Water Scarcity Dynamics in Central Asia: Implications for Regional Stability

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ABSTRACT. *This article explores the dynamics of water scarcity in the Central Asian region and its implications for regional stability. It discusses how global environmental disasters and crises affect climate patterns and freshwater availability, emphasizing the critical shortage of fresh water anticipated soon. The research findings highlight water scarcity's significant challenges, threatening social stability and potentially leading to geopolitical conflicts. Central Asia is identified as particularly vulnerable due to its limited water resources, which could exacerbate existing tensions and hinder regional development. It underscores the need for regional cooperation in managing water resources and implementing effective policies to mitigate the risks associated with water scarcity. Additionally, it predicts that population growth will worsen water scarcity in the region, intensifying interstate conflicts over water and energy resources. The article aims to thoroughly analyze water scarcity as a critical issue for regional stability.*

KEYWORDS: *water scarcity, Central Asia, climate change, geopolitical tensions, regional cooperation.*

INTRODUCTION

Sudden environmental events like climate change, unexpected heat waves, or unseasonal snowfalls don't discriminate based on location; they affect humanity. Over

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recent decades, earthquakes, floods, droughts, wildfires, and other natural calamities have claimed millions of lives worldwide and incurred billions in economic losses. Furthermore, water scarcity and ongoing soil erosion in regions across Asia, Africa, and Australia have led to significant humanitarian crises. Projections suggest that by 2050, over 140 million people from Africa, South Asia, and Latin America could be displaced due to climate change (UN, 2020).

The World Bank warns that without intervention, the world could see 216 million climate change refugees by 2050. Coastal countries already face the brunt of hurricanes, floods, and volcanic eruptions, contributing to the migration crisis witnessed in European nations, fueled by environmental refugees whose lives are endangered by natural disasters (UN, 2022). Additionally, in 2020, an international consortium of scientists conducted a comprehensive analysis of the environmental outlook, projecting various scenarios for rising global temperatures and population growth. Their findings suggest that by 2070, between 1 and 3 billion people worldwide could confront uninhabitable climate conditions (Xu et al., 2020).

Central Asia grapples with numerous environmental challenges, both natural and human-induced, including persistent droughts, excessive water extraction from rivers and lakes, desertification, soil salinization, and infrastructure damages from industrial accidents. These widespread issues not only jeopardize the well-being of people and economies across Central Asian nations but also pose a significant threat to regional stability. Consequently, there is a pressing need for a comprehensive examination of water scarcity dynamics.

The significance of addressing water scarcity stems from the exacerbation of political and socio-economic issues by climate change and global warming. Disruptive changes to people's familiar surroundings can result from sudden catastrophes or the gradual accumulation of environmental problems, leading to deteriorating living conditions and economic hardships. Migration, being an inherent aspect of societal life, is a multifaceted process with diverse causes and intricate consequences. Presently, there is a dearth of comprehensive studies examining the intricacies of water scarcity within the Central Asian region. Hence, investigating water scarcity dynamics in Central Asia, characterized by unique natural and climatic conditions, resource disparities, ethnic diversity, and socio-economic challenges, emerges as a pertinent and crucial research endeavor. Such circumstances underscore the necessity of selecting this research topic.

In his address at a meeting of the Council of Heads of State of the Founders of the International Fund for the Rescue of the Islands, President K. Tokayev of Kazakhstan cautioned about the severe repercussions of drought in the Central Asian region by 2050 if preventive measures against environmental disasters are not implemented. He emphasized, "The security of Central Asia is imperiled by global climate change, water resource depletion, and inadequate irrigation water availability." Tokayev highlighted that temperatures in the region are escalating faster than the global average, resulting

in glacier shrinkage, which serves as the primary water source for the Aral Sea basin. Over the past five decades, glacier volume has declined by 30 percent. Experts predict that by 2050, drought in Central Asia could cause a loss of 1.3 percent of GDP annually and prompt approximately 5 million internal "climate" migrants (Tengrinews, 2023).

The focal point of the discussion revolves around identifying the primary implications of water scarcity for regional stability, as well as deciphering the root causes and ramifications of this phenomenon in Central Asia. The findings of this study have the potential to enhance water policy and ensure environmental and demographic security. A political analysis of water scarcity issues will provide invaluable insights for Kazakhstan, enabling the nation to draw essential lessons from the research outcomes.

LITERATURE REVIEW

Water scarcity in Central Asia has become an increasingly critical issue, drawing significant attention from scholars and policymakers alike. The region, characterized by its arid climate and limited water resources, faces numerous challenges that threaten both its ecological and socio-economic stability.

Research on water scarcity in Central Asia has been extensive, with scholars examining the multifaceted nature of the problem. Studies by Sembayeva et al. (2023) and Amirgaliev et al. (2022) delve into specific issues such as land cultivation and transboundary reservoir pollution, underscoring Kazakhstan's multifaceted nature of water security challenges. Additionally, Duzdaban (2021) emphasizes the priority of water resources and water security for regional countries following their independence, reflecting the broader significance of this issue.

The implications of water scarcity extend beyond immediate environmental concerns, affecting regional stability and international relations. Researchers have highlighted the importance of international cooperation in addressing water security issues. Brassett et al. (2023) emphasize the necessity of collaboration with countries beyond the region to effectively manage shared water resources and mitigate conflicts.

Further, the global dimension of water security has been noted by scholars like Wegerich et al. (2015), who underscore the prominent place of water issues on the global agenda concerning river resources. Similarly, Karatayev et al. (2017) and Park et al. (2022) highlight the global nature of water-related challenges, including shortages, pollution, and environmental degradation, with significant implications for human development.

Central Asia's water scarcity is exacerbated by several factors, including excessive water extraction from rivers and lakes, desertification, soil salinization, and industrial accidents. These issues not only threaten the region's environmental sustainability but also have profound socio-economic impacts. Studies suggest that without effective intervention, water scarcity could lead to significant economic losses and social upheaval.

Addressing these challenges requires comprehensive strategies that incorporate political analysis, regional cooperation, and long-term planning. Scholars emphasize the need for policies that not only manage current water resources efficiently but also anticipate future challenges posed by climate change and population growth. By focusing on these areas, Central Asian countries can enhance their water security and ensure regional stability.

In summary, the existing literature highlights the urgent need for a coordinated approach to managing water resources in Central Asia. By leveraging international cooperation and implementing effective policies, the region can address the pressing issue of water scarcity and its implications for regional stability. This study aims to build on this body of work, offering insights and recommendations to inform policy and ensure sustainable water management in Central Asia.

RESEARCH METHODS

Given the multifaceted nature of water scarcity issues in Central Asia, an interdisciplinary approach was imperative for this study. This approach enables a comprehensive examination of the diverse factors influencing water resources and facilitates an understanding of their interconnectedness and repercussions for regional stability. To address the research objectives, a combination of conventional and specialized scientific methods of analysis was employed.

Historical analysis was utilized to provide insights into changes in water availability and usage over time, helping to contextualize current challenges within a broader temporal framework. This method allows for the identification of long-term trends and patterns in water management and scarcity.

Systems analysis was employed to examine water scarcity issues within the framework of systemic interrelations. This method considers the impacts of water scarcity across various spheres of life, including economic, social, and political dimensions. By employing systems analysis, water scarcity problems were not only viewed as isolation but were also regarded as integral components of regional security. This approach highlights the interconnected nature of water resources with other critical areas such as agriculture, energy production, and socio-economic development.

RESEARCH RESULTS

The study revealed that Central Asia, characterized by a dry climate, has witnessed a consistent rise in average annual temperatures since the late 19th century, with projections indicating a further increase of 3-5°C by 2080. These environmental shifts have been accompanied by phenomena such as drought, desertification, and heightened occurrences of extreme events like floods, dust storms, and landslides, all attributed

to climate change. These developments significantly impact people's livelihoods and regional stability (RCPDCA, 2023).

Furthermore, the research highlighted the significant dependence of the economies and lifestyles of Uzbekistan, Kazakhstan, Tajikistan, Kyrgyzstan, and Turkmenistan on transboundary rivers of interstate significance, given the arid steppes, deserts, and semi-deserts characteristic of the region. A key feature of this area is the uneven distribution of water resources, with Tajikistan and Kyrgyzstan situated in the upper reaches of river flows originating from the Alatau and Pamir ranges, while the remaining republics occupy lower areas along these waterways (Evolvelium, 2020).

For instance, the average annual flow of the Syrdarya River, spanning 2212 km, amounts to 37 cubic km, with distribution as follows: Kyrgyzstan claims 74%, Uzbekistan 14%, Kazakhstan 9%, and Tajikistan 3%. Similarly, the average long-term flow of the Amudarya River, stretching 1415 km, totals 78 cubic km, with over 80% originating in Tajikistan, 6% in Uzbekistan, 2.4% in Kyrgyzstan, 3.5% in Turkmenistan and Iran, and 7.9% in Afghanistan (Tileukulova, 2022).

Moreover, more than two-thirds of the Shu and Talas rivers originate from the glacial peaks of the Kyrgyz Alatau. It is projected that within the next 25-50 years, the flow of these rivers could decline by 25-45% due to climate change, posing a risk of glacier melting and disappearance in the two river basins by 2100. The Shu-Talas Basin Inspectorate reports a total of 41 reservoirs (5 larges, 36 small) under republic ownership in the basin of these rivers. Additionally, communal ownership includes 111 reservoirs and 80 ponds, while private ownership encompasses 9 reservoirs and 5 ponds. However, the feasibility of filling these reservoirs with water shortly appears increasingly uncertain (Zakon.Kz, 2023).

Furthermore, on January 31, 1983, based on the order of the USSR Ministry of Water Resources No. 1/1-36-427 9428 dated April 27, 1981, Deputy Minister of Land Reclamation and Water Resources of the USSR I.I. Boradovchenko signed the "Regulations on the distribution of the Talas River flow." According to this regulation, all water resources in the Shu River basin are subject to distribution, amounting to 6.6 million cubic meters (with 42% allocated to Kazakhstan and 58% to Kyrgyzstan). Similarly, the resources of the Talas River (1.6 million cubic meters) were divided equally, with 50% allocated to each country (Borisova, 2021).

Water plays a crucial role in sustaining agriculture, the primary economic sector of the region. Recent data indicates that Uzbekistan and Turkmenistan, situated in the lower reaches of the region's rivers, are the largest consumers of available water resources, utilizing up to 80-90% of the total. Tensions between the upper (Tajikistan, Kyrgyzstan) and lower (Kazakhstan, Turkmenistan, Uzbekistan) riparian countries in Central Asia primarily stem from differences in water usage regimes (Orynbayev & Muminov, 2024). Kazakhstan and Uzbekistan, being economically developed and having substantial

reserves of oil, gas, and other natural resources, are also the most populous countries in the region. However, downstream countries heavily rely on upstream countries like Kyrgyzstan and Tajikistan, situated in the mountains, which effectively control the main waterways, such as the Amu Darya, Syr Darya, Shu, and Talas (Morozova, 2021).

Furthermore, the impacts of climate change are significantly evident in Central Asia on a global scale, with weather fluctuations becoming increasingly frequent. Over the past century, international sources have documented a rise in air temperatures and a decrease in precipitation across the region. A comprehensive study published in the journal Science highlights that glacier melt in Central Asia is projected to peak between 2035 and 2055, with glaciers melting at a faster rate than the global average (Buzan et al., 1998). Water consumption is projected to increase by 46% by 2040, creating a deficit of up to 12 m^3/year, especially in the scenario of possible reductions in flows from neighboring countries. Without large-scale action, water shortages could triple by 2050 (Orynbayev & Tumashbai, 2022).

The prevailing trend reveals a worsening of climatic conditions, particularly evident in the alarming levels of water shortage and drought. This deterioration has led to a significant environmental catastrophe: the desiccation of the Aral Sea. During the Soviet Union era, extensive agricultural practices in the Aral Sea basin, including the cultivation of water-intensive crops like cotton and rice, coupled with the construction of numerous artificial reservoirs, exacerbated regional water scarcity. For instance, in the Amudarya River basin alone, 63 reservoirs were constructed, with Tajikistan hosting 12, Turkmenistan 19, and Uzbekistan 32. Similarly, along the Syrdarya River, 66 reservoirs were built, with Uzbekistan accounting for 39, Kyrgyzstan 15, Kazakhstan 9, and Tajikistan 3. Consequently, between 1960 and 2009, the Aral Sea's surface area dwindled from 67,499 km^2 to a mere 6,700 km^2, a reduction of over tenfold. Presently, more than 35 million individuals residing in the sea basin endure the repercussions of this ecological crisis. Moreover, over 20,000 square kilometers of former seabed have transformed into barren wastelands laden with mud and salt (Ulukbek uulu & Abdyldaev, 2022).

Each year, gusts from wind-raised dust storms lift thousands of tons of fine sand, pesticide and herbicide residues, dust, and soil infused with sea salt particles into the atmosphere, carrying them across vast distances from Central Asia to Antarctica, traversing the globe. The aerosols composed of chemical contaminants and sea salt not only pose health risks to local populations, flora, and fauna but also contribute to accelerated glacier melting in the Tien Shan and Pamir mountains of the region (Peña-Ramos et al., 2021).

The primary cause behind the desiccation of the Aral Sea stems from the diversion of water from the Amu Darya and Syr Darya rivers into artificial canals, coupled with excessive consumption for the expansion of irrigated agriculture, particularly focused on cotton and rice cultivation. Notably, the Karakum Canal in Turkmenistan stands as

the world's longest irrigation canal. Initially stretching 1,350 km from Akhun Khan to Ashgabat, it traversed the southern expanse of the country, drawing water from the Amu Darya River. This artificial waterway serves to irrigate desert regions and cotton plantations in Turkmenistan. With a formidable capacity of 500 cubic meters per second, the Karakum Canal supplies water to the Ahal and Balkan vilayets in the northern regions of the Kopet Dag Range, as well as the Murgab oasis in the southeast. Constructed between 1959 and 1976, the colossal canal initially irrigated an area of approximately 500,000 hectares. In response to the environmental catastrophe unfolding in the Aral Sea, Turkmen authorities extended the canal's length to 1,435 kilometers and augmented its water flow to 1,000 cubic meters per second, aiming to expand irrigated lands to cover 1 million hectares. However, the Turkmen government acknowledges that 28 percent of the canal's water is lost due to seepage or evaporation before reaching its intended destinations, although scientists argue this figure could be as high as 60 percent (BBC, 2021).

Furthermore, authorities in Turkmenistan are constructing a vast reservoir dubbed the "Lake of the Golden Age" within the Karashor depression, situated amidst the Karakum desert. Spanning 120 kilometers in length, 65 kilometers in width, and 80 meters in depth, this reservoir comes with a price tag of $4.5 billion. Proponents claim that this artificial lake will harness water currently lost in the desert, bolster agricultural water supplies, moderate scorching temperatures, and ensure enhanced water reserves for the future. However, they display a dismissive attitude toward the fate of the Amu Darya River and the Aral Sea, discounting the severity of potential environmental repercussions for the planet (Boyarkina, 2024, pp. 72-73).

Moreover, the shrinking of the Caspian Sea in recent years has been a cause for significant concern. The Caspian Sea's water level is heavily reliant on inflows from the Volga and Ural rivers, while its water content, and subsequent drainage, is contingent on basin precipitation. In total, approximately 325 cubic kilometers of water are poured into the Caspian Sea by all its rivers, accounting for 83% of the sea's water balance. On average, around 180 millimeters of precipitation, in the form of rain and snow, falls onto the Caspian Sea's surface, constituting about 16% of its water balance. Groundwater contributes the remaining 1% to the sea's inflow. Throughout the year, a significant portion of water from the Caspian Sea is consumed by evaporation from its surface (95%), with the remainder flowing into the Kara-Bogaz-Gol Bay (5%), where it also evaporates (BBC, 2021).

In terms of water consumers, recent UN data projects that the population of Central Asia will reach 82 million people by 2030 and 100 million people by 2100. Demographically, Central Asian countries are experiencing steady growth, with Tajikistan leading the trend with a population surge of 60% over 20 years. In 2001, Tajikistan's population stood at 6.2 million, and by 2021, it had increased to 9.9 million. Following closely in terms of population is Uzbekistan, boasting a growth rate of 42.3% over two decades, with its population rising from 24.8 million to 35.3 million. Turkmenistan and

Kyrgyzstan exhibit similar growth patterns, both in total population and rate of increase. Turkmenistan's population grew from 4.5 million to 6.1 million, while Kyrgyzstan's rose from 4.9 million to 6.7 million, representing growth rates of 35.6% and 36.7%, respectively (Boyarkina, 2024). Kazakhstan, on the other hand, demonstrates the slowest population growth in the region, with its population expanding by 28.2% over the past 20 years, from 14.9 million to 20 million people.

The surge in population and industrial growth has led to a notable rise in water consumption rates, a trend observed not only in Central Asia but globally, according to UN statistics. Despite possessing abundant water resources, Central Asia faces various challenges contributing to water scarcity. These challenges include geographical limitations, inefficient water management practices, political tensions, technological deficiencies, the necessity to continuously bolster agricultural and industrial output to meet the demands of a rapidly expanding population, and the degradation of irrigation infrastructure and reservoirs.

Presently, water scarcity is acutely felt in regions such as Zhambyl, Turkestan, Kyzylorda, Aktobe, Atyrau, and Mangistau in Kazakhstan, along with central areas of Ulytau and Karaganda. These regions, including Sary-Arka, Betpak field, Irgyz, Ustir fields, Moyynkum, and Kyzylkum, are predominantly desert regions (Orynbayev et al., 2024). For instance, in 2023, a state of emergency was declared in the Zhambyl region due to summer droughts, while the Shalkar district of Aktobe faced the threat of sandstorms. The drying up of rivers like Zhem, Sakig, and Oyil in the western region has resulted in a shortage of drinking water not only for crops but also for livestock. Given the severity of the situation and the necessity for a revised water policy, President K. Tokayev of Kazakhstan proposed the establishment of the Ministry of Water Resources and Irrigation on September 1, 2023 (Vohra, 2021).

Similarly, much of Uzbekistan grapples with water shortages, particularly arid regions such as Karakalpakstan, Karakum, Kyzylkum, bordering the Aral Sea, and the adjoining Aralkum desert, along with Khiva, Bukhara, Navoi, and Surkhandarya regions. Approximately 80% of Turkmenistan's territory comprises desert regions devoid of regular river flow. Rivers exist only in the southern and eastern regions, with the Murgab and Tedzhen rivers disappearing into the Karakum Desert. The Amu Darya River serves as the primary water source, diverted through the Karakum and Shavat canals, along which reservoirs like Zeyd, Khauzhan, and Kopetdag have been constructed. These artificial water channels have significantly contributed to the retreat of the Aral Sea. Lake Sarikamys, situated on the Uzbekistan-Turkmenistan border and fed by the Amu Darya River, contains saltwater, exacerbating the challenge of water scarcity for Turkmenistan's populace, given its predominantly sandy, desert landscape susceptible to drought and salinization.

The mountainous regions of Kyrgyzstan and Tajikistan are experiencing the adverse impacts of global warming and climate change. Each year, the glaciers that feed mountain

rivers are diminishing in size, leading to a reduction in the availability of running water. Abnormal weather patterns have also resulted in an increase in landslides, mudflows, floods, and earthquakes in these areas. Consequently, these natural disasters wreak havoc on the traditional way of life and economy of the people inhabiting these regions. In summary, the factors driving environmental issues in the Central Asian region are exacerbating, unsettling the population.

While there are indeed regions in Central Asia that are conducive to human habitation and possess adequate water resources, these areas are typically already densely populated, with flourishing agriculture. However, in the future, even these regions may witness increased strain on water resources, exacerbating existing challenges. Furthermore, as water scarcity exacerbates, the need for sustainable water management practices becomes increasingly urgent. Many Central Asian countries are already taking proactive measures to diversify their economies, ensure the sustainability of climate-sensitive industries, and integrate climate priorities into national development strategies and public policies.

In the context of regional security, the main question for Central Asian states is whether transboundary river waters can cause conflict between Central Asian states. And how can this be prevented or, if it happens, how can it be regulated? From 2012 to 2022, 144 conflicts occurred between Kyrgyzstan and Tajikistan. The most common cause of conflict is water (Gazeta.Uz, 2022). Although Central Asia comprises only five states, the region was the scene of twenty conflicts over thirty years, namely from 1990 to 2019 (Sorbello, 2024). The cause of the conflict in the village of Kok-Tash, Batken district in 2021 was the water intake of Golovnoy (BBC, 2021). This facility is used by both Tajiks and Kyrgyzs. The main reason for the interstate dispute is that both sides consider this object to be theirs.

There are several types of settlement of transboundary river conflicts:

Mediation: With the collapse of British India, the unified system of water management was destroyed, and internal rivers became transboundary. At the same time, on the territory of India, which became the “upstream state,” there were a few hydroelectric complexes that supplied water resources to the irrigation canals of downstream Pakistan. Thus, Pakistan became dependent on India’s water policy. The problem is complicated by the fact that, in an arid climate, 92% of Pakistan’s territory requires water, and more than half of the country’s population is employed in agriculture, which is the basis of the state's economy. In April 1949, India completely blocked the Indus, changing the course of the river, and Pakistan had to pay for the water. In addition, Pakistan was also denied access to the Ravi and Sutlej rivers. The dispute over water rights to international rivers was resolved only in 1960, when the conflicting parties concluded the Indus Waters Treaty. An important role was played by the World Bank (WB), which acted as a mediator in resolving the conflict (Alekseeva, 2024).

Mutual Benefit: In November 2021, Israel, Jordan and the United Arab Emirates (UAE) signed an important agreement that will set an example not only for the Middle East, but for the entire world. According to the contract, the United Arab Emirates (UAE) will build a solar power plant in Jordan that will operate 300 days a year. The plant produces 600 megawatts of solar energy and exports $180 million annually to Israel. The proceeds will be divided between the UAE and Jordan. But more importantly, Israel will instead send 200 million cubic meters of desalinated water to Jordan. The project is expected to become operational in the next five years (Vohra, 2021).

Today, the four Turkic states of Central Asia (except Tajikistan) are solving the problems arising around water through negotiations. The sharing of the Kempir-Abad water reservoir between Kyrgyzstan and Uzbekistan was decided within the framework of negotiations. At the end of 2022, Uzbekistan and Kyrgyzstan ratified an agreement on sections of the state border and an agreement on the joint management of the Kempirabad (Andijan) reservoir. As part of the documents, 4,957 hectares of the reservoir territory and an additional 19.5 hectares for maintenance and protection of the dam were transferred to Uzbekistan; 1,019 hectares of pasture land were transferred to Kyrgyzstan as compensation (Gazeta.Uz, 2022).

Also, the governments of Kazakhstan, Kyrgyzstan, and Uzbekistan agreed on April 15, 2024 to establish a joint company for the construction of the Kambar-Ata-1 dam on the Naryn river, around 150 kilometers south-west of Kyrgyzstan's capital Bishkek. The significance of the Kambar-Ata-1 dam and hydroelectric power station (HPP), if built, will improve energy security in a region with growing power shortages. Kazakhstan (33%), Kyrgyzstan (34%), and Uzbekistan (33%) will co-own the company responsible for the construction, according to the agreement. Funding will come both from government budgets and from loans and grants from international financial institutions, like the World Bank and the IMF (Sorbello, 2024).

CONCLUSION

In conclusion, this study sheds light on the environmental challenges and water scarcity prevalent in the Central Asian region. The analysis reveals a complex interplay of natural, anthropogenic, and technogenic factors contributing to these issues. Historically, political decisions aimed at transforming Central Asia into agricultural hubs disrupted the region's natural balance. Massive irrigation projects and extensive planning during the Soviet era led to significant environmental consequences, including the drying up of the Aral Sea. The study highlights critical challenges in Central Asia's water security, including aging infrastructure, outdated management methods, weak flood protection, inadequate training, and regulatory framework issues, emphasizing the imperative for coordinated regional cooperation and innovative policy reforms to address water scarcity risks and promote sustainable development and regional stability.

Addressing these challenges necessitates a coordinated water policy among countries in the region, particularly those situated at the headwaters of Mountain Rivers and in river deltas. However, achieving consensus remains challenging, as each country prioritizes its national interests and security. Despite the inevitability of water shortages in the region, proactive measures can mitigate their severity and consequences. Strategies include maximizing water conservation through modern irrigation technologies, combating environmental disasters like desertification, promoting water-efficient agriculture, and fostering a culture of responsible water usage. Additionally, efforts to increase forest cover, protect against wildfires and illegal logging, and facilitate planned resettlement from environmentally vulnerable areas are crucial. Collectively, these actions can help promote sustainable development in the Central Asian region and ensure the long-term viability of its ecosystems and communities.

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