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Water resources market: Formation the opportunities and searching for solutions (In Case of The Central Asia)

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Abstract
The water resources market, despite its particular relevance within Central Asia, is experiencing significant difficulties in its formation, due to the growing water deficit and the need for more effective and sustainable solutions for water resources management. This is due to population growth, industrialization and other processes, against the backdrop of climate change, which significantly stimulates the adoption of such a solution.
The formation of the water resources market should help solve a number of problems that require immediate solutions, which should ensure effective water resources management using technologies for the use, purification of water and protection of water resources. Along with solutions for the use of water resources, envisaged by government initiatives and legislation of the Central Asian countries, it is also necessary to pay special attention to the list of issues that can accelerate the search for optimal solutions for regional cooperation in the use of water resources in Central Asia.
The search for such solutions requires significant direct investments in the implementation of technologies for the use, monitoring and management of water resources. The importance of governance in this area is also linked to the policy of safe development of countries and the preparation of information for those responsible for making adequate and optimal decisions at the national, regional and, very importantly, local levels.

Keywords: Water resources market, innovations, technologies for rational use of water, water resources management, safe development

Introduction

The formation of the water resources market is usually carried out within the framework of water resources management policy. Water resources management policy is based on the achievements and practice of water resources trading and involves the implementation of a mechanism for using water in case of shortage and regional water use. At the stage of formation of the water resources market, special attention should be paid to its differentiated potential in different countries, depending on the level of economic development. Among other problems on the way to formation of the water resources market within Central Asia, it is necessary to highlight, first of all, the factor of availability in use of water, which has its own special influence and is closely interdependent on the manifestation of other factors.
The main factors of water distribution across the territory of Central Asia include both natural-territorial and socio-political factors. Natural-territorial factors include the location of water sources, climatic and geological conditions that determine the sources and nature of water resource distribution. Factors of a socio-political nature, which largely determine the features of water use and water resources management, are closely dependent on the level of water management infrastructure, which influences the use of water volumes and the formation of water resource distribution systems in the Central Asian. Along with the above, within the framework of the emerging water resources market in Central Asia, special attention should be paid to issues of integrated water resources management, including solutions for the use of water protection technologies, purification from pollution and water loss. The formation of a water market by the middle of the 21st century should naturally be based on knowledge of the formation of such markets and legal mechanisms for the use of water resources by a group of countries. Such mechanisms in agreements between countries are based on the use of water as a commodity, a commodity of special significance and influence, which must be quantified and can be presented in various forms of distribution and use of water 2017 [24]. Taking into account the above, the formation of a water resources market in Central Asia can be presented as a sustainable water resources management strategy to address issues of water demand and shortage in the region. However, unfortunately, there are a number of problems on the way to the formation of the market and management of water resources in Central Asia, many of which remain today. The problem is that the water deficit, combined with problems of interstate management, is explained not only by the manifestations of global climate change, but also by the absence of serious decisions on integrated water resources management. The shortage of water resources and their inefficient use in Central Asia is exacerbated by the weak transboundary water management. It results in the imbalance between needs and water consumption, the economic and social instability, and the violation of the environmental sustainability of Central Asian countries. Water resources allocation generates competition for the right to own it.
It should be noted that existing agreements between Central Asian countries on water use do not always resolve issues of optimal use and distribution of water resources in Central Asia. This is also explained by the fact that as a result of the collapse of the Soviet Union and the emergence of five new independent republics in Central Asia, many natural resources, and above all water resources, have acquired a

transboundary character. The uneven distribution of water resources in Central Asia led to the interdependence of upstream and downstream countries. Tensions were also caused by the divergence of political and economic interests of the riparian states regarding water resources and ineffective resource management at all levels: regional, basin, national and local. If we turn to the practices of countries with a mature water market, the water trading policy used can help regulate water use and, to a certain extent, mitigate the problem of water scarcity. Ultimately, the decisions used on water use lead us to the conclusion that the formation of a water resources market can be one of the most important mechanisms for the usefulness of such a market and the need for its creation. One of the options for the possibility of forming a water resources market may be to study the achievements of different countries in solving such an issue. In this case, as an example of the implementation of water markets, we can turn to the experience of the Australia 2017 [24], the USA 2020 [8] and the Chile 2020 [3], as well as the People's Republic of China 2014 [10] and the South Africa 2019 [9]. We will return to the analysis of water use mechanisms within the water market in the Results section of this article.

Since one of the most important reasons for creating a water market is a water management decision, we should focus our discussion on characterizing the main factors that influence water use in the region. Ultimately, we should approach solutions that can ensure the formation of a water market and offer innovative approaches to water management at different levels of water use.

Materials and Methods

The problem of distribution, demand and deficit of water use in Central Asia reveals a close interdependence with the geographical location and the effect of climate change in the region. Most of the territory of Central Asia is located in semi-desert and desert zones, where aridity and sharp changes in temperature and water balance are observed. The rate of warming in Central Asia is on average higher than on a global scale. Therefore, the Central Asian region is very vulnerable to the effects of climate change. According to local observations, the average annual temperature in the Republic of Uzbekistan has increased by 1.6°C since 1980 2016 [15], in the Kyrgyz Republic by 1.5°C since 1983 2016 [16], in the Republic of Tajikistan by 1.5°C 2016 [17], in the Republic of Turkmenistan, by 1.4°C since 1950 2013 [18], and in Republic of Kazakhstan by 1.6°C 2013 [14]. The continuation of such a trend in the average annual temperature change may lead to the fact that already in the near future of the next 10 years (see, after 2023), despite the efforts of even all countries of the world and the Central Asian region to reduce carbon dioxide emissions, one of the causes of the current phenomena, the upcoming event can no longer be changed - this may be the beginning of a climate catastrophe that should be stopped or at least slowed down. This is explained by the fact that climate change is manifested through the accelerated melting of mountain glaciers and snow fields, which will ultimately lead to a change in the water level in local rivers, increase water shortages and accelerate the demand for water in the Central Asia.

In this regard, I believe in, first of all, it is necessary to determine threshold or critical levels, the overcoming of which creates an irreversible nature of the change processes. Definitely, we would like to give more hope the results of research and our reasoning, but the problem is not whether these results would be positive, but whether they could help us at least accurately describe the problem we are facing, namely the cause of global climate change. This is especially important, because of in practice we often mix up the causes and effects of climate change at the global and local levels and try to use solutions that are acceptable at the local level and transfer them to the global level. The search for solutions to the growing climate crisis is revealing some encouraging but also discouraging results. Since the problem is global, the solutions must be global. But in practice, we most often negotiate solutions at lower levels - countries or regions. One of the results of this approach may be that the necessary solutions, within the framework of uncertainty, are born when the problems have already gone beyond our control. Which further confirms that many of the efforts were aimed at benefiting local, sub-global groups such as countries and companies. Thus, solutions must be truly global, even if this runs counter to the interests of existing groups.

Scientifically, it can be assumed that the ecosystem of Central Asia is a concentration (alloy) of heterogeneous substances (i.e. the elements of ecosystems) and, in this case, the law of phase transitions can be applied to the analysis of the state of the ecosystem. Climate change and related consequences, after the last stage of cooling (e.g. the glaciation, which occurred 11 thousand years ago) can be considered as a transition phase in the Central Asian ecosystem 2006 [1]. How long this transition will last and what consequences should be expected from such a change require in-depth scientific research that should help resolve the current issue of insufficient knowledge, information and communication on climate risks and resolution of the most problematic issues. Moreover, efforts to address climate and water issues at the national level are most often distributed across line ministries. This is cost inefficient, both in terms of scale and in budgeting and implementing water use policies. Creating clear sectoral synergies, particularly around the water-food-energy nexus, for example, would facilitate the implementation of a holistic climate action approach. To implement it, it is necessary to establish a functional practice of information and knowledge exchange in the Central Asian region, containing comprehensive data on climate, its change and consequences, with a focus on the state of water use in this region.

Water, as one of the most important resources of Central Asia, is also a factor in the development of the entire region and neighboring territories. However, there is a risk that this factor may become a bottleneck for future development if we fail to jointly resolve the global water crisis. Water resource management is facing unprecedented challenges on two fronts: population growth and competing economic sectors that are constantly increasing demand for water, while degrading water quality and increasing water pollution. Ultimately, freshwater availability is declining, and climate change may only exacerbate the problem 2017 [12].

The following scheme of research and assessment has been proposed as a methodological basis for studying the state of water use. At the initial stage, an assessment of hydrological and institutional water needs is proposed, which should subsequently lead to an assessment of the issues of developing and implementing a water market. And finally, a

review and assessment of future needs will be proposed, with proposals for solutions for water management in Central Asia. The lack of fundamental scientific research in areas such as monitoring surface and groundwater, monitoring the anthropogenic impact of climate change on water and agriculture indicate the need to develop new tools for assessing water demand and scarcity and vulnerability to climate change, with an emphasis on assessing the damage to economic activity and water use in Central Asia.

Results

Trends related to water use in the context of climate change are best viewed at broad geographic scales and over long periods of time, rather than at local scales over several years or seasons. While the climate is constantly changing, not every climate change indicator shows a consistent pattern of steady change. The Earth is a complex system, and there are always natural fluctuations from one year to the next, for example, a very warm year followed by a colder year. Droughts and associated crop failures in Asia (e.g. the India, Pakistan), Africa (e.g. the Lesotho, Zimbabwe), Europe (e.g. the Russia, Spain, Portugal), and the Americas (e.g. the Brazil, Argentina, USA) are associated with the devastating effects of prolonged water shortages, and with the very real possibility that such a situation could become the new normal as the climate changes. Overall, the emerging situation has led to renewed efforts to find solutions to the water crisis, both in terms of increasing supply and reducing demand. In most cases, these efforts have focused on market mechanisms, including water banks and water trading, to allocate water among competing demands and to facilitate the transfer of water from low-value to high-value uses. Based on the general characteristics of the state of water resources, the critical situation of water using in the Central Asia caused by climate change, inefficient water management and increasing water consumption is no longer just a hypothetical problem. It affects all parts of the region, and it is happening now. The state of the water crisis can be seen as a result of competition for water using 2016 [6]. At the same time, low efficiency of water uses against the background of certain disagreements and differences in approaches to water use in the region leads to the need to create a new platform for interactions and the use of a water use mechanism, which can be the water resources market in Central Asia.

The analysis of the achievements of the formed water markets in various countries of the world, which was discussed above, leads to the question of what should be used as the basis for the formation of the water market in the Central Asia. The functions of such water using mechanism should include: water lease, trade in water rights and trade in water distribution. In general, it can be noted that all these functions of the relationship mechanism within the planned water resources market take place in the Central Asia. However, in relationships and in some cases in the sharing of water, one may find a predominance in the use of one form or another. It depends from many reasons, such as the common past in the Central Asian countries in terms of water use, differences in water use legislation, traditions and local characteristics in water use. In any case, it can be said that the lack of a unified approach and measures for assessing water as a commodity with a price for this commodity create significant problems and disagreements on rational water use in the Central Asia. Moreover, the effectiveness of such a market should be aimed at identifying and eliminating obstacles to water use in Central Asia.

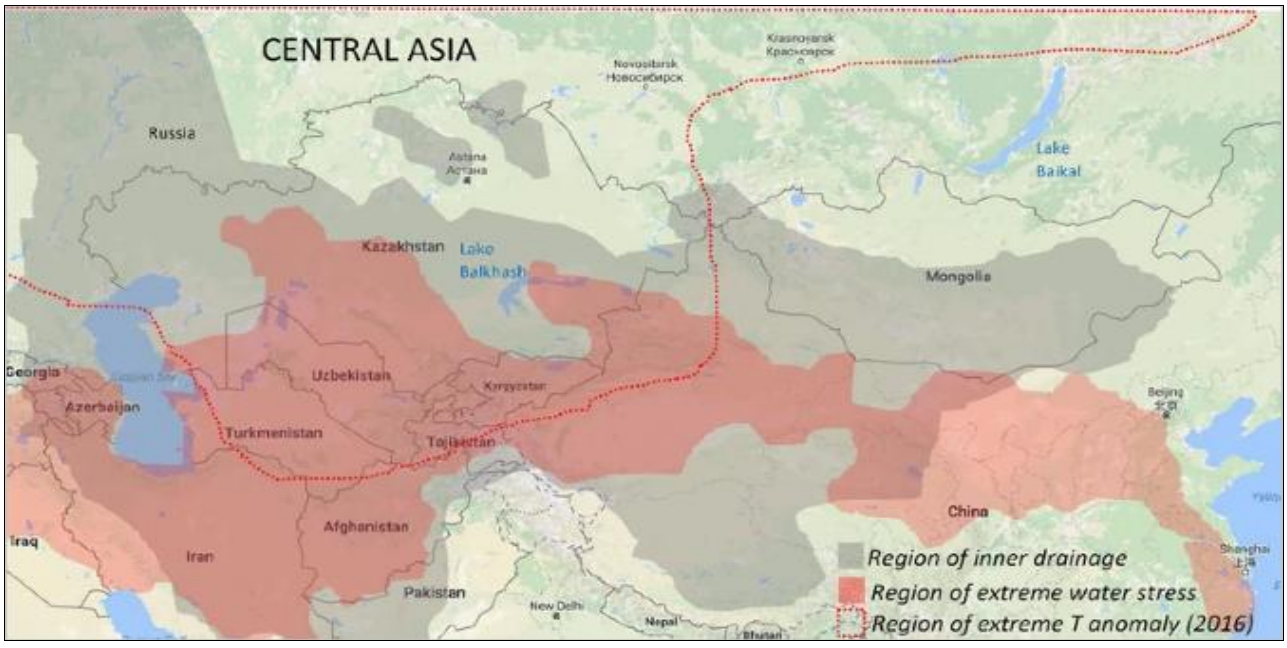

Fig 1: Spatial distribution of water resources in the Central Asia 2017 [5].

Thus, the Central Asia has one of the largest inland drainage basins in the world, and its continental location results in limited availability of both surface and groundwater. About one-third of the world's drylands are located in the Central Asia 2012 [2]. Compared to other regions, the Central Asia has a large proportion of endorheic basins, which have internal drainage networks and therefore no direct connections to the ocean (figure 1).

Since the beginning of the twentieth century, the region's water resources have been exploited beyond their sustainable levels. The needs of the agricultural, energy and raw materials sectors, as well as population growth and its

uneven concentration across the Central Asia against the backdrop of climate change, have not only increased water withdrawals but also left a diverse and strong trace of pollution on rivers, lakes and groundwater bodies.

Such changes in the quantity and quality of water not only led to the degradation of aquatic ecosystems, but also threatened the socio-economic development of the region. The complexity of the Central Asia's water problems requires integrated approaches to assessment and management. For example, since rivers and groundwater are not tied to administrative boundaries, an internal regional dispute over water can easily escalate or provoke a regional crisis and even conflict 2017 [4].

Five main rivers flow through the territory of the Central Asia: the Syrdarya, Amudarya, Balkhash-Alakol, Ob-Irtysh and Ural, which indicate sufficient volumes of water for water use. The using of water resources within the framework of the Central Asian water market can be based on various approaches and mechanisms. As that was noted above, the water lease can be used for such forms of use so that the water user can plan safe access to water during the period of time specified in the agreement. However, the experience of practical use of water, according to agreements between the Central Asian countries, has shown insignificant efficiency to date, since the countries are not entirely correct in planning the use of the necessary volumes of water and may violate the terms of the agreements on water use. I believe that in order to overcome such situations, it is necessary to conduct and present to the public an analysis and monetary value of both direct and indirect consequences of inadequate transboundary cooperation on water resources management in the region.

Water distribution trade as a form of water use is based on determining the price of water and agreeing on trade agreements for water as a commodity 2020 [23]. In past years, as part of a union state, until 1990, the problem of water use was solved by compensating Kyrgyzstan and Tajikistan by transferring fuel resources (coal, oil and gas) to the Republic of Kazakhstan and Republic of Uzbekistan for the use of water from these mountainous territories 2017 [13]. Unfortunately, after the collapse of the Soviet Union state, previous agreements were cancelled, and each country began to use its resources as a commodity in foreign trade. But, if there was already a certain price for fuel and energy resources, then the price for water remained unresolved.

Another form of water using can be called as the water rights' trading, where the constant transfer of water rights (property rights) determines either a share or a fixed amount of available water in a given source. However, in the conditions of the Central Asia, this method of water using is limited due to changes in the flow regime and the growth of low-water periods in rivers, as well as the outdated irrigation system in the region, when only 40% of the water is used for irrigation, the rest of the water is lost irretrievably.

Thus, to introduce a water resources market in the Central Asia, using various forms of water use, it is necessary to carry out the following activities. First of all, it is necessary to assess the hydrological and institutional needs of the Central Asian countries. Such measures should lead to an assessment of the future water market, including an assessment of the development and implementation of water management mechanisms. The steps noted towards market formation and its effective operation require ongoing review and assessment of future needs, with different issues requiring assessment at each stage. Am important aspect of such actions towards the formation of a water market in the Central Asia is the expansion and transfer of information for water resource planners, which should be taken into account when considering the usefulness of water trading processes for better management of water scarcity, necessary for further practical applications and testing of the water resource market structure.

The hydrological needs of the Central Asian countries are calculated using various methods and models. These calculations are based on information on changes in temperature and precipitation, which occur unevenly across the region and can lead to different impacts on water resources. In general, both an increase in average temperatures at 1.9-5.6°C range and an increase in precipitation at 5.5-10.1% are projected for the period up to the end of this century 2023 [7].

Changes in the flow of rivers in the Central Asia, associated with the melting of glaciers in mountainous areas and the volumes of water withdrawal can also have a significant impact on the state of water use. The above-stated factors will have a significant impact on changes in the hydrological regime of rivers and, ultimately, on the demand and deficit of water in the region.

Under the taking into account the all above-mentioned, one cannot but agree with the statement that a "one size fits all" approach to water resource management will not be effective in the Central Asia. Instead of that, the water using strategies must be tailored to the specific conditions of each watershed, as well as each country, taking into account both the unique combination of climate, topography and glaciation of each area, and standards and decisions for water use that do not conflict with the general and national interests of the Central Asian countries.

Thus, the analysis of water management legislation of the Central Asian countries, the certain differences in water using policy were revealed. For example, among the five Central Asian countries, the Water Code of the Republic of Uzbekistan does not contain an article on payment for water using 1993 [11]. Taking into account the size of the territory and population of the Republic of Uzbekistan, most of which is concentrated in the eastern foothill zone of the Fergana Range, this may create difficulties in conducting calculations for water trade within the water resources market.

From the other hand, the fact that in four out of five Central Asian countries, the possibility of charging for water use has been defined within the framework of legislation on water and water use creates a certain basis for discussing the formation of a water resources market in the Central Asia (2013, 2005, 2020) [19, 20, 21].

Discussio

The using of water resources in the Central Asia is one of the most important strategies for the socio-economic and safe development of the region. At the same time, the specifics of water resource management are closely dependent on external factors, primarily climate factors, and the lack of a sustainable water use policy. Institutional and legal aspects of water use, as well as outdated traditional methods and technologies of water use in the Central Asian countries, pose new challenges for transforming water resources management in general. Such transformations in

water management policy should help to change existing and use new forms of water management.

One of the ways of legal regulation and management of water resources could be the formation of a water market in the Central Asia, which provides for water trading. According to such fact, the water rights are allocated to each country in the region and each sector, and they use it according to their needs, buying when they need more water and selling when they need less. Water trading is essentially a water market mechanism that treats water as a commodity that users can trade according to their needs and capabilities. It should be noted that there are two types of water trade: permanent trade, which is the trade in water rights (known as "rights trade") and temporary trade, which is the annual trade in water quotas (known as "quota trade"). What form of water trade the Central Asian countries will choose is a matter of time and discussion, both at the government and public levels. By the way, public discussion can play a significant role, as it will help expand the knowledge of water users and overcome the mental attitude of the local population towards water use. It should be noted that water trading can provide significant cost savings while achieving the same water quality goal. It can also provide greater flexibility in terms of the timing and level of technology that a country or even a business can use. For example, the sectors of a country's economy that have a surplus of water at a given time can then sell their rights to those who need additional water, and this is effectively water trading and a very common practice in developed countries among the industrial and agricultural sectors, the main consumers of water. However, along with changes in water management, the water trading can lead to higher water delivery fees for the remaining users, water shortages, and increased disease incidence in the local population. At the same time, changes and adjustments in water management can be quite complex.

Therefore, the necessity and possible difficulties of water trading policy within the water market, let us turn to the analysis of existing problems and potential solutions that were discovered during our research. The most important problems of water using include distribution of water. Hydrological uncertainty and extreme weather events are perceived as some of the most serious threats, creating a gap between predicted demand and available water supply, contributing to chronic water shortages. Climate change is worsening the situation by changing hydrological cycles and creating unpredictable water use conditions, increasing the frequency and severity of floods and droughts. Hence, there is growing recognition of the role of water scarcity and drought in exacerbating instability and conflict. The regime of payments for water using, especially in the irrigation sector, despite the adoption of laws on water charges, has not yet entered into full force and is not always recognized as a possible mechanism for objective and fair management of water resources. In order to achieve the optimal water resources' management and address these complex and interrelated water-related challenges, the Central Asian countries need to improve the way how to manage their water resources and related services.

With a purpose to enhance the water security in conditions of rising demand, water scarcity, increasing uncertainty, greater extremes, and fragmentation challenges, the Central Asian governments will need to invest in strengthening the water and information management institutions and developing the natural and supporting infrastructure. The institutional instruments such as legal frameworks, water pricing, and incentives are needed to allocate, regulate, and conserve water resources more efficiently. Investments to innovative technologies for improving the productivity, conserve and protect water resources, as well as recycle storm and wastewater pose challenges to increase water supplies, including replenishment and restoration of aquifers. Ensuring rapid dissemination and application of these advances will be key to strengthening regional water security in the Central Asia.

In this regard, one of the most important tasks on the path to water management and the formation of a water resources market in the Central Asia is the elimination of root causes aimed at improving the culture of water use, with a change in our thinking (or behavior) in water use and decision-making on water use management, related not only to water users, but also to government structures and policies.

Based on the all-above mentioned, we must strive to counteract harmful models of water use and encourage positive ones. The life and consequences of measures, especially in recent years, to overcome water shortages and droughts have shown that public institutions, unfortunately, do not fully cope with the development of proposals and operational decision-making on water. Therefore, based on the experience of a number of the EU countries, water management should move to the use of other approaches or models. Such models of water management, especially at the local level, can be: public, where the responsible public organization can bear direct responsibility for the provision of water services and its management, mixed, when a state enterprise (usually on a local level) and private company can manage water resources jointly and private, in which either the responsible state institution appoints a private company to manage water using tasks.

Conclusion

Studying the problems of water resource management, against the background of climate change, as well as the demand for water in the Central Asia, leads to the conclusion that the water market can be presented as a solution tool. However, the functioning of such a market and the possibility of making decisions on the above-mentioned problems, presupposes knowledge of what place should be given to the water market within the framework of water resources management policy and its differentiated potential in the countries of the Central Asia. This tool can enhance water users' knowledge of the basics of water trading, its use as a mechanism for water reallocation in cases of scarcity, and can be made accessible to water management practitioners and decision makers.

The key consequences of irrational water use in the context of climate change are already leading in many areas of the Central Asia to an increase in the population's need for water and, at the same time, to a reduction in water reserves. In the current conditions, it is necessary to take into account all actual types of water and methods of their use. Naturally, in order to make decisions on water use, water users need access to data on water use at the regional and local levels. Due to the fact that we cannot replace water with an alternative source, improving water management practices should focus not only on accounting for water resources and water quality, but also assessing the condition of irrigation

infrastructure that is approaching the end of its planned life, hence the effects of climate change, such as more extreme weather events, will further limit its ability to function normally.

Since the state of irrigation infrastructure and the established attitude towards water use in the Central Asian countries are almost identical, decisions on water resource management and the introduction of a water market should be based on expanding and strengthening cooperation between the Central Asian countries. It should be noted that water trade is not a new issue internationally. It has also been discussed quite often within the Central Asian countries and should be aimed at solving the problems of water shortages, increasing the efficiency of food security, in drought conditions and protecting the environment. Ultimately, the water market can help manage water distribution, depending on the state of water resources of each country in the region and the models and specializations used in agriculture. Expectations from the formation of a water market in Central Asia include the possibility of developing and implementing a mechanism for distributing initial rights to water or discharges of pollutants.

However, it should be remembered that trading schemes in the future may be very information-intensive and therefore costly to administer. Although water markets do not completely replace water management, they can make water systems flexible and pollution control less costly to society. By providing assistance in determining beneficial uses of water, water markets can help resolve conflicts.

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