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A comprehensive analysis of water security from historical perspectives to contemporary challenges

Abstract. *Water is a vital resource for both human life and the economy, and its use and management are critical security issues. The scarcity of water resources has adverse effects on the economy, ecology, and public health, leading to lower crop yields, increased food costs, reduced living standards, and a higher risk of conflict between states. Water security has become a major cause of conflict in recent times. This article provides a historical overview of the term water security and conducts a comparative analysis of the various definitions of water security presented by authors and organizations. The article examines the theories of scholars who have written about water security and concludes that it is a complex concept encompassing various aspects of ensuring the safety of water resources, including preventing pollution, ensuring access to clean drinking water, protecting water bodies, developing mechanisms for managing water resources, and preventing conflicts over water. Furthermore, this article analyzes water security within the framework of national security and provides examples from different regions to emphasize the importance of water for individuals and the state.*

Keywords: *Water resources, water security, transboundary rivers, water scarcity, Kazakhstan, Central Asia, United States of America.*

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Introduction

Water has always played a crucial role in the emergence and development of ancient civilizations. The availability of water in the form of large rivers has facilitated the growth of agriculture and commerce, connecting different regions and laying the foundation for civilization. However, with the development of industry and human activities, water pollution and scarcity have become major challenges for modern societies. Inefficient use of water resources, climate change, and the lack of proper purification systems have led to conflicts between countries over water access. Effective mechanisms of cooperation and agreements are needed to manage shared water resources and to ensure sustainable development. According to scientists, ancient civilizations arose under specific climatic conditions, with the availability of water being one of the main factors. Many of these civilizations developed in the valleys of large rivers such as the Tigris and Euphrates, Nile, Indus and Ganges, Huang He and Yangtze, Amu Darya, Syr-Darya, and others. These rivers played a significant role in human life, providing fertile soil for agriculture and connecting different regions for trade [1].

Water pollution has become a significant global issue with the growth of industrialization. The contamination of water resources is not only an economic concern but also a serious threat to public health. Various factors, including the discharge of industrial waste, chemical fertilizers, and household waste, are contributing to this problem. The situation is more critical in developing

countries where the inadequate water purification systems have resulted in increased cases of waterborne diseases and deaths. Therefore, addressing water pollution is crucial for sustainable development and human well-being.

Water scarcity is becoming an increasingly pressing issue globally due to natural factors such as droughts, as well as human activities such as inefficient water use and the impact of climate change. This scarcity can cause conflicts among nations, particularly in regions where water resources are limited. Climate change has exacerbated the issue, resulting in more frequent and severe droughts, leading to a greater need for effective management and cooperation to ensure sustainable access to this vital resource.

This paper aims to explore the concept of water security, discussing various definitions and theoretical frameworks proposed by scholars and organizations. It examines the different dimensions of water security, including environmental, economic, and social aspects, and highlights the interconnection between water security and national security.

Moreover, the paper presents examples of successful international cooperation and collaboration in managing water resources, including the UN Watercourses Convention and various transboundary river basin organizations. It also discusses the importance of technological innovation in ensuring water security and sustainable development, such as the development of water purification and reuse technologies.

Finally, the paper concludes with recommendations for future actions to ensure water security, including strengthening international cooperation and collaboration, improving water governance and management, promoting water conservation and efficiency, and investing in technological innovation. The aim of this paper is to raise awareness about the importance of water resources and the urgent need for action to ensure their security and sustainable use for present and future generations.

Materials and methods

This study aims to identify and systematize changes in water resources in the security system in interstate relations by analyzing theories of water security. A logical analysis was conducted to study the evolution of the water security paradigm and determine its place in world politics. To achieve this, a comparative analysis of the works of authors who conducted research on water security was carried out to determine the main features of the development of the old and new paradigms of water security. The selected works were analyzed using a qualitative research approach, and the findings were interpreted based on the context of the research question. The study employed secondary data analysis as the primary data source. The data were collected from published literature, including books, journals, reports, and academic papers, and were analyzed using content analysis techniques.

Discussion

In light of the growing global population, the issue of water security has become increasingly relevant. The existence of 263 international basins, covering almost half of the earth's surface and housing 40% of the world's population, emphasizes the need for effective management of shared water resources. Moreover, international basins are vital to human development, as they contain 60% of the planet's freshwater. It is worth noting that these basins partially cover 145 countries, with 21 states fully encompassed within them. Despite the significance of shared water resources, only 37 water-related armed conflicts have occurred in the last 50 years, while 150 water-related treaties have been signed. These figures indicate that the mechanisms for resolving conflicts over water resources have been relatively successful. Nonetheless, the challenges associated with water security remain, and concerted efforts are required to ensure the sustainable use of shared water resources [2].

The increase in the number of people on earth, the construction of many industries, the

withdrawal of water and many other reasons make water one of the most valuable resources of the twenty-first century. According to the results of UN studies, human demand for water resources increases by 1% annually. The demand for water resources is increasing, especially in developing countries. According to UN studies, in 2050 about 5 billion people will live in areas with limited water resources [3]. International relations experts predict that conflicts over water resources will intensify in the future. Therefore, the states are now paying great attention to solving the water problem. The concept of state security as a whole and the scope of its application are expanding. For example, state security, national security, economic security, etc. To the types of safety are added relevant and important types such as Water security, food safety and environmental safety.

The concept of water security encompasses a range of intricate, interrelated factors. The rise in water demand has resulted in heightened competition for water usage at the local, regional, and global levels, encompassing essential societal requirements such as drinking water access, irrigation, hydropower, and industrial purposes. Water quality is also a critical aspect of water security, further emphasizing the significance of appropriate water usage.

Water is a vital resource for human survival and development, yet it is scarce and unevenly distributed on Earth. With water covering 70.8% of the planet's surface, only 2.7% of it is fresh water, and only a small fraction of it (0.36%) is easily accessible. Of the world's population, 2.8 billion people (40%) still lack access to safe and reliable drinking water for domestic use. This highlights the need for effective and sustainable management of water resources to ensure equitable access to water for all [5].

The water-related issues highlighted by the United Nations include the following [6]:

- Over 2.2 billion people lack access to safe drinking water.
- Around 2 billion people receive healthcare services without basic water supply.
- Safe sanitation and hygiene services are not accessible to more than half of the global population, i.e., 4.52 billion people.
 - Inadequate sanitation, poor hygiene, and unsafe drinking water cause the death of 297,000 children under the age of five every year due to diarrhea.
 - Water scarcity affects around 2 billion people living in different countries, and it has already impacted four out of every 10 individuals.
 - Water is the primary cause of 90% of natural disasters worldwide.
 - Approximately 80% of wastewater is released into the ecosystem without treatment.
 - Two-thirds of the world's transboundary rivers lack joint management agreements.
 - Global water consumption by agriculture accounts for 70% of the total.

The strategic importance of water as a resource

Water plays a crucial role as a source of sustenance for humans, while also being a strategic asset for governments. By breaking down the significance of water into different levels, we can better understand its importance in both realms.

Table 1. Human water requirement levels [7]

Demand levels	Description
The first level of need	A chemical element used as drinking water and for cooking.
The second level of need	A liquid used in the cultivation of fruits and vegetables.
The third level of need	Hygiene (washing, bathing).

Table 2. Strategic importance for the state [7]

Importance	Description
First	Independence from other states in the field of water resources.
Second	Drinking water, a resource used in agriculture.
Third	Water supply of residential buildings

Understanding water security. Water security is a concept that gained prominence at the Second World Water Forum held in The Hague in 2000. Today, this term is frequently used by world leaders to address water-related issues. The concept of water security has multiple definitions, and various measurement options are available to determine water security [8]. This article discusses the urgency of ensuring water security as only 2.5% of the world's water resources are freshwater suitable for human use, and global water consumption is increasing by 1% annually. Water security is essential for human health, food production, and energy, making it a significant social, economic, environmental, and political problem of the 21st century [9].

The understanding of water security is still developing, and presently, the emphasis is on water infrastructure. The Global Water Partnership (GWP) and the Organization for Economic Co-operation and Development (OECD) reports have recognized the crucial role of infrastructure in ensuring water security. Furthermore, the reports highlight the need to shift the focus of water security towards identifying risks and opportunities.

The Asian Development Bank's 2016 Asia Water Outlook report divides water security into 5 dimensions: 1) Domestic water security. 2) Economic water security. 3) City Water security. 4) Environmental safety of water. 5) Resistant to water-related accidents. Each of them has directions based on solving their own problems. According to the report, 1) household water security: "Providing all people with reliable, safe water and sanitation services. Domestic water supply is an important foundation for efforts to eradicate poverty and support economic development"; 2) economic water security: "Water grows our food for human consumption, powers our industry, and cools our power plants. Water use in these sectors should no longer be considered separately. Economic water security is a measure of the productive use of water to support economic growth in the food, industry and energy sectors; 3) urban water security: "In the Asia-Pacific region, about 48% of the population now lives in cities, and by the middle of this century this figure will reach 64%. Urban water security is a measure of good water management to support water-hungry and livable cities; 4) environmental water security: "Asia's environment and valuable natural resources have been hit hard by decades of neglected policies as the region's authorities prioritized rapid economic growth over environmental concerns. As more attention is paid to sustainable development and inclusive growth, Asian leaders are now taking on the challenge of greening their economies. The Environmental Water Security Indicator assesses the condition of rivers and measures progress in river and ecosystem restoration on a national and regional scale. The sustainability of development and the improvement of life depend on these natural resources"; 5) Resilience to water-related disasters: "The growth and development of the region is associated with unprecedented changes in economic activity, urbanization, nutrition, trade, culture and communication. It has also increased the level of uncertainty and risk associated with climate variability and change. The resilience of communities in the Asia-Pacific region to these changes, especially water-related disaster risk, is assessed using the Water Disaster Resilience Indicator. To minimize the impact of future disasters, it is necessary to accelerate the creation of resilient communities that can adapt to change and reduce the risk of water-related disasters" [10]. He defined the state's water security situation in five dimensions.

The Global Water Partnership (GWP) report addresses three main dimensions of water security: social equity, environmental sustainability and economic efficiency.

Economic aspect:

- increase in water productivity and its conservation in all water-consuming territories

- Sharing economic, social and environmental benefits from the management of transboundary rivers, lakes and aquifers.
- Social aspect:
 - ensure equal access to water services and resources for all through a well thought out policy and legal framework at all levels.
 - formation of the population's resilience to emergency situations through the implementation of "soft" and "hard" measures.
- Environmental aspect:
 - sustainable management of water resources within the framework of the "green" economy.
 - restoration of ecosystem services in river basins for the improvement of rivers [11].

There are multiple definitions of water security, and scholars and water management organizations have attempted to define the concept in various ways. Grey and Sadoff define water security as the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production, along with an acceptable level of water-related risks to people, environments, and economies [12]. According to Patrick Webb and Maria Iskandarani, water security refers to access to sufficient safe water for a healthy and productive life for all individuals at all times [13].

On the other hand, different organizations and institutions have defined the concept of water security in their own ways. The United Nations defines it as the capacity of a population to ensure sustainable access to adequate quality water for livelihoods, human well-being, socio-economic development, environmental protection, and political stability[14].The Global Water Partnership views a water-secure world as one where every person has access to safe, affordable, and clean water, and communities are protected from water-related disasters[11]. The Asian Development Bank defines it as the availability of sufficient water to support safe and affordable water supply, inclusive sanitation, improved livelihoods, healthy ecosystems, and sustainable and resilient rural-urban economies while reducing water-related risks [15].

These definitions of water security share similarities and nuances with each other. However, it is evident that the challenges surrounding water resources are mounting each year, and finding a resolution has become urgent. Even with a growing amount of research on water security, scholars like Christina Cook and Karen Bakker argue that a singular definition is still lacking. The choice between a broad or specific definition can significantly impact how water security issues are approached and addressed, highlighting the significance of defining water security clearly in decision-making [16].

The concept of water hegemony has been defined by Mark Zeitoun and Jereon Warner as the establishment of control over water resources at the river basin level through strategies such as capturing, consolidating, and limiting access. These strategies are achieved through the use of various tactics, including pressure and contracts. Additionally, the authors distinguish between the concepts of hegemony and domination, defining the former as leadership based on authority and the latter as leadership based on coercion [17]. Based on their ideas, a straightforward mathematical formula can be derived to define these concepts.

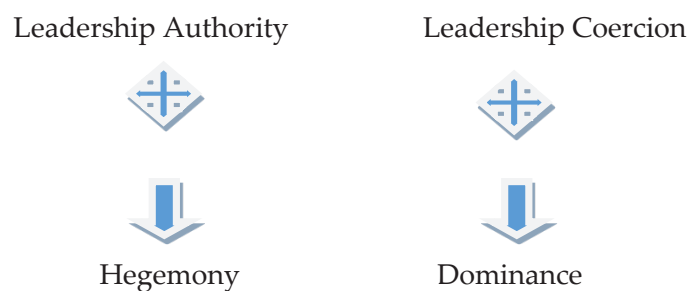


Figure 1. A mathematical model for understanding hegemony and dominance

The Figure 1. shows two boxes representing two concepts: Hegemony and Dominance. Each box has two components: Leadership and either Authority or Coercion. The arrows represent the connection between each component. The labels at the bottom of each box represent the resulting concept that emerges when the components are combined. The labels on the right side of the figure represent adjectives that describe the resulting concept.

Water security and international water doctrines

When it comes to the joint use of transboundary river basins, there exist four main legal doctrines that guide the process. These include the doctrines of absolute territorial sovereignty, absolute territorial integrity, limited territorial sovereignty, and common interests. These doctrines provide a framework for addressing the competing claims and interests of different states in the use of shared water resources and aim to facilitate cooperation and equitable sharing of benefits among riparian countries [18].

Legal doctrines for transboundary river basins include the Doctrine of Absolute Territorial Sovereignty, also known as the Harmon Doctrine, which allows upstream states to use river waters at their own discretion without regard for downstream impacts [19]. On the other hand, the Doctrine of Absolute Territorial Integrity prohibits coastal states from using water resources in a way that harms other coastal states, although upstream countries generally do not accept this doctrine. Other legal doctrines include the Doctrine of Limited Territorial Sovereignty and the Doctrine of Common Interests, providing different approaches to managing transboundary water resources [20].

The Doctrine of Limited Territorial Sovereignty is based on the principle that individuals must use their property in a way that does not harm the property of others. This principle extends to the state's right to use the water of rivers flowing through its territory, with the condition that it does not infringe on the interests of other riparian countries that have rights and obligations in the use of water resources of transboundary rivers [21].

The Doctrine of Common Interests emphasizes the idea of transboundary river basins as a single hydrological unit, requiring collaborative management. This means that any action by one riparian country affecting the shared water resources, without the consent of its neighbors, gives the affected country the right to take appropriate countermeasures [18].

Water security cannot be considered separately from national security. Peter Gleick, in his article "Water and Conflict: Fresh Water Resources and International Security", proposed the point of view according to which "states in regions with limited water resources and water scarcity consider the issue of access to water within the framework of national security" [22]. According to Thomas Homer-Dixon, the resource that causes interstate war is river water. Water is a very important resource for the survival of man and nation. Because river waters originate in one country and flow into another, the actions of one country can affect another country's access to water resources. If the downstream state is highly dependent on river water and relatively stronger (militarily/economically/politically) than the upstream state, the likelihood of water conflict increases. It is believed that downstream states use water as a tool to influence upstream states [23]. For example, in the Nile River system, the Egyptian state is much stronger militarily, economically and politically than Ethiopia, Sudan, Rwanda and Tanzania. Egypt consumes more water than any other country, despite being located on the lower reaches of the Nile River. The upstream states could use their geographic advantages to control the Nile, but if these actions create barriers to Egyptian access to the Nile waters, it could open the door for Egypt to resort to military force to protect its national security. Therefore, the power and influence of Egypt will force the weakened coastal states, which do not want conflict with Egypt, to agree to an unfair policy of distributing water resources [24]. This case can be explained by soft power politics. The famous American political scientist Joseph Nye argues in his article "Soft power" that if one state can impose on other states what it wants, then this can be called cooperative or soft power [25]. That is, the presence of hard power creates the effect of soft power.

Water resources are a scarce resource in the Middle East, South and Central Asia, but water is becoming an increasingly important resource for economic and agricultural development in the countries of the region. Water resources in these regions have become a matter of “high-level politics,” increasing the likelihood of water conflicts [22]. Joachim Blatter and Helen Ingram identified water as a resource of economic value, a vital resource, and a component of national security. In the context of national security, water is being transformed from a mere chemical element into a valuable resource. At the same time, when water is a necessary element for the existence of a nation and the formation of a nation state, it becomes a conceptual issue of national security. Rivers are often used as borders between two states. For example, the Rhine serves as a dividing line between the Germans and the French [26].

The White House Action Plan for Global Water Security, published by the United States (USA) in 2022, emphasizes that water security is considered one of the pillars of national security [27]. According to US Vice President Kamala Harris, “The White House Global Action Plan for Water Security will increase the ability to achieve water security goals, which are an important element of US national security” [28].

It is clear that Kazakhstan and the states of Central Asia consider water security within the framework of national security. This is due to the fact that the stability of the economy directly depends on water resources. This dissertation was written by Professor D.L. Baideldinov mentioned in his article “The Dangers of Kazakhstan’s Water Security: Legal Aspects”. More precisely, according to Professor Baydeldinov, in the conditions of limited and declining water resources in Kazakhstan, water security issues are considered as a component of national security [29]. Article 6, paragraph 18 of the Law of the Republic of Kazakhstan “On the National Security of the Republic of Kazakhstan” states that “a sharp deterioration in the environmental situation, including the quality of drinking water, earthquakes and other natural and man-made emergencies, epidemics and epizootics” [30] are on level of national security.

Conclusion

In conclusion, water is a vital resource for human life and the economy, and its use and management are critical security issues. The scarcity of water resources has a detrimental impact on various aspects of life, including the economy, ecology, and public health, and it increases the risk of conflict between states. Therefore, water security has become a major cause of conflict in recent times. This article has provided a historical overview of the term water security and conducted a comparative analysis of the various definitions of water security presented by authors and organizations. Based on the theories of scholars who have written about water security, we conclude that it is a complex concept that includes ensuring the safety of water resources, preventing pollution, ensuring access to clean drinking water, protecting water bodies, developing mechanisms for managing water resources, and preventing conflicts over water.

Furthermore, this article has analyzed water security within the framework of national security and highlighted the importance of water for individuals and the state. It provides examples from different regions to emphasize the significance of water as a crucial resource for national security. Therefore, it is essential to take necessary measures to ensure the security of water resources and to prevent conflicts over water. Cooperation between states in the field of water security is crucial for ensuring peace and security, and states should consider the interests of their neighbors before ensuring their own security. Ultimately, managing water resources in a sustainable and equitable manner is of paramount importance for achieving water security and for the overall well-being of society.

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Су қауіпсіздігін тарихи перспективалар мен қазіргі қауіп-қатерлер тұрғысынан кешенді талдау

Аңдатпа. Су – адам өмірі үшін де, экономика үшін де маңызды ресурс және оны пайдалану мен басқару қауіпсіздіктің маңызды мәселесі. Су ресурстарының тапшылығы экономикаға, экологияға және халықтың денсаулығына теріс әсер етеді, бұл өнімділіктің төмендеуіне, азық-түлік құнының өсуіне, өмір сүру деңгейінің төмендеуіне және мемлекеттер арасындағы қақтығыстар қаупінің жоғарылауына әкеледі. Су қауіпсіздігі біздің заманымыздағы қақтығыстардың негізгі себептерінің біріне айналды. Бұл мақалада «су қауіпсіздігі» терминіне тарихи шолу жасалады және авторлар мен ұйымдар ұсынған су қауіпсіздігінің әртүрлі анықтамаларына салыстырмалы талдау жасалады. Мақалада су қауіпсіздігі туралы жазған ғалымдардың теориялары қарастырылады және бұл ластанудың алдын алу, таза ауыз суға қол жеткізуді қамтамасыз ету, су объектілерін қорғау, суды басқару тетіктерін әзірлеу және суға байланысты қақтығыстардың алдын алу сияқты су ресурстарының қауіпсіздігін қамтамасыз етудің әртүрлі аспектілерін қамтитын кешенді ұғым деген қорытындыға келеді. Сонымен қатар, мақалада ұлттық қауіпсіздік шеңберіндегі су қауіпсіздігі талданады және судың адам мен мемлекет үшін маңыздылығын көрсету үшін әртүрлі аймақтардан мысалдар келтірілген.

Түйін сөздер: су ресурстары, су қауіпсіздігі, трансшекаралық өзендер, су тапшылығы, Қазақстан, Орталық Азия, Америка Құрама Штаттары.

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Комплексный анализ водной безопасности от исторических перспектив до современных вызовов

Аннотация. Вода является жизненно важным ресурсом как для человеческой жизни, так и для экономики, а ее использование и управление являются критическими вопросами безопасности. Недостаток водных ресурсов оказывает негативное влияние на экономику, экологию и здоровье населения, приводя к снижению урожайности, увеличению стоимости продовольствия, снижению уровня жизни и повышению риска конфликтов между государствами. Водная безопасность стала одной из основных причин конфликтов в наше время. В данной статье представлен исторический обзор термина «водная безопасность» и проводится сравнительный анализ различных определений водной безопасности, представленных авторами и организациями. В статье рассматриваются теории ученых, которые писали о водной безопасности, и делается вывод, что это комплексное понятие, охватывающее различные аспекты обеспечения безопасности водных ресурсов, включая предотвращение загрязнения, обеспечение доступа к чистой питьевой воде, защиту водных объектов, разработку механизмов управления водными ресурсами и предотвращение конфликтов по поводу воды. Кроме того, в статье проанализирована безопасность воды в рамках национальной безопасности и приведены примеры из разных регионов, чтобы подчеркнуть важность воды для человека и государства.

Ключевые слова: водные ресурсы, водная безопасность, трансграничные реки, дефицит воды, Казахстан, Центральная Азия, Соединенные Штаты Америки.

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