

Article

Transboundary Waters and Their Status in Today's Water-Scarce World

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Abstract: Approximately 40% of the world's population lives in transboundary river and lake basins, accounting for an estimated 60% of global freshwater flow. These shared water resources support the livelihoods of more than 3 billion people. Today, with the decrease in the amount of water in the world, the dispute over transboundary waters has increased. In this research, using library studies (including articles, books, reliable reports from the United Nations and other relevant organizations, etc.), problems of the most important transboundary waters have been investigated. Because transboundary water problems are widespread all over the world, solutions by researchers, relevant organizations such as UN sub-organizations, and politicians have been suggested. In this research, emphasizing the cases of diplomacy and hydro-hegemony, risk, water-energy-food nexus, and 5P, this issue is investigated. Finally, by examining the most important problems of transboundary waters all over the world, as well as the most critical cases and using successful experiences in the world in solving transboundary water crises, peaceful proposals to solve such problems and reach sustainable solutions in order to reach the Sustainable Development Goals (SDGs) have been proposed depending on the regional and country conditions of each of these basins.

Keywords: water scarcity; transboundary waters; water cooperation; water conflict; water diplomacy; sustainable development; SDGs



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1. Introduction

With the increase in population in recent centuries, the demand for water has increased both for drinking and for industrial, agricultural, and domestic use. At the same time, critical issues, such as climate change, have even reduced the supply of available water [1]. Therefore, due to the imbalance between the supply and demand of water in today's world, the problem of water scarcity is serious. 2.3 billion people live in countries with water stress and 733 billion of them are now dealing with high water stress or its critical state [2]. In addition, because the nexus of water, food, and energy are intertwined, with the weakness of one, the others will also be weakened, with the lack of water, there is a lack of food, and with a lack of water security, food security is also at risk [3]. The importance of water scarcity and water supply is so critical that it has become a fundamental issue in sustainable development [4].

Surface transboundary waters (consisting of rivers and lakes) have covered more than half of our world, and 40% of people live in these basins. Also, 90% of people live in countries with common basins. Transboundary waters include both surface waters (rivers and lakes) and aquifers, among which 276 transboundary surface water basins and 592 transboundary aquifers have been identified so far [5]. According to these statistical data, it is concluded that special attention should be paid to transboundary waters as one of the main sources in solving the water scarcity problem or preventing the situation

from becoming more acute. Due to the multiplicity of stakeholders (two or more countries involved), transboundary waters have a different status than the internal waters of the countries. In the case of transboundary waters, diplomacy is involved and the issue is drawn to cooperation or conflict between countries [6]. In the meantime, understanding the complexity of the interests of local stakeholders in the issue of transboundary waters and leading it toward management and a sustainable solution is one of the basic duties of governments [7]. In fact, efforts and solutions should be beyond the level of a river basin or underground water, and on a local, social, urban, national, and global scale to ensure water security in the issue of transboundary waters [8]. So far, the number of large-scale violent conflicts has been very low compared with the cooperation that has been carried out over transboundary waters [9]. However, this trend can be changed due to global water scarcity and population growth [10]. Low-level conflict over transboundary waters is common and even reported to be increasing [11].

Of course, within the framework of sustainable development goals (SDGs), the solution is definitely cooperation. There is no general solution for transboundary water management, and depending on its location, status, and basin, a solution can be provided for its management. In any case, there are three dimensions of security, economic development, and the environment which should be considered in the proposed solution in order to provide a sustainable and acceptable solution [12].

In 2000, the Millennium Development Goals (MDGs) were announced by the United Nations and followed by countries. The MDGs had eight goals and were followed from 2000 to 2015. Ultimately, the MDGs were considered the greatest anti-poverty movement [13]. Therefore, the United Nations ensured the effectiveness of such a framework and announced the SDGs in 2015. The SDGs, which are targeted until 2030 (2030 Agenda), have 17 goals, 169 targets, and 248 indicators. The SDGs can be summarized in five pillars, which include people, planet, prosperity, peace, and partnership [5]. Also, the SDGs are placed in three aspects of sustainable development, i.e., environment, economy, and society [14]. Of course, these aspects cannot be separated by clear and decisive borders, just as the SDGs cannot be cultivated in a one-dimensional way and ignore other goals.

Goal 6 (SDG6) is to ensure safe and hygienic drinking water for everyone. This goal, which has eight targets and eleven indicators, deals with the issue of water and sanitation in different ways in its eight targets. Target 6.5 specifically mentions water resources management and considers it to include transboundary cooperation. Indicator 6.5.2 specifically deals with the issue of transboundary basins and international cooperation [13]. Therefore, to examine the issue of transboundary waters in the framework of SDGs, indicator 6.5.2 should be referred to and international cooperation should be pursued.

When looking for a sustainable solution to transboundary water, diplomacy comes into play. A process in which states interact with the goal of avoiding hostilities is called diplomacy [15]. The role of diplomacy with the above definition regarding transboundary waters is to strengthen cooperation [6]. If cooperation does not take place and countries are not willing to cooperate for some reason, it may lead to conflict and even water war in the current water-scarce situation.

The problem of international waters is an origin problem that is viewed from different points of view in different regions of the world. For example, in Europe and North America, the situation is far better than in other regions of the world, including the Middle East [16]. Therefore, in this research, emphasizing the cases of diplomacy and hydro-hegemony, risk, water–energy–food nexus, and 5P, this issue is investigated.

In this research, an attempt will be made to analyze the situation of transboundary waters as accurately as possible to examine their problems, the cooperation or conflict between the countries in each basin, and if the cooperation is happening when examined within the framework of SDGs. For this purpose, in the following, the research materials and methods, which are in the form of library studies, will be described first. Then, the results and discussion about the situation of transboundary waters are expressed in the framework of SDGs. Finally, the conclusion and recommendations for other transboundary

waters whose problems have not yet been fully resolved and cooperation has not been fully implemented are expressed.

2. Methodology

In this research, using library studies (including articles, books, reliable reports from the United Nations and other relevant organizations, etc.), problems of the most important transboundary waters were investigated. Because transboundary water problems are widespread all over the world, solutions by researchers, relevant organizations such as UN sub-organizations such as the United Nations Environment Programme (UNEP), and politicians have been suggested. Therefore, their interconnected study and the preparation of successful policies and cooperation in accordance with indicator 6.5.2, as well as the report and analysis of unsuccessful policies or even leading to conflict, has been the main goal of this research. In the following, SDG6 and indicator 6.5.2 are explained more.

2.1. Indicator 6.5.2

It is mentioned in the UNESCO-IHP report that without transboundary waters cooperation (indicator 6.5.2), it is impossible to achieve sustainable development [5]. Therefore, the importance of indicator 6.5.2, which refers to the issue of transboundary water cooperation, is shown in this section. The current status of indicator 6.5.2 in different countries is shown in Figure 1.

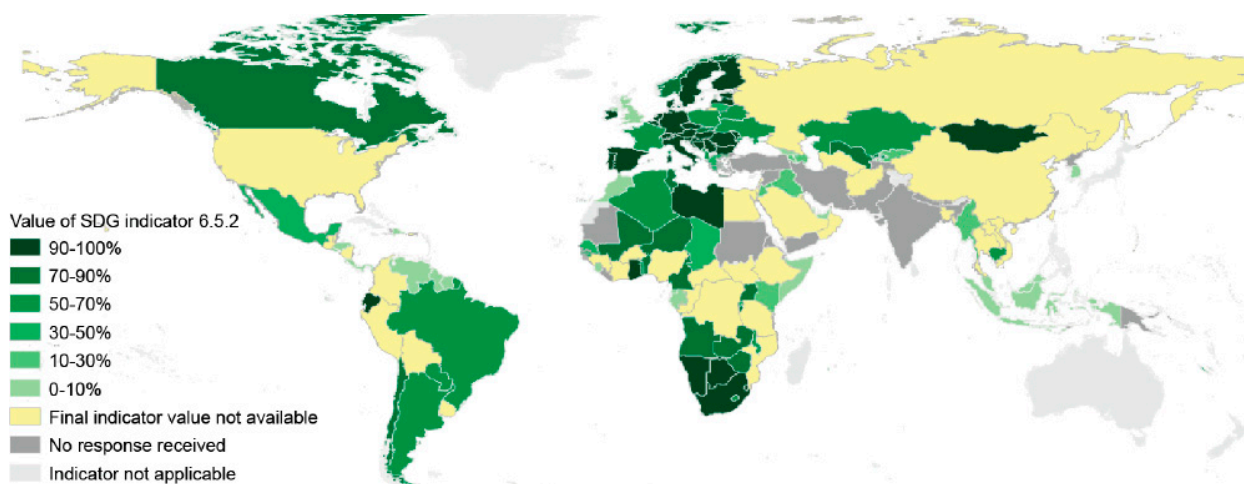


Figure 1. Global map of SDG 6.5.2 indicator value per country [16].

Figure 1 shows how much each country values indicator 6.5.2. As can be seen, this valuation is higher in Europe and North America than in other regions of the world. In the following section, the status of SDG6 and its relationship with other SDGs are examined.

2.2. SDG6

SDGs are established in such a way that they can be achieved at the global, local, and individual levels. At the global level, according to the power of politicians and the tools they have, they can embed resources and smart solutions. At the local level, policies can be implemented, budgets can be set, organizations can be organized, and frameworks defined. At the individual level (people), which includes the private sector, youth, academics, etc., they can put pressure on the implementation of determined policies and demand their implementation [16]. Considering that the earth is a large natural system [17], integrated water resources management (IWRM) is necessary in order to see all aspects of sustainable development in the field of water resources management. According to this point and according to the six targets of SDG6, a table like Table 1 can be set up to connect the targets of SDG6 and targets of other SDGs.

Table 1. SDG6 targets link to targets of other SDGs [5].

SDG6 Targets	Targets of Other SDGs
6.1 Access to water	1.4, 3.1, 3.2, 4.1, 4.2, 5a, 11.1
6.2 Access to sanitation	1.4, 3.1, 3.2, 5a, 11.1
6.3 Water quality	2.4, 7.a, 9.4, 12.4, 14.1, 15.4, 15.5
6.4 Water scarcity	2.4, 7.a, 8.4, 9.4, 15.4, 15.5
6.5 Integrated water resources management	13.2, 15.4, 15.5, 16.1
6.6 Water-related ecosystems	7.2, 15.1, 15.8

Table 1 shows well how SDG6 is related to other SDGs. However, this issue can be seen from another grouping point of view. SDGs that are directly related to water and sanitation and SDGs that are indirectly related to water and sanitation. Regarding SDGs that are directly related to water and sewage, it can be referred to as SDG3, SDG12, and SDG15.

SDG3, which is related to human health, mentions in targets 3.1 and 3.2 that without access to safe water and sanitation systems, human health is at risk. Target 3.3 refers to diseases caused by water. Also, target 3.9 mentions the reduction of illness and deaths caused by water pollution, etc. These items can be seen in targets 6.1, 6.2, and 6.3.

SDG12, which refers to responsible consumption and production, in target 12.4 orders the release of chemicals in waters. This goal includes water quality, which is mentioned in target 6.3. Also, in target 12.6, the disclosure of sustainability information is ordered, which is consistent with target 6.5 and the aforementioned cooperation from the beginning of the paper.

SDG15, which is responsible for the protection of terrestrial ecosystems, including forests, deserts, etc., in targets 15.1, 15.4, 15.5, and 15.8, in different ways orders to protect water resources and ecosystems. How to improve the condition and protection and productivity of these items are in direct contact with target 6.6, which deals with water-related ecosystems.

Other targets of SDGs (SDGs except for SDG3, SDG12, SDG15, and of course SDG6) are indirectly related to water and sanitation. These targets are mentioned in a limited way in Table 1, the detailed explanation of the indirect relationship of each of them is beyond the scope of this research, but for example, in the case of SDG1—which refers to ending poverty—in target 1.4, “basic services” are considered, which can include access to safe water among the basic services [5].

In the next section, the status of some important transboundary waters is examined. Successful cooperations according to indicator 6.5.2 are highlighted, and unsuccessful cooperations that even lead to conflict are also investigated, and the results and discussion of these investigations are stated.

3. Results

In this section, first, cooperation on transboundary waters is examined based on indicator 6.5.2, and then conflicts are examined.

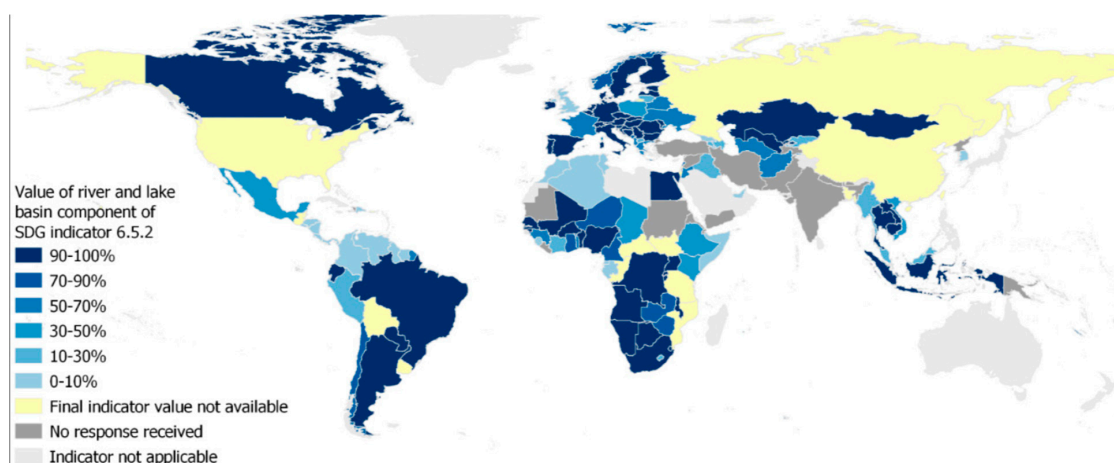
3.1. Cooperation

Regarding cooperation in the field of transboundary waters, several cases have been achieved in recent years. Some of them have been so strong and good that they have been approved and encouraged by the United Nations and are considered a success in determining the frameworks for this organization. Some of these cooperations are shown in Table 2. Due to the limitation in mentioning the agreements and listing all items in Table 1, some items are not mentioned there, such as the “Albufeira agreement 1998, Toulouse agreement 2006”.

As can be seen in Table 2, extensive and good cooperation between these countries has been carried out in recent years, and the cooperation whose date is before 2015, as well as some of the contracts signed in 2019 and even 2020, have remained in effect, which shows the determination of governments to solve transboundary water problems as a solution to their water scarcity problems. Also, the proportion of transboundary river and lake basin area in a country covered by an operational arrangement is shown in Figure 2.

Table 2. Some recent arrangements and agreements for transboundary water cooperation [16,18].

Arrangements and Agreements	Year
the Republic of Poland and the Republic of Belarus—in the Field of the Protection and Rational Use of Transboundary Waters	2020
China, Myanmar, Cambodia, Lao, Vietnam, and Thailand—Mekong-Lancang Vientiane Declaration	2020
Romania the Republic of Serbia—in the Field of Sustainable Management of Transboundary Waters	2019
The Republic of Bulgaria and the Republic of North Macedonia—in the Field of Environment and Water Protection	2019
Hungary and the Republic of Serbia—in the Field of Sustainable Management of Transboundary Waters and Basins of Common Interest	2019
Mozambique and Zimbabwe—the Buzi Watercourse	2019
Myanmar and China—in Ganges-Brahmaputra, Irrawaddy, Mekong, Salween Water Resources Management	2019
Sweden and Norway—in accordance with the European Union Water Framework Directive	2018
Montenegro and the Republic of Albania—in the Field of Management of Transboundary Waters	2018
Cooperation in Finnish-Russian transboundary waters	2018
Uzbekistan and Tajikistan—the Farkhad Dam (Aral Sea)	2018
Turkmenistan and Uzbekistan—on Water Management Issues	2017
Botswana, South Africa, Namibia—the Stampriet Transboundary Aquifer System (STAS)	2017
Kyrgyz Republic and Uzbekistan—the Orto-Tokoy (Kasansay) Reservoir (Aral Sea)	2017
Indonesia and Timor-Leste—Loes Basin	2017
The Russian Federation and the Republic of Kazakhstan—the Ural Transboundary River Basin	2016
Finland and Norway—the Tana River	2016
The Republic of Moldova and Ukraine—the Dniester River Basin	2012
Agreement on the Prespa Park Area	2010
Guarani Aquifer Agreement	2010

**Figure 2.** Proportion of transboundary river and lake basin area in a country covered by an operational arrangement [16].

As can be seen in Figure 2, cooperation in transboundary waters is much more prevalent in European and North American countries than in other regions of the world (27 countries out of 42 countries). The next category is sub-Saharan Africa with 18 out of 42 countries. Then, there are the Asian countries, and finally, Latin America, the Caribbean, and in the last category, North Africa and West Asia with only one country out of 17 countries. In the next section, some of the good cooperations are explored in more detail, as well as finally, some of the not-so-good cooperations.

3.1.1. Good Collaboration

For example, the 31-article agreement between Ukraine and Maldives regarding the Dniester River basin is one of the successful cooperations that was signed in 2012 at the meeting of the Parties at the Convention on the Protection and Use of Transboundary Watercourses and International Lakes and came into effect in 2017. This agreement aimed to solve the environmental problems of the river along with a comprehensive view of all aspects of sustainable development, i.e., society, economy, and environment. In some cases, such as the protection of biological resources, they went beyond the two conventions—they developed the terms and principles of the two conventions with respect to their particular watershed. This agreement is an example of good cooperation in the transboundary water basin, which is in accordance with the principles of sustainable development, indicator 6.5.2, and includes all the interactions of SDGs with each other [19].

An example of good cooperation for transboundary groundwater is the Garzweiler site in Germany, where mining activities affect the groundwater resources of both Germany and the Netherlands. In this context, a contract was signed between Germany and the Netherlands, and Dutch experts were also present to assess the environmental effects of Germany's actions on the Garzweiler site. Therefore, based on the nature of the environmental assessment, this cooperation has also been in the direction of sustainable development and SDGs, and it is considered to be among examples of good cooperation considering indicator 6.5.2 [20].

3.1.2. Bad Collaboration

In diplomacy, each party has different powers in terms of decisive power in the negotiation. These powers will be discussed further in the discussion section. The same difference in the power or weight of the governments in cooperation agreements for transboundary waters is visible in some cases, which can be called bad cooperation [21]. In general, when transboundary water cooperation is concluded, but the parties still only think about their own interests and abuse their influence and power in diplomacy, this problem occurs. To solve this problem, it has been suggested that firstly, experts and managers with experience should be used and that they also declare their satisfaction with the contract, secondly, no violation should be seen, and thirdly, the governments should not be in a hostile state towards each other [13]. Of course, bad cooperation is better than no cooperation. Because in this case, the situation goes towards conflict and even in some cases to a water war. In the following, this issue will be examined.

3.2. Conflicts

The conflict of transboundary waters can manifest in different ways. Through shifting boundaries to exercising power [22]. For example, the Harirud River originates from the mountains of Afghanistan and is considered transboundary water with Iran and Turkmenistan. The problems surrounding each country's share regarding this river are becoming more complicated every day to the extent that the United Nations and the World Bank have also expressed concern about this. The problematic issue is the construction of a dam by Afghanistan as an upstream country, which increases its share from 40% to 74%, while the share of Iran and Turkmenistan each decreases from 30% to 13%. It is in such cases that conflict rises. Now, in the case of the Harirud River, Iran is using its investment tools and diplomatic and military power in Afghanistan, and the friendship treaty with

Turkmenistan does not help in this conflict. Therefore, it can be seen that in a state of conflict, the interests of all countries are at risk, and even previous cooperation is lost, ignored, or greatly reduced [23].

The Mekong River, which originates in China and passes through Myanmar, Laos, Thailand, Cambodia, and Vietnam, and is known as the hydrological backbone of Southeast Asia, is one of the conflicted transboundary waters. China, which in the years after 2000, with its economic dynamism, having no financial problems in building ambitious dams on the Mekong River, has caused protests and warnings from the countries of Cambodia, Laos, Thailand, and Vietnam with its dam constructions. Also, by building another dam, Laos has brought strong protests from the governments of Cambodia and Vietnam. The president of Vietnam talked about economic growth and conflict of interests, and it is in such cases that the water conflict can progress to a water war. Therefore, it can be seen how much transboundary water conflict can affect water security and regional security [24].

There are areas in the world that always attract attention and the political sensitivity is more focused there. One of these regions includes Jordan, Syria, Lebanon, Palestine, and Israel, which also share transboundary waters with each other. What is needed in this area is a sustainable strategy with the goodwill of all parties. So far, there have been failures in the cooperation of the parties involved, be it between two countries or several countries with each other, all of which have arisen from the imbalance of power, lack of trust, and other fundamental problems that exist between them, which can be solved with fair and wisely formulated solutions toward a better direction [16,25,26].

So far, cases of cooperation and conflict have been discussed. Next, in the discussion section, the issues affecting cooperation or the formation of conflict are examined.

4. Discussion

In this part, effective and influential cases of cooperation or conflict, such as water diplomacy, risk, water–energy–food nexus, and 5P of SDGs are examined.

4.1. Diplomacy and Hydro-Hegemony

In water diplomacy regarding transboundary waters, it is necessary to look at the interests of all parties. Also, in cases where there are more than two countries, it is necessary to holistically examine and consider the interests of all countries at the same time. With the cooperation of two countries out of several countries (using friendship or pressure) and leaving aside other beneficiary countries, the trust of other beneficiary countries decreases, and cooperation becomes more difficult [27]. It should also be noted that the strategies of using various factors of water diplomacy in transboundary waters, including power, do not necessarily have a negative burden, but can help the security and peace of a region [28].

In water diplomacy, it is important to defend the interests of each country that can pursue nationalism. What is certain is that in academic environments and research papers, it is possible to put aside such views and look for sustainable strategies to solve problems by putting aside different nationalities [29]. The role of power and political changes in the beneficiary countries in transboundary water, such as a transboundary river, is always of special importance. If this power leads to its abuse by one (or several) countries, as is the case with the Nile River, it should be looked at with a critical perspective and tools should be used to deal with it [30,31].

hydro-hegemony is used in some studies with a negative charge, which is not the case, and it should be used and expanded in hydropolitical studies and strategies [32,33]. In water diplomacy, the strategic concept of hydro-hegemony is used to control transboundary river basins. In this sense, by applying strategies (including applying pressure or treaties), governments act to control water resources. The four pillars including three types of powers influencing hydro-hegemony and water diplomacy are shown in Figure 3 [31].

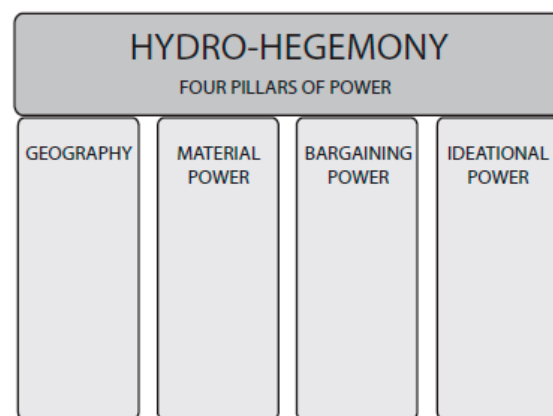


Figure 3. 4 pillars of hydro-hegemony [31].

Figure 3 showed, in a very simple way, four pillars affecting hydro-hegemony, which are geography, material power, bargaining power, and ideational power. In Figure 4, these tools are displayed for the beneficiary countries in the transboundary waters of three rivers in the Middle East (Tigris–Euphrates River Basins, Lower Jordan River Basin) and Eastern Africa (Eastern Nile River Basin) [31].

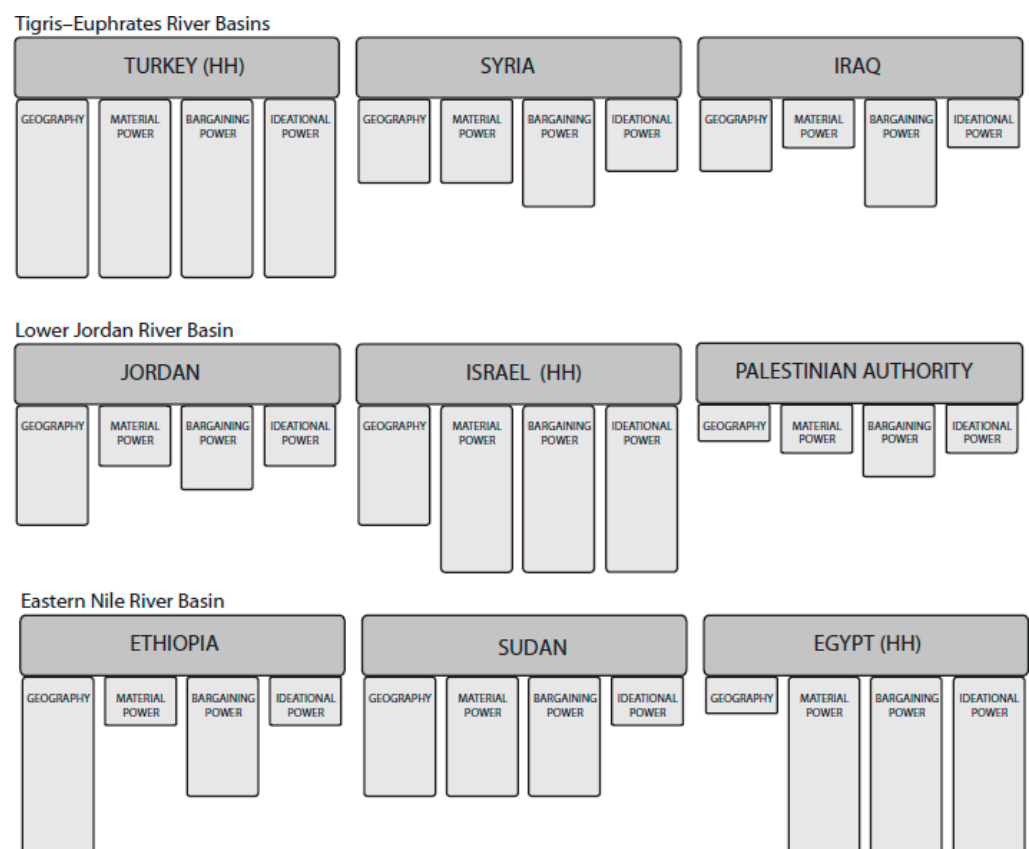


Figure 4. 4 pillars for the beneficiary countries in the transboundary waters of the Tigris–Euphrates River Basins, Lower Jordan River Basin, and Eastern Nile River Basin [31].

From Figure 4, it can be seen that the source of the river, the military and ideological power of the states, and even their economic resources are influential in their hydro-hegemony applications. Also, in addition to hydro-hegemony, which is in the hands of governments, another case can be introduced in the field of transboundary waters—which

should be reduced as much as possible—but cannot be controlled like hydro-hegemony, which is the risk that will be discussed in the next section.

4.2. Risk

According to an analysis by the Transboundary Waters Assessment Programme, the risk is generally higher in areas in sub-Saharan Africa and South and Southeast Asia than in developed areas such as Europe, Australia, and North America. However, high-risk systems are scattered in all regions and no region of the Earth is free of risk. Therefore, in all regions of the world, special attention should be paid to transboundary waters. Also, the risk is spread in three areas: biophysical, socioeconomic, and governance, which can be reduced with proper management and conscious political interventions. This is because the ultimate goal is to preserve the ecosystem and human well-being [34]. Therefore, action must be taken in the direction of the 5Ps of sustainable development with respect to the water–energy–food nexus (which will be explained in the next two sections).

4.3. Water-Energy-Food Nexus

Water, energy, food, and ecosystems are interconnected. A crisis or scarcity in one of them leads to a security crisis and a scarcity in other cases. To understand this, Figure 5 is displayed [3].

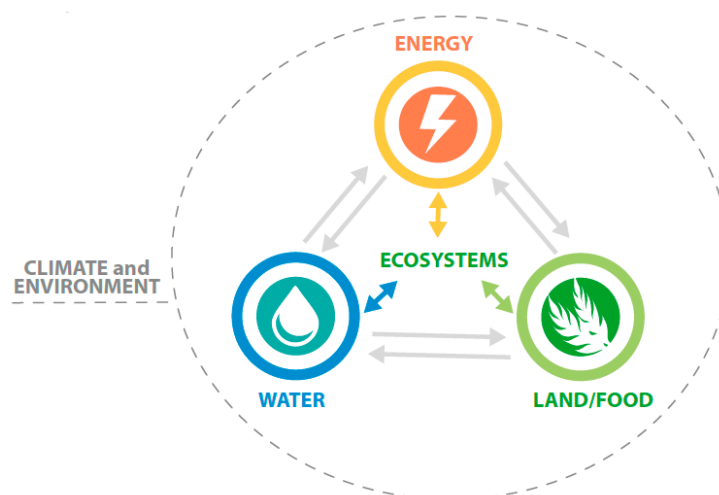


Figure 5. Nexus conceptual graphic [3].

As can be seen from Figure 5, water, energy, food, and ecosystems cannot be separately considered. This is also reflected in the review of SDGs. Therefore, so that there is no problem in this nexus, or it does not turn into a crisis, the following suggestions can be considered:

- For better management of the basin's resources, transboundary nexus assessment can be used as a facilitator. Of course, it should be noted that the evaluation should be conducted after some time and maybe it is necessary to reconsider the relationship.
- Planning is important in transboundary nexus assessment. Other stakeholders or experts may be needed, and therefore sufficient data for a meaningful analysis at the right time are essential.
- Note that the implementation of nexus solutions is challenging. The sources and different parts of the nexus must be considered together, and comprehensive and multi-part solutions are needed here.
- Stronger multi-sectoral transboundary planning and coordination are needed. In order to manage the nexus, coherent national policies are also needed, that is, even at the national level, this coherence must be created.
- The significant benefits of increasing transboundary cooperation in basin resource management must be considered. With cross-border cooperation, there are many

advantages for individuals, societies, the economy, and sustainable development in general, which paves the way for more and better cooperation [3].

In the next section, due to the importance of 5P in sustainable development, the effect of transboundary water on 5P is explained.

4.4. 5P and Transboundary Water

People: Due to the nexus that was discussed in the previous section and the nexus between water and food, in relation to people's discussion, food security and sustainable agriculture can be mentioned as a part that is affected by transboundary waters. Food security and concepts such as ending hunger, which is one of the SDGs, are directly related to people.

Planet: the sustainable management of water resources is a matter that is directly related to the planet and according to the previous discussions, it has a great impact on various sectors such as forest protection, which are all part of the SDGs.

Prosperity: prosperity will be undermined by the mismanagement of the "cross-border" element or the forgetting of this concept. Because development (also sustainable development) requires nature, and without the concept of transboundary waters, nature as we know it will not exist.

Peace: contrary to what has been going on until now, and unfortunately transboundary waters have brought conflict between countries in most cases, transboundary waters should act as a cooperation and peace factor and help to realize sustainable development as best as possible, which of course is the case with decision makers and statesmen.

Partnership: as mentioned in the "Peace" section, transboundary waters can be used for cooperation, in such a case, it is an excellent exercise for partnership. This cooperation is exactly the topic and demand of indicator 6.5.2 [5].

According to the concepts discussed so far, in the next section, the conclusion of this research will be discussed.

5. Conclusions

In this research, an attempt was made to determine the importance of transboundary waters in water supply by briefly introducing the water scarcity in today's world and stating statistical data about transboundary waters. Then, the concepts of MDGs and SDGs were discussed. Then, SDG6, target 6.5, and indicator 6.5.2 were introduced in more detail. As a research method, a library and analytical research were considered. The reports of the United Nations and related organizations were considered the most important references. Besides that, related articles were also studied as library resources. Then, the relationship between SDG 6 and water and sanitation with other SDGs was investigated. Finally, in the results section, the cooperation between countries, which has become more intense, especially in 2017 onwards, was introduced and analytically analyzed in two parts (good and bad cooperation), which can be said if the cooperation is with good intentions from the parties, cooperation brings good, but if it is through the abuse of diplomatic pressure and other power tools of the parties, then cooperation is considered bad. Good cooperation is the desired cooperation in indicator 6.5.2, which is considered by the United Nations. Also, conflicts in today's world over transboundary waters were analyzed, which have become this way due to non-cooperation. Finally, the concept of transboundary waters with the concepts of water diplomacy and the four pillars in hydro-hegemony, existing risks, water–energy–food nexus, and 5Ps of sustainable development were examined, which in summary suggest that cooperation concerning transboundary waters to be in the interest of all countries because they are tied to concepts that, like SDGs, may not be directly visible, but affect all countries.

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Conflicts of Interest: The authors declare no conflict of interest.

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