : Water Resources Management

WWAP : United Nations World Water Assessment Programme

WWF : World Wide Fund for Nature

WWC : World Water Council

1. INTRODUCTION

Since Industrial Revolution, structure of the world has changed in all aspects. Capitalism has become the new world order and it has caused many problems. The need of raw materials and ever-growing consumption for its survival has imposed a serious burden on nature. Increasing technological progress has also contributed to this burden. These destroying couples have taken effect mostly on the main source of the life: Water.

Water has unique meaning for human beings. Beyond being just a main source of life, water also makes sense for all of life's occasions. Survival of people, ecosystems and production largely depend on sufficient and improved water resources. Agriculture, energy and health sectors also profoundly hinge on water's availability. Although water resources cover almost whole world, according to State Hydraulic Works [SHW], freshwater resources such as lakes and rivers constitute only 2.5% of the water on the planet and 90% of all freshwater is locked up in glaciers.[1] To sum up, there is no substitution for water.

With a growing pressure since the industrial revolution, water resources have been used unconsciously and excessively. Also, global warming causing floods and drought has endangered the sustainable future. Another important destroying effect is increasing population. Water resources and population are not equally distributed in the world. This situation brings about the allocation and management problems of water worldwide. As a scarce source, water has become a current issue for the whole world.

In many parts of the world, water managements are not efficient and poor people could not get sufficient water supply and sanitation. According to the report published by United Nations World Water Assessment Programme [WWAP], there are still 663 million people lack to access to improved drinking water sources and it is estimated that 2.4 billion people globally still use unimproved sanitation facilities.[2] According to World Resources Institute [WRI], more than a billion people currently live in water-scarce regions and 3.5 billion people could come up against water scarcity by 2025.[3]

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[1] http://en.dsi.gov.tr/land-water-resources [accessed 01.02.2016].
[2] UN World Water Assessment Programme [WWAP], (2015). *The United Nations [UN] world water development report 2015: Water for a sustainable world.* Paris, UNESCO.
[3] http://www.wri.org/our-work/topics/Water [accessed 01.02.2016].

Associated with growing capitalism, property concept arose. This concept affected water resources in addition to education, health, and transportation. The insight regards water as a human right and the notion assumes that water should be managed in accordance with its market value contradict. While the former is in favor of free or not commercialized access to water, the latter argues for market oriented management and allocation of water.

There is a view that sees economics as a part of the water problems because of insufficient concepts related with value of water. If economics fails to determine the value of water, this impedes necessary approaches to solve the water crisis. In this regard, although it is hard to assert the value of water exactly, water should be managed in compliance with its value to sustain the natural balance and provide economic requirements.

The need to manage the scarce water resources in the face of growing human population and climate change becomes crucial under present conditions. As economics is a science interested in allocation of scarce resources to unlimited human needs and desires; and water is the most threatening scarce resource, the need of recommendations for water management with current data is mainly required. To sum up, adding regulations that increase public awareness to literature has a great importance, especially for Turkey which has fairly low saving conscious when compared with other countries.

The purpose of this dissertation is to analyze, assert and interpret theoretically the economic value of water and efficient water resource management which is necessary for Turkey as well as other countries. The economic value of water is analyzed with historical perspectives and threats to water resources and economic instruments which are effective to determine the value are examined. In addition, applications, regulations and some worldwide examples for better understanding of situation about water management are given. In this study, making the policies and recommendations a useful tool is also tried for raising awareness in society which tends to ignore the environmental disasters and regulations when there is no economic gain or loss.

This study is wholly a theoretical approach to economic value of water; and national and international literatures were reviewed in accordance with the scope of the study. There are few studies that examine water management in Turkey. The study for economic analysis of water could not be found at the postgraduate level. Studies on similar subject are pretty much in foreign literature. In this sense, this study will contribute to create original literature for Turkey. The data for water resources and water use are taken from World Databank and OECD database and the reports are specified in the references.

2. LITERATURE REVIEW

As Tietenberg and Lewis (2009, p. 204) indicated, water is one of the most essential elements of life. Human beings need water to survive in aspects of both continual loss of body fluids and food sources. Therefore, water resources deserve special attention. Water has importance in terms of sustainable economic, social and environmental life. In other words, "water resources, and the essential services they provide, are among the keys to achieving poverty reduction, inclusive growth, public health, food security, and long-lasting harmony with Earth's essential ecosystems (Ban Ki-moon, Former Secretary-General of the United Nations)".[4]

According to Abdullaev and Rakhmatullaev (2014, p. 1425; p. 1437), the limited water resources are threatened by some factors. And, these factors such as increasing competition for water between users, and climate change makes water resources management a challenge. As they indicated in their article, access to clean drinking water, to irrigation water for food and use of water for energy production are potential problems for water resources management to solve. In the face of such a complex situation, the quantity and quality of the water resources deteriorate in many parts of the world and water could become a source for instability.

Mostly in developing and emerging economies, demand for water is largely driven by increasing standards of living and ever-increasing water demand for food, energy and production of goods which require considerable amounts of water (WWAP, 2014, p. 23). According to Agarwal et al. (2000, p. 6), economic and social development activities pose challenges related to water. As they stated, the problems such as shortages, deteriorated quality and floods require greater attention and action.

According to Bahri (2012, p. 18), what is important in terms of water availability is not only adequate quantity; also water at desired quality determine available water for particular uses. In general, because of insufficient wastewater treatment, poor urban water resources have significant effects for ecosystems, health, and people. Irina Bokova (Director-General of UNESCO) asserted that around 748 million people do not have access to an improved source of drinking water, and water demand for manufacturing is expected to increase globally by 400

[4] WWAP, (2015). p. v.

per cent between 2000 and 2050.[5] Farolfi (2011, p. 7) noted that the significant differences in terms of access to water largely linked to the differences of people's living conditions, and some observers stated that "Water flows where money is".[6]

Abdullaev and Rakhmatullaev (2014, p. 1438) asserted that the lack of efficient water management institutions and the long-term basin plans exacerbate the problems further, especially in developing countries. They stated that advancement in data management and implementation of the data management tools are useful to solve water related problems and potential water-conflicts. According to Sullivan (2002, p. 1198), data development and its integration with economic accounting systems is a significant basis for sustainability because water is an essential factor for economy and healthy ecosystems.

According to Spanos (2014, p. 9), warmer temperatures and changes in precipitation patterns and runoff increasingly affect the ability to manage water resources. Successful planning considers all competing needs and takes into account social, environmental, and economic impacts. The solution to a problem may mean rethinking the problem in a holistic way. For example, instead of building a new dam, an upstream watershed can serve as a natural storage infrastructure that serves multiple purposes.

Farolfi (2011, p. 10) pointed out in his study that availability of water largely affects economic and social progress, and development is influenced by how water resources are managed. He implied that water resources should be managed with a holistic water management practices for improving human development and social welfare, as well as protecting environment. In other words, water management covers a broad process which includes development, distribution and management of scarce water resources (Sümer, 2011, p. 1).

Starting from the nineties, a new concept was introduced: Integrated Water Resources Management (IWRM). This concept highlights the human component of water management, with particular emphasis on water demand management, and consequently the economic value of water, stakeholders' involvement and participation, the role of women, institutional governance, and environmental sustainability (Farolfi, 2011, p. 9).

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[5]WWAP. (2015). p. v.

[6]Oral communication by Prof. A. Szollozi-Nagy, Rector of the IHE Unesco Institute for Water Education.

According to Agarwal et al. (2000, p. 6), IWRM is a process which can assist countries to deal with water issues in a cost-effective and sustainable way. As Farolfi (2011, p. 2) stated, the factors such as efficiency, equity and environmental health should be taken into account when planning and applying IWRM which requires substantially reinforcement of existing capacity for improved water management and decision-making.

Boltz (2017, p. 1) asserted that valuing water resources in terms of economic, environmental and social benefits is a pre-condition for efficient management, which removes tradeoffs among competing users. Hanemann (2005, p. 2) stated in his study that economists sometimes use insufficient older ways such as market mechanism to analyze economic value. Furthermore, the complexities of water as an economic good are not evaluated efficiently by economists although these complexities diversify water from other goods and contribute to the clarifying the current water crisis.

Ward and Michelsen (2002, p. 425) noted that water has economic value only when its supply is scarce relative to demand. It means in the economic sense that if water is available in unlimited supply, it is free to consume. According to them, scarce water reflects an economic value as many users compete for its use. The economic value of water is defined by its price in a market system. This economic value of water provides a useful tool to allocate water among alternative uses by yielding the greatest total economic return.

Hanemann (2005, p. 3) criticized the statement of Ward and Michelsen. According to him, there would not be an economic value for non-marketed commodities if economic value is measured only by market price. For example, public goods which are not sold in the market would have no economic value. In such a condition, economic value would be a narrow concept by stating confusion about what is valuable.

Howard (2003, p. 1) advocated that water like other commodities only has economic value in relation to its scarcity. Hence, the economic value of water is related to the reliability of its supply. As other commodities, the value of water is determined by its role in the production of other goods and services. According to him, the measures of both reliability of water and its impact on economic activity must be included in the determination of the economic value of water.

According to Kılıç (2009, p. 45), water would be an economic good which can only be consumed by who pay the price, if the freshwater services were carried out by the private sector that acts upon profit maximization. Tuluay (2010, p. 2) stated that the companies which have the right to exploit water adjust prices at will and this condition restricts the people's rights of use for water resources. She pointed out that this negative privatization process is growing rapidly in Turkey as well. According to Uluırmak (2014, p. 130), capitalist and free market approaches dominate international processes, institutions and conventions.

Güzelsarı and Tuluay (2011, p. 54) argued that private sector participation in water management both in urban and rural water services and commercialization of water has been an agenda especially in the last two decades throughout the world and in Turkey as well. They are against the policies and reform proposals which seek to make private sector a participant in water management and advocate that water crisis can be solved only if water is managed in the market principle context.

Ward and Michelsen (2002, p. 423) indicated that defining the economic value of water provides a basis for decision makers to make efficient choices on water usage, management, conservation and allocation in the face of increased water scarcity. In other words, specifying the economic value of water conceptually and empirically accurate is a significant principle to allocate scarce water resources between uses and users.

As a consequence, Rahaman (2009, p. 10) discussed in his study that using economic principles in water management can yield more efficient water services. However, according to him, water usage for basic needs should not be treated within market-oriented concept. He concluded that whether water is a common or an economic good should be discussed with more analyses and studies.

3. THE MEANING OF ECONOMIC VALUE

The concept of economics is generally defined as the study of the use of scarce resources to satisfy unlimited human wants. While analyzing these sources, economics uses their ‘economic values’ in order to evaluate them efficiently. According to Whittington et al. (2013, p. 8; p. 9), “the concept of the economic value of any good or service (including water) rests on the notion of exchange– how much of something else an individual or household would trade in exchange for the good or service in question”. It means that the economic value depends on individuals’ preferences for different situations.

To put it more explicitly in a modern style, while exchanging goods and services, individuals are willing to pay the maximum amount of money which satisfies them. In other words, “economic value is determined by the impact on social welfare, which is given by the aggregate impact on the utility of individuals. The utility is determined by preferences, which individuals express in their willingness to pay for goods and services (Turner et al., 2004, p. 31)”. All of these statements reflect the difference between demand and supply. Attributing value to an item rests on the worth for individuals, not its costs. Hence, this item may be cheap stating that its total cost is low, but highly valuable for individuals with great total value, or vice versa (Hanemann, 2005, p. 5).

Economists also attribute value to goods and services depending whether these are private or public. “The value placed on a given unit of a private good is that of a single user with the highest use for the item. Conversely, the value placed on a public good is that of all those for whom the item has some value (Hanemann, 2005, p. 13-14)”. However, there is a common confusion about value and price of a good or service. The economic value and price may have different meanings for economists. As Hanemann (2005, p. 3) points out, “price does not in general measure economic value, and items with no market price can still have a positive economic value. Water as a commodity clarifies the economic concept of value”.

Before going further, one subject mentioned in the previous paragraph has to be enlightened at this point. By using Smith’s ‘diamond-water paradox’ and ‘value in use’ vs. ‘value in exchange’ differentiation, Hanemann (2005, p. 3; p. 4) differentiates market price from economic value and asserts that “the market price of an item need not reflect its *true* value. Market price reflects the fluctuating circumstance of daily life (sudden scarcity, monopoly or temporary needs and changes), while the true value is something more basic, enduring, and stable".

Hanemann may be right about his claim for plentiful amount of water. Obviously, economic value is a broader concept which involves price. But, he may be mistaken while analyzing current conditions just like Adam Smith. The difference between economic value and price may be valid in some circumstances and for other types of goods, non-scarce or nonmarket goods. However, water is accepted as an economic good and it is generally exchanged in the markets or a price is appreciated for it. Also, it has become scarce resource for the whole world. To sum up, the price which is measured with willingness to pay in monetary terms can be used instead of economic value.

3.1. Historical Dialectic for Value of Water

Determining the value of water has long been a cause celebre for the economists and philosophers. The prominent example of this pursuit of the value is Adam Smith's fallacy on the 'diamond-water paradox'. In his famous book *An Inquiry into the Nature and Causes of the Wealth of Nations*, Adam Smith coined the paradox that water is essential for life but has little value in exchange (and the price of water is low), while diamonds are extremely valuable in exchange, but are unnecessary for survival (and their price is very high).

Smith explains his idea as "Nothing is more useful than water: but it will purchase scarce anything; scarce anything can be had in exchange for it. A diamond, on the contrary, has scarce any use-value; but a very great quantity of other goods may frequently be had in exchange for it (Smith, 2007, p. 26)". According to Whittington et al. (2013, p. 16), "because Smith spent his life in the United Kingdom, a water-rich country, he never experienced firsthand the challenges of establishing an economic value of water in conditions of scarcity".

The 'diamond-water paradox' was solved by Marginalists with a simple logic–marginal utility theory. Marginal utility, in economics, is described by Britannica[7] as "the additional satisfaction or benefit (utility) that a consumer derives from buying an additional unit of a commodity or service". This concept

[7]http://www.britannica.com/topic/marginal-utility [accessed 18.12.2015].

implies that the utility to a consumer of an additional unit of a product is inversely related to the number of units of that product he already owns.

If the marginal utility is applied to the paradox: because water as an essential for survival and a basic need is already plentiful, an additional unit of water has a very low utility (value) to someone when consumed. On the contrary, because diamonds are scarce they are valuable to a person. It means that their marginal utility from an additional unit is higher than water because of their extraordinary beauty to a person, as well as their rareness. "The distinction between marginal and total gives full resolution of the paradox: water may have a smaller value than diamonds at the margin, but it undoubtedly has a larger total value (Hanemann, 2005, p. 6)".

Hanemann (2005, p. 26) points out that "in economic valuation involving water, the relevant quantity that needs to be known is the marginal value rather than the average or total value of water". The logic behind this idea is that "the marginal value involves the derivative of a relationship. On the contrary, the average value can be estimated simply by dividing two quantities without any understanding of how they are related in reality (Hanemann, 2005, p. 27)".

3.2. Water: What Kind of Good?

As water has multifaceted characteristic, there is no certain and simple taxonomy of water as a commodity. In 1992, the International Conference on Water and the Environment [ICWE] was held in Dublin. Some principles (known as Dublin Principles) were declared in this conference. According to one of these principles, "Water has an economic value in all its competing uses and should be recognized as an economic good".[8] In other words, water is different from other commodities and it has various distinctive features which make it a special economic good.

According to Farolfi (2011, p. 15), "the two required fundamental characteristics for a good to be an economic good are usefulness (economic agents consider that its consumption increases their utility) and scarcity (limited availability implying economic choices in its allocation)". Undoubtedly, both of

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[8] http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html [accessed 20.01.2016]. Details are given in the Section 7.3.2.

these characteristics are valid for water. Thus, water can be recognized as an economic good. However, “water is not a simple economic good; it is sometimes a public good, sometimes a private good and often lies somewhere in-between. Its development can lead to natural monopolies, and it presents major economic and physical side effects or externalities (Rogers et al., 1998, p. 24)”.

Whether a good/service is private or public is determined according to two generally accepted criteria. The first one is rivalry criterion which reflects the impact of one person’s use on the potential use for others. The second one is being excludable criterion which implies to exclude the non-payer beneficiaries. Goods and services are called *private goods* and are exchanged on markets if they are rivalrous in consumption and have the feature of excluding non-payers. Conversely, the goods and services are *public goods* and are provided by some non-market mechanism if they are non-rivalrous in consumption and there is no possibility to exclude non-payers (Booker et al., 2012, p. 169).

In the light of this information mentioned above, the factors that differentiate water as a special economic good from other commodities and have significant impacts on the economic analysis of water can be analyzed more specifically. First of all, water is *mobile* stating that specifying certain units of the water is a great challenge and exclusion is considerably costly. Secondly, water supplies are *highly variable and unpredictable* which largely affects the water management. Finally, water is *universal solvent* for removing contamination. Lack of water in adequate amount poses quality problems in terms of the concentration of contamination (Farolfi, 2011, p. 16).

More specifically, the most complex economic good, water, can be classified as both a private good and a public good. Bottled water can be said as pure private good. Also, the agricultural, industrial and domestic water are private good with high rivalry and excludable feature. Water as a basic human need which exists as surface and groundwater is public good with high exclusion costs (no exclusion) and non-rivalry. These are also called *common-pool* resources if water is left in situ (its natural state), for instance, as aquatic habitat or for recreation (Booker et al., 2012, p. 169; Hanemann, 2005, p. 13). However, “as only a very small part of the total water available and used is extracted and bottled to be commercialized on a market and labeled, it is never a commodity (Farolfi, 2011, p. 19)”.

3.3. Water as an Economic Good: Values and Costs

Water resources which were historically plentiful are becoming scarce because of climate change, population growth, pollution and economic practices for development. When water is assumed as abundant, it is considered as free good. In such case, economic analyses are focused only on the resources that have impacts on economic activities such as optimal allocation of scarce funds for infrastructure among competing demands. In brief, economic value of water, for instance value of the water running through the system, is generally ignored by economists (Sadoff et al., 2003, p. 21).

As stated earlier, defining the economic value of water is a challenging task. Particularly, when water is available in plentiful amount, it becomes a public good with high exclusion costs and non-rivalrous in consumption. Also, because of non-exclusion feature of public goods, free-riding problem occurs. Hence, it is hard to specify a unit of water and its value exactly. However, when it comes to scarcity, economic value of water becomes easier to ascertain. Ward and Michelsen (2002, p. 425) underpin this claim and state that "water has economic value only when its supply is scarce relative to its demand. Whenever water is available in unlimited supply, it is free in the economic sense. Scarce water takes on economic value because many users compete for its use".

In this framework, the most appropriate measure for the economic value of water is willingness to pay for water. In other words, "an economically sound method for calculating the value of water is to evaluate the consumer's willingness to pay for additional water supplies (Howard, 2003, p. 5)". However, according to Howard (2003, p. 1), "this concept may lead to inadequate water development and human hardship in developing countries". On the other hand, "it can be useful for establishing objective levels of service in developed countries where alternatives can be substituted for some level of water consumption".

In addition to scarcity, economic value is also mainly determined by utility and quality concepts. From the point of utility, marginal value plays an important role in policy analysis and allocation decisions. For example, as the capacity for water is aimed to be expanded, "economic efficiency requires that it can be expanded as long as the marginal value of the additional capacity exceeds its marginal cost. Likewise, the efficient allocation of scarce water among competing uses occurs only when marginal value per unit of water is equal for all uses (Ward and Michelsen, 2002, p. 430)".

According to Ward and Michelsen (2002, p. 430), "use of estimated average value usually leads to an over-investment in water supply capacity or over-use of water since it is typically much larger than marginal value". Apart from this, water is subject to diminishing marginal returns. "For any potential quantity that could be supplied, demand is limited. So, the economic value of an additional unit of water supplied decreases as greater quantity is offered to water users (Ward and Michelsen, 2002, p. 428)". It means that the utility gained from the first glass of water is higher than the second one. There is no utility obtained when someone's thirst is quenched.

In respect of quality, both values and costs are affected. The values and costs are based on different water qualities for different uses. The finest quality water is used for drinking or cooking and this high quality provides high value and costs much to the users. However, the best quality water does not necessarily have to be used for bathing, flushing of toilets or gardening. These kind of uses of water reflects different and lower qualities of water, levels of value, and hence willingness to pay (Rogers et al., 1998, p. 16).

Apart from scarcity, utility and quality, there are also several factors which affect the economic value of water. One of these factors is costs incurred for conveyance, storage, and processing of water. Another factor is technological change which can be exemplified as increasing economic value of water in agriculture by means of the expensive investment on effective drainage systems (Ward and Michelsen, 2002, p. 436; p. 444). Also, "the economic value of a unit of water varies widely across different uses. A unit of water for drinking or industrial use generally has a much higher economic value than the same volume of water used to produce cereal crops (Whittington et al., 2013, p. 8)".

In addition, timing and reliability for water have crucial effects on the economic value of water. In terms of timing, economic value of water covaries with demand differences for water in irrigated agriculture. For example, in dry season (water scarcity), the economic value of water is higher than the value in abundance. Also, timeliness in irrigation for crops at the required and most significant stage of growth affects economic value of water. On the other hand, reliable water supply has great importance for all uses. While providing improved and reliable water to users creates higher costs and prices with regard to capacity and/or pumping, lack of reliable water, for instance in agriculture, brings about low output and lack of willingness to pay the costs of water (Rogers et al., 1998, p.14; p. 15).

In the face of increased scarcity, pollution and climate change, the economic value of water (including its benefits and costs) provides a useful tool for managers to make more rational decisions on water development, allocation, and competing uses. In addition to designing incentives, political tools and economic instruments against current water challenges, valuation increases public awareness for water related issues in integrated and holistic socio-economic perspective (Ward and Michelsen, 2002, p. 444; WWAP, 2012, p. 534). Also, "in the context of access to critical transboundary water resources, valuing can inform governments about the advantages of cooperation instead of conflict (WWAP, 2012, p. 543)".

Complex nature of water makes its economic value difficult to ascertain. As well as being environmental good for ecosystems, "water is both a private and public good. Also, it is recyclable, bulky and difficult to transport (Kochhar et al., 2015, p. 6)". Moreover, acquiring data is not possible in some cases or founding effective mechanisms to obtain data is too costly. As stated earlier, another significant problem is determining the unit of measure for water used such as in recreation activities. Also, ignoring the externalities (benefits and costs) distorts economic value of water by causing underinvestment or overinvestment in water infrastructure (WWAP, 2012, p. 536; p. 547).

3.3.1. Types of water values

Evaluating the economic value of water resources from a specific or narrow point of view is a misleading action. Water is such a complex good that it is an economic good (production input or final good), a social good (basic need) and an environmental good (ecosystems). Because of its nontrivial nature, there is no single kind of economic value for water resources. "The value of water varies widely according to factors such as the use it is put to, the socio-economic characteristics of users, its availability in space and time, as well as the quality and reliability of supply (Turner et al., 2004, p. 60)".

As discussed in Section 3, the most appropriate measure for the economic value of water is market price. However, this situation is true if an efficient and well-founded market system exists. Also, "it does not necessarily mean it must be sold at market price because markets are not everywhere competitive (Sadoff et al., 2003, p. 22)". Moreover, "the market value of water is intrinsically regional or even local meaning that price observations from one context may have little relevance in another (WWAP, 2012, p. 543)". In brief, there are several components and types of value for water in economic terms.

While analyzing the value of water, the inductive method is applied. Full use values, non-use values and total economic value of water are examined respectively. The first one is composed of direct values (value in use), indirect values (externalities) and system value. The second one consists of existence value, bequest value, philanthropic value, option value and intrinsic value. The last one, total economic value, is the sum of all these values.

- **Full Use Values:** It contains both direct and indirect use values of water. The *Direct Use Values* include water for consumption (value to users) such as agricultural, industrial and domestic use as well as water for non-consumption uses such as hydroelectric generation and recreational activities (WWAP, 2012, p. 535). According to Rogers et al. (1998, p. 11), "value to users for industrial and agricultural uses is at least as large as the marginal value of product. For domestic use, the willingness to pay for water represents a lower bound on its value".

The *Indirect Use Values* do not cause from mutual interaction of human being with water resources. In other words, these values arise from "the indirect environmental services provided by water including waste assimilation and the protection of habitats, biodiversity and hydrological functions (WWAP, 2012, p. 535)" as well as "flood protection provided by wetlands or the removal of pollutants by aquifer recharge (Turner et al., 2004, p. 54)". These can be called as externalities because they cause both positive and negative effects that should be taken into account while analyzing the economic value of water.

Classification of externalities as positive or negative can be respectively exemplified with "recharging ground water table by a part of the water diverted for irrigation canals, which provides water for livestock, flora and fauna (Rogers et al., 1998, p. 11)", and "water logging and salinization of soils, declining groundwater tables and pollution of water from agrochemicals and waterborne diseases (Rogers et al., 1998, p. 12)".

"*System values* aggregate the economic value of water in all of its uses within a river basin or watershed (Whittington et al., 2013, p. 8)". It means that the system value is a broader concept than user value and involves opportunity costs and externalities, namely the economic value of water to users. While a number of factors such as the hydroelectric potential, the agricultural user values and the losses due to evaporation and leakage determine the system value in a river basin, the user values and the costs stem from other users such as water abstraction determine this value in municipal systems (Whittington et al., 2013, p. 18; p. 19).

The rationale behind the system value is that a system perspective gives the opportunity to observe changes in water availability, overall benefits and costs which stem from nature, interventions, investments or regulations. In addition to broader cooperation in a river basin, both productivity and quality of water resources can be increased in a sustainable way by maximizing the system values of water in a national or international river basin (Sadoff et al., 2003, p. 32; Whittington et al., 2013, p. 18).

- **Non-use values:** The other type of values composing the economic value of water is non-use or passive values. Such values stem from some people's willingness to pay for water in situ to sustain ecological cycle. For instance, "some Europeans are willing to pay to preserve the current hydrologic regime of the Sudd swamps (in South Sudan) in order to sustain the migratory bird life that winters there and summers in Europe (Sadoff et al., 2003, p. 19)".

People attribute a value on ecosystem services because they continue to exist *(Existence Value)* or because they will be available in the future *(Option Value)* as a safety valve or for the use of future generations *(Bequest Value)*. Also, they value water and ecosystems because these simply exist *(Intrinsic Value)* and these are available to contemporaries in the current generation *(Philanthropic Value)* (Turner et al., 2004, p. 55; Farolfi, 2011, p. 17; WWAP, 2012, p. 535).

- **Total Economic Value:** It is the sum of the components mentioned above as it is shown in the Figure 3.1. When the effective allocation of water resources among competing uses is aimed, using Total Economic Value provides a useful tool to make decisions and it yields more rational allocating process. By obtaining the total economic value, economic costs of water resources to users can be determined in more efficient way. According to Rogers et al. (1998, p. 5), “regardless of the method of estimation, the ideal for the sustainable use of water requires that the values and the costs should balance each other; full cost must equal the sustainable value in use”.

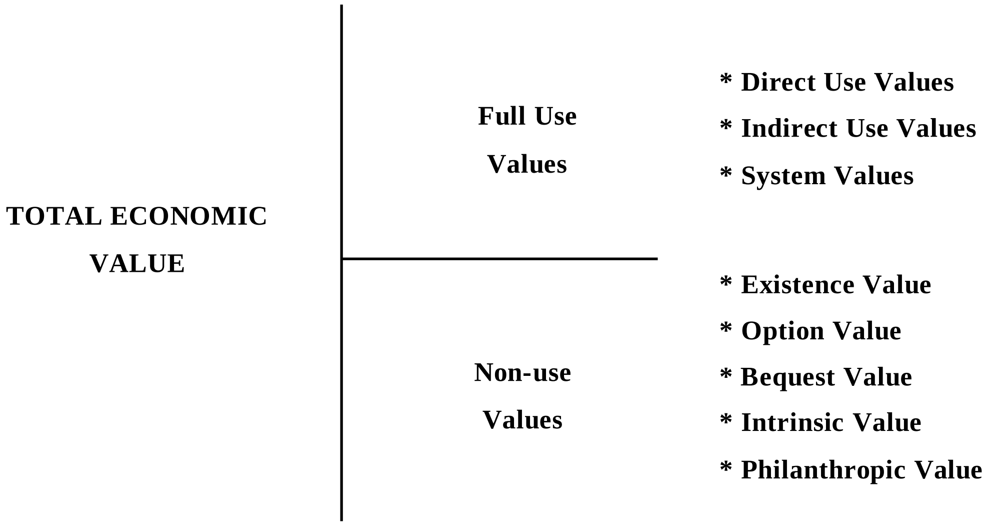

Figure 3.1. *Components of Total Economic Value*
Source: *Turner et al., 2004, p. 55.*

3.3.2. The cost structure of water

As for the value of water, economic costs of water were usually handled with a narrow perspective. “The economic cost of water was conceived as simply the cost of building and maintaining the infrastructure necessary to supply this resource (Sadoff et al., 2003, p. 22)”. It can be valid for bottled water or water markets. However, for agricultural, industrial or recreational water, there are other components to be included in cost structure. In other words, there are economic and environmental externalities and opportunity costs which affect and differentiate the value of water.

While analyzing water in terms of cost structure, broader perspective should be applied. In addition to financial costs such as operation and management costs, economic costs such as externalities and opportunity costs should be taken into account. Although presenting the costs and values related with water resources is a challenging process, the costs of water resources can be classified mainly on three interdependent types (Sadoff et al., 2003, p. 21):

- **Use Cost (Full Supply Cost):** It is the classic way of analyzing the costs related with water resources. This cost indicates the financial expenses for the use of water. There are two components for this type of cost. The first one is *Operation and Maintenance [O&M] Costs* which are "purchased raw water, electricity for pumping, labor, repair materials, and input cost for storage, distribution, and treatment plants (Rogers et al., 1998, p. 6)". The second component is *Capital charges* including "capital consumption (depreciation charges) and interest costs associated with reservoirs, treatment plants, conveyance and distribution systems (Rogers et al., 1998, p. 6)".

- **Full Use Cost (Full Economic Cost):** The Full Economic Cost of water comprises the Full Supply Cost, the Opportunity Cost and the economic externalities. *Opportunity cost* indicates "cost of the alternate use of the same water resource for another user (Rogers et al., 1998, p. 7)". For example, when water is used for agricultural activities, the opportunity cost of this water would be the waived benefits for livestock or energy production. "Ignoring the Opportunity Cost undervalues water, leads to failures to invest, and causes serious misallocations of the resource between users (Rogers et al., 1998, p. 8)".

Economic externalities are "the production or consumption costs associated with, for instance, the impact of an upstream diversion of water and with the over-extraction or contamination of water resources (Rogers et al., 1998, p. 8)". However, the externalities are classified as positive or negative. What matters with regard to cost structure is *Negative Externalities* which requires imposing costs of externalities on who creates these for others. An example may be cost caused from salinity on water resources by third parties. One example for *Positive Externalities* may be "surface irrigation for both meeting the evapotranspiration needs of crops, and recharging a groundwater aquifer (Rogers et al., 1998, p. 8)".

- **Full Cost:** It is the broader cost concept with economic and environmental impacts as it can be seen in the Figure 3.2.This type of cost includes *Environmental Externalities*, which are the costs to public health and ecosystems, in addition to the Full Economic Cost. "These costs have to be determined based upon the damages caused, where such data are available, or as additional costs of treatment to return the water to its original quality (Rogers et al., 1998, p. 9)".

According to Rogers et al. (1998, p. 31), “the Full Cost should present the context for setting water prices, effluent charges, and incentives for pollution control”.

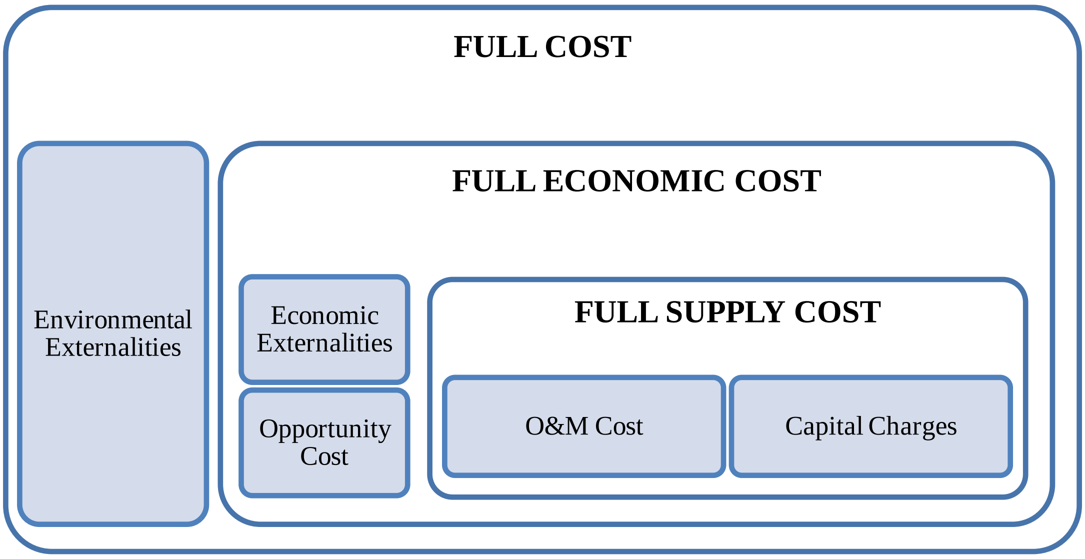

Figure 3.2. *Cost Structure of Water*
Source: *Agarwal et al., 2000, p. 20.*

Although accepting and treating water as an economic good requires compensating the full costs for all uses in order to sustain investment and financing for services, human right perspective for access to water should be taken into account as well. Since “there are well-established practices of cross-subsidization from better-off water users to the poor in the provision of municipal and rural water supply (Clausen, 2004, p. 62)”, recovery of full supply cost and poverty alleviation purpose contradict. Also, the cross-subsidies may create predatory pricing (low price). Due to this reason, subsidies should be applied directly and in a transparent management manner.

Rogers and Hall (2003, p. 5) state that there is possibility to estimate values and costs via computers and software by using systems analysis models. However, if there is no possibility to use such models, partial equilibrium analysis which requires estimating opportunity cost across uses can be applied. For example, obtaining the full use (economic) cost of agricultural water use requires estimating value for the best waived alternative use (e.g. the industrial sector or domestic usage).

4. THE ECONOMIC INSTRUMENTS AND THEIR RATIONALE

Economic instruments are important tools for managing water in accordance with its economic value. These are also used for establishing and applying environmental policies as well as contributing to sustainable development. The economic instruments provide a range of opportunities such as incentives for behavioral change and technological innovation. These instruments also provide the generation of revenue for financing further environmental investments and the reduction of pollution at the lowest costs to society. Because these instruments make the polluter pay for the damage rather than society as a whole, they are significant tools for the application of the "polluter and user pays" principle (Kraemer et al., 2003, p. 1-3).

Sadoff et al. (2003, p. 1) claim that "an economic perspective shed light on the economic, social, and environmental tradeoffs inherent in political decisions and provide an objective language and framework". Also, economic instruments can be used to form a basis for management schemes and to analyze the incentives and the economic aspect of water usage. These are applied in many European countries as an effective policy tool. According to Rogers et al. (1998, p. 31), "raising water tariffs, levying effluent charges and encouraging water markets can play significant roles in improving economic efficiency and environmental sustainability of water use".

Finally, these instruments are useful toolkit in water pricing which is conducive for cost recovery. It means that environmental costs can be involved in the prices of goods and services. In conclusion, these are highly effective by sending price signals to consumers to reduce inefficient and wasteful use of resources (Kraemer et al. 2003, p. 3). "Prerequisites for successful application of most economic instruments are appropriate standards, effective administrative, monitoring and enforcement capacities, institutional coordination, and economic stability (Clausen, 2004, p. 61)".

4.1. The Economic Instruments

It is broadly accepted that using market forces for supporting environmental aims generates many benefits. Because they integrate environmental concerns with economic decision making processes, economic instruments have currently gained particular attention as an important tool in environmental policy making (Kraemer et al., 2003, p. 47). Economic instruments include the use of prices and other market-based measures to improve water use and management.

Economic instruments are not substitutes for other tools of water governance such as monitoring, regulation and enforcement of public health and environmental standards.[9] Some examples of economic instruments are water prices and tariffs, taxes, subsidies, and water markets. Figure 4.1 shows the economic instruments which are examined in this section of the study.

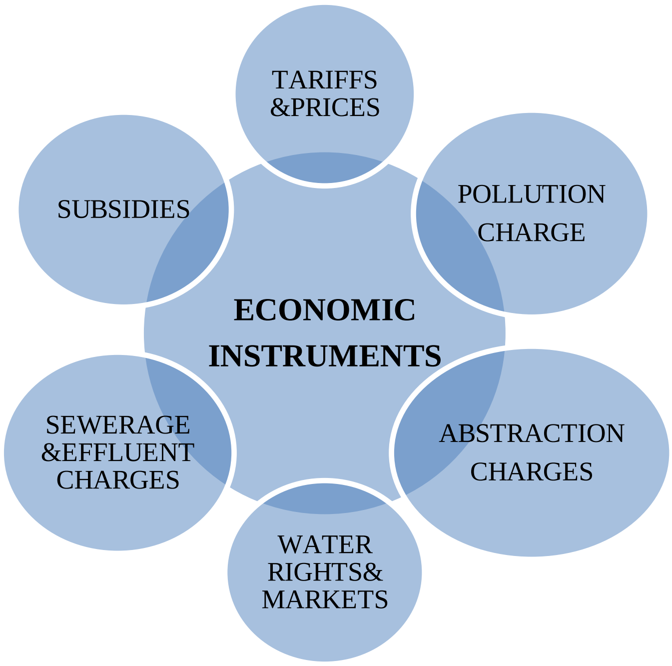

Figure 4.1. *Economic Instruments for Water Management*
Source: *Adapted from Kraemer et al., 2003, p. 6.*

4.1.1. Water tariffs and prices

The major economic instrument is charging a price for water according to a water tariff. In other words, water tariff is a price charged for water supplied with pipelines to users. However, prices put for water itself are different from tariffs and are called water abstraction charges. Water pricing is generally applied to three main users which are households, industry and agriculture. Tariffs are applied to both freshwater and wastewater. Tariffs are determined according to the amount of

[9]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/ [accessed 24.12.2015].

water consumed, its source, or the time period in which it is used. Charging a price for water signals its economic values including its costs that occur while making it available for users (Farolfi, 2011, p. 92; gwp.org[10]).

The term of water pricing has different processes to set a price for water. Water resources which are abstracted and put in bottles by private or public companies are called as bottled *water.* This kind of water is sold at market prices in the market and its price differs in accordance with brand, size of bottle and place of sale (restaurant, kiosk etc.). For *piped water* which is supplied by utilities, the price including sewer tariffs is determined administratively per cubic meter. The price for bulk water distributed by *tanker trucks* where people lack access to piped water is determined in the market per cubic meter (Farolfi, 2011, p. 91).

When metering is applied in water and wastewater tariffs, it is called as *volumetric tariff*. If metering is not applied, it is *flat rate tariff.* Also, *seasonal tariff* which differs in peak and normal seasons is applied when demand or scarcity for water is huge. When a tariff decreases with the amount of water consumption, it is *decreasing-block tariff.* If it increases with water consumption, the tariff is *inverted-block or increasing tariff*. In OECD countries, the most commonly applied tariff is increasing-block tariff. While applying tariffs, human right perspective is taken into consideration. To protect poor people, first block of tariff is mostly set at low levels (Farolfi, 2011, p. 92).

Water and wastewater tariffs aim to raise revenue. This revenue is used for recovering the costs of investment (for pumps or pipelines), distributing water to users, water storage and treatment. It is also a source for future environmental expenses. As well as being a financing tool, water pricing provides an incentive as a significant policy tool. "Water prices which represent full costs (economic and environmental costs) provide price signals to users resulting in a more efficient water use and generate the means for ensuring a sustainable water infrastructure (Kraemer et al., 2003, p. 7)".

The price charged for water should include the full costs of delivery. In general, water prices involve three types of cost: direct economic costs, social costs, and environmental costs. *Direct economic costs* represent water prices that

[10]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/Pricing-of-water-and-water-services/ [accessed 24.12.2015].

include operation and maintenance costs, construction costs and the reserves for water infrastructure in the future. *Social costs* involve the direct or indirect social benefits. *Environmental costs* appear generally as externalities instead of being reflected in the prices (Kraemer et al., 2003, p. 6).

Tariffs should be applied as volumetric for effectiveness by indicating the level and timing of consumption. As Clausen (2004, p. 63) indicates, water tariffs provide little incentives for the sustainable use of water if charged at a flat rate independent of the amount used. Some examples of charge rate structure are given in the Figure 4.2. Apart from the tariff structures described by Farolfi, there is also Seasonal Rate Structure which is applied when demand or scarcity for water is huge.

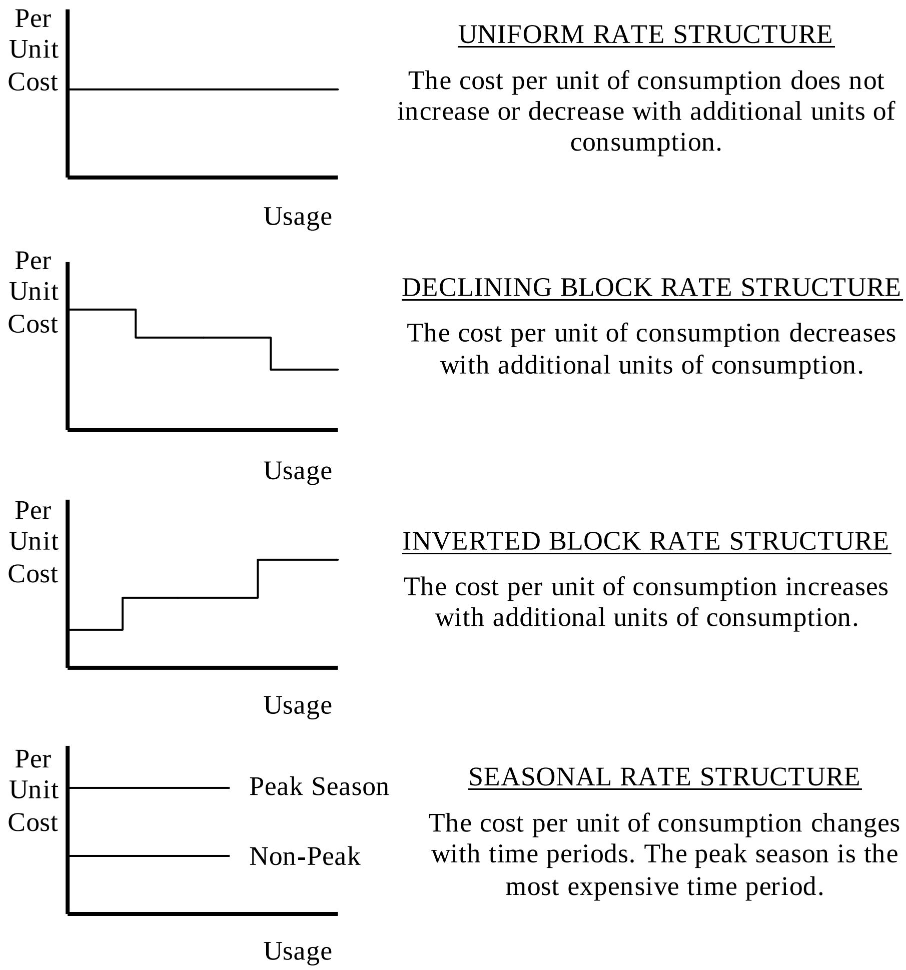

Figure 4.2. *Examples of the Charge Rate Structure*
Source: *Tietenberg and Lewis, 2009, p. 226.*

Market prices for water services (especially for household and industry) provide an opportunity to obtain water's economic value directly. However, prices for water used in irrigation are usually determined administratively by using a flat rate. In this case, statistical data analysis between water consumption and price can be to measure the economic value of water to the final user if historical administered prices vary and water buyers freely adjust their demand to price changes (Ward and Michelsen, 2002, p. 434; Farolfi, 2011, p. 91).

On the other hand, Tietenberg and Lewis (2009, p. 231) advocate that the principles of marginal-cost pricing should be applied. It means that more-expensive-to-serve users (users unconnected to a network) should pay higher prices for their water than their cheaper-to-serve counterparts (users connected to public network). Hanemann (2005, p. 19) asserts that "water prices reflect physical supply cost and *not scarcity value*. Users pay for the capital and operating costs of the water infrastructure, but in the USA and many other countries, there is no charge for the water per se (known as water abstraction charge)". Finally, if continuous monitoring and efficient data are not provided, water pricing cannot adjust the long-term uncertainty of water resources and future challenges.

4.1.2. Water abstraction charges (taxes)

Water abstraction charges or taxes are certain amounts of money levied on abstractions of surface and ground water. These taxes are generally charged from industries and farmers. In addition to their revenue-generating functions to recover the costs of a service, charges are also designed as incentives that raise the customer's awareness of its value for a more economic use. Water abstraction charges may be set to reflect the relative scarcity of water. Effective water abstraction taxes which reflect marginal costs of water abstraction induce a change in users' behaviors resulting in lower water demand along with increasing cost effectiveness (Kraemer et al., 2003, p. 4-5).

These economic instruments aim to regulate the overuse of water, to minimize environmental damages, and to provide the opportunity cost of the water (one person's use deprives some other user of its benefits). Apart from the consumptive use, there are also non-consumptive water charges which are applied for thermal power and industrial cooling applications and are normally at a lower rate than for consumptive use.[11]

Some countries earmark the revenues from abstraction charges for water management. For example, “water abstraction charge exists in France, where revenues are re-invested in the water sector. In Germany, abstraction fees exist only for groundwater and only in some states, and their proceeds go into the general state budget (Farolfi, 2011, p. 91)”. Agriculture and small quantities of water abstraction are generally exempted from abstraction charge in almost all countries.

Charge for abstracting water directly from rivers, lakes and aquifers rarely exists to manage inefficient use and water pollution. “Although some countries such as France, Germany and Holland, charge for water abstraction, these charges tend to be in the nature of administrative fees and are not generally based on an assessment of the economic value of the water being withdrawn (Hanemann, 2005, p. 19)”. Abstraction charges which reflect the scarcity value of water are largely applied as volumetric (based on metered abstraction). These charges provide an incentive to save water if rates are determined efficiently high. According to Kraemer et al. (2003, p. 3), the success of such a tax can be determined by the extent to which initial revenues from it fall as behavior changes.

4.1.3. Sewerage and effluent charges

Sewerage and effluent charges are tariffs which require paying a certain amount of money for the discharge of used water (domestic sewerage or effluents discharged into the sewer system). As water abstraction charges, sewerage charges provide financial function that generates revenue for management purposes (recovering the costs for operating and maintaining), as well as incentive function. The incentive function, in accordance with the polluter-pays principle, is a useful compensating element for treatment costs and environmental externalities. Calculation of the charge is often volumetric and based on metered water consumption (Kraemer et al., 2003, p. 7; p. 17).

Integrating this significant tool with management tools serves a function into monitoring and controlling the contaminants discharged, in particular for industrial

[11]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/Pricing-of-water-and-water-services/ [accessed 24.12.2015].

polluters (Clausen, 2004, p. 64). For successful and efficient incentive function, sewerage and effluent charges should be set at a level that signals to consumers for conservation and conscious usage.

4.1.4. Water pollution charge

Pollution charges are an economic instrument for controlling pollution in accordance with 'polluter pays principle', which is designed to reflect the financial and economic costs imposed on society and the environment by discharging wastes and pollutants into water bodies (not a sewer). Major water polluters are water authorities and companies. Pollution charges penalize the discharge of contaminated water into public water bodies or aquifers and also aim to have an impact on the economic behavior of polluters. The alternative to pollution charges is so-called "*command and control*" [C&C] regulation which stipulates what water pollution can and cannot be permitted.[12]

Polluters are forced to change their detrimental activities and to reduce pollution that they cause or treat their effluents by means of paying for the costs of their discharges. Contrary to other charges, pollution charges mainly aim to set incentive mechanism for abatement of pollution. Generated revenues from these charges are usually allocated for environmental purposes. Because the existence of a feasible database and exact information about the wastewater is required, deciding optimal pollution charge that minimizes the cost of pollution is a challenging process (Kraemer et al., 2003, p. 7).

Consequently, it is obvious that these charges are more effective when applied with robust political power and management policies. Also, these charges should be set at an adequate level that induces polluters to reduce pollution. An effective pollution charge should include the all components of the wastewater pollution.

4.1.5. Subsidies

Subsidies can be defined as government interventions by means of direct and indirect payments, price regulations and protective measures. Unlike prices and taxes, subsidies are provided to reward virtuous actions and mitigate the impacts of

[12]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/Pollution-charges/ [accessed 26.12.2015].

policy on poor and other deserving groups. Subsidies are usually used in household and irrigation water services. Subsidies falsify the true economic value because full cost recovery principle does not exist when a service is subsidized. It means that subsidies create externalities which are hard to be included in the economic value. Some examples of subsidy are tax allowances, low-interest loans, guaranteed minimum prices, and preferential procurement policies (Kraemer et al., 2003, p. 7; gwp.org[13]).

Major aims of subsidies are to compensate a cost for consumers and to provide the necessary incentive for obtaining a desired result. In addition, subsidies are used for lowering the general level of tariffs/charges for political aims and for paying water bills through social security motives. As well as creating incentives, subsidies may lead to inefficient results such as wasteful and inefficient use of water because of low water prices for industry, free or cheap irrigation water and low household bills (Kraemer et al., 2003, p. 8). But, despite its social benefits, it is hard to eliminate a subsidy. This situation causes dependency on subsidies and places fiscal burdens on budgets.

"There is an increasing trend, particularly in developed countries, to abolish subsidies that distort the price of water below its full cost. It is recognized that inefficiencies in water use are the result of users who do not pay the full cost (WWAP, 2015, p. 62)". For effective and adequate application, polluters must absorb the financial burden of subsidies in accordance with 'polluter pays principle'. Briefly, the subsidies which cause low tariffs and harm other water users have to be eliminated (Çubukçu, 2006, p.3).

4.1.6. Water rights and water markets

Water rights are legal property rights that provide owners the right for using water or selling and renting their unused water. With government regulation and guarantee, "water rights are managed through water allocation regimes that determine levels of abstraction, manage licensing or other registration regimes for water users, and potentially create markets for the trade of water rights".[14]

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[13]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/Subsidies/ [accessed 26.12.2015].
[14]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Regulatory-Instruments/Water-rights-and-allocation/ [accessed 27.12.2015].

In addition to its legal aspect, water rights form an economic instrument by creating water markets in which these rights are sold by owners to other users. “Such water markets exist in parts of Australia, Chile and the Southwestern United States (Farolfi, 2011, p. 91)”. “Although farmers are the main players in these markets, some large trades are done by cities to secure water for household use. Also, public authorities might purchase water as a precaution against severe drought, or to release into rivers to preserve minimum environmental flows”.[15]

Apart from raising revenue, water rights and markets are effective instruments for raising awareness to protect the nature among users who tend to underestimate the environmental disasters and regulations when there is no economic gain or loss they will obtain. However, some necessary measures have to be taken for efficient water markets. First of all, there must be an adequate and clear mechanism for allocation of water rights. Furthermore, because these rights are secured with laws and cannot be removed immediately, legal and economic framework must be placed for effective market operation to avoid market imperfections (e.g. monopolistic market power) and other external effects.

4.2. Factors for Effective Implementation of Economic Instruments

In most cases, some outstanding factors are necessary to apply economic instruments for services-in particular water resources. First of all, for successful implementation of economic instruments, there must be robust institutional and political practices along with broad participation of all users in decision-making process and integrated management of the resources. For example, as well as controlling and monitoring system, there must be adequate financial resources and qualified human resources to promote water allocation and conservation. Also, economic instruments must be transparent (understandable and clear) for general public acceptance. In addition, for effective functioning market with economic instruments, full cost pricing practice is necessary for taking environmental costs into account, as well as reflecting most rational economic value (Kraemer et al., 2003, p. 45).

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[15] http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Economic-Instruments/Water-markets-and-tradable-permits/ [accessed 27.12.2015].

Another significant factor is effective and holistic water laws that ensure water allocation regimes which are consistent with the environmental boundaries and eliminate conflicts between water laws. For example, environmental liability laws are a fundamental expression of the polluter-pays principle and they provide incentives for a more environmentally-friendly behavior to compensate victims of pollution. Finally, one of the most important factors that raises political acceptance for the introduction of economic instruments is earmarking of revenues which is used for further water management activities or used as an additional source of finance (Kraemer et al., 2003, p. 5; p. 8)

4.3. Challenges to the Implementation of Economic Instruments

One of the major challenges to the implementation of economic instruments is lack of efficient integrated management of water resources. Water management is usually performed in a top-bottom manner with limited participation of key stakeholders, which reduce the system's transparency and complicate the perception of problems. Also, legal framework and institutional capacities are not adequate. Another major challenge to economic instruments is that in most countries effective monitoring and controlling mechanisms for water and its related components do not exist or existing systems are not clear because of conflicts between different institutions (Kraemer et al., 2003, p. 40).

The success of economic instruments is also hindered by lack of reliable and adequate data and information about availability of water resources. Because economic instruments are most acceptable tools for better understanding of economic value, lack of data in both quantity and quality poses serious economic and political disadvantages. For example, lack of databases and information on water uses and users expose the implementation of economic instruments and the enforcement of environmental legislation to major deficiencies which exist with respect to supervision and pollution control, as well as with regard to the measurement of contamination (Kraemer et al., 2003, p. 42; WWAP, 2014, p. 46).

Besides lack of data and information, the lack of adequate and qualified crew for water resources is also a significant challenge. Finally, future risks and uncertainty affect the success of an economic instrument. In such a case, some probabilities or future costs and benefits cannot be internalized efficiently into economic valuation process of water (Turner et al., 2004, p. 63).

According to researcher of this study, the most significant challenge is lack of data because market requirements and structures of the economic instruments depend on availability of current data for water. This situation creates uncertainty for estimating exact economic value. Without data and information, it is difficult to set a price on water or charge a tax from users. Sadoff and Muller (2009, p. 76) underpin this view and claim that “water rights and allocations are generally premised upon historical water availability. As climate change causes future water availability to diverge from the past, past rights and mechanisms may no longer be viable”.

On other normative dimensions, the necessity of water for life may override economic efficiency considerations, leading to government intervention into supply and pricing of domestic water. Thus, competitive markets seldom are the chosen allocative mechanism for water, and modeling of economic costs and benefits are valuable tools for public evaluation of water policy proposals (Booker et al., 2012, p. 169).

5. WATER USAGE

Previously, water resources were demanded for food and energy along with increasing populations. In today's world, demand for water is globally affected by energy production, industrialization, agriculture, population growth, urbanization, and tourism. Ecosystems and domestic usage are the other components of water usage. Within the scope of manufacturing associated with trade globalization, ever-changing production and consumption patterns such as spreading energy-consuming devices and motor vehicles also make contribution to this demand. Indeed, water demand is expected to rise in all sectors. "By 2050, global water demand is projected to increase by 55%, mainly due to growing demands from manufacturing, thermal electricity generation and domestic use (WWAP 2015, p. 2)".

In addition, Sullivan (2002, p. 1196) says in her article that if standards of living increase, water consumption per capita also increases. It means that availability of water depends largely on economic and social progress, stating that how water resources are managed affects development. According to the report by WWAP (2015, p.10), "increasing living standards of middle income class have led to sharp increases in water use particularly where supplies are vulnerable or scarce and where its use, distribution and price are poorly managed".

5.1. The Main Consumers of Water

Water is at the core of life. In all parts of the world, sustainable economic and social developments from food and energy to environmental health and human well-being are closely linked with water, which places serious pressure on water resources through agriculture, energy and industry. In the near future, as well as climate change, continuously increasing demand for water causing from development, growing population, and urbanization will add to the pressure.

Excessive water withdrawals for agriculture and energy are main causes of water scarcity. Some statistics declared by WWAP (2015, p. 11) reveal a part of the picture: The agricultural sector is the largest user of water resources, accounting for globally 70% of all freshwater withdrawals and over 90% in most of the world's least-developed countries. Freshwater withdrawals for energy production are expected to increase by 20% through 2035, which currently account for 15% of the world's total. Groundwater supplies are diminishing, with an estimated 20% of the world's aquifers are currently over-exploited. India, China, Nepal, Bangladesh and Pakistan alone account for nearly half the world's total groundwater use.

Some examples about the need of water in production are given in Table 5.1. In addition to the water need to produce these goods, it shows the sectors which should be carefully analyzed in terms of sustainability. In this respect, the cement industry will probably be the most suffered sector from water scarcity condition. Policies and regulations worldwide to increase efficient use of water by promoting productivity in all sectors, to reduce struggle among the water users, to manage water demand for industrial and domestic uses through efficient, effective, and equitable economic instruments should be made and put into practice immediately.

Table 5.1. *The Need of Water in Production*

QUANTITY OF PRODUCT	QUANTITY OF WATER CONSUMED
1 liter of petroleum	10 liters of water
1 can of vegetables	40 liters of water
1 kg of paper	100 liters of water
1 ton of woolen cloth	600 liters of water
1 ton of dry cement	4,500 liters of water

Source: *Haapala, 2002, p. 35.*

According to SHW[16], 44 billion m^3 of water (32 billion in irrigation, 7 billion for domestic water and 5 billion in industry) is used in Turkey. Ward and Michelsen (2002, p. 424) put forward that rapidly growing human population and increasing demands for protecting endangered species and other environmental values are new uses of water. In this study, all components of water usage are not mentioned in detail. The main consumers of water (energy sector, agriculture, industry, domestic usage, ecosystems and tourism) are examined. These are thought to be most remarkable factors affecting the value of water.

5.1.1. Energy sector

Water and energy are considerably interconnected. For producing and transporting energy water is needed. On the other hand, energy is used for

[16]http://www.dsi.gov.tr/toprak-ve-su-kaynaklari [accessed 01.02.2016].

distribution, extraction and treatment of water. Energy production is largely water-intensive. Approximately 90% of global power generation is water intensive (WWAP, 2014, p. 2). Considerable amounts of water are used for energy production-“especially for pumping, processing, treating, and cooling in the oil, coal, and gas industries. And significant amounts of energy are used to extract, treat, and transport water for human consumption, as well as to collect and treat wastewater”.[17]

“Thermal power generation and hydropower respectively account for 80% and 15% of global electricity production. Conversely, it is estimated that electricity accounts for 5% to 30% of the total operating cost of water and wastewater utilities (WWAP, 2015, p. 54”). Turkish Statistical Institute [TSI, TUIK in Turkish acronym][18] states that 6.5 billion m^3 of water was abstracted by thermal power plants in 2014 and 98% of this amount was used for cooling. Also, these thermal power plants discharged 6.4 billion m^3 of wastewater in 2014. It should be noted that only 9 million m^3 of 92.5 million m^3 total wastewater apart from cooling water was treated in this process.

Increasing population, urbanization and rising living standards give rise to boom in demand for water and energy. Meeting ever-growing demands for energy along with other users such as agriculture and industry will increase water stress. “Agriculture accounts for 70% of global water withdrawals and the food production and supply chain accounts for about 30% of total global energy consumption. The industrial sector accounts for about 37% of primary global energy use and proportionately uses significantly less water (WWAP, 2015, p. 55-56)”.

Demand for energy is expected to grow in its all forms. For example, demand for oil is expected to grow by 13%, for coal by 17% and for renewables by 77%. It is also expected that the share of renewables which is considered as 30% of all electricity production by 2035 will double. As the dependency of thermal power on water resources at the rate of 90% is taken into account, it is estimated that 70% increase in electricity production by 2035 will trigger an increase in freshwater withdrawals by %20. Moreover, increasing biofuel production and power plants

[17]http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Water%20and%20Energy%20Briefing%20Note.pdf [accessed 31.03.2016].
[18]http://www.tuik.gov.tr/PreTabloArama.do?metod=search&araType=hb_x [accessed 31.03.2016].

with advanced cooling systems which increase consumption are expected to cause an increase in water consumption by 85% (WWAP, 2015, p. 54).

Table 5.2. *Electricity Generation and Shares by Energy Resources, 2000-2015*

Year	**Total**	**Coal**	**Natural Gas**	**Hydro**	**Renewable Energy and Wastes***
	(GWh)			(%)	
2000	**124,922**	30.6	37.0	24.7	0.3
2002	**129,400**	24.8	40.6	26.0	0.3
2004	**150,698**	22.8	41.3	30.6	0.3
2006	**176,300**	26.4	45.8	25.1	0.3
2008	**198,418**	29.1	49.7	16.8	0.6
2010	**211,208**	26.1	46.5	24.5	1.9
2012	**239,497**	28.4	43.6	24.2	3.1
2013	**240,154**	26.6	43.8	24.7	4.2
2014	**251,963**	30.2	47.9	16.1	4.9
2015	**261,783**	29.1	37.9	25.6	6.5

*It includes geothermal, solar, wind, solid biomass, biogas and waste.

Source: *http://www.tuik.gov.tr/UstMenu.do?metod=temelist [accessed 29.03.2017].*

Table 5.2 shows the electricity generation and shares by energy sources in Turkey between 2000 and 2015. Since 2000, electricity production has been dominated by natural gas and coal. Recently, this dependency on natural gas and coal seems to be on the rise. As the share of water decreases, renewable energy has started to be used for electricity production according to table. However, this share of renewables is still too low in terms of environmental concerns.

Another point is that government dominance in the water and energy sectors has begun to replace with private sector participation. But, control mechanism should be placed effectively because of potential risks like moral hazards. That is, for the purpose of profit maximizing private sector has the root of environmental unconsciousness. Decision-makers have to understand potential impacts of energy production on the water sources.

Effective pricing mechanisms and regulation are critical for managing demand and promoting behavioral changes. Increasing energy and water use efficiency save significant amounts of energy and conserve water. “Besides displacing water intensive thermal power, renewables offer additional benefits, including enhancing energy security and diversity, reducing greenhouse gases emissions and local air pollution, contributing to 'green growth' (WWAP, 2015, p. 56)".

5.1.1.1. *The water–energy–food nexus*

Water, energy and food are strongly related. Water is a major input for agriculture and energy such as hydropower. On the other hand, energy is used to produce and distribute water and food: to pump water from groundwater or surface water sources, to power tractors and irrigation machinery, and to process and transport agricultural goods. The water–energy–food nexus could be summarized as follows: Water usage for irrigation increases food production, but reduces river flows and hydropower potential.

Moreover, biofuel production such as palm oil and soya beans increases water withdrawals. Replacing surface irrigation with highly efficient pressurized irrigation could save water but consumes more energy (WWAP, 2014, p. 54). As mentioned previously agriculture is the major user of water on a global scale, accounting for 70% of total water withdrawal. And, the food production and supply chain accounts for about 30% of total global energy consumption (WWAP, 2014, p. 54).

Meeting the world's hunger is the top priority recently. According to GWP[19], over the next 40 years the world will need to double its food production to meet growing populations. That is, efforts to increase food production will have to be undertaken with less water, especially as climate change puts water resources under greater stress. Apart from these, when considered, wasting foods means wasting water and energy. It is asserted by GWP[20] that 30-50% of food is wasted. It means that approximately half of the annual water withdrawals used for irrigation and energy are wasted.

Countries with water scarcity can import food from 'surplus' areas. Trading food is trading the water that goes into producing it which is known as 'virtual water'. "When we look at the world's virtual water trade percentages, animal protein sources (meat, animal products and seafood) take place on the top. This is

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[19] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Briefing_Note_Political%20profile_final.pdf [accessed 31.03.2016].

[20] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Briefing_Note_Food_security_final.pdf [accessed 31.03.2016].

followed by grains, and then oil (İlhan, 2011, p.12)". According to WWAP (2014, p. 25) an interesting and notable flip side of the water–energy nexus is that wastewater is becoming recognized as a potential source of energy. In several countries, water supply companies are working towards becoming energy neutral.

5.1.2. Agriculture

Agriculture is on the top of water consumption worldwide. Globally agricultural activities rely heavily on inefficient irrigation systems. "Agricultural irrigation uses 70-75% of global freshwater withdrawals and up to 95% in South and Central Asia".[21] It can be easily forecasted that these withdrawals will increase along with increasing population. "By 2050, agriculture will need to produce 60% more food globally, and 100% more in developing countries (WWAP, 2015, p. 4)".

Table 5.3. *Water Consumption for Agricultural and Food Production*

Product	Amount of water (m^3/ton)
Potato	160
Corn	450
Milk	900
Wheat	1.200
Soybean	2.300
Paddy	2.700
Chicken	2.800
Egg	4.700
Cheese	5.300
Beef	15.000

Source: *Muluk et al., 2013, p. 13.*

Table 5.3 provides some examples of water use in agricultural and food production. It can be easily seen from the table that production of animal products is largely dependent on water availability. According to report of a project made by formerly named as Turkish Ministry of Environment and Forestry [Çevre ve Orman Bakanlığı in Turkish Acronym] (2011, p. 16), in the pilot area which is called as Altınekin Province, about 12.5 million tons of water were wasted for agriculture.

Recently, another outstanding issue is increased agricultural activities in

[21] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Briefing_Note_Food_security_final.pdf [accessed 31.03.2016].

significant quantities for biofuel production. Plants produced for biofuels consume a lot of water and cause severe pressure on local water resources, and hence, additional pressure on water resources. In addition, according to Sadoff et al. (2003, p. 5), rainfall variability put a serious threat to agricultural production, and poor agricultural practices worsen the negative impact of rainfall variability. Agricultural activities necessarily consume water and therefore modify the hydrologic cycle, differently from hydropower generation or fish production.

Reduction of water used in irrigation is not very realistic because it is likely that more than current areas will be used for farming in the coming decade given the population growth and urbanization. Also, infrastructure systems that use water efficiently are quite expensive. Agricultural land leases in Turkey are widespread and tenants are not inclined to invest in efficient irrigation infrastructure. There are deficiencies in water management capacity of the majority of local irrigation associations (Muluk et al., 2013, p. 27).

Habitats, aquifers, and rivers are also negatively affected by agricultural activities. It is a known fact that lost of available water amount by evaporation from the reservoir dam is quite huge. In general, keeping in the dam of all water from streams for the purpose of agricultural usage leads to drying out of wetlands that depend on these rivers. Although it is necessary that a certain amount of water should be released to ensure the continuity of the natural habitats in Hydroelectric Power Plant [HEPP] projects, many wetlands have been affected negatively by the projects.

Undoubtedly, in the near future many wetlands and river basins will be faced with water stress. For example, though Ereğli Reeds located in Konya, Ereğli once upon a time was the Europe's most important wetland with 23,000 hectares; today it is completely dry (Muluk et al., 2013, p. 33). By 2030 in Turkey, in the interior and the western regions water stress is expected to exceed the rate of 40% (Muluk et al., 2013, p. 18). For sustainable water use in agriculture, surface systems should be replaced by efficient irrigation techniques such as sprinkler or drip systems to reduce non-beneficial consumption (Jägermeyr et al., 2015, p. 3073).

Also, awareness about protecting natural resources especially between farmers should be raised. In addition, water management should be integrated and the crops needing less water should be grown. As stated in the report by WWAP (2015, p. 8), agriculture is less vulnerable to rainfall variability due to the widespread adoption of advanced agro-technology, highly efficient irrigation techniques, reliable wastewater reuse and soil conservation techniques.

5.1.3. Industry

Water is main input for industrial production as well as agriculture. Although water usage in industry which is 20% of total water resources (Muluk et al., 2013, p. 14) globally is less than in agriculture, the need for accessible, regular, and environmentally sustainable water resources continues. Haapala (2002, p. 32) state that "globally the industrial water use is at least twice the domestic use". Majority of developing countries are on the onset of industrialization. As they try to be industrialized economies, these developing countries will most probably experience severe water problems.

Water extraction for industry, in general, is referred as energy consumption and water used in small industries is included in domestic water usage. This condition obscures how much water is actually used in industry. Companies deal with SHW for the allocation of water. In addition, because many companies take water from their own underground water sources, net figures on the use of water are unknown. Additionally, industrial enterprises in or near the city use tap water, and this amount goes into domestic use (Muluk et al., 2013, p. 29). There are no effective control mechanisms or system for monitoring water usage.

As regular industrial production requires regular and safe water, water scarcity and degradation pose an increasing risk for industry. Risks associated with water quality limits the development of the industry. Sadoff and Muller, (2009, p. 32) state that uncertainty regarding both the quantity and quality of water available to industrial users can threaten production. On the other hand, industrial untreated wastewater causes environmental damage.

Many industrial sectors need high-quality water, which creates the need for additional treatment. In the case of use of contaminated surface and groundwater, the need of high cost treatment may occur. Though this condition force industry to use water as effectively and recyclable, it will most probably cause shifting industrial activities to more convenient location in terms of water resources. The move of manufacturing plants to low income countries and efficient use of industrial water may be possible for developed countries via technology, but such moves may be interrupted due to lack of access to water for water-dependent industries (WWAP, 2014, p. 71).

In the report by WWAP (2015, p. 4), "global water demand for the manufacturing industry is expected to increase by 400% from 2000 to 2050, leading all other sectors, with the bulk of this increase occurring in emerging economies and developing countries". Sadoff and Muller (2009, p. 33) assert that many large industries from textiles to steel production not only used large volumes of water in their production processes but also disposed of large volumes of effluent, which polluted the streams into which they were discharged.

For more efficient and sustainable future in terms of industrial activities, there is an urgent need to set policies which include some instruments. First of all, control mechanisms should be well founded by using legislation power and setting standards. Also, economic instruments such as charges for water withdrawals and wastewater should be used. Finally, "fiscal instruments and incentives that can affect cost–benefit analyses in industry and change the business as usual [BAU] status such as public expenditure, subsidies and taxation should be implemented (WWAP, 2015, p. 62)".

5.1.4. Domestic usage

Domestic water use includes water consumption in cities and other residential places. The daily average per capita water consumption in developed countries (500-800 m^3) is about ten times of water consumption in developing countries. For example, in Asia, Africa and Latin America daily water withdrawal per capita is between 50-100 m^3. In addition, in the regions that water scarcity occurred, this ratio shot up to daily 20-60 m^3 per capita. Global population growth estimations predict population will reach 9.2 billion until 2050 (Muluk et al., 2013, p.15). In addition, there is no doubt that urban population growth over the next 40-50 years will be a big problem. This population growth is predicted to occur in most developing or underdeveloped regions.

Loss occurred in drinking and tap water network physically is caused by seeps and leaks in pipelines and reservoirs. Loss from the water supply varied between 60% and 40% in Turkey. This figure is around 20% in developed countries.

Domestic water uses vary greatly across the country. Domestic water consumption is the highest in the Marmara Region; the Northeast and East Anatolia Region is far below the national average (Muluk et al., 2013, p. 30).

Deficiency and lack of facilities, insufficient drinking water network maps in municipalities, failure to make necessary maintenance and repair in transmission lines and distribution networks in time are main causes of physical water losses. It is necessary to revise the estimates for the future regarding the use of domestic water and to remove these deficiencies immediately.

Table 5.4. *Freshwater Abstraction and Sectoral Use, 2014*

Country	Total Freshwater Abstraction (billion m^3)	Freshwater Abstraction per capita (m^3/percap/year)	Domestic (%)	Industrial (%)	Agricultural (%)	Population (million)
India	761	585	8	2	90	1.3 (billion)
China	554	396	12	23	65	1.4 (billion)
USA	478	1498	14	46	40	319
Pakistan	184	995	5	1	94	185
Japan	82	646	19	14	67	127
Mexico	80	640	14	9	77	125
Brazil	75	364	23	17	60	206
Russia	66	458	20	60	20	144
Turkey	40	526	15	11	74	76
Canada	39	1083	12	78	10	36
Bangladesh	36	226	10	2	88	159
South Africa	13	241	31	6	63	54
Yemen	4	154	7	2	91	26
Kuwait	0.91	228	44	2	54	4
Qatar	0.44	220	39	2	59	2
Bahrain	0.36	360	49.8	5.7	44.5	1
European Union	252	496	18	54	28	508
OECD	1051	808	15	40	45	1.3 (billion)
World	3909	535	18	22	60	7.3 (billion)

Source: *www.databank.worldbank.org [accessed 10.05.2016].*

When water withdrawals are analyzed from a broad perspective, Table 5.4 provides freshwater withdrawals as total and per capita along with population and sectoral water use as percentage of total withdrawal at randomly selected countries level, OECD, European Union and world countries level. According to World Bank Databank, water resources are mostly used for agriculture worldwide and at OECD level. China and India, not surprisingly, has the largest share for total freshwater abstraction and they use water largely in agriculture. As seen from the table, European Union countries use water largely for industrial purposes. This condition is valid also for Canada, Russia and USA.

5.1.5. Ecosystems

Ecosystems (forests, wetlands and meadows) are at the centre of the global water cycle. All water sources need continuous and healthy ecosystems. For example, "dams only work effectively when supported by healthy ecosystems. Unhealthy ecosystems cause dams to become damaged by flood waters or degraded with pollution (WWAP 2015, p. 30)". Therefore, being perceived of the water cycle as a biophysical process is necessary for sustainable water use. Historically ecosystems are seen as unproductive water users. However, this is a wrong approach; ecosystems do not use water, on the contrary, these recycle water.

As GWP [22] states, one of the greatest barriers to achieve sustainable development is the increasing depletion of natural resources resulting in the degradation of ecosystems that are essential for human well-being and economic prosperity. "High demand for water and energy threatens ecosystems. Extracting water for agriculture, energy, and domestic use can lead to a loss of habitat and more pollution".[23]

All terrestrial and aquatic ecosystem services (e.g. Flood control, food production, climate regulation, soil fertility, carbon sequestration and nutrient recycling), is supported by the presence of water (Muluk et al., 2013, p. 15). The existence and quality of water for direct human consumption is a service provided by the ecosystem as well as the easing of ecosystem services such as flood and severe drought. Preferring one ecosystem service to the other inevitably brings an imbalance with it.

5.1.6. Tourism

Tourism is one of the major users of water. When considered, millions of

[22] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/P816_GWP_Ecosystems_Briefing%20Note_WEB.pdf [accessed 31.03.2016].
[23] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Water%20and%20Energy%20Briefing%20Note.pdf [accessed 31.03.2016].

people travel and take vacation especially in the summer months. According to İlhan (2011, p. 20) about 700 million people a year are in the international tourism activities. Tourism sector in Mediterranean constitutes 7% of wastewater pollution in the region by producing 180 liters of waste water per person per day.

With an increasing number, low-income countries are trying to achieve economic development through tourism. Water shortages began to emerge in many countries that have managed this goal by increasing number of places where a variety of recreational activities such as swimming pools, golf courses, recreational water parks exist. In addition, in the regions having coast on sea, both increasing wastewater with population growth and salt concentrations left by desalination centers cause serious marine pollution. Golf tourism is placed on the top about the water consumption in tourism. For an 18-hole golf course, the use of water up to 2.3 million liters per day is needed (İlhan, 2011, p. 20).

6. THREATS FOR WATER

Major challenges for water resources in our century are feeding the growing population, climate change, deficient information and pollution along with urbanization and human activities. Also, “the competition between water ‘uses’ and water ‘users’ increases the risk of localized conflicts and continued inequities in access to services, with significant impacts on local economies and human well-being (WWAP, 2015, p. 2)”.

According to Hanemann (2005, p. 15), the major challenge for most large water systems is the spatial and temporal matching of supply with demand. This variability affects not just the engineering of water resource systems but also the legal and institutional arrangements for the use of water. Apart from these challenges for water, agricultural and industrial practices, energy sector and tourism can be regarded as threats for water resources. All of the factors shortly mentioned in this part of the study are related with economic value of water because these falsify this value in many aspects.

6.1. Water Footprint

Although water footprint concept is not a threat for water by itself, it is examined in this part of the study because it shows the effects of water users on the water resources. “Arjen Y. Hoekstra coined the term ‘water footprint’ in 2002. But; the underlying idea is based on J. Anthony Allan’s concept of ‘virtual water.’ It is described as the amount of water needed to produce a good or service, taking into account its entire production or supply chain (Whittington et al., 2013, p. 65)”.

The water footprint measure indicates both direct and indirect freshwater use of consumers or producers. The water footprint for a product is measured by the total use of freshwater in production of the product. This indicator shows water use by source and type of pollution. There are three different types of water footprint. *Blue water footprint* includes the consumption of surface and groundwater resources, namely blue water resources, over supply process of a product. *Green water footprint* involves the consumption of rainwater (green water resources). *Grey water footprint* indicates the freshwater amount needed to assimilate pollution (Hoekstra et al., 2011, p. 2).

Given the explanation above, it can be said that the magnitude of a country's water footprint is affected by production and consumption preferences, wealth and its climate. "Determining and assessing water footprints is challenging in terms of data requirements, and the method still needs to be refined further, particularly with respect to grey-water footprint accounting (Pahlow et al., 2015, p. 301)". Components of water footprint are given in Figure 6.1. As it can be seen from the figure, non-consumptive water use (return flow) is not a part of the footprint. Also, unlike water withdrawal, the water footprint involves gray and green water and indirect use.

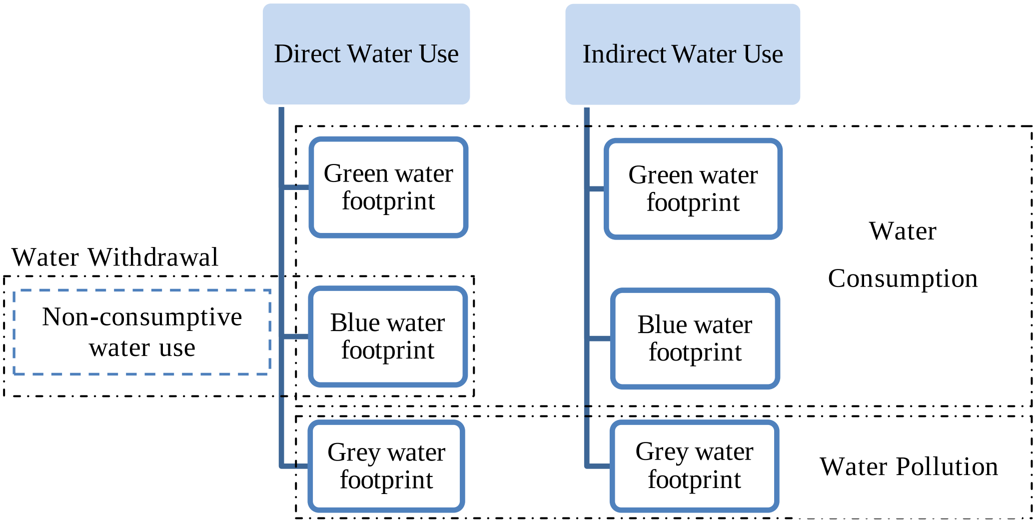

Figure 6.1. *Components of Water Footprint*
Source: *Hoekstra et al., 2011, p. 3.*

Hoekstra et al. (2011, p. 4) state that the aim of estimating water footprints is to analyze the effects of human activities or specific products across water scarcity and pollution. Whittington et al. (2013, p. 65) assert that water footprints are simply estimates of water use during production and do not indicate the economic impacts of that use. Moreover, water footprint calculations reveal nothing about the opportunity cost of allocating water to a specific use in a specific location. They also point out that The National Water Commission in Australia has concluded that estimates of virtual water (and water footprints) are not a useful indicator for allocating scarce water to different uses.

6.1.1. Water footprint of Turkey

Turkey's water footprint is calculated by World Wide Fund for Nature [WWF]. In this part of the study, only water footprint of production and consumption are mentioned to show a part of the picture. Also, statistics about Turkey's water footprint taken from WWF-Turkey's water footprint report are given (see Figure 6.2). "Water footprint of production is calculated by the total water amount to produce for all products within a country. The water footprint of consumption is the amount the total water for the production of goods and services consumed within the country (Pegram et al., 2014, p. 16)".

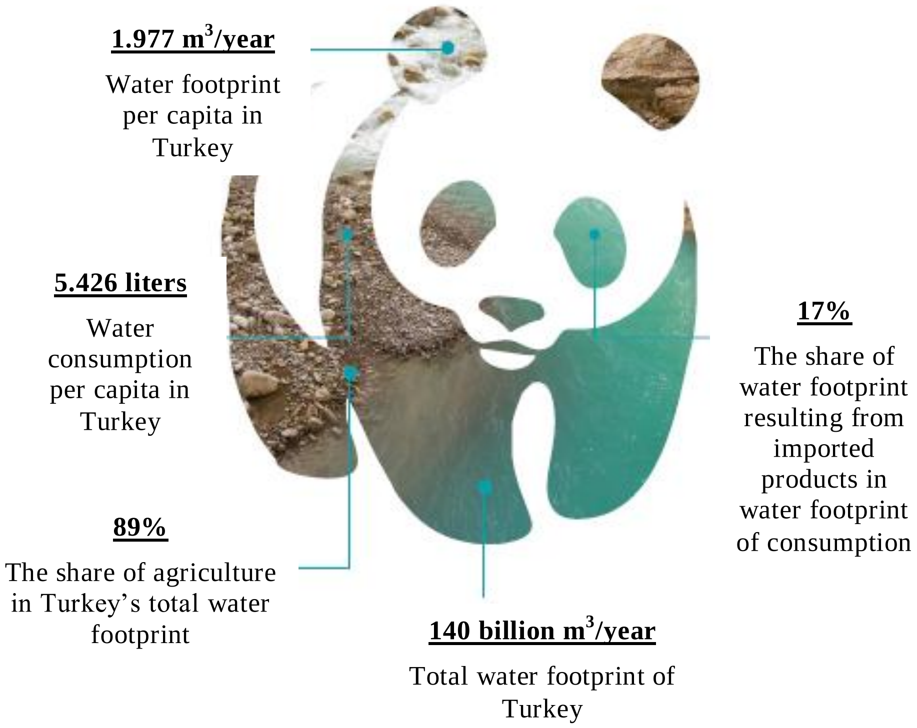

Figure 6.2. *Turkey's Water Footprint Statistics*
Source: *Pegram et al., 2014, p. 70.*

Turkey's water footprint calculations reveal that the production and consumption taking place in our country are largely dependent on the domestic water sources. Therefore, the sustainable management of freshwater resources in Turkey is one of the most important elements that directly affect the country's economy. The report revealed that the primary factor of Turkey's water footprint is agricultural production; approximately 89% of total water footprint and 83% of agricultural water footprint due to vegetative production (Pegram et al., 2014, p.7).

Water footprint of production in Turkey is about 139.6 billion m^3/year. 64%

of the water footprint resulting from production in Turkey is green water footprint; the blue water footprint is 19% and the gray water footprint is 17%. Agriculture constitutes the largest share with 89%. Domestic water use and industrial production cover parts respectively in all water footprints, 7% and 4% (Pegram et al., 2014, p. 20). Water footprints of some products are given in the Table 6.1. Animal products have great share in water footprint as seen in the table.

Table 6.1. *Water Footprints of Some Products*

1 portion red meat	3.100 liters
1 piece of hamburger	2400 liters
1 portion white meat	780 liters
1 cup of coffee	208 liters
1 glass of milk	200 liters
1 glass of orange juice	170 liters

Source: *Pegram et al., 2014, p. 62.*

Water footprint of consumption in Turkey is about 140.2 billion m^3/year. 66% of the water footprint resulting from consumption is green water footprint; the blue water footprint and the gray water footprint have a share of 17% separately. The largest part of the water footprint of consumption is caused by agriculture with 89%. Industrial and domestic water uses generate 6% and 5% of the water footprint of consumption, respectively (Pegram et al., 2014, p. 30).

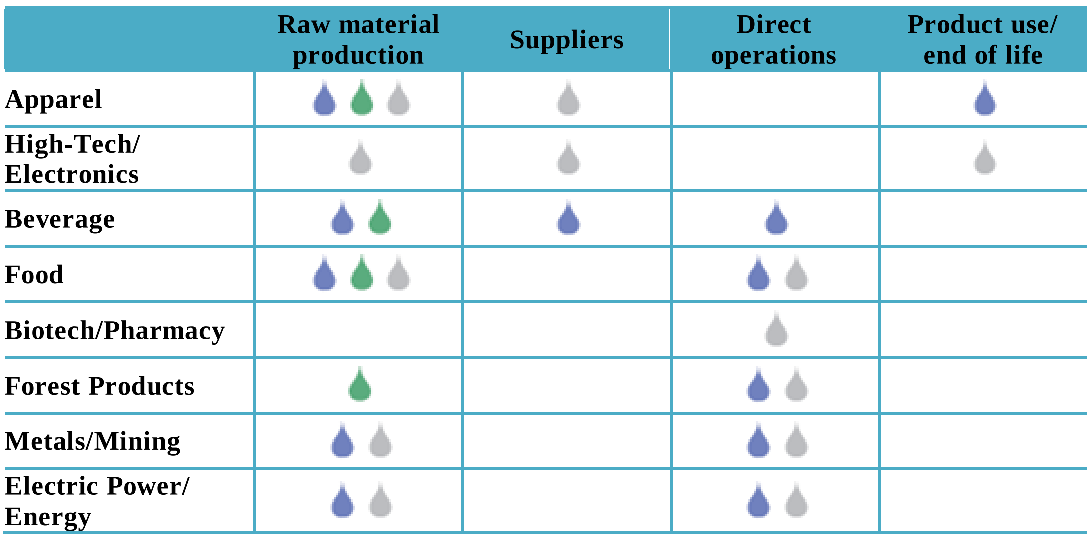

Figure 6.3. *Water Footprint of Some Industrial Sectors*
Source: *Morrison et al., 2009, p. 20.*

Low share of industrial and domestic water footprint in total water footprint for Turkey does not mean that its impact on water resources to be too low. While assessing agricultural water footprint, the blue and green water footprint is in the foreground. The situation changes in domestic and industrial water footprint; the gray water footprint is focused. In Turkey, in domestic and industrial water footprint, gray water footprint has large proportion as 87% and 92%, respectively (Pegram et al, 2014, p. 29). Figure 6.3 shows some examples of water footprint in industrial sectors. Water drops indicate blue, green or gray water footprint intensity. It can be said that almost all industrial sectors have gray water footprint intensity.

As long as global consumption continues the current trend, there will be a significant increase in the use of water in the coming years. Population growth, economic growth and changing consumer preferences are the main reasons behind the increase in water consumption. In addition, the climate change causes differences in countries' water footprints. Turkey should consider the pressure that increasing population, growing economy, agriculture and manufacturing create on the water footprints; water issues should be integrated into the macroeconomic decision.

All sectors that use water should act together to ensure the sustainability of water resources. While decision-makers are developing more appropriate strategies to overcome the high water footprint and its impacts, businesses and individuals must take several steps at different scales. As it can be made for a country, water footprint can be calculated for sector, business, factory, individual, and product or in the river basin scale. In this context, a more detailed water footprint study for sectors hold an important place in Turkey's economy will be beneficial decision (Pegram et al., 2014, p. 62).

6.2. Water Pollution

Water pollution is largely caused from human activities. Some of the main reasons for the pollution of water resources are overuse of natural resources, the uncontrolled and irregular industrialization and urbanization, domestic and agricultural activities. Water pollution affects water quality and threatens human health and increase competition for water. According to Haapala (2002, p. 29), the lack of sanitation and sewage treatment is the biggest factor regarding water pollution. Many rivers in developing countries are more likely open sewers than rivers. Most of the centers in these regions do not have drains or even service to collect the garbage. “In the absence of proper drainage systems, sewage mixes with storm water causing further pollution. It is estimated that up to 90% of all wastewater in developing countries is discharged untreated directly into rivers, lakes or the oceans, causing major environmental and health risks (WWAP, 2015, p. 44)”.

İlhan (2011, p. 40) asserts that agricultural water use is one important component of groundwater pollution. Large amounts of fertilizers and pesticides which are used to improve product yield for many years are source of contamination. Poor quality water causes many economic, social, environmental and health-related problems such as decline of agricultural yield, increased costs of water treatment. Another factor which causes environmental pollution is the industrial activities. “Although industrial waste water is approximately 1% of the total discharged waste water, the materials with high toxicity such as mercury, lead, and zinc pose enormous threats (Muluk et al., 2013, p. 34)”.

Large share of groundwater contamination in Turkey is caused from urban use. Because in many cities untreated wastes is emitted to nature, the majority of these are leaked into underground water sources. “2321 (72%) of 3225 municipalities in Turkey have sewerage network, but only 362 of them have Wastewater Treatment Plant service (İlhan, 2011, p. 40)”. Also, “it is estimated that over 80 per cent of wastewater worldwide is released into the environment without treatment”.[24]In this regard, wastewater treatment systems should be expanded. To reuse and recycle wastewater, solutions should be put into practice immediately. Also, the cost of wastewater management has to be reduced. As stated in the report by WWAP (2015, p. 61) applying a fine for pollution would be less expensive than huge amounts of money paid for treatment.

6.3. Climate Change

Climate change is one of the major threats not only for human beings, but also for all living creatures. Climate change has critical impacts on nature such as

[24] WWAP. 2017. *The United Nations world water development report 2017. Wastewater: The untapped resource*. Paris, UNESCO, p. v.

floods, droughts, declining amount and quality of water, and temperature increases. There are some drivers that exacerbate these impacts and damage nature: population growth, economic development and changes in consumption patterns, technological developments, climate mitigation strategies, urbanization and land use change (Sadoff and Muller, 2009, p. 50).

Climate change affects the natural water balance and water availability by changes in spatiotemporal patterns and variability of precipitation which increase risk and uncertainty (WWAP, 2015, p. 66). According to GWP[25], the combined effects of climate change, population growth, and hydrological variability result in a greater reliance on energy-intensive options for water supply, such as water transport or desalination plants. Variability in water sources has also significant impact on economic growth and ecosystems. All water using sectors and dynamics of economy are negatively affected from the changes in the availability.

As climate change entails a risk largely for water, efficient water management should be first step. More transparent and better information on data sources, integrated institutions and approaches to water resources, and economic instruments to manage water in accordance with its economic value are among the main tools to cope with climate change.

6.4. Water Resources and Urbanization

In every part of the world, urbanization is becoming a warning issue on a large scale. It creates serious pressure in particular on freshwater resources. The quality and quantity of water are deteriorated by overpopulation in the cities. Huge quantities of water are consumed and big amounts of wastewater are released to nature. Urbanization is also a deepening driver that contributes climate change and water pollution.

In addition, urbanization has caused emergence of private water companies, over-pricing of water and illegal hazards. For example, 76 million people have difficulty in accessing clean water in India and Indian government has been struggling against illegal water wells and water mafia who tries to sell water at high prices. Wrong urban planning associated with pollution and other threats makes

[25] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Water%20and%20Energy%20Briefing%20Note.pdf [accessed 31.03.2016].

situation worse.[26]

As Haapala (2002, p. 99) states, the big cities, mega-cities are becoming our primary places of living. These cities are highly overpopulated, which has caused various problems. The lack of finance, education, knowledge and action make the situation harder to solve. According to report published by WWAP (2015, p. 11) more than 50% of people live in cities, with 30% of all city dwellers residing in slums. Urban populations are expected to increase to 6.3 billion by 2050. Developing countries account for 93% of urbanization globally, 40% of which is the expansion of slums.

"The growing urbanization and associated industrialization may result over-pumping of groundwater. This leads to the lower water tables and land subsidence. As groundwater levels decrease, the pumping of water from lower levels becomes more costly (Haapala 2002, p. 37)". The urbanization problem and its associated components like overuse can be solved with directed urban population to rural areas or restricting more migration to urban areas. Before it is too late, regulations for increasing urbanization should be carried out immediately.

6.5. Population Changes

Ever-growing population poses significant risks for both human being and nature. Because it is main source of life, water is seriously at risk. In the overpopulated cities many problems have occurred. Some of these are insufficient infrastructure for wastewater, water and air pollution, and unbalance between water supply and demand. This situation endangers sustainability of water resources. Because of increasing population, funds which can be used for more efficient purposes are used for water related problems. It brings out economic problems.

"Particularly in Africa, but also in Asia and Latin America, growing water scarcity is primarily a result of growing populations competing for the same amount of water, rather than any change in the availability of the resource itself (Sadoff and Muller, 2009, p. 51)". When doubled world's population in the last 50 years is taken into account, there are twice as many expanding industries to supply with food and water. But there is no more water today than 50 years ago. For example, in

[26]http://www.bbc.com/turkce/haberler/2016/03/160321_hindistan_su_mafyasi [accessed 22.03.2016].

South Asia, the amount of water available for each person is one-fifth of what it was 50 years ago because of population growth.[27]

According to the report of WWAP (2015, p. 11), the world's population is growing by about 80 million people per year. It is predicted to reach 9.1 billion by 2050. By 2030, the world is projected to face a 40% global water deficit under the BAU scenario. Although there is enough water for the whole world, it is not equally distributed. Projection about population growth should be made for the next 100 years. Population should be placed in accordance with potential of the regions or cities. Access to water with adequate quality, quantity and price should be provided to every human being in the world. Management tools must include integrated approach. All actors must feel responsible for every possible causes and solutions.

6.6. Economic Challenges

Almost all economic activities (agriculture, energy, industry, tourism etc.) depend on water availability. As stated in the WWAP report (2015, p. 98), it means that many paths to sustainable development are linked to water, but the decisions that determine how water resources are used or abused are largely driven by economic sectors. But, especially in water scarce areas, economic practices create problems for water resources. These activities also damage healthy ecosystems. "While economic development leads to ecosystem decline, ecosystem services underpin economic development, so the real challenge is in building awareness of the economic value of healthy ecosystems (WWAP, 2015, p. 30)".

As economic situation changes (e.g. rising personal income), consumption patterns of individuals also change. Water usage is affected by this change. For example, "a shift from grain to meat consumption is associated with substantial increases in the amount of water consumed per capita. Most changes in consumption as a result of rising standards of living also have the effect of expanding water footprints (Sadoff and Muller, 2009, p. 52)".

Competition among water users to sustain production brings out pressure on water resources and flow of economic activities to water security areas. Obviously, there is a policy need to integrate water management and allocation. Moreover,

[27] http://www.gwp.org/Global/About%20GWP/Publications/Briefing%20notes/Briefing_Note_Food_security_final.pdf [accessed 31.03.2016].

general economic standards about water usage for economic purposes should be set.

6.7. Uncertainty and Time Horizons

Uncertainty and time horizon are advanced problems for developing and developed countries. The major drivers for these problems are climate change and overuse of water resources. The report published by WWAP (2015, p. 5) states that "there are major uncertainties, which are exacerbated by the climate change, about the amount of water required to meet the demand for food, energy and other uses, and to sustain ecosystems". As Clausen (2004, p. 11) indicates that "almost all the freshwater sources originate from precipitation, which varies immensely over time and space. Most tropical and sub-tropical regions of the world are characterized by huge seasonal and annual variations in rainfall".

Sadoff and Muller (2009, p. 52) claim that uncertainty pervades every aspect of climate change adaptation planning. Also, major water resources infrastructure, such as large reservoirs or pipelines, routinely takes over a decade to design and construct. Another point is that because water is a bulky resource, it takes ages to transport and this condition poses huge transportation costs. For example, in case of sudden shortage large quantity of water cannot be instantaneously moved (Hanemann, 2005, p. 16).

As uncertainty and time horizon bring out ever-changing situations, today's collected data about hydrological cycle may make no sense for future. To understand and manage current situations in decades to come, innovations and latest updates should be done to reduce information gap. In other words, water storage options should be made for a century-long period. And, information systems should be strengthened and projected for every possible scenarios and long periods. Also, for minimizing risk of uncertainty, water pollution should be reduced.

7. WATER MANAGEMENT AND WATER INSTITUTIONS IN TURKEY

Over the last decades, efficient water management and founding effective water institutions has gained great importance because of challenges to water resources, in particular climate change and ever-increasing population. Farolfi (2011, p. 8) illustrates these challenges in his article and claims that population and pollution are at the origin of the problems of water sector. According to him, two main paradigms of water management were developed to face these problems: Modernist/hydraulic mission (water supply through investments for development and Environmentalist/giving voice to society, stakeholder participation (water demand management).

In this part of the study, brief explanation for Water Resources Management and Integrated Water Resources Management is given. In addition, some legal and international perspectives for water management are examined briefly in order to constitute a meaningful whole for the purpose of the study. Also, institutions related with water management in Turkey are given in accordance with the scope of the study.

7.1. General Principles and Importance of Water Resources Management

Water which is the main source of the life and a significant input for both production and environment has become dramatically scarce resource for the whole world. In addition to its scarcity, some threats on water such as competition between its users, climate change etc. pose an obstacle for the sustainable future. Therefore, water resources management deserves special attention. Economists have had difficulty to understand the value of water and manage water resources. The most famous and earliest example is the 'diamond-water paradox' which confused Adam Smith and other economists for a long time.

"Water Resources Management [WRM] is the wholeness that collects all the conditions and methods related to the determination and planning of need concerned with water resources, rational water use, detailed observation, and efficient protection under its framework (Eroğlu[28], 2007, p. 323)". "Water resources management is a broad practice which involves water allocation, wastewater

[28]Prof. Dr. Veysel EROĞLU, The Minister of Forestry and Water Affairs of Turkey.

collection and treatment, capacity building, data collection and analysis, billing and revenue collection, drainage and flood protection, pollution control and ecosystem protection (Rees et al., 2008, p. 14)".

The fundamental of water development and management is water governance which "refers to the whole range of political, social and economic institutions, networks, directives, legislations and norms (Farolfi, 2011, p. 84)". The other preconditions for effective water management can be summarized as defining current and future quantitative and qualitative conditions of resources, planning, monitoring and controlling water supply and demand to manage scarcity and to prevent overuse and pollution by leading to conscious water use and running legal, managerial and economic instruments efficiently without causing externalities or market failures.

Another perspective is that effective water management is a driving force for the whole economy, especially for the development in a sustainable manner. "It is therefore advisable to link water policy with other policies, such as environmental, agricultural, industrial, economic, energy, trade and foreign policies as well as with international cooperation (Pahlow et al., 2015, p. 311)". Also, use of economic values in the management of water resources is a significant principle. Economic value helps authorities to set efficient policies and decide priorities. "Valuation is also an important guide in the setting of environmental 'prices' in the form of taxes, charges or tradable permits (Turner et al., 2004, p. 60)".

There are two main subjects for water management to handle in terms of uncertainty. "The first one causes from water supply, which reflects water availability and the impacts of human activities that affect the natural flow of water and water quality. The second one is related with variability and the growth in water demands (Cosgrove and Cosgrove, 2012, p. 39)". Apart from being incentive for water saving, technological developments have also negative impacts on water, especially in terms of quality, and its management. "Many new chemical and medicinal products are disposed of and disseminated through the water cycle with unpredictable consequences for human health (Sadoff and Muller, 2009, p. 52)".

Besides these, "if there is not transparent, equitable and integrative governance, water management is more vulnerable and unable to adapt to changes political and social risks and institutional failure (Rogers and Hall, 2003, p. 9; p.

28)". Even though there are robust legislative regulations, adequate and sustainable allocation of water resources among users poses a problem for water management. According to Hanemann (2005, p. 30), "the problem is matching demand with supply by ensuring that there is water at the right location, and the right time of year, and at a cost that people can afford and are willing to pay for".

For overcoming the multidimensional and complicated water problems, "efficiency and equity implications of water management policies must be addressed. This imperative is the essence of proposals to treat water as an economic good (Sadoff et al., 2003, p. 55)". As stated in the previous section, the main paradigms to solve water management problems are the hydraulic mission (supply oriented) and the Integrated Water Resources Management [IWRM] (demand oriented) which is more broadly examined in the study.

7.1.1. Hydraulic Paradigm and Development

Hydraulic paradigm is the basic approach taken in the shaping of water policies in Turkey and many countries in the last century. This approach sees technical knowledge as the only source of information and is a paradigm that evaluates water separately from the river and the land it flows. According to this assumption, a single solution for water shortage problem in a region is transferring water with channels from another which has relatively more of water. Hydraulic paradigm incontrovertibly has importance in the establishment of the modern nation state, urbanization and is a driving force for development. However, this paradigm also has devastating impact on all life sources of the world including human beings. This century-long paradigm underlying the global water problem still continues its dominance (İlhan, 2011, p. 31).

7.1.2. Integrated Water Resources Management [IWRM]

Water is a key factor for healthy ecosystems. Hence, its quantity and quality requirements must be managed in a holistic manner. "Integrated Water Resources Management [IWRM] is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Agarwal et al., 2000, p. 22)".

The IWRM concept involves both the management of water demand and its supply. The natural system (hydrological cycle), more specifically surface and groundwater, falls within the supply side with its vital importance for availability and quality of water. On the demand side, the human system exists by essentially reflecting the use and the pollution of the water resources (Clausen, 2004, p. 23). This concept also includes some tools to manage water and related risks. In other words, progress in IWRM requires using some instruments to take into account geographical contexts and to handle the existing social, economic and political conflicts.

IWRM is an ongoing process with different sizes and stages. As Clausen (2004, p. 9; p. 33) indicates, “it is specific to the geographical, historical, cultural and economic context of any country stating that there is no one size fits all” and “no country ever completes the cycle”. It means that new or additional conditions about water resources may occur and IWRM practices may vary by country. Also, IWRM practices may differ in terms of the development stage of the country. For example, “developing countries see water resources management as a factor in addressing poverty, hunger, health and environmental sustainability (Clausen, 2004, p. 15)”.

For successful IWRM process, the bilateral relationship between its application and policies should be carefully analyzed. For example, “energy and food policies may have a profound impact on water resources – and vice versa (Clausen, 2004, p. 27)”. Also, policies should be set in accordance with the purpose of abating water pollution and overuse of water resources. Moreover, for effective water allocation, policies should take into account relative economic values of water from a systems perspective. In other words, “the physical interdependencies of water use in a river basin that result in opportunity costs and positive and negative externalities drive the need for IWRM (Whittington et al., 2013, p. 18)”.

A strong IWRM process requires effective integrated plans including economic, social and environmental aspects of the water resources management (see Figure 7.1). To promote efficient use, conservation and recycling of water, regulatory instruments which set standards to manage the results related with water management and economic instruments such as water markets, pricing and subsidies to achieve more efficient water allocation are inseparable parts of the

IWRM. In addition, assessment instrument such as risk and vulnerability management helps to adjust plans for uncertainty that scarcity or climate change bring about.[29]

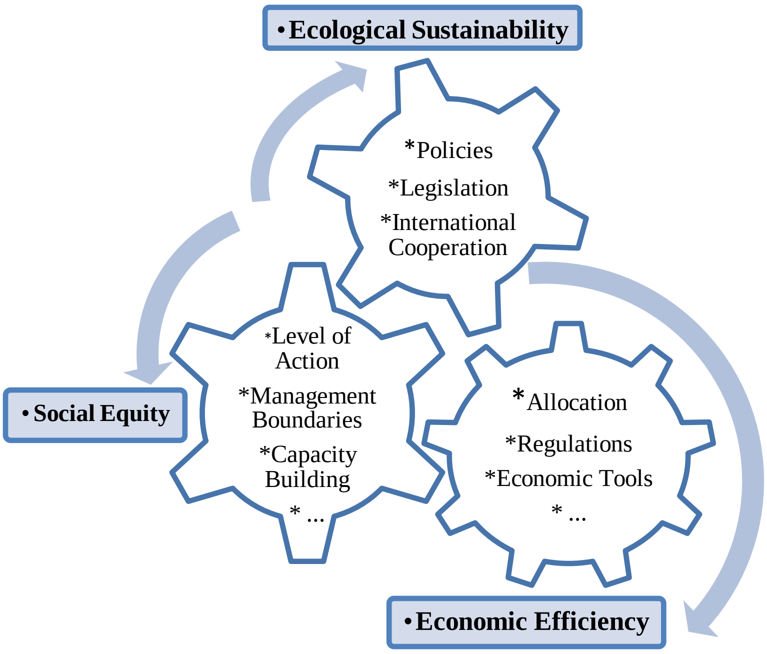

Figure 7.1. *General Framework for IWRM*
Source: *Adapted from Agarwal et al., 2000, p. 31.*

As Abdullaev and Rakhmatullaev (2014, p. 1438) state, data management should be made with modern information technologies in the IWRM process for sustainable and efficient water management. In addition, "universal indicators which reflect current actual conditions in terms of challenges, applications and results should be developed and adopted as part of the IWRM process (Clausen, 2004, p.33)". Apart from these, different scenarios under different situations should be taken into account by policy makers. It means that effects of different factors such as water scarcity, growing population, urbanization, industrial development and agricultural practices should be involved in IWRM process in addition to climate change (Spanos, 2014, p. 35).

It should be noted that although it promotes competition and eliminates bureaucracy, private sector involvement in the water sector cannot solve problems without a strong political and legal framework. Government intervention is necessary to cope with externalities and market failures such as monopoly power.

[29]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/ [accessed 01.02.2016].

As Clausen (2004, p. 34) points out, government should take place in the market as main mechanism to implement and control the regulatory instruments such as laws, policies and plans. Another aspect is that “cooperation among the riparian countries is vital for promoting integrated water resources development and management along the transboundary river basins (Rahaman, 2009, p. 10)”.

Because the IWRM concept is complex and multidimensional, pure integration of all components may seem unrealistic. But, it has the potential to solve water problems if some challenges are handled. First of all, application of the IWRM concept is challenging by itself. “There is a huge gap between theoretical principles of IWRM and their implementation (Rahaman, 2009, p. 25)”. “Existing policies tend to take a rather narrow view of the concept and have largely failed to incorporate the principles. Also, the integration of different sectors related to water management is a difficult and challenging task (Rahaman, 2009, p. 9)”.

Because they usually seek to get their own benefits from collective actions and there are no effective policies for putting the theory of transboundary water management into practice, integration of riparian countries into supranational concept is also a challenge. “It is noteworthy that 158 of the world’s 263 transboundary water basins lack any type of cooperative management framework (WWAP, 2015, p. 11)”. Finally, resolving the problems related with IWRM concept in different regions with overly general policies is a counterproductive practice (Rahaman, 2009, p. 9).

7.2. Institutions Related to Water Resources Management in Turkey

There are several institutions and organizations which are structured at different levels and are interested in the development, conservation and management of water resources in Turkey. Eroğlu (2007, p. 324) explains the levels as “Prime Ministry and various ministries at the decision making level, governmental organizations under the ministries at the executive level and the governmental and nongovernmental organizations (municipalities and irrigation cooperatives etc.) at the user level”.

The General Directorate of State Hydraulic Works [SHW], which is placed under the Ministry of Forestry and Water Affairs since 2011, is mainly responsible for managing water resources. “SHW is responsible for developing fresh water resources by realizing and managing projects for the purpose of irrigation, hydroelectric power generation, domestic and industrial water supplies, creation of recreation areas and prevention the damage caused by water”.[30]

SHW manages the water resources in accordance with the legal framework (The Establishment Law, Groundwater Law and Law on Supply of Drinking Water to Ankara, İstanbul and those cities with population higher than 100,000), government policies, development plans and investment programs (Eroğlu, 2007, p. 331; SHW[31]). But, by removing population condition in 2007, SHW was authorized for the construction of drinking and industrial water facilities in which municipality exists.

In addition, SHW obtains sufficient and robust data in both quantity and quality of water for effective water resources management by means of ‘Hydrometric Observation Network of Turkey’ which observes “water levels of lakes and groundwater, stream flow rates, sediment loads and water quality in rivers as well as such meteorological variables as precipitation, temperature, evaporation and humidity (Eroğlu, 2007, p. 327)”. There are currently operating 1813 stream flow, 126 lake levels, 130 snow gauging, and 167 meteorological stations located across Turkey. [32] There are also 1086 groundwater level observation wells in Turkey.[33]

One of the other main executive institutions is General Directorate of Bank of Provinces (İller Bankası) which is “responsible for developing urban plans, supplying municipal water, constructing sewerage systems and treatment plants, and providing loans to municipalities for the financing of such projects (Eroğlu, 2007, p. 324)”. “General Directorate of Electric Power Resources Survey and Development Administration [EIE] works coordinated with SHW in collecting hydrometric data and development of hydropower (Eroğlu, 2007, p. 325)”.

“Urban water and sewage administrations in metropolitan municipalities work for constructing, operating, and maintaining water supply and treatment facilities, and are responsible for networks of industrial establishments within the boundaries

[30]General Directorate of State Hydraulic Works [SHW]. (2007). *Catalogue for International Congress: River Basin Management*. Antalya. p. 28.
[31]SHW. op. cit. p. 33.
[32]http://rasatlar.dsi.gov.tr/# [accessed 09.03.2016].
[33]http://www.dsi.gov.tr/dsi-resmi-istatistikler/2014-yili-verileri [accessed 09.03.2016].

of metropolitan municipalities (Eroğlu, 2007, p. 325)". Apart from these, the Ministry of Environment and Urbanization, the Ministry of Food, Agriculture and Livestock, and the Ministry of Health are the other significant actors for monitoring the water resources in Turkey.

Although the scope of the each institution is laid down by the laws, legal and administrative controversies among them usually occur when a project or work related with water resources is implemented. For handling such problems, Basin Management Plan/Model is implemented with 25 basins in Turkey by SHW as indicated in its Establishment Law (Eroğlu, 2007, p. 321; p. 331). According to Uluırmak (2014, p. 133) "by means of some enacted legal arrangements whose oldest one is 1926 dated Water Law, it has been realized both determination of national water policies at the central level and organization of river basin approach at local level".

It was 1930s when initiatory studies on Turkey's water potential have conducted with limited facilities on certain river basins. In 1950s, scientific researches in terms of data acquisition and evaluation on potential of water resources on river basin have started. Until 1980, water policies have mainly focused on structural problems such as meeting water demands.[34] It is noteworthy that unlike quantitative practices, qualitative and environmental consideration of water resources in Turkey has been kept in the background until the enactment of 'Environmental Law' in 1983.

As the first remarkable governmental action, the Environmental Law introduced the 'polluter pays principle' to Turkey. In 1988, the 'Water Pollution Control Regulation' was put into effect with regard to the aims of the 'Environmental Law'. With this regulation, the approaches that protect and improve water quality and treat water resources as a part of ecosystems were introduced. Lastly, the Environmental Impact Assessment [EIA] was put into practice in 1993 within the scope of 'Environmental Law'. Dams and groundwater basins which provide more than 10 million m^3/year water withdrawal have been subject to EIA due to this regulation (Eroğlu, 2007, p. 327).

[34]SHW. op. cit. p. 28.

7.3. International Considerations for Water

From past to present, water problems have been one of the issues that occupy the world's agenda. The effects of these problems have spread over the whole dynamics of the life, thereby the economy, such as agriculture, energy, industry, environment and health. As Rahaman (2009, p. 1) points out, because the problems are too complex, interconnected and multidimensional at the present time, it has become obvious that water professionals or policy makers alone can no longer resolve the water problems of a country or a river basin.

As the problems pose threats for the whole world, for handling water problems in an integrated and efficient way, international attempts have been held. The selected conferences and directive given in the next sections which form basis for the study are briefly summarized to serve general perspective.

7.3.1. The European Water Framework Directive

"The European Water Framework Directive [WFD] is one of the first environmental policy Directives of the European Community that explicitly draws on economic instruments for achieving its objectives. Economic approaches integrated into the Directive foremost include the polluter-pays and the cost-recovery principles (Kraemer et al., 2003, p. 39)".

The Directive's outline contributes to the logic behind the economic analysis of water. It states that adequate water supply should be conserved and this is one of the drivers behind the introduction of pricing which is innovation of Directive. For achieving the environmental purposes under Directive and sustainable water use, pricing water adequately is an incentive. The price charged to consumers is required to reflect the true costs such as water abstraction and waste water treatment costs.[35]

7.3.2. Dublin 1992: International Conference on Water and Environment

The International Conference on Water and Environment [ICWE] was held in Dublin, Ireland in January 1992. By the end of this conference, the Dublin Statement and the Conference Report were adopted. The Conference Report set out four guiding principles (the Dublin Principles) which heavily influence current thinking on the crucial issues in water resources (Rahaman, 2009, p. 5).

[35]http://ec.europa.eu/environment/water/water-framework/info/intro_en.htm [accessed 20.01.2016].

The four Dublin principles are given. Also, because it underpins this study, the explanation of the fourth principle is presented in accordance with the scope of this study:

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
2. Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.
3. Women play a central part in the provision, management and safeguarding of water.
4. Water has an economic value in all its competing uses and should be recognized as an economic good. Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.[36]

7.3.3. Rio 1992: UN Conference on Environment and Development

The UN Conference on Environment and Development [UNCED], also known as The Earth Summit, was held in Rio de Janeiro, Brazil on 3-14 June 1992. One of the key agreements adopted in Rio is Agenda 21. According to this agenda, water resources assessment and integrated water resources development and management are among the mainly proposed topics (Rahaman, 2009, p. 6). Another major agreement is the Rio Declaration on Environment and Development which declares 27 principles. The most significant principle related with the scope of the study is the Principle 16. It proclaims that “National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.”[37]

7.3.4. The Hague 2000: 2nd World Water Forum & Ministerial Conference

World Water Forums (the First World Water Forum was in Marrakech) organized by the World Water Council [WWC] are held every three years since 1997. The Second World Water Forum was held in The Hague, Netherlands on 17-

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[36] http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html [accessed 20.01.2016].
[37] http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163 [accessed 20.01.2016].

22 March 2000. The most related issues indicated in the Forum with the scope of the study is changing the full cost for water services: Users should be charged the full cost of the services–with appropriate subsidies made available to the poor (Rahaman, 2009, p. 6). Also, in Ministerial Declaration of The Hague, valuing water is stated as a future challenge which has to be met "to manage water in a way that reflects its economic, social, environmental and cultural values for all its uses, and to move towards pricing water services to reflect the cost of their provision".[38]

[38]http://www.worldwatercouncil.org/fileadmin/world_water_council/documents/world_water_forum_2/The_Hague_Declaration.pdf [accessed 20.01.2016].

8. DEBATES ON THE TAXONOMY OF WATER

Since ancient times, water has been treated as public good. In the whole world, water services were mainly managed by public institutions. As a different option, private sector participation has received more attention by the 1990's. The conflicts have arisen between advocator of these strategies. According to these two policy options:

a) Water is a human need. As it is commercial meta, its price should be paid by client in accordance with market requirements.

b) Water is a human right. It should be provided as cheap as possible in accordance with public interest principle (Tuluay, 2010, p. 15).

8.1. Should Water Systems be Privatized?

As Adam Smith stated in *Wealth of Nations*, liberal thought defines water as "free good" within the framework of the famous diamond-water paradox. According to them, water has high value in use for human being, but it is a commodity with no exchange value. "This insight has changed with the rise of neoliberalism. Water is presented as a "scarce" economic commodity anymore (Güzelsarı and Tuluay, 2011, p. 57)".

The basis of the new right-wing water reform is commodification of water/commercialization of services. Until 1990s, organizations such as the OECD and World Bank have argued that resources can be managed effectively by decentralized departments with comprehensive planning and pricing policy. Measures were focused to ensure that public institutions to manage water as an economic good (Yılmaz, 2009, p. 6).

The adoption of water as an economic good, and then throughout the process of marketization and intensifying the commodification of water worldwide in 1992 is the milestone. International Conference on Water and Environment in Dublin was held on 26-31 January 1992. The most important outcome of the conference is as the adoption of "water is an economic good" (Güzelsarı and Tuluay, 2011, p. 60).

Since the 1980s, privatization has been a phenomenon seen as popular solution to the failure of state enterprises. Publicly owned institutions have been seen as inefficient and incapable of providing even basic services because of the short-term political interventions, struggles for political advantage, and managers ‘pursuing their own utility (Rees, 1998, p. 5). In contemplation of reducing costs and prices, many countries privatized their water supply systems by selling to a private company.

However, it is not obvious that privatization provides the desired efficiency. According to Tietenberg and Lewis (2009, p. 232), “privatization of water supplies creates the possibility of monopoly power and excessive rates”. As Rees (1998, p. 11) indicates, “private companies are not social services. They only provide public goods or below cost water supplies if they can recover the costs involved which can only be compensated directly from the public purse or from an increase in water charges”. Private sector also may create costs to nature by profit seeking. Overusing, depleting or polluting water sources are some of these costs.

The most attractive side of privatization is affording the very large investment needs of the water and sanitation sector. But, for the private sector large scale investments always involve significant risks i.e. they cannot be removed for use elsewhere. There are no obvious alternative uses for the sewerage system or sewage treatment plants (Rees, 1998, p. 12).

8.1.1. Privatization of urban water services in Turkey

Although there are many examples of water resource privatization, only three examples are presented for the purpose of giving brief information about privatization practices in Turkey. The first one is Antalya Water and Wastewater General Directorate [AWWD]. AWWD delegated its authority related to water in 1995 to Antalya Infrastructure Management and Consulting Services Inc. [AIMCS] and ANTS (French water company Suez) consortium according to the loan agreements made with the World Bank. The increase in water prices between 2000 and 2004 reached 357% in this application process. Antalya Metropolitan Municipality had to cancel the contract before the 10-year agreement period in the face of increasing water prices (İlhan, 2011, p. 92).

The second one is Çesme-Alaçatı example. Within the context of "Çesme-Alaçatı Water Supply and Sewerage Project", on the condition that transferring of the service business, Çeşme Municipality received World Bank loan. After the agreement had entered into force, operating cost per unit of water has doubled and the results such as delayed and incomplete investments, increasing water prices and nondecremental water loss emerged (İlhan, 2011, p. 93).

Ankara Metropolitan Municipality is the last and most extreme example of the privatization of water services in Turkey. After meter reading services is subcontracted in Ankara, with a sudden and unexpected gradual water tariff determined by the municipality, water users were obliged to pay double tariff for the amount of water exceed limit set. Bills covering a month period were changed to 1.5-month and many users have been involved in double tariff quota. Another application of the Ankara Water and Sewerage Authority [AWSA] is the prepaid water meter. In addition, when people of Ankara were without of water, AWSA also negatively affected social perception towards the tap water by using Kızılırmak water which is regarded as second grade quality drinking water (İlhan, 2011, p. 93).

8.2. Human Right Perspective

According to Kılıç (2009, p. 45), Freshwater would be an economic good which can only be consumed by who pay the price, if the freshwater services will be carried out by the private sector that behaves with profit maximization. There are some efforts against this tendency. One of these is the recognition of water as a human right by the United Nations Committee of Economic, Social and Cultural Rights [CESCR] in 2002 with the General Comment No.15.

There are three fundamentals defined by CESCR to identify water right. First principle is *Availability* which means supplying water sufficiently and continuously to every person for domestic use. Second principle is *Quality* indicating safe water which does not pose chemical and radiological threats to human health. Third one is *Accessibility*. According to this principle, water resources and water-related services have to be accessible for everyone (CESCR, 2002, p. 5-6).

"In July 2010, the UN General Assembly adopted a Resolution on the Human Right to Water and Sanitation, which declared, the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights".[39] The human right perspective takes water within the scope of human rights and social rights. In this perspective, access to clean, adequate and

[39]http://www.gwp.org/en/ToolBox/TOOLS/Management-Instruments/Regulatory-Instruments/Water-Services[accessed 15.11.2015]

cheap water is a fundamental human right. State provides physically and economically equitable access to sufficient quantity and quality of water and water-related information for everyone.

In water services, positive discrimination is made on behalf of the disadvantaged such as the low-income segments of society, nomadic communities, and people living in arid and semi-arid regions. Water with adequate amount and quality which is necessary to meet basic human need is free. State participates in international cooperation for the solution of the problem in countries experiencing water scarcity (Şirin, 2010, p. 163).

Being founded of water companies and transferring of water resources to these companies by privatization created a situation that the source of water for the people of the world was used by domestic and global capital as hegemonic tool. Companies invaded the water sources restrict people's right to use water by setting prices as they wish (Tuluay, 2010, p. 1). "What happened in Cochabamba, Bolivia, illustrates just how serious a problem this can be. After privatization in Cochabamba, water rates increased immediately, in some cases by 100–200 percent (Tietenberg and Lewis, 2009, p. 232)".

Global water agenda is generally determined by global financial institutions and multinational companies engaged in the global water business. In case of water and sanitation services carried out by the private sector, this situation will make profound differences in access to water that is basic resource for life and may lead to social unrest. After the transfer of water services to the private sector, especially in Latin America, these types of events occurred a lot (Kılıç, 2009, p. 56).

Profit is targeted instead of serving people. Not water saving is encouraged, but water consumption is. Companies get richer with profit from the public. Local governments become dependent on global companies. Opening basic public services areas such as education, health and water to the private sector creates an important area for international capital profit. Major investment deficit in water services (estimated $ 180 billion in 2025) and the increase in demand in proportion to population day by day makes water services one of the most profitable investment areas (Yılmaz, 2009, p. 3; Güzelsarı and Tuluay, 2011, p. 56; İlhan, 2011, p. 123).

There are some worldwide examples of human right application: Since January 1, 2010 water service in Paris is provided by Eau de Paris (Paris Water) which is a public enterprise. The ownership of the company belongs to Paris Municipality. Uruguay and Netherlands legally blocked privatization of water. Drinking water and wastewater services of Munich have been carried out by public institutions since 1880s. Dikili Municipality provides 10 m^3 of water consumed per month per household for free. If this quota is exceeded, the total amount of water used is charged with normal tariff (İlhan, 2011, p. 129-p. 137).

Providing water at least for poor generates some economic gains in terms of human capital which can be used for more productive purposes. According to report published by WWAP (2012, p. 538), "although it is not measured in monetary terms, poor people who do not have access to water pay a high opportunity cost for their basic needs". When water for basic needs is provided for these people, the opportunity cost "paid in terms of lost school days or lost working days are channeled for creating wealth (WWAP, 2012, p. 538)".

9. WATER RESOURCES: STATUS AND AVAILABILITY

Water has such a different feature that "people may pay thousands of dollars for a quart of water if it keeps them alive. When flood conditions threaten lives and property, people may pay thousands of dollars to fight floods that keep water away (Ward and Michelsen, 2002, p. 443)". It means that water has to be available in adequate amount and in desired quality for all uses with equitable access. However, it does not seem to be achievable given the fact that water resources are severely under threat. In this part of the study, the facts about are given largely with graphs and tables.

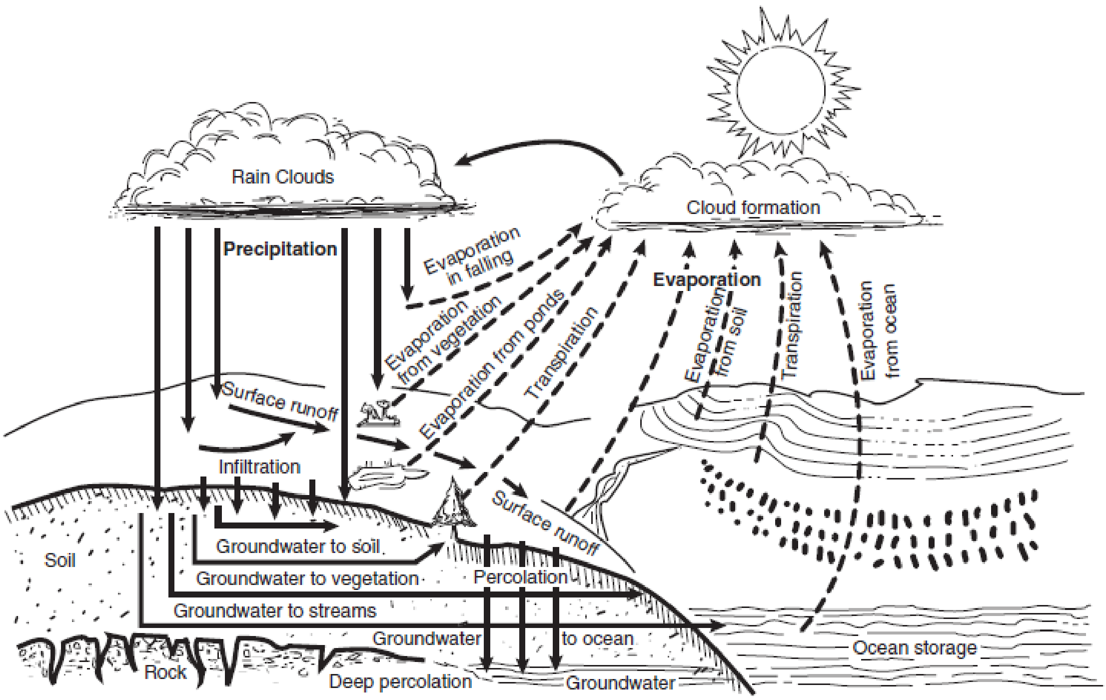


Figure 9.1. *Hydrologic Cycle*
Source: *Tietenberg and Lewis, 2009, p. 205.*

Water availability depends on ground and surface water which flow through hydrologic cycle as shown in the Figure 9.1. However, world's water resources are not equally distributed and are subject to periodical changes, access to water is a significant problem in some parts of the world. "The total water volume in the world amounts to 1.4 billion km^3, 97.5% of which is saline water in the oceans and seas, 2.5% of which is fresh water in the rivers and lakes".[40] When the fact that 90% of fresh water

[40]http://en.dsi.gov.tr/land-water-resources [accessed 01.02.2016].

exists in the polar ice cap is taken into account, it can be understood how serious the availability and allocation problem is.

Climate change, variability in precipitation and pollution exacerbate the problem by affecting the hydrological cycle with changes in runoff, aquifer recharge and water quality. Also, insufficient or non-existing monitoring systems for water availability over time and space pose a challenge (WWAP, 2014, p. 44; WWAP, 2015, p. 13). Furthermore, the loss of water by leaking entails a risk for future. "In many cities in developing countries piping systems are reasonably old, and non-effective. Leakage of water may make up as much as 40 to 60 per cent of the total water supply in developing cities (Haapala, 2002, p. 36)".

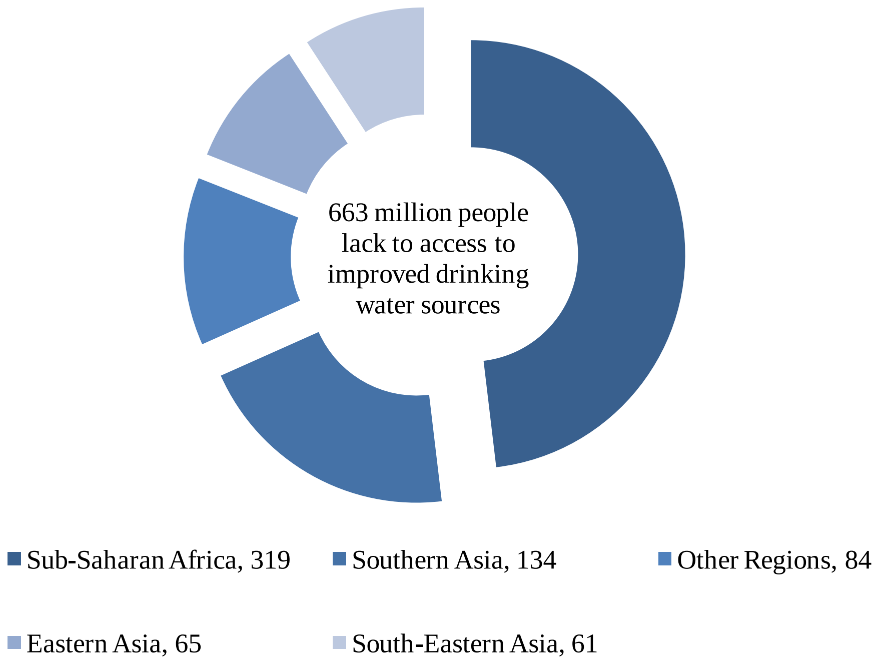
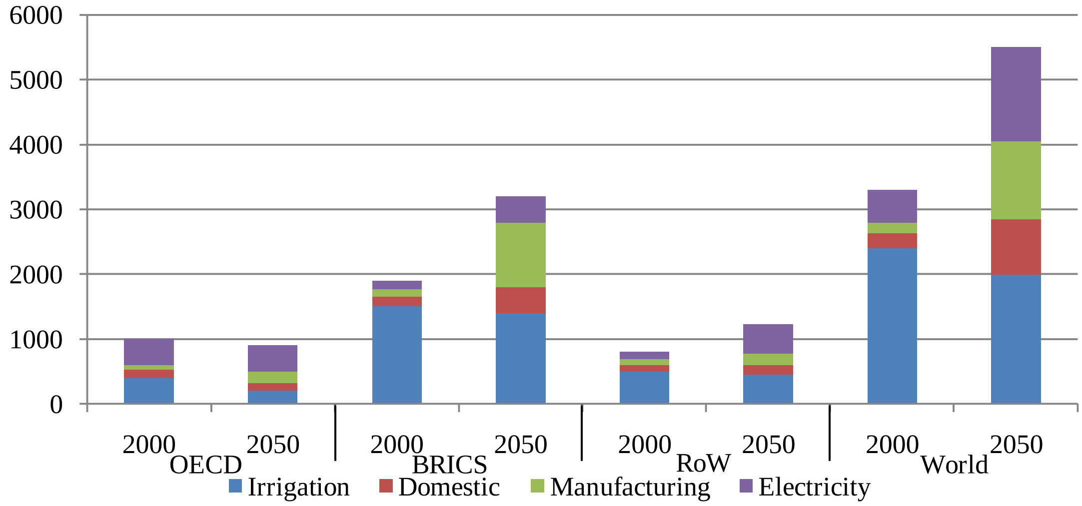


Figure 9.2. *Population without Access to Improved Drinking Water Resources in 2015, By Region.*
Source: *UNICEF and World Health Organization [WHO], 2015, p. 7.*

Continuity of water resources in adequate amounts and quality play a key role for all kind of water usage. But, as Figure 9.2 shows, 663 million people lack access to improved drinking water resources according to UNICEF and WHO. The largest portion of these people, nearly half of them with 319 million, lives in Sub-Saharan Africa countries. Another significant part of these people, 134 million, lives in Southern Asia.

Water demand of all uses largely depends on groundwater resources. "Worldwide, 2.5 billion people depend solely on groundwater resources and these resources provide drinking water to at least 50% of the global population and accounts for 43% of all water used for irrigation (WWAP, 2015, p. 13)". However, groundwater resources are currently at risk because of uncertainty and other challenges. As pointed out in Section 5.1., it is estimated that 20% of the world's aquifers are currently over-exploited. Also, increasing rate of groundwater abstraction globally by 1% to 2% per year is indicative of scarcity (WWAP, 2014, p. 27).



Note: BRICS (Brazil, Russia, India, China, South Africa); OECD (Organization for Economic Co-operation and Development); Row (Rest of World). This figure only measures 'blue water' demand and does not consider rainfed agriculture.

Figure 9.3. *Global Water Demand (Freshwater Withdrawals) Baseline Scenario, 2000 and 2050.*
Source: *WWAP, 2016, p. 23.*

When Figure 9.3 is examined, the huge global water demand scenario for 2050 seems to be caused largely by BRICS (Brazil, Russia, India, China, and South Africa) countries. When more deeply analyzed, it can be seen that the most populated countries, China and India, are in this group. In addition, although water demand for irrigation is expected to decrease in all groups, demand for electricity and manufacturing are expected to increase. Water demand growth for these sectors also stems from BRICS countries, especially from China and India. Because these countries are not a member of OECD, decrease in demand from this group can also clarify this situation.

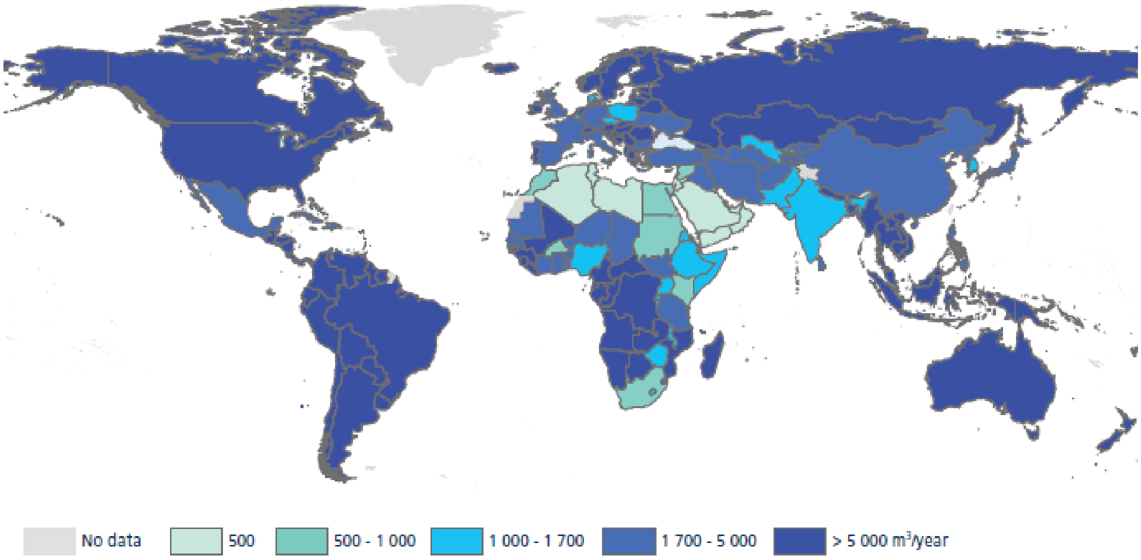


Figure 9.4. *Total Renewable Water Resources (m^3 per capita per year), 2014*
Source: *WWAP, 2016, p. 16.*

Figure 9.4 shows general condition of the world countries in terms of total renewable water resources per capita in 2014. It can be said that water shortage condition exists in India and Pakistan. Also, water scarcity arises for Yemen, Oman, Saudi Arabia, Morocco, Algeria, Egypt, Sudan and Chad. According to legend in the figure, Turkey has renewable water resources per capita between 1700- 5000 m^3. It means that Turkey is not a water rich country and it may be approaching water shortage condition.

In general, water potential of a country is evaluated based on water quantity per head. According to international criterion, the country which has annually bigger than 10.000 m^3 water potential per head is water rich country, between 10.000 m^3 and 3000 m^3 water potential per head is self sufficient country, between 3000 m^3 and 1000 m^3 water potential per head is water scarcity and the country that has annually less than 1000 m^3 water potential per head is accepted as water poor country (Uluırmak, 2014, p. 36). Turkey is water scarcity country with approximately 1422 m^3 water potential per head in accordance with this classification.

Another widespread criterion is Falkenmark index which is applied for water scarcity or water stress. Falkenmark index classifies scarcity/ stress condition as follows in accordance with annual water quantity per head in country or region:

· If more than 1.700 m^3, no water problem,

· If between 1.700-1.000 m^3, water shortage,

· If between 1.000-500 m^3, water scarcity,

· If less than 500 m^3, absolute water scarcity (Muluk et al., 2013, p. 24).

According to this classification, Turkey is currently a country under the condition of water shortage with 1422 m^3 water potential per head. TSI forecasts population in 2030 will be 88 million in Turkey.[41] It means that the annual available amount of water per head in Turkey will be about 1,200 m^3 by 2030. Given these circumstances, it can be easily said that Turkey is not a water rich country and in the near future it will most probably be a country under water scarcity condition. However, all these estimates base on the assumption that available resources will be transferred after 20 years without destroying them.

Table 9.1. *Total and per capita Renewable Freshwater at OECD Countries Level*

	Total Renewable Freshwater (billion m^3)		Total Renewable per capita (m^3/cap)	
Country	**Rank**	**Value**	**Rank**	**Value**
Brazil	1	8.426	6	42.237
Russia	2	4.259	Not Available	29.622
Canada	3	3.524	3	98.666
China	4	2.862	31	2.053
USA	5	2.478	17	7.772
India	6	1.869	36	1.475
Chile	7	1007	5	56.885
New Zealand	8	485	2	107.527
Mexico	9	472	22	3.942
Japan	10	414	23	3.259
Norway	11	393	4	76.506
Australia	12	387	10	16.483
Turkey	13	234	24	3.046
Sweden	16	186	8	19.197
Iceland	17	170	1	523.106
Finland	22	110	7	20.165
Latvia	37	34	9	16.526

Source: *OECD iLibrary. http://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en [accessed 09.04.2017].*

Table 9.1 shows the OECD data on total and per capita renewable freshwater at OECD countries level including key partners such as Brazil, India and China. Although these partners are in the top ten in terms of total freshwater, they fall

[41] http://www.tuik.gov.tr/PreHaberBultenleri.do?id=15844 [accessed 31.03.2016].

behind other countries in terms of renewable water per capita and take place near the bottom because they are overpopulated. On the other hand, the European and developed countries such as Norway, Finland and Iceland have renewable water less than others. However, these are not overpopulated and have more water resources per capita.

As stated earlier, over one billion people currently live under water scarcity and 3.5 billion people, about two thirds of the world population, could face with water scarcity by 2025. According to OECD (2008, p. 7), “63% of the population in Brazil, Russia, India and China together are already living under medium to severe water stress; this share will increase to 80% by 2030 unless new measures to better manage water resources are introduced”.

A current study by WRI shows the future water stress in 167 countries under the BAU, pessimistic, and optimistic scenarios by 2020, 2030 and 2040. By combining a set of climate models and socioeconomic scenarios into a measure of competition and depletion of surface water, WRI presents scores and ranking of future water stress for countries.[42] “Water stress is defined as the ratio between total water withdrawals and available renewable surface water at a sub-catchment level. Higher scores on the scale from 0 to 5 correspond to greater competition among water users for available surface water (Luo et al., 2015, p. 3)”.

Table 9.2. *Water Stress Thresholds*

CATEGORY	SCORE	RATIO OF WITHDRAWALS TO AVAILABLE WATER (PERCENT)
Low	0-1	< 10
Low to medium	1-2	10-20
Medium to high	2-3	20-40
High	3-4	40-80
Extremely high	4-5	>80

Source: *Luo et al., 2015, p. 3.*

As seen in the Table 9.1, water stress level category differs according to score and taxonomy is made as from low level to extremely high level. It should be noted that only BAU scenario for the year 2040 is given in this study to present general perspective for water stress. Luo et al. (2015, p. 5) indicate that “these indicators

[42] http://www.wri.org/blog/2015/08/ranking-world%E2%80%99s-most-water-stressed-countries-2040 [accessed 31.03.2016].

should not be seen as predictions, but rather as potential outcomes under specific climate and socio-economic trajectories, which are subject to uncertainties".

Table 9.3. *Water Stress in 2040 with BAU Scenario*

Rank	Country	All Sectors	Industry	Domestic	Agriculture
1	Bahrain	5.00	5.00	5.00	5.00
1	Kuwait	5.00	5.00	5.00	5.00
1	Qatar	5.00	5.00	5.00	5.00
1	San Marino	5.00	5.00	5.00	5.00
1	Singapore	5.00	5.00	5.00	No Data
1	United Arab Emirates	5.00	5.00	5.00	5.00
7	Palestine	5.00	5.00	5.00	5.00
8	Israel	5.00	5.00	5.00	5.00
9	Saudi Arabia	4.99	5.00	5.00	4.99
10	Oman	4.97	4.97	4.97	4.97
27	Turkey	4.27	4.59	4.53	4.13

Source: *Luo et al., 2015, p. 6.*

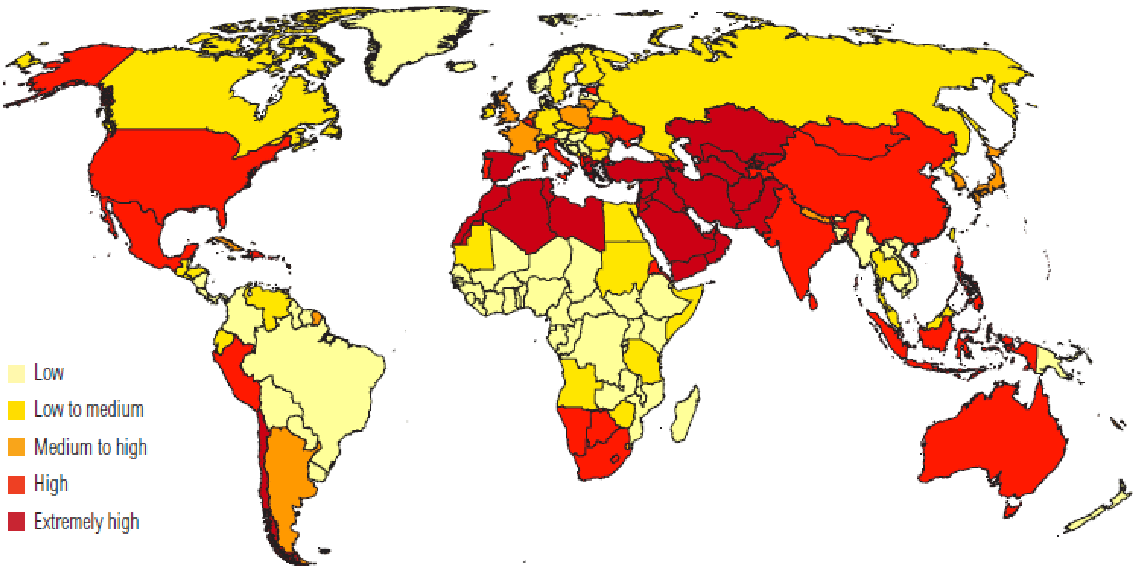
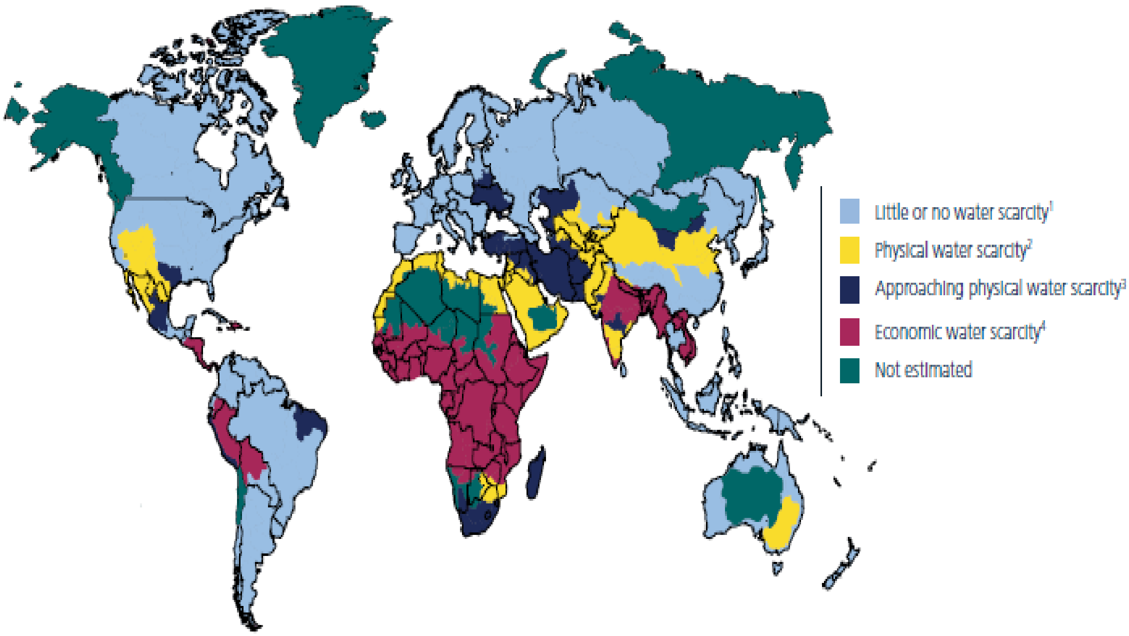


Figure 9.5.*Country-Level Water Stress in 2040 under the BAU Scenario*
Source: *Luo et al., 2015, p. 5.*

Table 9.3shows the top ten countries and Turkey in terms of water stress in 2040 with BAU scenario. As well as overall stress levels, stress levels for industrial, agricultural, and domestic users are also given in the table. Figure 9.5 gives overall picture of water stress in 2040 under BAU scenario. As Table 9.3 and Figure 9.5 are analyzed together, it can be easily seen that apart from San Marino and Singapore, the top ten countries which are considered as the most water stressed counties in 2040 are in the Middle East. Also, all of these countries have the score of 5.0 out of 5.0 which means extremely highly stressed.

According to table and figure, Turkey is considered as extremely highly stressed country at overall and sectoral levels. Also, the great powers such as China, India and United States are seen as highly stressed countries. Even though water stress level for each of all countries in the world is affected by different factors, stress on water resources considerably poses risks for water security, economic practices and environment.



Notes:
1) Little or no water scarcity. Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.
2) Physical water scarcity (water resources development is approaching or has exceeded sustainable limits). More than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows). This definition – relating water availability to water demand – implies that dry areas are not necessarily water scarce.
3) Approaching physical water scarcity. More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future.
4) Economic water scarcity (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands). Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

Figure 9.6. *Global Physical and Economic Water Scarcity*
Source: *WWAP, 2016, p. 19.*

Current conditions of world in terms of physical and economic water scarcity can be seen in the Figure 9.6. Africa as a whole has considerably water scarcity problem. Significant part of Africa has the feature of economic water scarcity although water in nature is available locally to meet human demands. North Africa countries, some parts of China and Saudi Arabia have physical water scarcity problem which means that more than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes. According to the figure, Turkey is approaching physical water scarcity and its sustainable future is in danger.

Table 9.4. *Dried up and Endangered Wetland Areas in Turkey*

Area	Status	Reason
GavurLake	Dried up	Fight against Malaria and land reclamation
Ereğli Reeds	Largely dried up	Keeping influent resources in dams for irrigation
Eşmekaya Reeds	Dried up	Overuse of influent groundwater resources
Samsam Lake	Largely dried up	Land reclamation
Amik Lake	Dried up	Land reclamation
Burdur Lake	Under threat	27% decrease in reservoir volume
Tuz Lake	Under threat	Overuse of groundwater for agricultural irrigation
Akşehir Lake	Under threat	Overuse for agricultural irrigation
Eğirdir Lake	Under threat	Pollution caused from agriculture

Source: *Muluk et al., 2013, p. 33.*

Finally, when Table 9.4 is examined, the forthcoming danger for Turkey can be seen explicitly. The most important wetland areas in Turkey have been dried up or are under threat. Land reclamation purposes and overuse of these precious resources for agricultural irrigation are major causes for this condition. Unless government, nongovernmental organizations and individuals take action to minimize negative effects on water resources, there will be gloomy future for human beings.

10. CONCLUSION

Humankind has born witness to the age of technology in which many impossible things have been realized. However, producing water in any way could not be achieved yet. It means that water is highly exogenous factor. In this respect, the most significant problem is allocation of water across competing uses when the availability and distribution of water resources are taken into account. As the capitalist world system is founded on continuous and unconscious consumption need and people have to compete with others to exist in this system, this condition creates failures in optimal allocation of resources. The most supportive evidence is wasting food and water in the rest of the world while people in Africa and Middle East suffer from lack of food and water.

As it is emphasized throughout the study and can be especially seen from the graphs in the Section 9, sustainable future of water resources is in danger across the world. Meeting world hunger significantly creates burden on water resources and this devastating effect is exacerbated by climate change, ever-increasing population, pollution and urbanization. Because of these threats, water resources have become scarce in the face of unlimited demand, particularly in Africa and Middle East. As it is well known, economics is interested in optimal allocation of scarce resources against unlimited needs and desires. Hence, water resources need to be economically managed in an integrated way. The most useful measure for this purpose is economic value of water resources.

As water cannot be easily classified and it has multidimensional characteristic, attributing a simple value to water is not realistic. Water is fundamental of ecosystems (environmental good); it is basic need for human survival (social good); and water is a production input (economic good). It means that its value depends on several factors such as intended use, its quality and costs incurred to make water available for consumption. However, almost all forms of utilization of water resources recently satisfy both competition and scarcity conditions to be an economic good. Besides, according to internationally accepted principles (Dublin Principles), water has been recognized as an economic good and it has been generally managed in accordance with this criterion.

Accepting water as an economic good requires using its economic value or its value to users while evaluating this resource. This value generally is expressed by users' willingness to pay in monetary terms (its price) in which externalities and opportunity costs can be involved, even though economic value is a broader concept than price. For municipal and industrial usage, this measure gives the economic value closest to the real one. For agricultural use, economic value can be obtained by marginal value of crops. It means that economic value of water is different for different users or locations. Total economic value obtains all kinds of value which can arise from consumptive or non-consumptive purposes.

Most of the threats to water resources in terms of both availability and quality stems from intensive use for agriculture, industrial and electricity production and unplanned urbanization. As water shortage or scarcity occurs because of these threats, the poor will be rigorously affected. The problem cannot be solved by using only theoretical framework in economic terms. There must be strong institutional, legal and political practices. Economic principles should be integrated with social and environmental policies. In this process, governments have to take responsibility of control. Instead of generating macro level policies for local problems, they should show holistic approach by establishing dialogue with local bodies and riparians for effective coordination.

Instead of taking the easy way out by generating theories about economic value and management of water resources, theories have to be translated into practice. Economic tools such as water pricing and pollution charges help to achieve this purpose and send strong signals to users for effective usage. These are effective tools for polluter pays principle. Also, these tools are useful to assess the economic value and cost structure of water resources. It should be noted that effective economic instruments require full cost compensation, except for the poor. Failure in the application of this principle causes undervaluation and misallocations of water resources in the face of growing demand. Another point is that adequate and current data about water resources has key role for designing these tools.

For minimizing risks related to water resources, individuals and companies have to be conscious of impacts of their consumption patterns on water resources. They should avoid wastage and overuse of water resources. All of the actors in water management should work in partnership for the sustainability of water resources. Business world should support all kinds of activities and formation to increase environmental responsibilities. Also, by using water and energy saving methods with modern irrigation techniques in agriculture such as sprinkler and drip irrigation, more area can be irrigated with less amount of water. Water consumption can be also reduced by using collected rainwater in toilet flush and garden irrigation.

As there is no study on economic value of water in Turkish literature, this study theoretically addresses values and costs from uses of water to create a basis for the literature. Approaches related with evaluation of water resources in terms of value by means of valuation methods such as non-market valuations and empirical analyzes are beyond the scope of this study. Obtaining total economic value by using econometric analyzes along with Geographical Information System [GIS] which is another important component of IWRM and brings together data and information for decision makers in water planning and management judgements can give more meaningful results. Consequently, this study can be improved from these aspects.

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