

**REPUBLIC OF TURKEY
ANKARA UNIVERSITY
SOCIAL SCIENCES INSTITUTE
WATER POLICY AND SECURITY DEPARTMENT**

**TRANSBOUNDARY WATER ISSUES IN CENTRAL ASIA:
AN ANALYSIS OF BENEFIT SHARING APPROACH**

MASTERS THESIS

ŞEYMA KILINÇ

ANKARA, 2022

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Assoc. Prof. Dr. GÖKŞEN ÇAPAR

Assoc. Prof. Dr. VAKUR SÜMER

THESIS JURY MEMBERS

Name and Surname:

Signature

- 1. Prof. Dr. Mutlu YILMAZ**
- 2. Prof. Dr. Ali Merthan DÜNDAR**
- 3. Assoc. Prof. Dr. Gökşen ÇAPAR**
- 4. Assoc. Prof. Dr. Vakur SÜMER**
- 5. Asst. Prof. Dr. Sezin İBA GÜRSOY**

Thesis Defense Date

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TRANSBOUNDARY WATER ISSUES IN CENTRAL ASIA: AN ANALYSIS OF BENEFIT SHARING APPROACH

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DECLARATION

REPUBLIC OF TURKEY

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DIRECTORATE OF GRADUATE SCHOOL OF SOCIAL SCIENCES

With this document, I declare that I collected and presented all the information here within and in accordance with the academic rules and ethical behavior. This is in accordance with the rules and principles, and that all information not belonging to me, I acknowledge and declare the source of ideas and conclusions. (27/01/2022)

Thesis prepared by

Name and Surname

ŞEYMA KILINÇ

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ACRONYMS/ LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BVO	Basin Management Authorities
CAPCO	Central African Energy Company
ERI	Eurasian Research Institute
EurAsEC	Eurasian Economic Community
GDP	Gross Domestic Product
GWP	Global Water Partnership
ICG	International Crises Group
ICWC	Interstate Commission for Water Coordination
IFAD	International Fund for Agricultural Development
IFAS	International Fund for the Saving of the Aral Sea
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
LHWP	Lesotho Highlands Water Project
OMVS	Organization pour la mise en valeur du Fleuve Senegal
Sida	The Swedish International Development Agency
SPECA	The United Nations Special Program for Economies of Central Asia
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Program
UNECE	United Nations Economic Commission for Europe

UNESCAP United Nations Economic and Social Commission for Asia and Pacific
UNFCCC United Nations Framework Convention on Climate Change
USSR Union of Soviet Socialist Republics



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TRANSBOUNDARY WATER ISSUES IN CENTRAL ASIA:

AN ANALYSIS OF BENEFIT SHARING APPROACH

1. INTRODUCTION

1.1. Scope of Thesis and Argument

Central Asia is one of the regions, where water resources are scarce and dispersed, and they will be most affected by climate change. There is disagreement between downstream and upstream states, particularly over the use of water for hydroelectric power generation and irrigation. In previous studies on this subject, mostly the Soviet period and early independence periods were discussed (Becks, 2011; Hummel, 2014; Jalilov, 2010; Kasymov, 2010; Lange-Geise, 2005; McCreery, 1994; Pak, 2014; Radin, 2010; Waehler, 2012; Weinthal, 1998) and there are not many studies about the changing conditions the period after 2010. In this study, conditions that increase the pressure on the management of water resources in the region, such as global climate change, increasing population and urbanization, infrastructure problems and environmental disaster in the Aral Sea are examined. Thus, it is aimed to contribute gap in literature on two main issues related to the impact of climate change on water resources and the impact of urbanization on water resources in Central Asia.

There are two different arguments in literature that water problems are the cause of conflict or cooperation between countries. In this context, water problems in Central Asia were considered by some scholars as a reason for conflict (Becks, 2011; Heggenes, 2014; Kasymov, 2010; Lange-Geise, 2005; Samlı, 2017; Samlı, 2019; Scott, 2015; Waehler, 2012) and as a reason for cooperation by others (Jalilov, 2014; Ovezova, 2015; Radin, 2010; Weinthal, 1998). It is clear that the view that the problems experienced in the water issue will encourage conflict between countries does not contribute to the solution at all, and even causes the problem to grow more. Therefore, the main argument of this thesis is that the problems experienced in transboundary water should be solved with cooperation, and the potential cooperation to be established will encourage the establishment of different cooperation's in other fields. Benefit sharing approach also supports this view and guides the establishment of these collaborations. This study is important as it identifies potential opportunities for transboundary water resources in the Central Asia and encourage cooperation between countries within the framework of benefit sharing approach.

1.2. Literature Review and Theoretical Framework

There have been many studies in literature on water in Central Asia, which shows how important the water issue is for Central Asia. Studies on water in Central Asia are primarily concerned with whether water will lead to cooperation or conflict (Deng, Long, Wang, Li & Lei, 2012; Duarte, 2014; Hakim & Eshragh, 2018; Kasymov, 2010; Mosello, 2008; Ovezova, 2015; Pak, Wegerich & Kazbekov, 2014; Sojamo, 2008; Zhiltsov, Zonn,

Grishin, Egorov & Ruban, 2018) and even whether there will be a water war (Jenkins-Young, 2013). Studies have been carried out that draw attention to the environmental degradation in the Aral Sea and evaluate the situation as a crisis or disaster (Iyikan, 2013; Loodin, 2020).

Considering the studies in literature, it can be said that the issue of water is securitized in Central Asia and is included in the security discourse in various ways. These studies can be classified as studies that evaluate water, food and energy security in a holistic way (Jalilov, Amer & Ward, 2013; Stucki and Sojamo, 2012; Xenarios et al., 2018) and evaluate the water issue as a regional security issue (Janusz-Pawletta and Gubaidullina, 2015; Horsman, 2018; Stucki et al., 2016).

With the effect of increasing climate change worldwide, it is observed that studies in the field of climate change are gaining momentum in Central Asia as well. The impacts of climate change on water resources (Sorg et al., 2012 and 2014; White et al., 2014), whether climate change will increase the stress on water resources (Siegfried et al., 2012), the possibility of climate change to cause international water conflict in Central Asia (Bernauer and Siegfried, 2012) studies have been carried out. However, studies on the effect of urbanization on water resources in Central Asia are negligible, more studies are needed in this area.

For the solution of transboundary water problems in Central Asia, it is very important to make and implement integrated water resources management plans in a basin scale. It is observed that studies in this field have increased in recent years. The publications by Abdullaev and Rakhmatullaev in 2011, 2014 and 2016, by Dukhovny et al. in 2013, by Karthe et al. in 2013, 2015 and 2017 can be cited as examples of studies in this area. More work needs to be done on the implementation of integrated water management for each basin, for each country and regionally.

The theory of functionalism entered the international relations literature as an alternative method of integration in Europe after the first World War. Functionalism draws attention to the importance of international organizations, integration and cooperation in solving problems (Haas, 2008; Sağsen, 2012). Later, the theory evolved as neo-functionalism under the leadership of Ernst B. Haas. Neo-functionalism argues that focusing on functional areas rather than engaging in difficult political debates will contribute to international peace. It defines “functional diffusion” as the interconnection of various economic sectors or problem areas and the spread of integration in one policy area to others (Schmitter, 2005). The benefit sharing approach, which is used as an analysis method in this thesis, also takes its roots from this theory. The approach, which acts with the win-win principle, is based on the benefit of all its stakeholders (Arjoon, Tilmant, & Herrmann, 2016; Grossmann, 2012; IUCN, 2019; Sadoff and Grey, 2002 and 2005; Soliev, & Theesfeld, 2020).

The main argument of the "benefit sharing" approach in transboundary watersheds is based on the riparian countries that have problems with each other, starting cooperation on issues that will provide them with common benefits, and then developing their cooperation in different areas with the effect of spreading. This spreading understanding of cooperation can bring the parties closer together and lead them to produce common policies not only on water but also on other issues such as energy, agriculture, health, environment, water-based development sectors such as trade and transportation. The “benefit sharing” approach tries to both provide benefits to the cooperating parties and to help protect the natural balance by benefiting the water resources, which is the main subject of the cooperation (IUCN, 2019; Jagerskog, & Lundqvist, 2006; Sadoff and Grey, 2002, 2005; Soliev, Wegerich, Akramova, & Mukhamedova, 2018; Soliev, & Theesfeld, 2020).

The application of benefit sharing to transboundary water resources in Central Asia is a current issue and an increase has been observed in the studies conducted in this area in recent years. The following articles can be given as examples of studies in this field: “The costs of benefit sharing: Historical and institutional analysis of shared water development in the Ferghana Valley, the Syr Darya Basin (Soliev et al., 2015)”, “Balancing the discussion of benefit sharing in transboundary water governance: stressing the long- term costs in an empirical example from Central Asia (Soliev et al., 2018)”, “Benefit sharing for solving transboundary commons dilemma in Central Asia (Soliev and Theesfeld, 2020)”, “Calculating the benefits of transboundary river basin cooperation: Syr Darya Basin (Teasley and McKinney, 2011)”, “Competition and benefit sharing in the Ferghana Valley: Soviet negotiations on transboundary small reservoir construction (Pak and Wegerich, 2014)”. In addition, this thesis will provide a guide for the application of benefit sharing on transboundary water resources in Central Asia.

Consequently, the thesis has examined the leading primary and secondary sources in the literature with the qualitative analysis method. In the research, primary data were not collected, new inferences were made by examining the existing literature. Electronic and printed journals, articles, books, theses on the topic and personal interviews with scholars, internet sources in the field constitute the source of the documentary research data in the thesis. In addition, the thesis benefits from the relevant reports of institutions such as the United Nations and the World Bank, the agreements made by the Republics of Central Asia with each other, the internationally published statements and agreements, the reports published by the intergovernmental organizations, and the news reflected in the press on the subject. These resources help to showcase the water problems in the region and provide tools for solving these problems.

1.3. Chapter Outline

This thesis consists of five chapters in total, and it consists of two main parts to explain the conflicts and problems in the management of Central Asian water resources and to offer solutions to these problems within the framework of benefit sharing approach. Chapter 1 is the thesis introduction. Chapter 2 examines the water resources issues in Central Asia. Chapter 3 explains the benefit sharing approach used in this thesis and the concept of cooperation in transboundary water resources. Chapter 4 provides examples of how the benefit sharing approach has been applied to transboundary water resources around the world. It also makes an assessment of how and in which areas the benefit sharing approach can be applied in Central Asia. Chapter 5 provides the results of the study and provides recommendations for future work.

2. CENTRAL ASIA WATER RESOURCES

2.1. INTRODUCTION

This chapter is made up of six subsections. After the Introduction, in the second part, the current water situation, country profiles, historical water policies of the Central Asian states, upstream and downstream dilemma are investigated. In the country profiles section, the countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan were examined. Undoubtedly, the effects of China, Russia and Afghanistan on transboundary water resources in the region cannot be ignored. However, this study was geographically limited by examining the five Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) that have the most activity in the Aral Sea basin. In the historical analysis of Central Asian water management, the policies implemented in the Soviet period and post-independence period are mentioned. In this analysis, the Soviet period was briefly mentioned and focused more on the current water problems of the countries. The third part deals with integrated water management practices and its applications in Central Asia. In the fourth and fifth sections, the effects of climate change and urbanization on water resources and the management of these resources in Central Asia are specifically examined as two main issues. Because climate change and urbanization constitute the greatest pressure in the management of scarce water resources, and the extent and effects of these pressures are examined in detail in these parts. In the other part, the disaster experienced in the Aral Sea due to

mismanagement policies is examined. In the last part, the water policies implemented in the world and Central Asia are briefly mentioned and some policy recommendations for water management in the region are given.

2.2. WATER SITUATION

The hydrology of Central Asia consists of two large rivers which feed Aral Sea basin and provide almost all the water supply in the region (European Union, 2018; Horsman, 2001; Pohl et al., 2017). Two major rivers form the habitat of about 80% of the Central Asian population, feeding the Aral Sea and constituting 90% of all freshwater resources in Central Asia (European Union, 2018; Radin, 2010; Russell, 2018), are the Amu Darya River, whose starting point is Tajikistan (Fig. 1), and the Syr Darya River, which originates from Kyrgyzstan (Fig. 2).

The Amu Darya River originates in the Pamir Mountains at the confluence of Tajikistan, China and Afghanistan, forming an 1,800 kilometers border between Afghanistan and Tajikistan and a smaller border with Uzbekistan (Dadabaev, 2005; Kamil, 2021; Russell, 2018). Amu Darya, which travels 2,540 km to pour into the Aral Sea, collects water in an area of 309,000 km² (Kamil, 2021). Amu Darya comes through many channels and reservoirs along its flow from Tajikistan to Uzbekistan. This situation has made the hydraulic system and water distribution in Uzbekistan dependent on many external factors (Abdurasulov, 2008; Radin, 2010). The side rivers that originate from the Amu Darya and branch off are the Kafiernigann, Pamir, Kokacha, Wakhan, Kunduz, Shiwa, Vakhsh, Surkhandarya, and Sherabaddarya (Kamil, 2021). Built on the Vakhsh

River in Southern Tajikistan, the Rogun Dam is partially completed and is expected to be “the tallest and longest dam in the world” (Hambly et al., 2021; Rogun Dam, 2019).

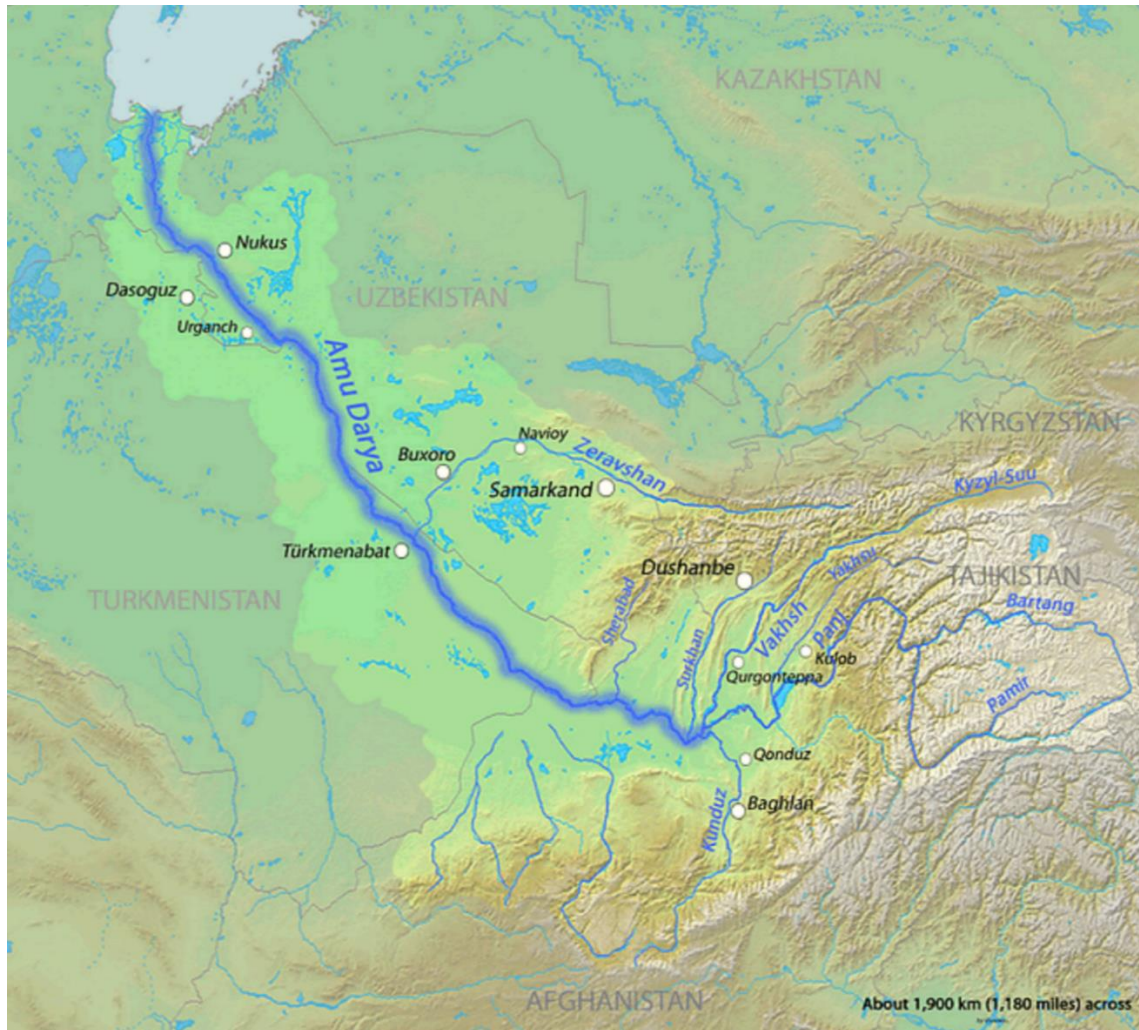


Figure 1 . Map of Amu Darya River Basin.

Source: (http://www.cawater-info.net/amudarya-knowledge-base/index_e.htm).

The Amu Darya, which previously had an annual discharge of about 75-78 cubic kilometers into the Aral Sea is currently unable to deliver any water to the Aral Sea, with all water diverted to meet needs of the cotton fields (Lipovsky, 1995; Radin, 2010). The total irrigated area of Amu Darya is said to be 6 million ha. Uzbekistan has the largest irrigated area in the Amu Darya basin with 2.3 million ha, followed by Turkmenistan,

which uses 1.7 million ha of land to irrigate. Upstream countries irrigate less area with the Amu Darya than downstream countries. Tajikistan uses the Amu Darya to irrigate about 0.5 million ha of land, while Kyrgyzstan uses Amu Darya to irrigate only approximately 0.1 million ha of land (Kamil, 2021).

Geographical profile of Syr Darya river is similar to that of the Amu Darya (Fig. 2). The river rises from Tian Shan Mountains of Kyrgyzstan and finally crosses into Kazakhstan with seven tributary rivers (Radin, 2010; Russell, 2018). Osh and Jalal-Abad in Kyrgyzstan; Namangan, Andijon, Fergana valleys in Uzbekistan are fertile agricultural areas that depend on the Syr Darya and its side rivers for agriculture (Radin, 2010). One of the most important tributary rivers in the Syr Darya, the Naryn River is controlled by many canals and dams in the Kyrgyzstan, the most important of which is undoubtedly the Toktogul reservoir (Radin, 2010; Sorg et al., 2014). The total volume of Toktogul, the largest reservoir of basin, is 19 billion cubic meters (Sorg et al., 2014).

Aral Sea has shrunk to 50% its original size between 1960 to 2021 due to both hydroelectric use of the upstream states and the heavy use of the downstream states for agricultural needs. And it went down in history as one of the biggest environmental disasters on a global scale (“Central Asia’s Water Worries in Spotlight,” 30 August 2003; Imshenetsky et al., 2021; Radin, 2010; Xenarios et al., 2018; World Bank Report, January 2004). One of the major reasons for the shrinkage in the Aral Sea is that the flow from the Syr Darya is no longer sufficient. The Syr Darya previously supplied the Aral Sea with around 34 cubic kilometers of water per year, but currently supplies less than 3 cubic kilometers of water (Radin, 2010).



Figure 2. Map of Syr Darya River Basin.

Source: (http://www.cawater-info.net/syrdarya-knowledge-base/index_e.htm).

Climate has serious effects on water resources. When the climate type of Central Asia is examined, it is seen that the region is characterized by a harsh continental climate. The high evaporation rate (up to 1,700 mm/y) and high summer temperatures (up to 49°C) are the most relevant indicators of this. High evaporation often leads to dry periods. When high evaporation comes together with high summer temperatures, the amount of usable fresh water in the region decreases in summer. Also, as a result of the continental climate type, winter precipitation and snow melt in spring cause the flow rates of water resources to increase in certain periods (Granit et al., 2012). In the Amu Darya and Syr Darya basins, Kyrgyzstan and Tajikistan receive the most precipitation in the region, and the places with the highest precipitation are mountainous areas (Russell, 2018). According to a study

in which the International Crisis Group examined the pressures on water resources in Central Asia; the rivers have made Central Asia's poorest republics, Kyrgyzstan and Tajikistan rated as possible world leaders in hydroelectric generation. However, contrary to expectations, Tajikistan has been incapable of providing electricity to most of its population for more than one hour a day in winter due to lack of energy (International Crisis Group, 2014). One of the reasons for these power cuts is that hydroelectric power generation from water resources in these countries is not yet sufficient. Therefore, these countries want to increase their hydroelectric energy production.

In addition, water pollution of both Amu Darya and Syr Darya Rivers (due to chemical fertilizers, excessive salinization, carcinogenic substances) adversely affects water users in the region (Lipovsky, 1995; Radin, 2010). Studies in this area are insufficient. Due to the contamination of water resources, the amount of usable fresh water will decrease in the region. This will lead to a deepening of the conflict between the countries in the region due to the sectoral use of water in the agriculture or hydroelectric energy.

The water of the Amu Darya and Syr Darya were mostly utilized in agriculture because of policy based mostly on cotton production inherited from the Soviet era (Linn, 2008). According to a report prepared by the United Nations, approximately 550,000 to 600,000 people were badly affected in Uzbekistan due to the water shortage experienced in 2001 and its effects on agricultural production (Linn, 2008; Radin, 2010). Considering that the population of Uzbekistan at that time was about 25 million (World Bank, 2021a), it is understandable how many people were affected by water shortages. Fergana Valley in Central Asia is one of the important areas for agriculture. The most fertile areas in the region are found in this valley. Even if only the Syr Darya basin is considered, it is determined that 45% of the irrigation area of basin takes place in the Fergana Valley

(Radin, 2010). It is claimed that this agricultural productivity makes the Fergana Valley the most densely populated region of Central Asia.

The population of the Fergana Valley consists mainly of Uzbeks, Kyrgyz and Tajiks. Each state in the Fergana Valley is home to minorities of at least two ethnic groups. For example, more than one million Uzbeks live as a minority in Tajikistan (Imshenetsky et al., 2021; Rekacewicz, 2006). Likewise, many Uzbeks who are engaged in trade and farming live in the Kyrgyz lands (Peña-Ramos, Bagus, & Fursova, 2021). The minority groups in the Central Asia countries causes conflicts over water in the Fergana valley from time to time (Peña-Ramos, Bagus, & Fursova, 2021; Rekacewicz, 2006). Minority groups claim that they are treated unfairly by saying that they are given less water or given a higher price. The discourses of minority groups can also affect the relations between countries and in some cases result in countries interfering in each other's internal affairs (Rekacewicz, 2006).

2.2.1. Country Profiles



Figure 3. Countries in the Aral Sea Basin

Source: (Aral Sea Basin, 2021).

Kazakhstan: Kazakhstan, officially Republic of Kazakhstan, has approximately 19 million population (Central Asia Population, 2020; ERI, 2021a).

Settlement: Russians constitute the largest minority in the country, about 20% of the population. The largest ethnic group in Kazakhstan is the Kazakhs with approximately 67%. Kazakhs make up about half of the population of Almaty, which was the capital of the country until 1997. Urbanization in Kazakhstan is increasing with external migration rather than the migration of Kazakhs from rural areas to cities. Foreigners coming to country mostly prefer to live in cities, causing more urbanization in the country (Smith et al., 2021). Currently, 59.1% of the population is urban (Water Yearbook, 2020).

Land: When the surface measurements of the countries are examined, it is observed that Kazakhstan has the most sovereignty area in the region. Country's surface area is 2,724,902 km² (World bank, 2021c) A third of Kazakhstan consists of plains, hilly plateaus and low mountain ranges occupy a large area. Due to the high evaporation rates in the plateaus, depressions filled with salt lakes have occurred. The highest point in Kazakhstan, Mount Han-Tengri, at 22,949 feet (6,995 meters), contrasts with other parts of Kazakhstan. The Great Barsuki and Aral Karakum, Muyunkum, Betpaqdala and Kyzylkum deserts are located in Kazakhstan. Most of these desert areas have light vegetation. This vegetation maintains its existence with groundwater (Smith et al., 2021).

Drainage: The east and southeast of Kazakhstan have extensive waterways: most of the rivers are part of inland drainage systems of the Caspian and Aral Seas, or the Tengiz and Balkhash Lakes. The Syr Darya, Ile, Chu, Irtysh, Ural, Tobol and Ishim rivers and Balkash, Balkhash, Zaysan, Alakol, Tengiz, and Seletitengiz lakes are important water bodies of the country (Water Yearbook, 2020). Kazakhstan has 1,450 miles of coastline to the Caspian Sea, which is described as the world's largest inland water body (Smith et al., 2021). The competent authority for water management in Kazakhstan is the Committee for Water Resources at the Ministry of Ecology, Geology and Natural Resources (MEGNR) (Water Yearbook, 2020).

Climate: Kazakhstan has a harsh continental climate. Temperatures fluctuate widely, with large variations between subregions. Basically, temperature differences are observed between the northern and southern regions of Kazakhstan. While the average winter temperature in the north varies between -19 and -16 °C, temperature between -5 and -1.4 °C is observed in the south. The situation is not different in summer temperatures, the average July temperature in the south is 9 °C higher than the north. The lowest winter

temperature recorded in the country is -45 °C, and the highest summer temperature is 45 °C, indicating extreme weather conditions (Smith et al., 2021).

Economy: The country with the highest Gross Domestic Product (GDP) among the Central Asian states is Kazakhstan with 182 billion. The GDP per capita is USD 9,812 (ERI, 2021b). Kazakhstan has rich natural resources, exploiting and trading them is one of its major economic activities. The fact that it is an energy exporting country has led it to have a greater say in the policies in the region. Kazakhstan is also an intensively cultivated country. Export of agricultural products is an important source of income in country. Kazakhstan mostly exports grain and flour products 71% in agricultural area (ERI, 2019b). One-fifth of the workforce earns their living by farming (Smith et al., 2021).

However, Kazakhstan suffers from reduced runoff and pollution (drugs, chemical fertilizers, salinization etc.). Unfortunately, 50-70% of Kazakhstan's surface water resources are described as "polluted" and "highly polluted" in terms of ecological status (Karatayev et al., 2017). In addition, it is claimed that the nuclear bomb tests carried out near Semey during the Soviet period polluted the surrounding lands (Duzbaban, 2021; Smith et al., 2021).

Kyrgyzstan: Officially Kyrgyz Republic, is a landlocked, mountainous, lower-middle income country in Central Asia located between Kazakhstan, Tajikistan, China and Uzbekistan (Allworth et al., 2021a; IFAD, 2021; McKinney, 2004). The capital city is Bishkek. The population of the country is approximately 6 million (Central Asia Population, 2020; ERI, 2021b).

Settlement: About two-thirds (62%) of the population live in rural areas, mostly in the valleys and foothills of the mountains. Its economy is heavily dependent on crop and

animal production (Allworth et al., 2021a; IFAD, 2021). The lowland areas of the country are home to most of its people, despite occupying only one-seventh of the total area (Allworth et al., 2021a).

Land and Drainage: The surface area of the country is 199,950 km² (World Bank, 2021c). Kyrgyzstan is an almost entirely mountainous country. The center of the Tien Shan Mountain system is located here. Floods, landslides, mudslides, drought and river erosion are the most common natural disasters in this area and becoming more frequent and intense (IFAD, 2021). According to the World Food Program (2021); *“two out of three food insecure people, live in remote valleys, where high altitudes, harsh winters and hot, dry summers limit livelihoods potential”*. Another problem in Kyrgyzstan is found extensively the radioactive wastes and wastes of mining industry in the land (ERI, 2021c).

The most important valleys in the country are Fergana Valley, Naukat Valley and Chu and Talas River valleys. The Naryn River, that is a side river of Syr Darya and flows into the Fergana Valley, and the Chu River, that forms part of its border in the north, are among the important water bodies of the country (Allworth et al., 2021a). The main water bodies in the Aral Sea Basin of Kyrgyzstan are the Kyzyl Suu River, Sokh, Karadarya, Chatkal, Naryn rivers (Burghart & Sabonis-Helf, 2004; McKinney, 2004). The Toktogul is the largest dam in the Syr Darya basin (Sorg et al., 2014). Ministry of Agriculture, Water Management and Regional Development is the country's authorized executive body on water. The authority to deal with drinking water supply and sanitation has been transferred to the Ministry of Transport, Architecture, Construction and Communications (Water Yearbook, 2020).

Climate: As the height of the western and north-facing slopes of the country increases, the amount of precipitation increases. Summers in the valleys are hot and dry, with an average of 28 °C in July. The average in January is -18 °C (Allworth et al., 2021a).

Economy: Kyrgyzstan has significant coal, oil and natural gas reserves. Hydroelectric energy ensures more than three-quarters of country's electrical power. The Kyrgyz have been dealing with animal husbandry and farming since ancient times. Livestock, cotton, fruit, vegetable, grain are the leading agricultural products (Allworth et al., 2021a). While Kyrgyzstan's agricultural exports consist of 33% vegetables, 21% fruits, 12% cotton, 11% prepared food, 9% dairy products and mostly prepared food is imported (ERI, 2019b). The GDP is 8 billion and GDP per capita is USD 1,309 (ERI, 2021b).

There are differences of opinion on whether or not agriculture is done adequately in Kyrgyzstan. About 39% of Kyrgyzstan's GDP comes from the agricultural sector, and about half of the population works in the agricultural sector (Burghart & Sabonis-Helf, 2004; McKinney, 2004). Allworth et al. (2021a) claim that industrialization has increased mechanization in agriculture and solved the agricultural production problem in Kyrgyzstan, which consists of mountainous lands. They also argued that cotton cultivation in the Fergana Valley has increased significantly, thanks to the fact that Kyrgyzstan does not experience water shortages compared to other Central Asian countries. On the other hand, it has been claimed that agriculture in Kyrgyzstan does not meet the needs and therefore it is argued that Kyrgyzstan is dependent on basic food imports, especially wheat. Inadequate agriculture has been attributed to factors such as small-scale ranches, limited access to finance and equipment, poor agricultural practices and inadequate postharvest protection (World Food Program, 2021). McKinney (2004), on the other hand, claims that the agricultural sector is unregulated and undercapitalized.

Tajikistan: Tajikistan, officially Republic of Tajikistan borders with Kyrgyzstan, China, Afghanistan and Uzbekistan (Asian Development Bank, 2013). Population of Tajikistan is approximately 9 million (Central Asia Population, 2020).

Settlement: Most of Tajikistan consists of areas normally unsuitable for human habitation (Xenarios, Laldjebaev, & Shenhav, 2021). However, desert and semi-desert lands with irrigated agriculture; cotton fields were tried to be transformed into thriving oases lined with gardens and vineyards. In the narrow valleys of the country; there are small villages (qishlaqs) surrounded by orchards and small cultivated fields. Most Tajiks continue to live in these qishlaqs, which consist of 200 to 700 detached houses built along an irrigation canal or riverbank, with less than one-third of the country's Tajiks living in urban areas. Contrary to the global trend, there is a general trend towards ruralisation in Tajikistan. Since 1970, the urban population has been decreasing in conjunction with fertility rates (Hambly et al., 2021; McKinney, 2004).

Land and Drainage: The surface area of the country is 141,380 km² (World Bank, 2021c). Most of Tajikistan's territory is mountainous; approximately 50% are at an altitude of 3,000 meters or more above sea level (Xenarios et al., 2021). The country's mountains are part of the Tien Shan and Pamir Mountain systems. Although the valleys cover less than a tenth of the country's area, they are important to Tajikistan's human geography. The western part of the Fergana Valley, Vakhsh, Gissar, Obikiik, Yavansu, Panj and Lower Kofarnihon valleys are among the largest valleys (ADB, 2013; Hambly et al., 2021).

The Panj river, which is tributary of Amu Darya River, is important in that it forms most of the country's southern border. Most rivers in Tajikistan flow from east to west and eventually complete their flow in the Aral Sea basin. The rivers reach their highest flow in summer and spring. While the rains falling in the spring and the melting of the

mountain snow are effective in increasing the flow of the rivers, the melting of the glaciers in the summer months is effective in this increase (ADB, 2013; Hambly et al., 2021).

One of the other important water bodies, lakes are found in Tajikistan mostly in the Pamir region. The major lake in the country is Karakul Lake, located at an altitude of approximately 13,000 feet. Most lakes in the country are of glacial origin. Iskenderkul lake in the Zeravshan Mountain Range is one of them. Sarez Lake, one of the lakes with different structures in the country, is a landslide set lake formed in the Murgab River due to the earthquake. When we look at the surface structure of Tajikistan, it is seen that it has a soil structure that is not suitable for agriculture but rich in minerals. It is known that two-thirds of the surface is covered with permanent snow and ice (Hambly et al., 2021). This situation can be shown as a natural reason why the country chose energy production and export instead of agriculture.

Climate: Like other Central Asian states, Tajikistan has a harsh continental climate and temperature and precipitation rates differ from region to region depending on the altitude differences. Therefore, there are local climatic differences between valleys and mountainous regions. While higher precipitation rates were recorded in the mountainous regions, the precipitation rates in the valleys remained between about 150 and 250 millimeters. With the melting of glaciers and snow, flow rates of rivers reach their highest amounts in spring (Hambly et al., 2021). Average temperature is about 16-17°C. In January, lowest temperatures were recorded -49°C. In July, absolute maximum temperature recorded 48°C (ADB, 2013).

Economy: The gross national income per capita is USD 807 (ERI, 2019a). Like other Central Asian countries, agriculture is an important economic sector in Tajikistan. However, compared to other Central Asian states, the mountainous land and infertile soil structure are not very suitable for agriculture. However, especially in the area where the

Rogun dam was built, agricultural activities gained momentum. More than two-fifths of the country's workforce is employed in agriculture. Although Tajikistan has rich mineral deposits (especially coal deposits), it has smaller natural gas and oil reserves compared to other Central Asian countries. This situation has led Tajikistan, which is among the countries with the highest hydroelectric potential in the world, to focus on hydroelectric production to meet its energy needs. The construction of the Rogun Dam¹ for hydroelectricity production, which was started during the Soviet period but stopped for various reasons, was restarted in 2016. In addition, hydroelectricity is produced at Kayrakhum Dam and Farkhad Dam built on Syr Darya, and at Nurek Dam, Golovnaya Dam, Baipaza Dam, Sangtuda 1 and 2 power plants built on Vakhsh River. Thanks to these hydroelectric power plants, the country is in a position to export the electricity produced in the summer months. However, since winter conditions are unfavorable for hydroelectric power generation, the country is dependent on coal energy and energy imports from other countries (Hambly et al., 2021).

Turkmenistan: It is bordered by Kazakhstan, Uzbekistan, Afghanistan, Iran and the Caspian Sea. The capital city is Ashgabat (Ashkhabad) (Allworth et al., 2021b). The population of the country is approximately 6 million (Central Asia Population, 2020; ERI, 2021a).

Settlement: It was previously said that Kazakhstan is the country with the least population density in Central Asia. The situation of Turkmenistan is not much different

¹ Rogun dam has an installed power equivalent to the installed power of three nuclear power plants.

from Kazakhstan, and it is the second least populated country among the countries in the region. The population, which is already low in the country, is unevenly distributed. This situation is the biggest obstacle to urbanization and fair distribution of infrastructure opportunities. While there is less population in the Karakum Desert and mountainous areas, it can be seen that large numbers of people live in the oases. The ratio of rural and urban population in Turkmenistan is similar to other Central Asian states. Considering the rate of population living in urban and rural areas, it is observed that the situation in Turkmenistan (about 50% of the population in rural areas, others in urban areas) is almost the same as in Uzbekistan (Allworth et al., 2021b).

Land and Drainage: Although Turkmenistan's area is second in Central Asia, the land in the country is mostly unsuitable for plant and animal life. The surface area of the country is 488,100 km² (World Bank, 2021c). Turkmenistan, which uses 1.7 million ha of land to irrigate (Kamil, 2021). Throughout Turkmenistan it seems to be divided into two parts of oases and deserts: an oasis region consisting of Kopet-Dag and other oases - determined by sufficient water supply, planted land and advanced industry; and a desert region divided into western Turkmenistan and Karakum, occupying nine-tenths of the territory of Turkmenistan. There are narrow strips of oases at the foot of Kopet-Dag Mountain Range and along the Amu Darya, Morghāb, and Tejen rivers. These; The Kopet-Dag oasis is the Morghāb oasis, the Tejen Oasis, the central and the lower Amu Darya oases. The Central Amu Darya oasis differs from other oases in that it stretches almost uninterruptedly for hundreds of kilometers and is almost completely planted. The Karakum desert which one of the leading sand deserts in the world in terms of width, is located in the middle of Turkmenistan and covers a very large area in this country (Allworth et al., 2021b; McKinney, 2004). Karakum Canal located in this area, is the world's largest irrigation canal (Granit et al., 2012).

Climate: Like other Central Asian countries, Turkmenistan has a strong continental climate with large fluctuations in temperature throughout the day and year. The average annual temperature is 14-16°C. During summer days the temperature rarely drops below 35°C, and in southeast Karakum the maximum high temperature reaches 50 °C in the shade (Allworth et al., 2021b; Jelen et al., 2020).

Economy: Turkmenistan is very glorious in terms of natural resources, and natural gas and oil are among the most revenue-generating resources (Radin, 2010). In agriculture, it is mostly specialized in cotton cultivation. GDP is 45 billion (ERI, 2021a). The GDP per capita is USD 7,411 (ERI, 2019a). About 25% of Turkmenistan's GDP comes from agriculture and about 44% of the population works in this sector (Burghart & Sabonis-Helf, 2004; McKinney, 2004). In the livestock sector, Turkmenistan is famous for its Karakul sheep, horse and camel breeding. Turkmenistan is leading in Central Asia by producing silkworm cocoons in many places, especially in the Amu Darya oasis. However, it has become very difficult to continue agriculture, animal husbandry and silkworm cocoon breeding in Turkmenistan due to the decrease in the flow of the Amu Darya, the drying up of the Aral Sea and the increase in pollution in water resources (Allworth et al., 2021b).

Uzbekistan: Uzbekistan, officially Republic of Uzbekistan borders with Kazakhstan, Kyrgyzstan, Tajikistan, Afghanistan and Turkmenistan. Karakalpakstan is an autonomous republic in the western part of the country. The capital is Tashkent. (Allworth et al., 2021c). The population of the country is approximately 34 million, making it the most populated country in Central Asia (ERI, 2021a).

Settlement: The population of Uzbekistan is almost equally divided in urban and rural areas. More people live in the eastern part of the country than in other regions. Densely

populated sloping basins and oases attract attention by being covered with a wide channel network. The Fergana Valley supports all types of settlements (old and new cities, towns, traditional villages, etc.). However, Karakalpakstan region (autonomous republic), is in danger of population decline due to environmental contamination of the Aral Sea region (Allworth et al., 2021c).

Land and Drainage: The surface area of the country is 448,924 km² (World Bank, 2021c). Uzbekistan has the largest irrigated area in the Amu Darya basin with 2.3 million ha (Kamil, 2021). About four-fifths of Uzbekistan's lands appear as barren land. It unites with Turan Plain in the northwest and Kızilkum in the south. The Ustyurt Highland is a region consisting of desert and salty lands, holes and grottos between Caspian and Aral Seas. Located in western Tien Shan Mountain system, the country's highest point is Beshtor Peak at 4,299 meters. In the southwest of Tashkent is the Mirzachol desert. Zeravshan valley is located in south-central Uzbekistan (Allworth et al., 2021c).

The Aral Sea basin has been severely damaged as a result of the diversion of the Syr Darya and Amu Darya rivers for various reasons. Countries in the basin have been dramatically affected by this situation. Undoubtedly, one of these countries is Uzbekistan, and the country's drainage system has become almost inoperable. The Aral Sea is extremely saline due to the decrease in the amount of water and has been polluted with pesticides and chemical fertilizers due to intensive agricultural activities in the region. This pollution and drop in water levels has damaged the once thriving fisheries and stranded many ships that formerly operated on the Aral coast. Contaminated dust remaining in the basin continues to most detrimentally affect the livelihoods and health of the human population on the lake shore, poisoning agricultural products and drinking water (Allworth et al., 2021c).

Uzbekistan needed more water resources for intense cotton production. In the early 1980s, it was desired to divert a significant amount of water from the Irtysh River to a pump system that would help irrigate parts of Kazakhstan, Uzbekistan and Russia. However, the project could not be realized (Allworth et al., 2021c).

Climate: Severe drought and annual average precipitation of 200 mm are seen in the Uzbekistan. It receives the most precipitation in spring and summer. While the country's average summer temperature is 32°C, in some cities such as Tashkent and in deserts, the daytime temperatures are more than 40°C. Although there are about 600 rivers in Uzbekistan, the drainage system is badly affected by the climate. Serious water losses are experienced due to evaporation and filtration (Allworth et al., 2021c).

Economy: GDP (USD) is 58 billion (ERI, 2021a). The GDP per capita is USD 1,750 (World Bank, 2021b). About 25% of the Uzbekistan's GDP comes from agriculture, and the number of people working in this sector corresponds to about 44% of the population (Burghart & Sabonis-Helf, 2004; McKinney, 2004). Uzbekistan is one of the names in this sector in the world, so the cotton sector (56% of its agricultural exports) is an important part of the economy of Uzbekistan (ERI, 2019b). Uzbekistan, which has significant mineral, oil and gas reserves, produces and exports large amounts of natural gas. Although Uzbekistan's nuclear, coal and oil resources are sufficient for electricity generation, hydroelectric production on the Syr Darya, Chirchik and Naryn rivers can facilitate increase electricity generation (Allworth et al., 2021c).

2.2.2. Central Asian Water History (The Soviet Era and Current Dynamics)

Examining the water issue in Central Asia with all its dimensions depends on considering the effects of the Soviet period water policies on the current water policies. After the collapse of the USSR in 1991 (Ergashev et al., 2013), the Central Asian countries became independent, but due to the unforgettable legacy left by the Soviet Union to the Central Asian Countries, these countries were almost unable to act on their own, especially with regard to water issues among them. In the Soviet Union, water and energy systems were centrally planned, countries upstream of water resources were rich in water resources, on the contrary, countries downstream of water resources were rich in fossil resources and poor in water resources. Therefore, in the central government system of the Soviet Union, water versus energy exchange was possible. This situation can be considered as the first version of the benefit sharing approach, which is being adopted today.

During the USSR government period, huge dams were built (such as Toktogul, Nurek, Tutamyun and Farkhad Dams). Dams such as Rogun and Kambarata-1, which were left unfinished after the dissolution of the USSR, caused problems between countries. Although the construction of dams only in some places during the energy-water exchange period was not considered a problem, this situation changed after the independence of the Central Asian countries. Today, the increase in pressure on water resources because of reasons such as increase in energy prices, population growth and climate change, intensive use of water in the field of hydroelectricity and agriculture prevents water-energy sharing practices as it was in the Soviet period. Water-rich countries (Kyrgyzstan and Tajikistan) started to empty the dams in order to increase their hydroelectric energy production during the winter months, which caused adverse effects

such as flooding in Uzbekistan, turning some parts of the country into swamps (Iyikan, 2013). As a result of Uzbekistan's stopping gas supply to these countries and reducing the amount of energy, most people in Kyrgyzstan and Tajikistan could not find electricity for weeks and faced heating problems (ICG, 2014; Iyikan, 2013).

Another problem that has survived from the Soviet period is that some water resources have come to the point of extinction as a result of widespread cotton production. As it is known, a large amount of water is used in cotton production (Iyikan, 2013; Linn, 2008; Radin, 2010; Varis, 2014). This production habit still continues and threatens the water resources in the Central Asia. As a result of the use of water resources in cotton farming during the USSR government period, the Aral Sea, which is the largest lakes in the world, shrank to a large extent, leaving behind a great environmental disaster that Central Asian countries had to solve together.

Each of the states that wanted to continue the Soviet-era water management understanding after their independence ratified the Almaty Agreement in 1992, which upholds and ratifies Soviet-era principles of water allocation, advising states “*Use your rights without harming others.*” and openly calls on them to exchange information (O’Hara, December 1998; Sojamo, 2008). Central Asian states have signed more than 300 agreements on basin management and are involved in many corporate bodies, such as the Interstate Coordinating Water Commission, abbreviated as ICWC and its Syr Darya and Amu Darya Basin Management Authorities, abbreviated as BVOs. (Horsman, 2001; Radin, 2010; Sojamo, 2008). The ICWC imposes quotas on the amount of water use, and the Amu Darya BVO and Syr Darya BVO monitor implementation of these quotas. Although the quotas set by the agreement retained Soviet-era levels, BVOs were empowered to change quotas up or down by 15% (ICG, 2014). It is argued that one of the problems with these organizations is that they do not have a significant influence on the

water policies of each state. Accordingly, in these organizations, each state openly expresses its complaints, but the agreements made due to these complaints are not implemented due to the short-term interests of the states (Axelrod, 1984; Radin, 2010). However, in order for countries to gain more benefits in the long run and to maintain cooperation between countries, they should put aside their short-term interests and focus on solving common problems.

In 1991, the Central Asian Republics gained their independence and started to abandon the centrally planned water-energy management systems from the USSR era. Now, market-oriented downstream states have started to put an end to the sharing in the context of water-energy from the Soviet era, using the increase in energy prices as an excuse. The states in the upstream wanted to use their water resources in hydroelectric production instead of directing them to the downstream states (Nazarbayev University; 2020; Xenarios et al., 2018). According to Johannes F. Linn (2008), the upstream countries consider water a commodity after gaining their independence and argue that it should be paid for by downstream countries precisely for this reason. On the other hand, downstream countries have adopted the view that water in a transboundary river basin is common good that must be shared by all basin countries (Granit et al., 2012). It has been claimed that in the post-independence period, water problems began to be examined from a socio-political perspective rather than a techno-economic perspective. This transformation could be seen with the establishment of many institutional mechanism including the ICWC, the International Fund to Save Aral Sea (IFAS), the Interstate Council for Aral Sea Basin (ICA) (Nazarbayev University; 2020; Xenarios et al., 2018).

Securitization theory is also important in understanding the current dynamics of water in Central Asia (Varis, 2014). In literature, it is simply defined as the cessation of examining an issue as a daily political or technical issue, and as a national or international

issue (Wæver, 1993). It is clear that countries in Central Asia often see the water issue as a national security issue. Therefore, many studies have been published discussing the dimensions of water security. According to a study by Stucki and Sojamo (2012), there are a range of definitions of water security, ranging from narrow definitions and completely political-military security to broad definitions in a broader political economy and environment context covering topics such as climate change, water scarcity, water supply and sanitation, and food security.

If we examine these broad and narrow patterns, seeing water issue as a political or military problem in a narrow sense (there are examples showing that Central Asian states have seen the issue in this way for years) will make it difficult to solve the problem with the rational and benefit sharing principle. In this respect, the water issue should be politically and militarily insecure. But if you look at the broad definition; addressing the issue on the axis of water, energy and food, evaluating water use with regard to environmental and sustainability, considering climate change's effects will allow subject to be examined in all dimensions (Leal Filho, 2015). This will undoubtedly help solve the water issue to the maximum benefit for all stakeholders. The definition of water security developed by the UN also tries to cover all dimensions of water. Water security has been defined as ensuring people's access to adequate amounts of water of acceptable quality, while maintaining their well-being and maintaining their socio-economic development. The limits of the definition were not left to this extent, but at the same time, ensuring water security was considered together with the achievement of sustainable development

goals² (UN-Water, 2013). We can observe that the subject has begun to be examined in this way in Central Asia, when we look at the studies in the literature and when we examine the news reflected in the press.

Another concept as important as water security in Central Asia is undoubtedly energy security. Since the USSR period, water and energy have been used together in Central Asia. Therefore, solving the water problems in Central Asia depends on ensuring the energy security of the regional states (Leal Filho, 2015). Energy security can be defined in many ways, such as water security. Over time, energy security has been removed from its traditional definition of threats such as natural disasters and terrorism on fossil fuels. Today, when it comes to energy security, it mostly refers to a security of supply in a broader political and military context. Basic components of energy security are redundancy, resilience, sensitivity of institutions, environment, supply sources, supply diversity, external supply dependency, global interdependence and exports to foreign countries (Stucki and Sojama, 2012). Countries can increase their resilience by diversifying their energy resources. Hydroelectric production is also important in terms of diversification of energy resources. Especially in countries with poor energy resources (Tajikistan and Kyrgyzstan), hydropower generation is critical in terms of energy supply.

² The United Nations has announced 17 Sustainable Development Goals (SDGs) that it thinks should be achieved worldwide by 2030. These are: 1. No poverty, 2. Zero hunger, 3. Good health and well-being, 4. Quality education, 5. Gender equality, 6. **Clean water and sanitation**, 7. Affordable and clean energy, 8. Decent work and economic growth, 9. Industry, innovation, and infrastructure, 10. Reduced inequality, 11. Sustainable cities and communities, 12. Responsible consumption and production, 13. Climate action, 14. Life below water, 15. Life on land, 16. Peace, justice, and strong institutions, 17. Partnerships for the goals (UN, 2020).

2.2.3. The Upstream and Downstream Dilemma and Political Dynamics

Partners in common water resources management in the whole world may be experiencing conflict between the up and downstream riparian states (Jalilov, 2010; Radin, 2010; Waehler, 2012). This situation is not different for the Central Asian states. When the region is examined, Tajikistan and Kyrgyzstan, which are the upstream states, want to use their water resources primarily in hydroelectric energy production (ICG, 2014; Iyikan, 2013; Radin, 2010, Russell, 2018; Pohl et al., 2017; Waśkiel, 2018), while water use in agriculture is defined as secondary needs. On the other hand, Uzbekistan, Kazakhstan, and Turkmenistan, which are among downstream states, tend to use their water resources intensively for irrigation needs (ICG, 2014; Iyikan, 2013; Radin, 2010, Russell, 2018; Pohl et al., 2017; Waśkiel, 2018) and to avoid uncontrolled winter flooding (Pohl et al., 2017). The truth is that Tajikistan and Kyrgyzstan (upper riparian states) are poor in terms of energy resources such as crude oil and natural gas have triggered their orientation towards hydroelectric energy production. However, paradoxically, this situation has also caused downstream states rich in energy resources to cease energy supply to Kyrgyzstan and Tajikistan by claiming the decreasing amount of water flow. The fact that the downstream riparian states, which are relatively better economically and politically unlike the examples in the world, are powerful decision makers in the management of transboundary water resources, has made the situation a difficult dilemma for many years. However, as in all dilemmas, the chance to turn the crisis into an opportunity can be obtained by changing the perspective. With the application of the benefit sharing approach to transboundary water resources in Central Asia, it exactly is aimed to turn the crisis into an opportunity.

The situation outlined above can be detailed and clarified as follows. According to the USSR water management system, While the Soviet Socialist Republics of Kyrgyzstan and Tajikistan met their oil, coal, gas and electricity needs from Turkmenistan, Kazakhstan and Uzbekistan Soviet Socialist Republics during the winter months, they supplied water to the Turkmenistan, Kazakhstan and Uzbek Soviet Socialist Republics³ to be used in agriculture in the spring and summer months (ICG, 2014; Iyikan, 2013; Radin, 2010, Russell, 2018; Pohl et al., 2017; Waśkiel, 2018). Kazakhs, Turkmen and Uzbeks had to supply water from Kyrgyzstan and Tajikistan, because the Soviet government constructed major dams in the region where Kyrgyz and Tajiks lived (Hogan, 2000; Pohl et al., 2017; Radin, 2010). Downstream states also had an obligation to provide energy. This is explained by Bajpae as follows: *“Power grids in the region were integrated under a single network so that upstream states could export electrical power to downstream states during the winter and import from them during the summer when water was drawn for cotton production (Bajpae, 2006).”*

At that time, since energy was cheap, hydroelectric power generation was not required and water resources could be used to irrigate agricultural lands comfortably. The upper riparian states' energy barter for water was made with the center planning of Soviets (Pohl et al., 2017). For this order to last, barrages in Tajikistan and Kyrgyzstan for many years stored water during the winter and autumn and released to develop downstream agriculture in the summer and spring (ICG, 2014; Iyikan, 2013).

³ Uzbekistan uses 90% of the water released from Kyrgyzstan and Tajikistan in cotton farming (ICG, 2014; Shirokova & Morozov, 2008).

As mentioned earlier, in the mid-1990s, some countries such as Uzbekistan and Kazakhstan had begun to demand market-oriented prices for energy and hydrocarbon exports. Kyrgyzstan and Tajikistan, which do not have the economic power to obtain gasoline to run their heating facilities, started to generate hydroelectric energy by using water to heat their own houses and factories in winter. Thus, the Soviet water policy, which prioritized agriculture in the downstream states, was abandoned and left an area of conflict in its place (ICG, 2014; Iyikan, 2013).

As a result, the system collapsed in the late 1990s mostly for economic reasons, and numerous bilateral and regional agreements so far have not been able to address this devastation (ICG, 2014). The uneven distribution of water resources in Central Asia resulted in an interdependence of the upstream and downstream countries. There have been diplomatic tensions between Central Asian countries on water from time to time, and disagreements have arisen among water users at the local level. In fact, this situation has been interpreted by the media as the future of war between states due to water resources (Waskiel, 2018). Climate change, increasing population and urbanization, poor water management, especially excessive use of water in agriculture, increase pressures on water resources. Central Asian countries must allocate limited resources equitably and sustainably, while trying to meet their upstream hydroelectric generation and downstream agricultural needs. For this reason, many scholars argue that cooperation in the region is vital (Russell, 2018).

The economic situations of the countries in Central Asia are different from each, Kazakhstan had the strongest economy and a GDP per capita in 2019 of USD 9,997, followed by Turkmenistan with USD 7,411, Uzbekistan USD 1,326, Kyrgyzstan USD 1,254, Tajikistan USD 807 (ERI, 2019a). The fact that the downstream countries are economically and politically strong and the upstream countries are weak has affected the

transboundary water policies in Central Asia (Hogan, 2000). The downstream areas, where agriculture is intensively made, have become completely dependent on water from above after the environmental degradation in the Aral Sea. But for years, this dependency has not been a problem, because the downstream countries have guided the water policies in the region with their political and economic power.

The claim that competition in the water field is a frequent source of conflict, especially between Uzbekistan and its neighbors, constitutes the building block of the up-down riparian dilemma in Central Asia (Russell, 2018). Kyrgyzstan operated the Naryn in hydroelectric mode for a longer time in winter to maintain energy levels and compensate for shortage in downstream energy imports. This caused to lowering of water levels in the summer months and shortages for downstream agricultural usage (Radin, 2010; World Bank Report, January 2004). Turkmenistan meets its water usage needs in the Amu Darya, which takes its source from Tajikistan and pours into Uzbekistan. According to the agreements, the same amount of water (22 cubic kilometers) was allocated to Uzbekistan and Tajikistan (Dadabaev, 2005; Radin, 2010; Varis, 2014). It is clear that this allocation is not fair, as Uzbekistan is larger with regard to population and territorial land (ERI, 2021a; World Bank, 2021c). Also, Turkmenistan has been completed Golden Age Lake in Karakum Desert since 2000, claiming it will increase agricultural production and as former president Saparmurat Niyazov put it, “symbol of revival of the Turkmen land” (Stone, 2008; Varis, 2014). Turkmenistan withdraws of 30 cubic kilometers of water per year because of inadequacies in its water infrastructure and continues the 3200 km Karakum Canal construction (Twice the water allocated from this channel will be drawn.) are damaging its relations with Uzbekistan (Dadabaev, 2005; Radin, 2010; Varis, 2014).

It has been accepted by many scholars that the pressure and stress on water resources in Central Asia is increasing day by day due to various factors (Berdimbetov, Ma, Liang & Ilyas, 2020; Bernauer & Siegfried, 2012; Ergashev et al., 2013; Siegfried et al., 2012; Pohl et al., 2017; Xenarios et al., 2020). In this study, the factors that put the most pressure on the water resources in Central Asia were determined as follows: the lack of integrated management of water resources on the basin basis, the negative impacts of climate change and increasing urbanization on water resources, the negative impacts of the Aral Sea environmental disaster on water resources and a fully established lack of cooperation mechanism. Defining what these factors are will shed light on the solution of the problem. It can be said that one of the pressures on water resources is population growth. The world population is currently 7.9 billion people, and a population of over 80 million is added to this figure annually. According to the UN future population growth projections, world population will reach approximately 9.7 billion in 2050 and 10.9 billion in 2100 (Population: The Numbers, September 2021; Varis, 2014). The current population of Central Asia is about 75 million (Central Asia Population, September 2021). Between 1990 and 2019, the total population of Central Asia increased by 46.1% from 50.1 million to 73.2 million. By 2050, Central Asia's population is expected to grow by 36.9%, well above the world average of 26.2% (UN Population Prospects: Case of Central Asia, September 2021). It is inevitable that the demand for water resources will increase in this new picture created because of population growth in the world and Central Asia. If water resources aren't managed more effectively and sustainably, there may be problems in meeting this demand.

2.2.4. Potential for Successful Cooperation

In the post-independence period, the Central Asian states avoided solving the disputes about water resources through direct violent conflict. However, the problems were not completely resolved in a constructive way, instead, short-term solutions based on bilateral agreements were produced.

There are many views as to whether scarcity of resources encourages conflict or cooperation among actors. While voicing the view of many scholars that scarce resources lead to conflict, Le Billon argues that many poor states remain relatively peaceful and that famine not only needs to cause conflict, but can also foster innovation and economic diversity. Le Billon explains it as follows; localized scarcity can be offset by international trade if the right policies are followed, and resource-poor states may be less prone to conflict because they depend on some economic input (Le Billon, 2001 and 2013; Heggenes, 2014).

The idea that water scarcity can be solved by international trade was supported by Antony Allan's virtual water trade in the 1990s (Bhaduri, Bogardi, Leentvaar, & Marx, 2014) and Arjen Hoekstra's development of water footprint concepts in 2002 (Hoekstra, 2003). The concept of virtual water refers to the water used in the production process of a good. Virtual water trade, on the other hand, refers to the situation where virtual water crosses international borders as a result of the trade of water-intensive goods (Bhaduri et al., 2014; Hoekstra, 2003). The water footprint, a method that reveals the extent of the virtual water trade, measures the amount of water consumed and polluted to produce goods and services throughout the entire supply chain (Hoekstra, 2003). These concepts were developed with an economic perspective and basically reflected the philosophy that we cannot account for something we cannot measure. If it can be determined how much

water is secretly exported, products that use less water can be preferred, the export of some products can be stopped or a virtual water balance can be achieved by importing some products. Although it is debatable how much this can be applied, it is aimed to ensure the fair, equitable and sustainable use of water resources globally by providing water saving and water efficiency. When the virtual water trade in Central Asia is examined, it is clear that the sustainability of the water resources of the region is in danger due to intensive agriculture and livestock activities, especially the intensive cultivation of cotton products (especially in Tajikistan and Uzbekistan) (ERI, 2019b). The abundance of agricultural lands in places where water resources are scarce such as Kazakhstan and Uzbekistan, and the scarcity of agricultural lands in places with abundant water resources such as Tajikistan and Kyrgyzstan make it difficult to maintain the virtual water balance. If water savings and water efficiency are to be achieved with water footprint, more research is needed in the region. But the Aral Sea environmental disaster proved that cotton farming threatens the sustainability of water resources, so intensive production and export of this product should be avoided.

In this context, although water resources are scarce in Central Asia, there has not been a major water-based conflict between countries and countries have tended to solve problems on a peaceful basis. While Kyrgyzstan and Tajikistan in Central Asia are in relatively good condition in terms of water resources, it is known that Kazakhstan, Uzbekistan and Turkmenistan experience difficulties due to insufficient water resources,

insufficient water use and dependence on upstream countries in terms of resources.⁴ Considering the way Le Billon advocates, we can say that these countries can balance the problems they experience in terms of water resources with international trade. Since water resources are insufficient, they need to be managed correctly, which makes it necessary for countries to stay in dialogue with each other and to use water resources efficiently with technological innovations. As a result, scarce resources will contribute to the creation of economic, political and technological cooperation areas.

⁴ 1. The total amount of water in Kazakhstan's rivers is 101 km³, of which 44 km³ comes from neighboring countries (Water Yearbook, 2020). The current water supply in Kazakhstan is 37,000 m³/km² and 3,650 m³ per capita e year (Karatayev et al., 2017; Water Yearbook, 2020). Total per capita water use of Kazakhstan is 1,319 m³/year (Russell, 2018).

2. There are no outside water in Kyrgyzstan, amount of water flowing outside Kyrgyzstan is 31,34 km³ per year. Water consumption limit for Kyrgyz Republic is 11,9 km³, Kyrgyz Republic used 24,7% of water formed within its territory (Djailoobayev, 2002). The total amount of water consumed in the republic is estimated at 10-12 billion m³ per year. Total per capita water use of Kyrgyzstan is 1,575 m³/year (Russell, 2018).

3. The average surface water flow of the Republic of Tajikistan is estimated at about 64 km³, Tajikistan uses about 18% of the flow formed in its territory (ADB, 2013). Total per capita water use of Tajikistan is 1,762 m³/year (Russell, 2018).

4. All major rivers of Turkmenistan are known to be transboundary, so 95% of the country's surface water occurs abroad (Water Yearbook, 2020). Total per capita water use of Turkmenistan is 5,952 m³/year (Russell, 2018).

5. Uzbekistan's average water use is 51-53 billion m³, of which 80% (approx. 41 km³/year) is provided through transboundary river water (Water Yearbook, 2020). The current water supply in Uzbekistan is 546 m³. Total per capita water use of Uzbekistan is 2,158 m³/year (Russell, 2018).

2.3. INTEGRATED WATER RESOURCES MANAGEMENT IN THE CENTRAL ASIA

2.3.1. Integrated Water Resources Management

Integrated water resources management approach (IWRM), which started to develop after the 1992 Dublin Conference on Water and Sustainable Development (Ako et al., 2010), basically aims to take measures for a sustainable life in the face of decreasing amount of usable water resources per capita and decreasing water quality. Dukhovny et al., (2008) say that “*Water resources management is an art to supply the required water volume with acceptable quality at the proper place in the proper time*”. The United Nations also stated that IWRM is not only an approach that tries to meet the demand in water resources, but also aims to manage water resources in an environmentally friendly and sustainable manner (Shaw, 2007).

Efforts such as the International Conference on Water and Environment (1992), Second World Water Forum (2000), International Conference on Freshwater (2001), World Summit on Sustainable Development (2002) and Third World Water Forum (2003) collectively led to breakthroughs of IWRM onto the political agenda (Rahaman & Varis, 2005). At the 1992 Dublin Water and Sustainable Development conference, four fundamental principles influencing international water policies were. These are adopted (Ako et al., 2010; Rahaman and Varis, 2005):

1. Fresh water is a scarce and fragile resource required for development, sustain life and the environment.

2. Water management and development should be participatory that includes planners, users and policy makers at all levels.
3. Women play a core role in the management, provision and protection of water.
4. Water has an economic value in all competing uses and should be considered an economic good.

Al Radif (1999) argues that the general purpose of water management, which adopts integrated approaches, is to meet the fresh water needs of countries for their sustainable development and attributes the success of sustainable integrated water resources management to a few factors. First, the integration approach should develop national water policies based on the allocation and equitable-efficient use of water resources. Then, awareness and knowledge should be provided by educating water users and water managers. Environmental and development issues should be considered together, and water plans should be included in development plans. While doing all this, it is extremely important to use financial and scientific tools.

Integrated water resources management creates a roadmap for how we can apply the benefit sharing approach. Because one of the key issues of water management is to try to reconcile its many uses across sectors and borders in a way that enhances sustainability and increases the benefits of water equitably for all stakeholders (Pohl et al., 2017). The main components of integrated water resources management are assessment, water resources strategy for protection and development of available water resources, action of implementation and monitoring and evaluation progress (UNDESA, 2014)

Monitoring: The first step in integrated water resources management should be to collect extensive data about basin (socioeconomic and physical) and to develop models of physical systems (hydrogeology, hydraulics and hydrology) (Ako et al., 2010). Existing

management should be analyzed, then possible good management practices should be determined.

Monitoring water resources is critical in Central Asian countries. Central Asian states, which share water resources among themselves in terms of quantity, often made biased accusations against each other without observing the changing conditions, and therefore conflicts have occurred in terms of water resources many times in history. If the benefits from water resources are to be distributed fairly, work should be started first by expanding monitoring activities. Thus, the effects of the Aral Sea environmental disaster, the pressure created by the increasing population, the pressure created by urbanization and the pressure created by the climate change will be evaluated correctly, the prejudiced attitudes of the countries against each other will be prevented and a common solution will be reached more easily when the problem is observed correctly.

Assessment: Data obtained through monitoring activities should be evaluated. Importance of evaluation can be explained with many examples. For example, considering how much water is used by the product, which constitutes a large part of water consumption, water savings can be achieved by choosing products that use less water. Or water savings can be achieved by choosing to produce products where they are grown with rainwater. Water leaks can be prevented by detecting the places where infrastructure resources are damaged, and thus the negative effects of climate change can be precluded to some extent. On the other hand, thanks to the data obtained by measuring water pollution, reduced agricultural productivity due to water pollution can be increased and public health can be protected. However, achieving all these benefits will be possible with the participation of all stakeholders equally in the evaluation process. The Central Asian Republics to evaluate the changes in water resources simultaneously and transparently will make the solution more permanent and feasible. In addition, it is critical

for all sectors that use water (agriculture, industry, domestic use, etc.) to take part in the evaluation process. Dukhovny (2008) says that criteria for success of sectors and stakeholder's coordination are "*inclusiveness (each stakeholder can show its interest); equity (rights for equal access to water); transparency; effectiveness; accountability; coherency (to listen others); responsiveness; comprehensiveness; ethical considerations*".

Protection and Development of Available Water Resources: The protection of water resources from deterioration constitutes another step of IWRM. The causes of deterioration of water resources are anthropogenic origin and climatic origin (Ako et al., 2010).

Eurasian Development Bank Report (2009) says that it is required for implementation and development of integrated water resources management in the region, in order to tackle climate change successfully. Internalization of integrated water resources management plans will help rationalize the distribution of water resources, control water demand, improve environmental protection, water quality and crisis-handling mechanisms.

2.3.2. Integrated Water Resources Management in Central Asia

Actually, the 1992 Almaty Agreement ("*The Agreement on Cooperation in the Field of Joint Water Resources Management and Conservation of Interstate Sources*") adopted an integrated approach to manage shared water resources in the Central Asia and to see them as the common interest of all Central Asian States (Agreement, 1992). Central Asian governments established number of regional institutions for water cooperation such

as the ICWC and IFAS, the Eurasian Economic Community (EurAsEC) which includes four Central Asian countries excluding Turkmenistan (Rahaman & Varis, 2008; Zmak, 2018). Pohl et al., (2017) claim that regional institutions such as IFAS and ICWC thus do not completely reflect developing national interests. Many international organizations also operate in order to increase cooperation and institutionalization in the region. For instance: The United Nations Special Program for Economies of Central Asia (SPECAs) became operational in 1998 both to increase the cooperation of Central Asian countries with each other and to integrate the region with the world economy. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the United Nations Economic Commission for Europe (UNECE) also support this program (Libert, 2008; Rahaman and Varis, 2008).

With the 1992 Almaty agreement, it was aimed to establish a regional cooperation and eventually to create an institutional structure (Agreement, 1992). However, when we look at the articles of the agreement, it is seen that countries adopt an approach based solely on protecting their national policies with this agreement. Countries setting water use limits for each other is quite different from the modern integrated water resources management approach. It is clearly observed that Soviet-era water management policy is being preserved. In addition, ICWC, which is one of the most important organizations established on transboundary water resources in the region, is criticized for its deficiencies in many ways. In particular, the ICWC has been criticized for the fact that it distributes water resources among countries in terms of quantity and gives priority to the agricultural sector in water use in the region. Other important shortcomings of the organization are not evaluating the environmental impacts that will arise due to water use and not considering the use of water resources in energy sector (Wałkiel, 2018). The deepening of the Aral Sea environmental disaster and the acceleration of the use of water

resources for hydroelectricity production, in fact, reveals how short the ICWC is in terms of transboundary water resources in the Central Asia. On the other hand, if we ignore the negative aspects, it can be said that the agreement is a good development in terms of creating a basis for cooperation among countries of the Central Asia, improving water management through information sharing and understanding the current water situation.

The IFAS, whose framework was drawn by an agreement made in 1993, is a critical regional agreement on transboundary water. The Aral Sea environmental disaster seriously affects all Central Asian states. The main objectives of this organization are; ensuring the rational use of limited land and water resources, maintaining adequate water quality in rivers, lakes and underground resources, and ensuring water supply to the Aral Sea. It also has secondary ecological goals, such as protecting migratory species (Agreement, 1993; Waśkiel, 2018). In fact, IFAS has listed these aims and summarized very well what needs to be done in the region. In this context, it can be considered as a good development that the organization brings together the countries of the region and brings the problems that the region has experienced and expected to experience regarding water and environment to the agenda of the countries. But unfortunately, when we look at the latest developments on water and environment in the region, it will be seen that the targets remain only in discourse and not put into practice. The realization of the solutions targeted by IFAS depends on the continuous cooperation of the countries, advanced information sharing and making the necessary legal arrangements.

The application of IWRM principles in the international agenda has begun to be considered as one of the first methods used in the management of transboundary water resources. Therefore, the implementation of IWRM principles in Central Asia is inevitable. However, modern integrated water resources management has not yet been established in the region. Until now, the countries of the region have started to include

these principles in their agreements. However, some of the scholars criticized the countries of the region on the grounds that the application level of these principles included in the agreements was low and some regulations remained only in theory (Rahaman, 2012; Waśkiel, 2018). Among the Central Asian states only Kazakhstan, fully prepared a National Integrated Water Resources Management Program in mid-2007 (Eurasian Development Report, 2009). In IWRM, the holistic evaluation of the basin and the involvement of all stakeholders in cooperation are critical for effective water management. Unfortunately, this situation has not been fully implemented in Central Asia. Afghanistan, from which the Amu Darya, one of the two important rivers in the region, which contributes approximately 10% to the Aral basin, derives its source, has been excluded from the cooperation on water issues, and has not been included in most agreements (Rahaman, 2012; Waśkiel, 2018). For the full implementation of IWRM principles, Afghanistan needs to be included in water cooperation.

There may be many obstacles to the implementation of an effective water resources management policy. Identifying these obstacles will shed light on the solution of the problem. When the subject is examined in the Central Asian axis, it is clear that the biggest obstacle to the implementation of an effective water resources management policy is conflicting political and economic interests. Lack of coordination between the different institutions collaborating on IWRM plans, the lack of solid establishment of River Basin Management Plans and River Basin Organizations (RBOs), and the lack of funding for RBOs are other obstacles that complicate the implementation of IWRM in Central Asia (S. Xenarios, personal communication, March 22, 2021). The CASA project, which plans the construction of power transmission lines between South Asia and Central Asia (Waśkiel, 2018), is a good example of conflicting economic and political interests in Central Asia. In this project, Kyrgyzstan and Tajikistan, which are poor in terms of energy

resources, aimed to meet the needs of their own citizens by producing hydrological energy and to generate income by selling hydroelectric energy to countries such as Iran, Pakistan, and India. However, the fact that Uzbekistan and Turkmenistan are primarily interested in the development of agriculture in cotton fields (White Gold), causes conflict of interests on water (Waśkiel, 2018).

Waśkiel (2018) says that *“The solution to the problem of managing water resources in Central Asia requires the political compromise and the reconciliation of economic interests”*. In fact, the new president of Uzbekistan, Shavkat Mirziyoyev, who took office in 2016, approved the establishment of the Kambarata-1 hydroelectric power plant in Kyrgyzstan and ended the discussions on the construction of the Rogun Dam in Tajikistan, which has been interpreted as the political compromise needed by the region. As soon as Mirziyoyev came to the administration, he visited his neighbors and started to provide flight service between Tashkent and Dushanbe (Soliev & Theesfeld, 2020; Waśkiel, 2018). All these developments are now interpreted as Uzbekistan's choice of a moderate policy on water (S. Xenarios, personal communication, March 22, 2021).

A study to explain interventions and technologies for a sustainable regional water, energy and food management made the following recommendations. In the water sector, designing hydroelectric systems in the upper riparian countries should take into account the release of sufficient water volumes for downstream irrigation in the summer, while the pressure on surface river basins should be reduced through increased use of groundwater resources. The energy portfolio in all countries of Central Asia should be diversified in a way to prevent explosions and sudden price fluctuations in energy commodities by investing more in renewable energies. In the agricultural sector, instead of cotton monoculture, horticulture and tree cultivation should be preferred, and the rehabilitation of irrigation and drainage systems should be carried out in operational,

maintenance and repair stages. In major river networks, minimum environmental flow should be ensured and human activities better monitored at basin level. (Xenarios, S.; Smakhtin, V.; Sehring, J.; Schmidt-Vogt, D.; Tsani, S.; Hannah, C.; & Michalena, E. 2018).

Overcoming the years-long lack of trust between countries in Central Asia is very important for sustainable water management. The implementation of the plans and the implementation of the decisions depend on the establishment of a trust mechanism between countries. In order to establish a trust mechanism between countries, it is necessary to establish a transparent and institutional management in the field of water, to make necessary legal arrangements to ensure sustainable management, and to impose various sanctions if these regulations are not complied with. The implementation of the sanctions should be overseen by an organization that the countries designate jointly. In water management, each river should be evaluated within the borders of the watershed, not within the national borders. It is necessary to make river basin management plans, to keep and share water-related data up-to-date, to periodically monitor and evaluate various technical issues, and to create new action plans in line with these activities in order to implement a sustainable water management in the region.

2.4. THE IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

Climate change means *“a change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time*

periods” (UNFCCC, 1992). According to the IPCC 2007 (4) report, it is proved that people cause climate change. According to IPCC to keep the global average temperature rise at 2 °C, the accumulation of greenhouse gases in the atmosphere should not exceed 450 ppm. Under several scenarios, the global average surface temperature is expected to increase by 0.6 - 6.4 °C during the 21st century (IPCC, 2007). The report, last published by the IPCC in 2021, also supports previous findings. In this report, it is suggested that the planet may be affected irreversibly as a result of human activities. Even in the scenario where all precautions are taken, the planet is warming by 1.5 °C by 2030. In only one scenario, temperatures increase by 1.5 °C with low emission rates, and this rate is exceeded in all other scenarios. It is estimated that many environmental disasters and socio-economic damage are going to be real within 100 years (IPCC; 2021). Considering the possible effects of climate change in water resources management, it does not seem possible to ensure a fair and sustainable benefit sharing. Therefore, it is extremely important to create scenarios for the climate change impacts, and by taking these scenarios into consideration, efforts should be made to reduce negative impacts or even prevent negative impacts before they occur.

One of the upcoming challenges in Central Asia is considered to be high climate variability with extreme weather conditions exacerbating floods and droughts (S. Xenarios, personal communication, March 22, 2021). According to a study in which air temperature changes in Central Asia from 1979 to 2011 were analyzed using 81 meteorological stations; air temperatures in Central Asia are increasing faster than the world average and the surrounding regions. Temperatures are expected to increase by an average of 3 °C to 7 °C in Central Asia in the future (Yu et al., 2019). The estimated

temperature rises⁵ above 3 °C is considerably higher than 0.85 °C increase shown in the IPCC fifty assessment report (Yu et al., 2019). This proves that the negative climate change effects currently being observed in the region will become more severe.

The difference in elevation in Central Asia also causes fluctuations in the amount of annual precipitation between regions. Although annual precipitation in mountain regions is generally between 1000 mm and 2000 mm; annual precipitation in the basin regions of Turkmenistan, Tajikistan and Uzbekistan and the Kazakhstan's south is less than 100 mm. Temperatures in the summer, reaching 24 °C with less rainfall cause severe land desertification and water shortage problems (Yu et al., 2019). With climate change, it is predicted that the greatest increase in precipitation and temperature will be in the north of Central Asia, in the high parts of Afghanistan and Tajikistan during the winter months, and the central regions will be drier in summer and autumn. It is estimated that the greatest increases in summer temperatures in Central Asia will be in the southern region (Hughes et al., November 2017).

The water resources in Central Asia are formed mostly by melting snow and glaciers from Hindu Kush, Pamir, Tien Shan Mountain Ranges (ICG, 2014). Hence, melting of glaciers and snow due to climate change will greatly affect water resources of entire region. Considering that 20% the glacial ice cover in Aral Sea basin disappeared between 1957 to 1980 and has decreased by 10% in the last 50 years, it can be observed how quickly the glaciers are melting (Nazarbayev University, 2020; Xenarios, 2018). The

⁵ The temperature increase in Central Asia is most noticeable in the northern parts of the region during the winter months.

research conducted in 2011 concluded that climate change will seriously affect the flow regime of the river, through a model developed for Syr Darya on the climate-ice-precipitation flow axis. According to this research, melting glaciers increase the flow of rivers, causing snow to melt earlier. The early melting of snow causes water shortage in summer and negatively affects agricultural activities (ICG; 2014). They especially argued that the Fergana Valley, which is densely populated and has very fertile lands for agriculture, is at high risk against climate change (Bernauer & Siegfried, 2012; Siegfried et al., 2012).

When Figure 4 is examined, it is observed that many effects are seen depending on climate warming. Increasing temperatures have short-term and long-term impacts as mentioned before. Premature and intensive melting of the permanent snow, glaciers, permafrost damages the mountain communities and existing infrastructures, while downstream countries face devastations in their water supply. Anymore, there is no reliable water source for agriculture in the summer.

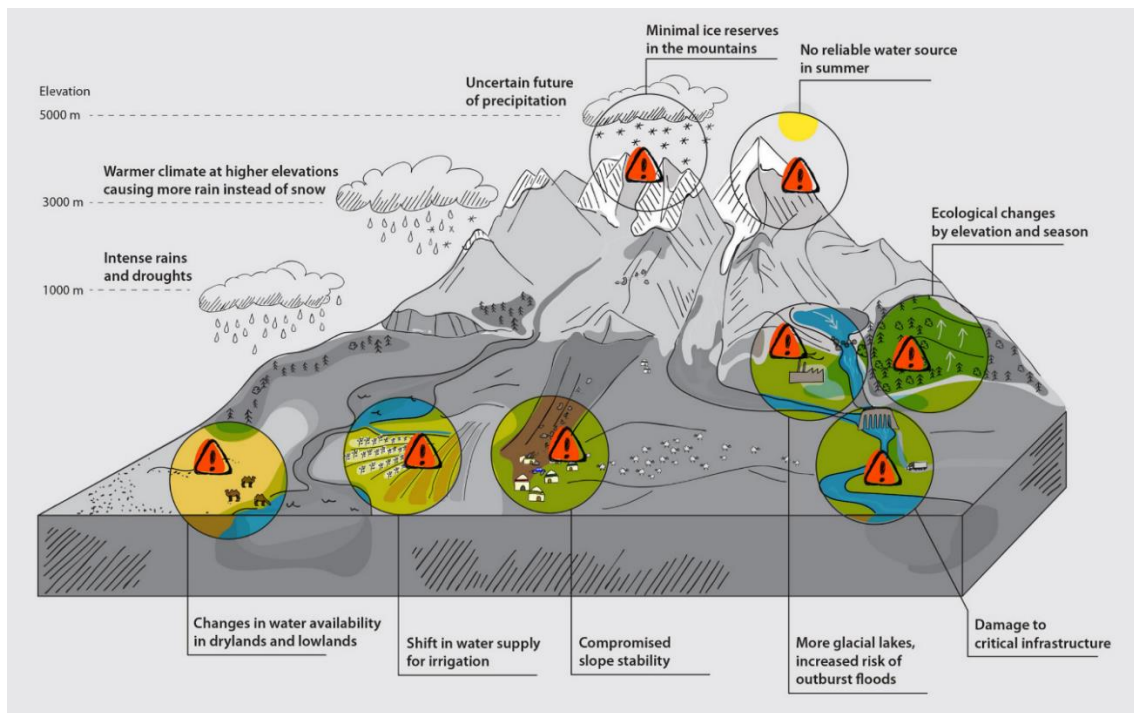


Figure 4: Climate Change Impacts on Central Asia High Mountains
Source: (Zoï Environment Network, 2018).

The harmfulness of some of climate change's avoided impacts can be minimized through adaptation and mitigation. Adaptation is defined as a natural process that plays a crucial role in the life cycle. As climate change pose serious risks and challenges to the world, it needs to be answered how communities will adapt to changing environmental conditions. Adaptation should be key element of benefit sharing approach in the transboundary river basin. Protecting water resources according to climate change and ensuring a sustainable life cycle depends on the adaptability capacities of countries. Due to climate change, sustainable and cooperative strategies need to be reached promptly in order to build a resilient environment (Gasparri, 2018).

Figure 5 evaluates the climate change impacts and adaptation in the Chu and Talas River basins. According to the figure, when the area of the Chu and Talas River basins within the state borders of Kyrgyzstan is examined, it is seen that the glaciers have melted and/or disappeared due to climate change, and the productivity in the pastures and forests decreases. In the figure, areas where water shortage is expected by 2050 in agricultural

areas are shown in green. Accordingly, shortage of water resources for agriculture is expected by 2050, especially in Bishkek. In addition, it is observed that the projected temperature and precipitation changes in the 2050s are compared with the changes in temperature and precipitation calculated between 1961 and 1990. Accordingly, it is expected that temperatures in both basins will generally increase, but especially in the upper region of the Chu River basin, under domination of Kazakhstan, serious temperature increases (up to +4 °C) are expected.

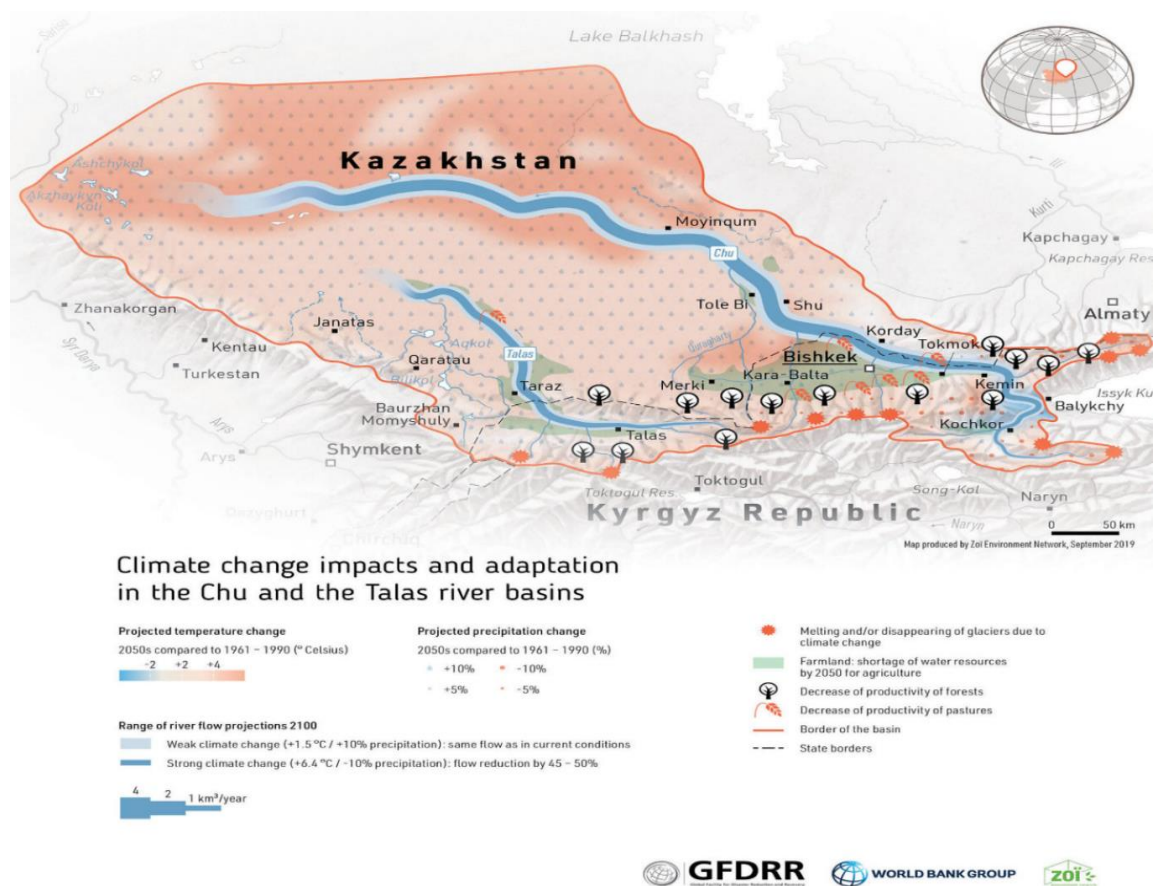


Figure 5: Climate Change Impacts and Adaptation in the Chu and in the Talas River Basins

Source: (Zoï Environment Network, 2019).

When the precipitation change is examined in Fig. 5, it is expected that in the 2050s, there will be a decrease of up to 10% in the part of these basins within the borders of Kyrgyzstan, and an increase of up to 10% in the remaining part of Kazakhstan. Finally,

the river flow projection of 2100 is included in the figure and an assessment is made according to two different scenarios, strong and weak climate change. It is claimed that in case of weak climate change (in the condition of +1.5 °C temperature and +10% precipitation) there will be the same level of flow as current conditions, while in case of strong climate change (in the condition of +6.4 °C temperature and -10% precipitation), the flow is expected to decrease from 45% to 50%. Adaptation capacity can be increased if correct measures can be taken against the projected changes.

Another important concept in climate change literature as well as adaptation is vulnerability. According to the World Bank, Central Asia is one of the most climate vulnerable regions of the world due to temperatures rising and melting glaciers (Gasparri, 2018). In addition, Central Asia is sensitive and vulnerable to climate change due to its arid and semi-arid ecosystem (Yu et al., 2019). In fact, most states are somewhat vulnerable to climate change, but poor countries and the poor people in them are the most vulnerable. In fact, those most exposed to climate change have fewer tools to tackle and adapt (Mitchell, Tanner, & Wilkinson, 2006). There is a dilemma between vulnerability and poverty. Poverty leads to being more vulnerable to climate change, and vulnerability to climate change to being poorer (Eriksen & O'Brien, 2007). Considering from another aspect, increasing prosperity leads to a decrease in vulnerability to climate change, while decreasing vulnerability to climate change leads to an increase in well-being. When the concept of vulnerability is examined on water resources, the result will not be different. Countries with increasing wealth use more efficient irrigation methods, improve their technical and humanitarian capacity, and begin to produce innovative solutions to problems; thereby increasing well-being helps improve water resources management. On the other hand, improving water resources management helps to further increase well-being and decrease vulnerability to climate change. Therefore, enhancing welfare of

countries and peoples through benefit sharing in water resources is also critical in combating climate change.

Central Asia is among the regions expected to be most exposed to the adverse effects of climate change. International conflicts in water resources, presence of water stress in the region, increase in water demand because of increasing population, regional and local problems in water supply can be seen as factors that increase vulnerability to climate change. In addition, the fact that five countries evaluated in the region are developing countries, which were established at a relatively new time (1991), struggling with political instability and socio-economic injustice are other critical reasons that increase vulnerability. The development of the adaptation capacity of these countries against climate change depends on well-defining the expected problems and producing common solutions to the defined problems.

For rivers, worse effects of climate change will be seen from source to termination. In Figure 6, the changes that may occur in the water cycle with the effect of climate change, how the sectors using water will be affected by this situation, the status of aquifers and wetlands, and the changes that will occur in natural disasters are shown in detail. In Figure 6, it is understood that the events that initiate the cycle are the temperature increase. The increase in temperatures causes the melting of glaciers, and the melting of glaciers causes the early melting of snow with increased river flow. In addition, the increase in temperatures brought the climate region to receive more rain and less snowfall. This situation not only prevents the aquifers and wetlands to be fed adequately, but also prevents the storage of sufficient amount of water for agriculture to be carried out in the summer months. Another consequence of increasing temperatures is increased evaporation rates. For this reason, there is a serious decrease in the amount of usable water and droughts occur more frequently. As the decrease in the amount of water will increase

the amount of concentrated pollution, the amount of usable water will decrease further. Temperature changes do not only decrease the amount of water, drought or erosion, but also increase the rate of disasters such as floods and landslides due to factors such as rapid seasonal changes, increased precipitation and snow-ice melting. The areas where cities and industries are established may be more threatened due to climate change (Zmak, 2018). In order to combat this situation, the adaptation capacity of these areas should be increased and settlement areas should be changed when necessary.

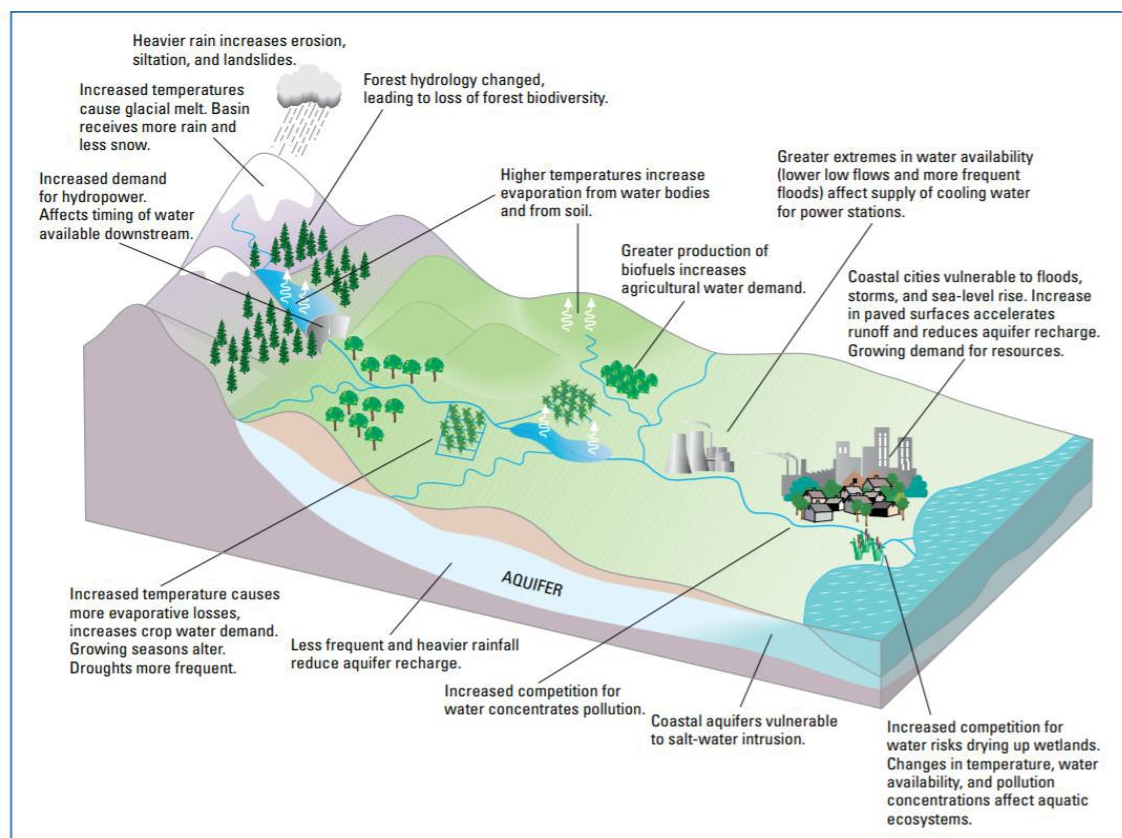


Figure 6. Water Cycle
Source: (Zmak, 2018).

On the other hand, some scholars have argued that climate change effects can be turned into opportunities. Melting glaciers cause an increase in the flow of rivers, if hydroelectric power plants are built in these rivers with increasing flow, countries will have the opportunity to meet their energy needs.

2.5. THE IMPACT OF URBANIZATION ON WATER RESOURCES

The world urban populations are foreseen to increase by about 2.5 billion people until 2050. Urbanization will grow to such an extent that competition between water usage for agriculture or cities will exacerbate and about 50% of the world's surface water-dependent cities of over 750,000 will compete with agricultural regions for water by 2050 (Garrick et al., 2019). The population of Central Asia has grown by approximately 19 million since 2000. The current population of Central Asia is 74,685,791. The 48% of population is urban [35,681,394 people in 2019] (Worldometer, 24 October 2020). Growing population means increasing water and infrastructure demands. Water infrastructure in many urban areas was last repaired in the 1950s. The amount of usable fresh water is lost due to loss and leakage. A large financial investment is required to repair the very old infrastructure. Migration from rural areas to urban areas causes problem to be multiplied (ICG, 2014).

All countries in Central Asia suffer from poor infrastructure (water, gas, electricity and sewerage) and lack of investments to remedy this situation (UN, ESCAP, 2013). First of all, if the infrastructure situation of small and medium-sized cities of Kazakhstan is examined; 60% to 95% of sewerage networks, central heat and water supply systems are worn and half of the pipeline network needs urgent repair. Secondly in Kyrgyzstan, where 70% of the urban infrastructure is old, the most difficult situation prevails in large cities (Jalalabad, Osh, Karakol), where the water losses in water supply lines up to 70% and often water supply lines need to be repaired. Similar results are encountered when looking at the infrastructure situation of Tajikistan. 75% of the country's infrastructure is in poor

condition. It is claimed that 50% of the water supply lines are unusable. Finally, the infrastructure situation in Uzbekistan, which is the largest country in Central Asia with regard to population, can be summarized as follows: Destruction rate of water supply reaches 39%, of sewage reaches 20% and losses of drinking water are estimated as 40%. Due to the current population growth and urbanization rate, it will require the amount of drinking water supplied in cities and towns in Uzbekistan to be increased to 1.2 billion cubic by 2025. In addition, with sewer pipelines (1,700 km) and water pipelines (3.700 km), urban gas lines (50%) will need to be replaced and 23% to 25% increase in electricity supply capacity; 10% to 12% increase in gas supply capacity; 200% capacity increase in urban waste disposal will be required (ESCAP, UN, 2013). The loss of between 50% to 80% of the water used for agriculture in Uzbekistan, and the efficient use of only 25% to 35%, is an indication that the country is now alarming for the renewal of the irrigation system (ICG, 2014; Shirokova & Morozov, 2008).

These states, which have gained their independence in a relatively new period, become able to bring infrastructure opportunities to less people in the face of increasing population with each passing day. Due to economic insufficiencies, the necessary funds cannot be provided, but if cooperation can be achieved, infrastructure problems can be solved to a large extent. According to a study conducted by the World Resources Institute in 2007; the rate of access to improved sanitation is 72% in Kazakhstan, 59% in Kyrgyzstan, 51% in Tajikistan, 62% in Turkmenistan and 67% in Uzbekistan. Rate of access to improved water source is 86% in Kazakhstan, 77% in Kyrgyzstan, 59% in Tajikistan, 72% in Turkmenistan and 82% in Uzbekistan (Stucki and Sojama, 2012). Over half of population in Tajikistan still do not have a source of clean drinking water at homes (Russell, 2018). The rapid growth of the urban population causes development policies focused on traditional rural and primary industries to be inadequate (Varis, 2014).

2.6. MISMANAGEMENT OF WATER RESOURCES: ARAL SEA CASE STUDY

Solomon (2010) called the Aral Sea the "hydraulic Chernobyl" of the USSR. The Soviets' transformation of the steppes into cotton-producing agricultural land can be evaluated as an effort to get something out of nothing. The efforts of the Soviets to create a paradise from the steppe by directing the water resources of Syr Darya and Amu Darya to cotton production caused the Aral Sea to be undernourished and thus the world's fourth largest freshwater lake to turn into a two salty and small lake (Zmak, 2018). This humanitarian intervention on nature has turned into an environmental disaster whose consequences can be observed by everyone. The scale of this environmental catastrophe is disastrously illustrated by the salt storms that were blown off the bed of a lake once transported. Because of these dust storms, cotton fields are over-salted and lose their productivity (Iyikan, 2013; Solomon, 2010; Yıldız, 2019; Zmak, 2018).

Many researchers claim that 90% of Aral Sea has mostly dried up as a result of mismanagement of water such as changing the direction of rivers and adopting the production of cotton plants that consume excessive water in half a century (Gaybullaev et al., 2012; Granit et al., 2010; Dukhovny & de Schutter, 2011; UNECE, 2011; Varis, 2014). Figure 7 and 8 show how the waters of Aral Sea have disappeared in years. An area of 54000 square kilometers in the Aral Sea has dried up (In this area, the Aralkum Desert, which is described as "the youngest desert in the world", was formed.) and retreated up to 170 kilometers from its former shores (Yıldız, 2019).

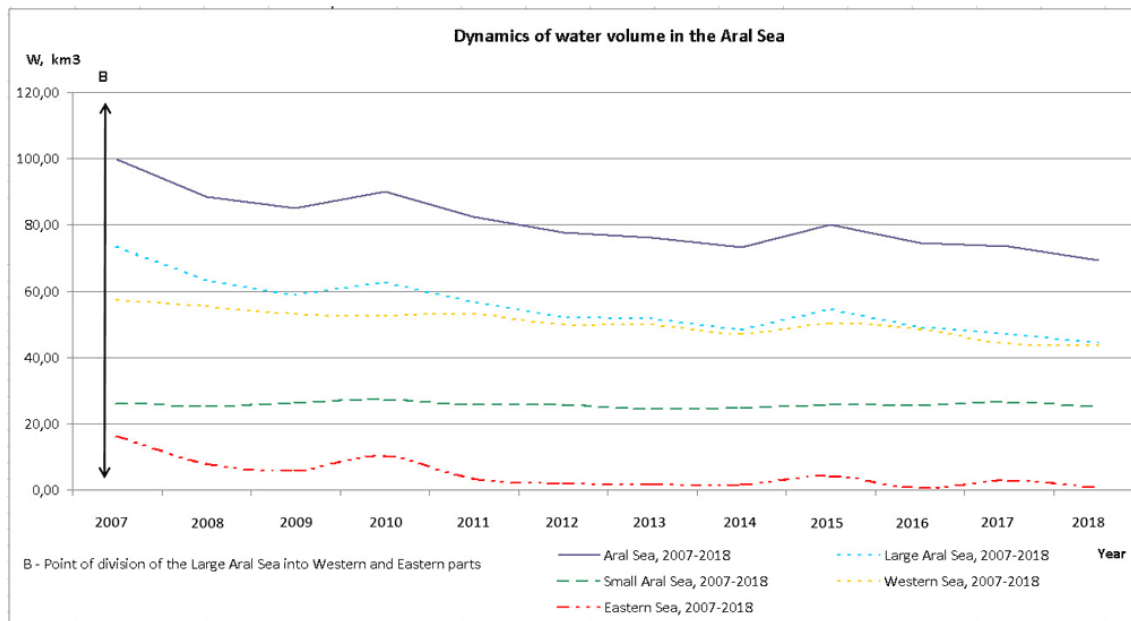


Figure 7. Changing of Water Volume in the Aral Sea

Source: (http://www.cawater-info.net/aral/data/morpho_e.htm).

The independent Central Asian states persistently wanted to maintain their status as a Soviet-era agricultural country and ranked among the top 20 countries in the world with the highest water consumption per capita (World Bank, 2013). When we look at the sectoral use of water, it is seen that 90% of water is used in agriculture, and if we look at agricultural water use, it is seen that water used for wheat and cotton production has the largest share (Varis, 2014).

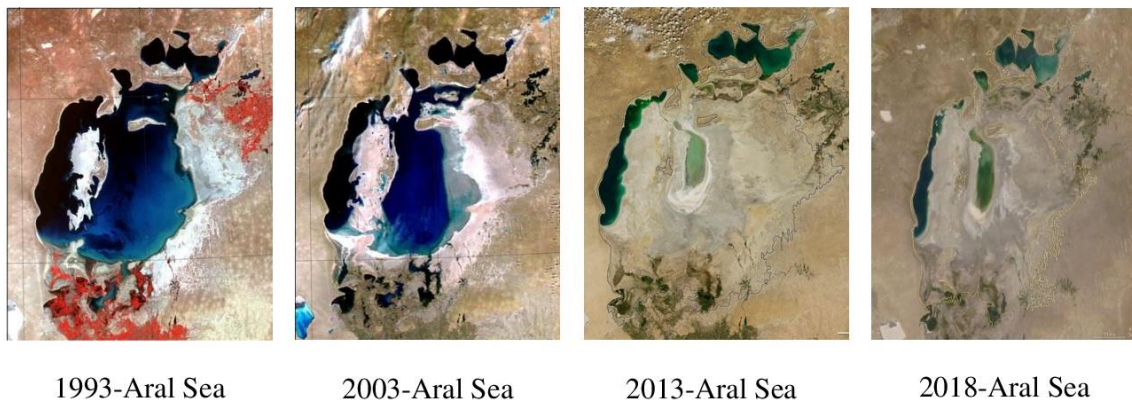


Figure 8: Aral Sea Volume Change in Time

Source: (http://www.cawater-info.net/aral/data/satellite_e.htm).

In Central Asia, which already has a harsh continental climate, it can be observed that winters are cooler and summers are warmer with the effect of this disaster in the Aral Sea basin (Zmak, 2018). Just as climate change has an impact on water bodies, sometimes the disappearance of water bodies changes the climate, as seen in the Aral Sea basin. Less rainfall, less snowdrifts, and less runoff in rivers perhaps caused an irreversible climate change. As the water bodies in the Aral Sea basin disappeared, local climate became harsher and the summers became extremely hot and the winters more severe cold. With the drying of the basin, dust storms started to occur and the wind spread salt and pesticides to agricultural areas hundreds of miles away, giving rise to respiratory and gastrointestinal diseases as well as diseases such as cancer, anemia and tuberculosis (Granit et al., 2010; UNEP, 2011; Varis, 2014). Since 1960, 70% of Turkmenistan has been turned into a desert due to the dust blown from the drying lakebed. In Uzbekistan, the situation is not much different. It is trying to cope with the salinization problem in its irrigated land, which is more than 50% due to excessive irrigation and the use of inappropriate irrigation methods. Water pollution is another growing concern throughout the region. Moreover, the disappearance of local livelihoods based on grazing, hunting and fishing, and the collapse of many ecosystems in and around the Aral basin have caused many socio-economic crises (ICG, 2014).

The Aral Sea has shrunk so much as a result of the decrease in the water resources that feed it, that the lake was divided into two as the Northern Aral and the Southern Aral in 1998 (Samli, 2017). The rescue work of the lake was first started in the Northern Aral which is entirely within Kazakhstan. In this context, the Kokaral dam has been started to be built by Kazakhstan in the area where Syr Darya spills into the lake to fill the Northern Aral. The dam, which was built with the loan of the World Bank, was completed in 2005

(Yıldız, 2019). Contrary to the general situation, efforts to save the Northern Aral Sea are a positive development (Libert, 2008).

In order to protect and save the Aral Sea, many international and regional organizations have supported efforts to date. One of the most important of these studies is the IFAS, which was founded in 1993 by five Central Asian countries (Rahaman & Varis, 2008). Unfortunately, IFAS could not fully establish the regional cooperation necessary for the solution of the problem. The positive development seen in the Northern Aral basin in the Aral basin has emerged as a result of the individual or bilateral studies of the countries. However, it can be considered as a positive development that IFAS held a meeting at the level of leaders in Turkmenistan in 2018 and decided to act jointly to combat the environmental disaster in the Aral Sea. It was suggested at the meeting to use 'green technologies' that reduce the need for irrigation and to add salt-resistant plants to the crop pattern in this meeting (Yıldız, 2019).

3. EVOLVING OF BENEFIT SHARING APPROACH AND TRANSBOUNDARY WATER COOPERATION

As the demand for water intensifies, its value also increases. Despite this, even though water has a vital importance, it is used carelessly by societies. The decrease in usable fresh water resources and the increase in water contamination are unfortunately not investigated as the primary problems of societies. This situation has to change in order for the potential contribution of water to the society to be provided (White et al., 2008). Water-based problems are generally examined in literature as a source of conflict, an auxiliary element affecting the actual conflict, or a tool used in the conflict. Especially in transboundary water resources, a state is cautious about water cooperation by evaluating the other state as its rival or potential enemy. For example, the dam built by the upper riparian state reacted with the concern that the control of water resources would be taken over by the lower riparian state. However, if we look at the benefits to be gained, the lower riparian state can provide protection against natural disasters such as flood and drought thanks to this dam.

But nowadays, transboundary river basin management planning has evolved from the "zero sum game" approach, which is based on the win of one side and the other side to lose, on the "positive sum game" approach based on the win on both side (Ze et al., 2017). Supporting this view, Sadeqinazhad et al., (2018) claims that there is motivation among the riparian to avoid conflict and to cooperate, because only in this way positive outcomes from the same basin can be increased and negative outcomes can be reduced. In order to spread the benefits obtained in one area to other areas, the riparian must act together and the benefits and expenses must be shared fairly. With the effect of common

efforts of riparian, the benefit basket is spread out to not only flood and drought control, sedimentation reduction, hydroelectric generation but also to comprehensive issues such as food security, environmental security and sustainable development. Practical solutions can be provided by cooperation, on issues requiring complex and long-term studies such as assuring food security, achieving sustainable development and protecting the environment which cannot be realized by a single country or local people (Sadeqinazhed et al., 2018).

Phillips and others argue that water resources began to be seen as a potential benefit rather than a conflict-causing factor, and that in the 1990s, the approach that saw water as a state-based security issue changed. Water has begun to be seen as an economic value benefited by various stakeholders (Phillips, et al., 2006). Supporting this view Sağsen claims that the benefit sharing approach on water which is considered as an economic commodity has started to come to the agenda with the change of perception of security and he argues that the problems in the field of water became about the allocation of water and sharing of benefits from resources (Sağsen, 2012). Sadoff and Grey (2005) say that approximately 40 percent of the global population lives within the basins of transboundary rivers, and more than 90 percent of the global population lives within the countries that share these basins. In a situation where natural boundaries are intertwined; countries have no chance to act differently.

1831 interactions in transboundary basins have been studied over 50 years by the Oregon State University, revealing that the parties tend to cooperate rather than engage in conflict (Giordano & Wolf, 2003). Although this situation is obvious to everyone, there are differences of opinion on how to collaborate and how cooperation will protect the interests of each stakeholder. Sadoff and Grey (2005), who state that cooperation in such rivers is inevitably long and complicated journey, summarizes the practical steps to be

taken as follows; 1. Potential benefits should be expanded as much as possible, 2. Benefits and costs should be distributed fairly among all stakeholders, 3. A form of cooperation should be adopted where maximum net benefit could be achieved.

In the last century, cooperation was seen as an ultimate goal to be achieved by the world, so the activities mentioned below have been realized. The international community has sought to promote cooperation in transboundary river basins through conferences held in Dublin and Rio “*The International Conference on Water and the Environment (Dublin), 1992 and the United Nations Conference on Environment and Development (Rio de Janeiro), 1992.*” and has achieved remarkable success in this regard (Guterstam, 2008). The turning point of these developments in terms of institutionalization was the United Nations General Assembly’s adoption of “*the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses*” in 1997 (Kallioras, 2006). In addition, Benefit sharing was discussed in the International Conference on Freshwater held in Bonn at the 2001, in the 3rd World Water Forum and Ministerial Conference of 2003 and in the Stockholm World Water Symposium of 2005. The international community has adopted conventions, declarations, and legal statements concerning the management of transboundary river basins, while basin communities have established countless new basin institutions (Giordano and Wolf, 2003).

In the response to necessity of institutional mechanism, the World Bank, the United Nations Development Program (UNDP) and the Swedish International Development Agency (Sida) created the Global Water Partnership (GWP) in 1996 (GWP, 2019; Rahaman & Varis, 2008). In February 2002 stakeholders in Central Asia and Caucasus (Armenia, Georgia, Azerbaijan, Uzbekistan, Kazakhstan, Turkmenistan, Kyrgyzstan and Tajikistan) launched a water partnership which called GWP CACENA at the regional level with the aim of enhancing a modern context of International Water

Resources Management (IWRM) and sustainable development (Guterstam, 2008; GWP, 2019; Rahaman & Varis, 2008).

As a result, transboundary water management has become a widely accepted method of managing water resources in an efficient and sustainable manner. However, this method which is accepted in theory, unfortunately suffers from difficulties in the activity phase. Therefore, another purpose of this study is to enable countries to see the potential tangible benefits that may arise from cooperation with benefit assessments and to activate cooperation stronger. Thus, countries be able to broad the scope of the cooperation by defining a "basket of benefits".

3.1. Identifying the Benefits of Transboundary Water Cooperation

Sadoff and Grey (2005) define benefit sharing as “any action designed to change the allocation of costs and benefits associated with cooperation”. Water benefits sharing focuses to optimize the values (economic, social, cultural, political and environmental) obtained from different uses of water and ensure that it is distributed fairly to water users and suppliers (White et al., 2008). The main argument of the “benefit sharing” approach in transboundary river basins is that the riparian countries that have problems between them start collaborating on issues that will benefit them jointly and then develop cooperation in different areas with the effect of spreading. This spreading understanding of cooperation can lead them to develop common policies not only on water but also on other issues such as water-based development sectors; energy, agriculture, environment, trade, transportation.

Tafesse (2009) claims that the attempts taken for transboundary rivers should be made to identify the typologies of benefits, aspects of benefit sharing, scenarios of benefit sharing and the optimization of benefits. And in terms of benefit sharing aspects, issues related to benefit sharing need to be addressed for whom, by whom and because of whom. Sadoff and Grey (2002 and 2005) specify four types of benefits (I) benefits to the river; (II) benefits from the river; (III) the reduction in costs because of the river; and (IV) benefits beyond the river. Phillips, et al., (2006) re-categorize these into three: (I) security; (II) economic; and (III) environmental.

Table 1: Types of Cooperation and Benefits on Transboundary Rivers

Type	The Challenges	The Opportunities
Type 1 Increasing Benefits To the River	Degraded water quality, watersheds, wetlands, & biodiversity	Improved water quality, river flow characteristics, soil conservation, biodiversity and overall sustainability
Type 2 Increasing Benefits From the River	Increasing demands for water, sub-optimal water resources management & development	Improved water resources management for hydropower & agricultural production, flood-drought management, navigation, environmental conservation, water quality & recreation
Type 3 Reducing Costs Because of the River	Tense regional relations & political economy impacts	Policy shift to cooperation & development, away from dispute/conflict; from food & energy self-sufficiency to food & energy security; reduced dispute/conflict risk & military expenditure
Type 4 Increasing Benefits Beyond the River	Regional fragmentation	Integration of regional infrastructure, markets & trade

Source: (Sadoff and Grey, 2002 and 2005).

If we open the classification made by David Grey; the concept of “Benefit to river” implies the emergence of benefits such as improving water quality through the management of the ecosystem, and ultimately ensuring sustainability by protecting the

soil and biodiversity. Net benefits can be increased with the “Benefits from the River” perspective. Basically, if the stakeholders cooperate in transboundary waters and protect the river in the long term, it indicates that many common benefits such as drinking water allocation, food supply, energy production and transportation can be obtained. Jalilov (2015) investigated the benefits of the river and found that cooperative management of the common rivers can provide significant benefits in food and energy production. Transboundary rivers sometimes cause tense regional relations and political economic impact. If we reduce cost “because of rivers”, we could ease tension between riparian states and make a policy shift to cooperation. “Benefits to beyond the river” concept refers to cooperation between riparian states lead to economic integration with spillover effect.

In ideal benefit sharing situations, the riparian countries view the benefits of water development and use as a positive-sum game associated with benefits optimization, rather than the zero-sum game associated with simple water sharing (Quaddumi, 2008; Ze et al., 2017). As stated by Grey and Sadoff (2007), cooperative management of shared river basins can provide opportunities to (a) increase the scope and scale of benefits, (b) generate basin-wide benefits and (c) establish and sustain transboundary institutions. There is a strong link between the potential benefits from transboundary cooperation and the Millennium Development Goals (Quaddumi, 2008) “*The MDGs call for: the eradication of extreme poverty and hunger; universal primary education; gender equality and the empowerment of women; the reduction in child mortality; improvement in maternal health; combat of HIV/AIDS, malaria and other diseases; environmental sustainability; the development of a global partnership.*”

Benefit sharing should also include some redistribution of benefits or compensation for lost benefits. The form of compensation can vary depending on the situation and actors. The actual form of compensation is largely specific to the situation,

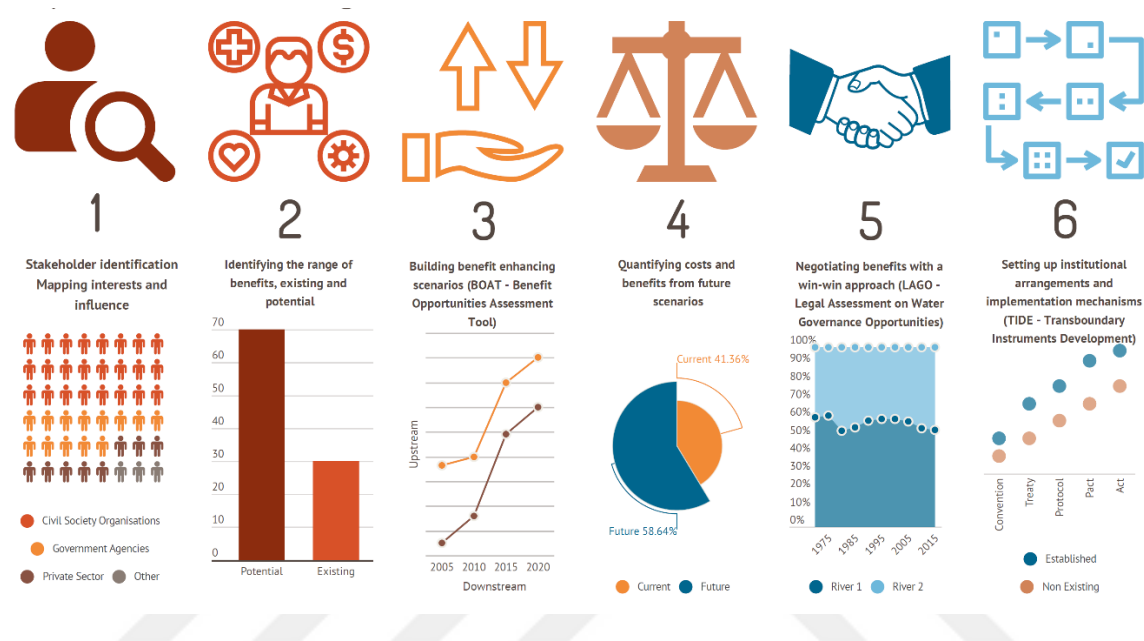
but can include money transfers, granting water use rights, financing investments, or providing unrelated goods and services (Sadoff and Grey 2002). Using a hydro-economic model, Jalilov researched economic benefits in various scenarios for agricultural and energy production and tried to explain how to use benefit sharing arrangements to facilitate cross-border cooperation. According to the scenarios, the total benefit in the field of energy and agriculture in the Amu Darya basin in the Central Asian region can be increased. However, in these scenarios, the sustainability of cooperation depends on the implementation of various compensation mechanisms, as some countries should give up the maximum benefit they can achieve. Energy bartering and monetary payments are given as examples of compensation mechanism (Jalilov, 2015). Soliev et al., (2018) highlights the challenges related to the originally perceived as beneficial compensation mechanisms (water swaps) within one basin and long-term cost implications. There is a need for revision of benefit sharing agreements to allow adaptation to new challenges.

In this benefit sharing mechanism, sometimes profits and losses may not be fully shared equally. But when the entire system is governed by a river basin authority, inequalities are minimized and all stakeholders get the maximum benefit they can reach. The economically efficient allocation of water is not necessarily equitable (Arjoon et al., 2016).

The traditional approach to estimating the economic benefits of cooperation relies on hydro-economic modelling (Arjoon et al., 2016; Teasley and McKinney, 2011). According to these studies, the common benefit obtained from each cooperation at various levels and for different purposes is economic benefits (benefits from the river). The World Development Report (2009) highlights that the inclusion of institutions and infrastructure services in economic integration is the most efficient way to achieve long-term benefits (Granit et al., 2012).

International Union for Conservation to Nature (IUCN)’s Global Water Program has developed a Six-Step Framework (Table 2) to be able to operationalize the benefit sharing approach in river basins.

Table 2: Six Steps to Benefit Sharing in the River Basins



Source: (IUCN, 2019).

3.2. Assessing the Benefits of Transboundary Water Cooperation

Benefit assessment is useful in informing new options, evaluating past options, and communicating new decisions. Approaches to assessment will also differ, as the types of benefits of transboundary water cooperation vary widely. Many, if not all, benefits are subject to a quantitative evaluation. Only a few studies have evaluated the monetary value of the benefits (UNECE, 2015). Thus, benefit sharing mechanisms can take monetary and

non-monetary forms, including revenue sharing, interest sharing, tax preferences, sharing of infrastructure expenditures and so on (Ze et al., 2017).

In literature, it has been tried to evaluate the benefits in water basins by using many ways. One of these is systems perspective, which is used to understand rural and urban regions, changing water use patterns and the redistribution of benefits and costs associated with it across multiple time scales. In this perspective, compensation mechanisms are designed to share benefits with the donor site (Garrick et al., 2019). Another method is Static game and numerical analysis. With this method, the benefit sharing mechanism in the Walter River basin located between Burkina Faso and Ghana in Africa was examined, and it was concluded that in this mechanism, if Burkina Faso uses discounted hydroelectricity as compensation, the water consumption of hydroelectric power plants will be limited and Ghana will reach the water it needs in agriculture (Ze et al., 2017).

Efficiency analysis has also been another preferred method for evaluating the net benefits that can be obtained in water resources. With this method, the changing economic benefits for the stakeholders in cases where water resources are used in hydroelectric power generation or in the agricultural sector are analyzed (Arjoon et al., 2016; Teasley and McKinney, 2011; Ze et al., 2017).

On the other hand; Soliev and Theesfeld (2020) examined benefit sharing in two ways: status quo benefit sharing and constructive benefit sharing. According to them; In status quo benefit sharing, existing benefits are evaluated as the amount of water sharing. Fair access to environmental resources and fair sharing of the benefits derived from their use are the main problems in status quo benefit sharing. Constructive benefit sharing, proposed by Soliev and Theesfeld (2020), claims that the benefits to be derived from the

use and allocation of water should be utilized. In this approach, cooperation established in one area can be extended to other areas to develop and increase benefits.

3.3. A Synopsis: Value of Benefit Sharing Approach in the Central Asia Case

As it is known, a cooperation was established between the lower riparian and the upper riparian partly on the energy-irrigation axis during the Soviet period. This cooperation was based on the upstream riparian's (Kyrgyzstan, Tajikistan) directing the water flow to the downstream riparian's (Kazakhstan, Uzbekistan, Turkmenistan) for cotton production in summer and spring, and the downstream riparian's supplying natural gas and coal to the upstream riparian for energy production in winter. Because while the downstream riparian needed water resources for agriculture in the summer months, the upstream riparian needed energy resources in the winter (Yıldız, 2019; Janusz-Pawletta & Gubaidullina, 2015; Pohl et al., 2017; Waśkiel, 2018) Although there were no current administrative borders during the Soviet period, this cooperation can be considered as the first example of the benefit sharing mechanism in Central Asia. The upper riparian could not produce the hydroelectric energy they needed, as they diverted the water flow downwards during the summer and spring months. This situation can be considered as one of the costs of the benefit sharing mechanism. This cost was compensated by sending Turkmen, Uzbek natural gas and Kazakh coal to Kyrgyzstan and Tajikistan to meet the increasing energy needs in winter and autumn. The benefits of this cooperation can be listed as follows: 1. Kazakhstan, Uzbekistan and Turkmenistan have access to the water

resource necessary for cotton production. 2. Kyrgyzstan and Tajikistan have access to the energy source they need without the investment cost for hydroelectric energy.

With the disintegration of the USSR government in 1991, independent Central Asian states were established and the cooperation in the energy-irrigation axis established during the Soviet period was not continued. As it is known, among the reasons why this cooperation could not be maintained, downstream states do not want to provide energy resources such as coal and natural gas to the upstream states in exchange for water due to rising energy prices and the upstream states want to use their water resources for hydroelectric energy production (Yıldız, 2019; Pohl et al., 2017). On the other hand, Central Asian states have not completely abandoned cooperation on water resources and have been involved in many regional and international water management mechanisms. These are ICWC, two inter-states Bodies for Basin Water Management: BVO Amu Darya and BVO Syr Darya, SIC, IFAS, EurAsEC, SPECA (Burghart & Sabonis-Helf, 2004; Horsman, 2001; Libert, 2008; Sojamo, 2008). These established mechanisms have tried to remove common water resources from being a subject of conflict. With the agreements made, it was tried to share the water in terms of quantity, but these sharing plans could not be implemented sufficiently as a result of the adverse impacts of increasing urbanization, population and climate change. Countries ignored existing pressures and blamed each other for not having access to sufficient water (ICG, 2014).

Another reason why the intergovernmental and international organizations established in the region cannot provide adequate solutions to the existing water problems is that nation states consider water resources as their own national issue and want to implement only their own policies on transboundary water resources. In particular, Uzbekistan, which is in a stronger position economically and politically in the region compared to other Central Asian states, has had a say in the management of transboundary

water resources in Central Asia for many years (Agayeva, 2017; Soliev & Theesfeld, 2020). However, the administration in Uzbekistan changed after Sevkhet Mirziyoyev won the elections in December 2016 and it was observed that the new administration adopted a more moderate policy in its relations with its neighbors (Soliev & Theesfeld, 2020; S. Xenarios, personal communication, March 22, 2021; Waškiel, 2018). It is expected that this policy change will improve cooperation in transboundary water resources and enable countries to build trust with each other.

With the changing conditions, it is necessary to seek new ways to solve the problems and conflicts in transboundary water resources in Central Asia. Policy change adopted by Uzbekistan and increasing pressures on water resources encourage the establishment of potential institutional and innovative collaborations in the region. In today's transboundary waters discourse, the concept of "benefit sharing" is getting more and more attention. It is argued that focusing on the sharing of benefits in the Amu Darya and Syr Darya basins will both contribute to cooperation and ensure that each stakeholder benefits in some way (Jagerskog and Lundqvist, 2006). Pohl et al., (2017), analyzed a monetary value of both the direct and indirect impacts of inadequate transboundary cooperation on water management in the Central Asia. They analyzed cost of inaction and future benefits of water cooperation for each Central Asian state and regionally and concluded that transboundary water cooperation is an opportunity for development on all sides.

4. IMPLEMENTING THE BENEFIT SHARING APPROACH IN THE TRANSBOUNDARY RIVER BASINS

The application of the benefit sharing approach on water resources in the world is a relatively new issue. However, equitable and reasonable development of water resources and effective protection of the environment from an ecological perspective will be possible with the implementation of benefit sharing mechanisms in the basins.

In this section, firstly, how the benefit sharing mechanism is applied on different water resources in the world will be explained with examples. In the second part, it will be examined whether benefit sharing mechanisms are applicable on transboundary water resources in the case study region and what benefits and costs will be for the countries of the region if they are implemented. In addition, benefit sharing mechanisms applied in transboundary water basins in Central Asia will be summarized. Another issue to be examined is how the total benefits that countries will gain in the event of the implementation of the benefit sharing mechanism will change and whether the cooperation established in a certain area will help to spread to other areas.

4.1. HOW IS THE BENEFIT SHARING APPROACH APPLIED TO DIFFERENT WATER RESOURCES IN THE WORLD?

The first applications of the benefit sharing approach on water resources were mostly specific to dams. It is not sufficient to apply the benefit sharing approach only to dams. In fact, in all transboundary river basins, it should be implemented in a holistic way, covering all uses and all stakeholders, without focusing on a specific use of water. Of course, it is not possible to implement this idea, which can be considered as idealist, all at once and perfectly. However, the more work is done in this area, the more the total benefit will increase, and the sustainable management of water resources, which are under pressure and in a difficult situation due to many factors, can be realized.

In this section, reservoirs on the Senegal, Orange-Senqu, Zambezi Rivers, which represent different hydro-political and incentive structures, are examined as a case study. In each case, cross-border benefit sharing mechanism and institutional arrangements of the various states associated with the dams were examined. These cases show how important it is to establish benefit sharing mechanisms in transboundary rivers.

Benefit Sharing Application on the Senegal River

The states of Senegal, Mali and Mauritania, which share the Senegal river basin, do not have enough dams for hydroelectricity, nor do they have sufficient financial capacity to build dams on their own. All these elements necessitate joint management of

the basin. This planned joint management should be based on a benefit sharing mechanism where infrastructure costs are shared in proportion to the expected flood control, food security, irrigation, navigation and hydroelectric benefits (Changchun, Yanfang & Wenjun, 2019; Grossmann, 30 May 2012; Hensengerth, Dombrowsky & Scheumann, 2012; Kramer and Pohl, 2016).



Figure 9. Map of River Senegal

Source: (<https://fortuneofafrica.com/wp-content/uploads/2016/01/river-senegal.jpg>).

With all these incentives three of Senegal River's riparian states, namely Senegal, Mauritania and Mali created "*the Organization pour la mise en valeur du Fleuve Sénégal (OMVS)*" in 1972 (Hensengerth et al., 2012). At its first meeting in 1972, it was decided to construct two more dams: an upstream dam in Manantali for flow regulation, hydroelectric generation and double-crop irrigation, and a delta dam in Diama for combating salt intrusion and for irrigation purposes. Two dams were completed in the 1980s. The benefit sharing mechanism agreed upon by the member states is as follows:

dams and other infrastructures belong to OMVS member states; co-owners guarantee the repayment of loans to OMVS; Investment and operating expenses are allocated to the partners according to the utilization of the benefits to be obtained from the dams; To define the sharing of costs, a method called “clé de repartition” was developed by Utah State University at the time (Hensengerth et al., 2012; Kramer and Pohl, 2016). For example, the electricity produced was distributed according to the investment rates of the three countries in the project. Thus, Mali, Mauritania and Senegal received respectively 52%, 15% and 33% of the electricity produced (Changchun, Yanfang & Wenjun, 2019; Hensengerth et al., 2012; Kramer and Pohl, 2016).

The allocation method developed by Utah State University for the construction costs and benefits of the Manantali and Diama reservoirs is exemplary in the practical application of the benefit sharing approach. When calculating costs and benefits, firstly irrigation, energy production and navigation gains are tried to be estimated. Irrigation gains were calculated according to the irrigation area of the three countries and the crop pattern desired to be planted. In the calculation of electricity production gains; heating and electricity prices, electricity production volume, historical average flows are taken into account. Finally, the transport earnings were calculated according to the earnings of equal goods transported in the same period as by road and rail (Changchun et al., 2019). As a result of the calculations, the percentage of costs allocated for Mali was 35.3%, 22.6% for Mauritania and 42.1% for Senegal (Changchun et al., 2019; Hensengerth et al., 2012; Kramer and Pohl, 2016).

When we look at the water use purposes of the countries in the Senegal river basin, it can be seen that Mali is more focused on Atlantic Ocean shipping and power generation, whilst Senegal and Mauritania are more focused on irrigation and power production. In the benefit and cost sharing ratios, it can be seen that the countries have achieved their

wishes to a large extent. Senegal (58%) received the most irrigation benefits, while Mali (82%, 52%, respectively) received the shipping and power generation benefits. Mauritania, on the other hand, has achieved many benefits in the field of irrigation (Changchun et al., 2019; Hensengerth et al., 2012; Kramer and Pohl, 2016).

In the case of the Senegal river, a fair cost-sharing agreement has been made, steps have been taken to contribute to international cooperation and economic development in the Senegal river basin, and mitigation measures have been implemented to address environmental and social impacts. However, there are criticisms that the multiple objectives of dam projects (irrigation, hydropower and navigation) are not fully achieved due to financial constraints, implementation gaps and poor planning. It has also been claimed that environmental and social impacts at the local level are not sufficiently taken into account in project planning (Kramer and Pohl, 2016).

Benefit Sharing Application on the Orange-Senqu River Basin

Originating in the Lesotho Highlands, the Orange River flows westward to form the border between South Africa and Namibia, then turns south and empties into the Atlantic Ocean. In the Kingdom of Lesotho, which receives an annual precipitation of 700-1000 mm, water resources are rich according to the region. In contrast, the average annual precipitation in South Africa is only 500 mm and water resources are scarce (Changchun et al., 2019).

To address these issues, the Lesotho Highlands Water Project (LHWP) Agreement was signed in 1986 between the two governments. LHWP aimed to construct a dam on

the Orange River in Lesotho and canalize water from the Orange River to Gauteng province. After the project is completed, it is aimed to provide hydroelectricity to Lesotho and 70 m³/h water to South Africa. South Africa will be responsible for water diversion construction costs and maintenance costs, whilst Lesotho will be responsible for hydroelectric power plant construction and operation and maintenance costs. So, 56% of the LHWP's net benefits are planned to go to Lesotho and 44% of remaining benefits to South Africa the phase II project agreement of the project, which is planned to be completed in four phases, was signed in 2011 (Changchun et al., 2019; Hensengerth et al., 2012).

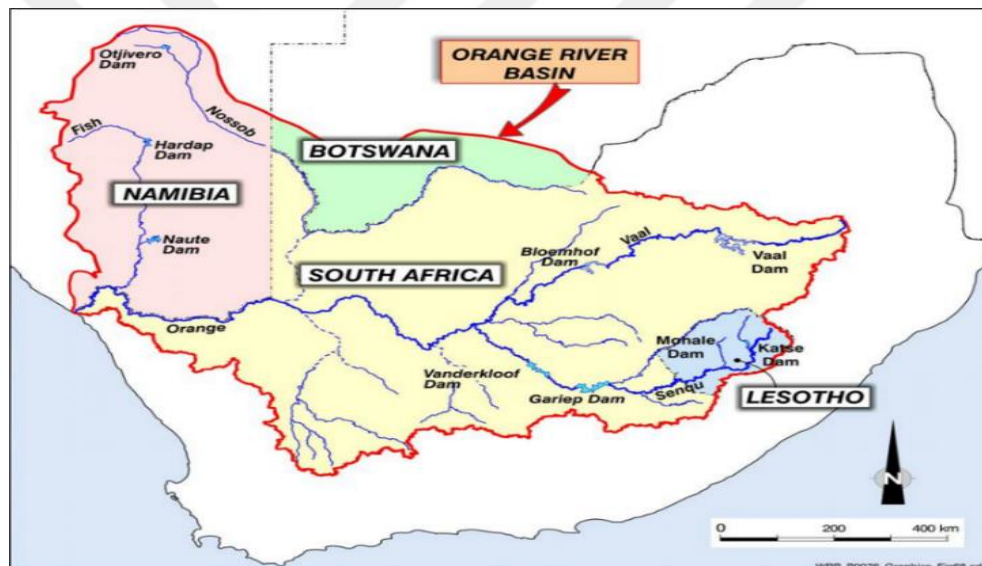


Figure 10: Map of the Orange-Senqu River Basin

Source: (<https://www.rvccdata.org/climate-data/water/>).

In the Lesotho Highlands Water Project (LHWP) on Orange-Senqu River, downstream state tried to save on water transfer costs by constructing a dam in the upstream state. And, the benefit sharing mechanism is as follows: downstream South Africa pays investment and operating costs and external costs of storage and transfer of waters from Lesotho; upstream Lesotho receives in-kind hydroelectric benefits; The net benefits of cooperation compared to unilateral action are shared (Grossmann, 30 May

2012; Hensengerth et al., 2012). So, it involves water purchasing regulations and financial regulations (Soliev & Theesfeld, 2020).

The phase II project agreement of the project, which is planned to be completed in four phases, was signed in 2011 (Changchun et al., 2019). Although the project remains important for the riparian states, it has been criticized for the environmental regression caused by the dam and the inability to integrate local people and stakeholders in the established cooperation mechanism. It has been criticized for its negative environmental impacts and its inability to integrate local people and stakeholders (Hensengerth et al., 2012). Thereupon, in 1998, a Memorandum was signed in Lesotho to ensure the participation by interest groups in the management and to safeguard the badly affected communities and people (Hensengerth et al., 2012). The fact that social and environmental problems are taken into account is of critical importance for a holistic solution of the problems.

Benefit Sharing Application on the Zambezi River Basin

The collaborative work in the Zambezi River basin is known to have begun in the beginning of 1950s, when Northern Rhodesia (Zambia) and Southern Rhodesia (Zimbabwe) were under colonial rule and merged into a federation with Nyasaland (Malawi) (Hensengerth et al., 2012). At that time, Zambia needed electric power for its copper mines and Southern Rhodesia needed electric power for its burgeoning industry, agriculture and mining sectors, so the Federation planned a hydroelectric generation project. As part of this project, Kariba Dam, constructed along a 760 km strip where

Zambezi River forms a border between the present states of Zimbabwe and Zambia, has two power plants with an installed capacity of 1,266 MW (600 MW in Zambia, 666 MW in Zimbabwe), providing 34 percent of the total electricity consumed in the Zambia and Zimbabwe (Hensengerth et al., 2012).

With the dissolution of the Federation in 1963 and the declaration of independence of Zambia and Zimbabwe, a new phase was entered in the management of the project. In the 1963, Northern and Southern Rhodesia founded the Central African Energy Company (CAPCO) to fulfil the civil works and operate system, including electricity production and transmission. The Company, controlled by both countries, was abolished in 1987 due to disagreements and was replaced by the Zambezi River Authority (ZRA) (Hensengerth et al., 2012).



Figure 11. Map of Kariba Dam on the Zambezi Basin

Source: (<https://www.victoriafalls-guide.net/zambezi-river.html>).

The Kariba Dam was built on the Zambezi River Basin, which forms a border between countries of Zimbabwe and Zambia. The countries of Zambia and Zimbabwe have adopted a benefit sharing mechanism where benefits and costs are shared equally.

Kariba Dam is operated by ZRA. In this mechanism, joint investment is made but benefits are allocated according to investment shares (Grossmann, 30 May 2012; Hensengerth et al., 2012).

As with every project, the benefit sharing mechanism in the Kariba dam has its shortcomings. The Kariba dam project was criticized on the grounds that it did not consider the social impacts while it was being implemented. The dam inundated the Zambezi valley, inhabited by Tongan people on both sides of the river. The connection between the northern and southern regions, where the people lived, was broken, and the Tongan people, who were engaged in agriculture on fertile lands before, were settled in areas that were not very fertile for agriculture (Hensengerth et al., 2012). If the views of the local people were sought while the project was being implemented, perhaps the project could be implemented in a place where fewer people could be harmed. Or, it would be possible to ensure that the benefit sharing mechanism is applied to all stakeholders by covering the damage suffered by the local people due to the project.

4.2. HOW CAN THE BENEFIT SHARING MECHANISMS BE APPLIED TO THE WATER RESOURCES IN CENTRAL ASIA?

The benefit sharing mechanism has mostly found application in dams. There is no reason why a benefit sharing mechanism on dams should not be established in Central Asia. It will be seen that the dams can actually be a benefit for all the riparian if they are scrutinized in a case examined in the Central Asian region. Tajikistan's construction of the Rogun hydroelectric power plant in the Amu Darya basin to ensure energy security

was not welcomed by the lower riparian states who thought their agricultural production would be compromised. However, Jalilov's research on various scenarios using a hydro-economic model has shown that the Rogun dam has the potential to increase overall benefit in all riparian states (Jalilov, 2015). Although there is no collaboration based on benefit sharing in the basin yet, it is a good example in terms of showing how the results can change thanks to the different point of view of water resources.

It is claimed that Kyrgyzstan and Tajikistan have enhanced only a small part of their hydroelectric production capacity (Soliev & Theesfeld, 2020). If these countries want to deliver the hydroelectric energy they produce to the domestic market of Central Asia or to the markets in Pakistan, Iran and India, they have to make an agreement with Uzbekistan, Turkmenistan and Afghanistan. Because energy transmission lines will pass through these countries (Soliev & Theesfeld, 2020). We can list the incentives in this cooperation as follows: If the reservoir is built collectively, the construction of the reservoir can be completed faster and less costly by sharing the costs. During the USSR period, the maintenance of the dams was done collectively at certain periods. The technical expertise and financial power gained on dams were dispersed among the countries with the disintegration of the Soviet Union (Agayeva, 2017). So, another incentive for potential collaboration is the sharing of technical expertise.

Varis (2014) attributes the basis of water problems experienced in Central Asia to the unsustainable overuse of water resources. If it continues in this way, he argues that the security of Central Asia will be endangered and says “Fixing the problem will mean developing regional industries that are less water intensive and more profitable than agriculture, by tapping human potential rather than natural resources”. For example, because of Turkmenistan's dry climate and poor soils, 2,000-4,000 m³ of irrigation water is required to produce one ton of wheat, whereas in nearby northern Kazakhstan,

agriculture can be practiced without irrigation, thanks to adequate rainfall and conditions (Varis, 2014). In other words, the amount of virtual water⁶ required for wheat production in Kazakhstan is less than in Turkmenistan. The possible benefits of a benefit-sharing agreement between Turkmenistan and Kazakhstan on wheat production can be listed as follows, according to the types of benefits developed by Sadoff and Grey (2002 and 2005) (In case of production in Kazakhstan):

- ❖ By preventing unsustainable use of water, ecosystem damage is reduced (benefits to the river)
- ❖ Kazakhstan can gain extra economic profit by exporting wheat (benefits from the river)
- ❖ Turkmenistan can gain economic benefits by directing its investments to more profitable and productive areas. By importing wheat from Kazakhstan, Turkmenistan saves water and does not waste its resources for an inefficient economic endeavor (benefits from the river)
- ❖ Water consumption is reduced, providing coverage for future generations (cost reduced because of the river)
- ❖ This cooperation, which is established more in the economic aspect, can increase the communication between the countries and pave the way for more cooperation opportunities in other fields (political, social, cultural, etc.) (benefits beyond the water sector due to enhanced cooperation between the parties in the basin)

⁶ For more information Bhaduri et al. (2014) and Hoekstra (2003).

Benefit sharing mechanism in agriculture is critical for the sustainable use of water resources. As it is known, agriculture is the sector that uses the most water in the world and in Central Asia. In Central Asia, a lot of water is used especially for cotton production. Kazakhstan, Uzbekistan and Turkmenistan want to use their transboundary water resources for agriculture, while Tajikistan and Kyrgyzstan's desire to use their water resources for hydroelectric energy causes conflict. On the other hand, the unsustainable use of water resources causes major environmental disasters, as in the Aral Sea, and this situation causes serious damage to countries in the long run. Benefit sharing mechanisms are considered as a method to solve these problems (Soliev & Theesfeld, 2020).

The potential benefits of cooperation in the field of agriculture could be: The quality of degraded soil and water resources can be restored. The loss of water resources through leakage can be prevented by renewing the mostly deformed outdated infrastructure. By increasing the efficiency in irrigation methods, more agricultural yield can be obtained with less water in less area. Increasing efficiency in irrigation contributes to the food security of countries by helping to meet the increasing food demand. It also contributes to water security by preventing the rapid depletion of water resources. Using less water in agriculture can make pollution from pesticides increase more slowly, thereby reducing environmental degradation. Another benefit is that as a result of increased irrigation efficiency, the conflict between downstream and upstream countries in the allocation of water can be alleviated. Incentives in this cooperation can be as follows, countries can access each other's agricultural markets and international markets more easily. They can jointly finance the renovation of outdated infrastructure and irrigation systems, which is ideal for dealing with a situation that is very difficult for a country to do on its own. Instead of supporting individual projects in divided basins, considering the

basin as a whole and producing projects for it will encourage international investment to flow to the region.

Apart from the agriculture and hydropower sectors, cooperation for common water resources is one of the overlooked issues in Central Asia. The reallocation of common water resources to other areas can increase net benefits. It is said that higher economic returns from water can be obtained in the industry and service sectors compared to the agriculture sector (Soliev & Threesfeld, 2020). Water resources are also used in areas such as fishing, river and lake tourism and transportation. The benefits and costs that will arise from the cooperation to be made in these areas are not clear. However, possible cooperation in these areas will increase the net benefits that can be obtained in transboundary water resources.

Studies in the context of benefit sharing in Central Asia have mostly been economically focused, calculating how more benefits can be obtained from agriculture or hydroelectric power generation. However, the ecological costs of the collaborations are often not calculated and these costs are not shared. The involvement of local actors in the benefit sharing mechanism has been ignored. As a result, there have been very serious environmental degradations in the long term and it has not been possible to implement water management with all beneficiaries. Soliev and Theesfeld (2020) also stated that choosing short-term economic policies may lead to systemic failures in ensuring fair sharing of benefits and sustainability of natural resource use. Therefore, the calculation and sharing of ecological costs in the future benefit sharing mechanisms and the inclusion of local actors in the benefit sharing mechanism are important for the sustainable management of water (Ze et al., 2017).

Due to increasing urbanization and population, the amount of waste produced in cities is increasing day by day. Water resources are polluted with both these wastes and

the contaminated wastes produced by the agriculture and industry sectors. Protecting water resources from further pollution and rehabilitating existing pollution for reuse are essential for a sustainable life. Establishing joint waste water treatment centers, waste treatment plants or recycling centers in transboundary water resources in Central Asia will be beneficial for the states of the region in many respects. To establish these treatment and recycling centers require investments in Central Asia that are difficult for a single state to finance. The establishment of centers will be facilitated by sharing the investment costs and the technical expertise of the countries. After its treatment, more water resources will be available and this resource will be used in different sectors. Sustainability will be ensured in the long term by jointly protecting the environment and water resources.

Afghanistan, as it is known, is the upstream riparian of the Amu Darya, but it was not involved in the agreements and regional cooperation in Central Asia. In this case, the political instability of the country was also effective. This situation needs to change in order to manage common water resources in a holistic way and to ensure sustainability in the basins (Sadeqinazhad et al., 2018). If the political situation in Afghanistan changes, Afghanistan will claim on the grounds that it is not a fair and equitable use. If Afghanistan is included in the benefit sharing mechanisms, this problem will be solved and the region will become more stable. Another benefit that can be obtained is that more efficiency can be obtained in agriculture by using the virgin and fertile agricultural lands in Afghanistan. On the other hand, water resources can be protected by preventing water pollution that started in Afghanistan. By renewing the infrastructure in Afghanistan and abandoning inefficient irrigation methods in agriculture, inefficient use of water resources can be prevented and the amount of usable water in the region can be increased.

In this study, it was argued that transboundary water resources in Central Asia should be managed regionally. However, while conducting regional studies, it should not

be overlooked what countries have done and what they should do for water management within themselves. Water resources management to ensure sustainability; should be evaluated at all levels: local, watershed, national, intergovernmental, regional and international. In particular, steps such as increasing water efficiency, preventing water losses, applying modern irrigation methods, and adopting basin-based water management within each country will help improve relations between the countries in the region. Improving each country's own water management will increase the net benefit from water resources. For example, in the light of Sadoff and Grey (2002 and 2005) methodology, the benefits that can be obtained in case of increasing water efficiency, preventing water loss and applying modern irrigation methods in Uzbekistan can be listed as follows:

- ❖ By taking these steps, the vital water required for the ecosystem can be released to nature and sustainable life can be provided (increasing benefits to the river).
- ❖ More water to be released to nature can prevent further desertification. In this way, human-induced climate change can be slowed down (reducing costs because of river and increasing benefits from the river).
- ❖ Especially with the prevention of loss and leakage in water resources, the drinking water and sanitation needs of people will be met more easily. In this way, the possible negative effects of increasing urbanization and population can be minimized. This will contribute to the development of water security in the country (reducing costs because of river and increasing benefits from the river).
- ❖ With the application of modern irrigation methods, the amount of virtual water used especially for cotton farming can be reduced. In this way, excessive virtual water trade due to cotton exports of Uzbekistan will decrease (reducing costs because of river). As a result, the sustainable management of water resources in Uzbekistan and the region will become better (increasing benefits from the river).

- ❖ As it is known, Uzbekistan supplies about 80% of its water use from transboundary rivers (Water Yearbook, 2020). The efficient use of water will reduce the tension that Uzbekistan has with its neighbors for the use of water in agriculture. This situation will contribute to regional peace (reducing costs because of river and increasing benefits from the river).
- ❖ The reduction of international tensions with good water management practices in Uzbekistan will facilitate cooperation between countries in different fields (increasing benefits beyond the river).

All these discussions aside, there are disagreements about the applicability of the benefit sharing approach in Central Asia, as in every opinion. Contrary to the general positive view, Xenarios argues that the benefit sharing approach is an oversimplified concept and remains too abstract to address the transboundary complexity in Central Asia, requiring more detail on benefits aspects and sharing between countries (Xenarios, personal communication, 2021, March 22). Of course, more work is needed to implement benefit sharing in the region. In order to establish benefit sharing mechanisms, what the benefits and costs will be for all water using sectors, what the benefits and costs will be for each country, what kind of benefits can be obtained regionally should be defined for short-term and long-term periods. Monitoring and evaluation studies should be carried out on how to implement the benefit sharing mechanisms to be established, and various management mechanisms should be established. However, with these detailed studies, it will be possible for Central Asian countries to overcome their past distrust towards each other and to manage transboundary water resources in a sustainable, equitable and fair manner. Studies in Senegal, Orange-Senqu, Zambezi River basins prove that benefit sharing mechanisms to be established on various issues can be successful.

CONCLUSION AND FUTURE WORKS

In this study, the problems seen in transboundary water resources in Central Asia were examined, and how these problems were evaluated by countries and regionally. There are many debates in literature about whether transboundary water resources cause conflict or cooperation. This issue has also been discussed in the context of Central Asia, and the views of scholars who both see it as a source of conflict and think that it can lead to cooperation are included. This thesis argues that transboundary water problems in Central Asia do not prevent cooperation and may even lead to cooperation in different fields. The execution of these cooperation will be easier with the establishment of benefit sharing mechanisms between countries.

In the second part of the thesis, it is discussed what the benefit sharing approach is and whether there are applications in Central Asia and in which other areas it can be applied. As a result, it has been concluded that the benefit sharing approach has a critical importance in solving the problems experienced or to be experienced in transboundary water resources in Central Asia. Problems such as the energy-water dilemma, food security, problems caused by urbanization and population growth, and the bad effects of climate change can be solved or reduced by various benefit sharing mechanisms. The adverse effects of the environmental disaster in the Aral Sea, climate change and urbanization can be reduced by a benefit-sharing mechanism created and implemented jointly by the countries, and further deepening of the crisis can be prevented.

As a result, this study aimed to explain the current problems in transboundary water resources in the context of Central Asia and to show how to combat these problems with benefit sharing mechanisms. However, this study is only a preliminary one and forms

the basis for future studies. There are not many studies on the application areas of the benefit sharing approach other than dams. In order for this approach to be applied systematically in transboundary water resources, it is necessary to quantify and calculate the benefits and costs for the benefit mechanisms to be established in different water use sectors. Since the basin in each region has its own characteristics, these calculations should be made by considering all water users on a basin basis. In addition, information studies should be carried out in order to prefer the benefit sharing method in transboundary water resources. Countries should be encouraged to create water management plans in basins and to implement these plans with cooperation between countries. Studies on the future of climate change, increasing urbanization, and various environmental destructions should be increased, and public awareness should be raised on this issue.

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ABSTRACT

This study aims to define the problems experienced in the transboundary river basins in the Central Asian region and to offer solutions to the problems related to the management of transboundary water resources throughout the region within the framework of the benefit sharing approach. In studies conducted in literature, water problems in Central Asia have been evaluated as a factor that increases conflict between countries. However, this study evaluates current problems such as the impact of climate change and urbanization on water resources, water management problems in Central Asia and the Aral Sea environmental disaster as a part of the solution. The benefit sharing approach is used to explain possible solutions. This approach, which is becoming increasingly important in the sustainable management of transboundary water resources, aims to establish cooperation mechanisms where benefits and costs are shared among water users.

In conclusion, more studies are needed to solve the problems experienced in transboundary water resources in Central Asia. The establishment of regional and international cooperation and various benefit sharing mechanisms between countries will help to solve these problems. If water users act alone, the benefit will be less than the benefit obtained as a result of cooperation. Increasing the benefits obtained from water resources and managing water resources in an efficient, fair and sustainable way can be possible with benefit sharing mechanisms to be established in river basins.

Keywords: Syr Darya River, Amu Darya River, Transboundary River Basins, Central Asian Water Resources, Benefit Sharing Approach

ÖZ

Bu çalışma, Orta Asya bölgesindeki sınıraşan su havzalarında yaşanan sorunları tanımlamayı ve bölge genelinde sınıraşan su kaynaklarının yönetimine ilişkin sorunlara fayda paylaşımı yaklaşımı çerçevesinde çözüm önerileri sunmayı amaçlamaktadır. Literatürde yapılan çalışmalarda, Orta Asya'daki su sorunları daha çok ülkeler arasında çatışmayı arttıran bir faktör olarak değerlendirilmiştir. Ancak bu çalışma, iklim değişikliği ve kentleşmenin su kaynakları üzerindeki etkisi, Orta Asya'daki su yönetimi sorunları ve Aral Denizi çevre felaketi gibi güncel sorunları çözümün bir parçası olarak değerlendirmektedir. Olası çözümleri açıklamak için fayda paylaşımı yaklaşımı kullanılmaktadır. Sınıraşan su kaynaklarının sürdürülebilir yönetiminde önemi giderek artan bu yaklaşım, su kullanıcıları arasında fayda ve maliyetlerin paylaşıldığı iş birliği mekanizmalarının kurulmasını amaçlamaktadır.

Sonuç olarak, Orta Asya'da sınıraşan su kaynaklarında yaşanan sorunların çözülmesi için daha fazla çalışma yapılmasına ihtiyaç vardır. Ülkeler arasında bölgesel ve uluslararası iş birlikleri ile çeşitli fayda paylaşımı mekanizmalarının kurulması bu sorunların çözümüne yardımcı olacaktır. Su kullanıcıların yalnız başlarına hareket etmeleri halinde elde edecekleri fayda, iş birliği neticesinde elde edilecek faydadan daha az olacaktır. Su kaynaklarından elde edilen faydaların artırılması, su kaynaklarının verimli, adil ve sürdürülebilir bir şekilde yönetilmesi nehir havzalarında kurulacak fayda paylaşımı mekanizmaları ile mümkün olabilir.

Anahtar Sözcükler: Seyhun Nehri, Ceyhun Nehri, Sınıraşan Nehir Havzaları, Orta Asya Su Kaynakları, Fayda Paylaşımı Yaklaşımı