Is the ecosystem approach effective in transboundary water systems: Central Asia as a case study?

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Abstract
In the context of international environmental law and International Water Law (IWL), the Ecosystem Approach (EA) has become a source of heated debate. In recent years, there has been growing recognition of the negative impacts that human activities have on freshwater ecosystems. Accordingly, the protection of such ecosystems has been identified as integral to ensuring the good governance of water resources. This article reviews key areas of research around the conceptualization and application of EA. First, we adopt a holistic approach to the concept of EA when applied to existing environmental challenges, before exploring the issues that arise when applying EA to water-based ecosystems. Next, we assess the effectiveness of implementing EA in the management of environmental issues linked to transboundary water contexts. Our findings indicate that International Environmental Law, which applies a sector-specific approach, poses challenges for the instrumental implementation of EA because the latter requires a holistic approach to resource management. Furthermore, in transboundary water contexts the competing needs of river-basin countries are also identified as key factors complicating the implementation of EA. The article concludes with recommendations for policy makers and scholars.

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“legal and governance strategy for the integrated management of land, water and living resources” (De Lucia, 2017, p. 91) and is being adopted in international environmental regimes related to international watercourses, oceans, climate change, and so on (De Lucia, 2017). Since its inception, the underlying understanding of EA is that a more holistic approach to resource management is needed to meet existing environmental challenges. The development of EA on an international level began in the 1970s with the Stockholm Declaration and has gradually evolved over the following decades (Platjouw, 2016). The approach has received considerable support in line with widespread acknowledgement of the substantial negative impacts that human activities have on freshwater ecosystems, often resulting in irreversible damage to the natural environment and knock-on effects on people whose livelihoods depend on it (Erdem, 2013; Tarlock, 2016). In practice, the approach has also strongly influenced the making of environmental law and water agreements, reflecting the commitment of nation states to protecting the ecosystems of transboundary freshwaters, such as by taking “affirmative steps to protect such ecosystems and to develop plans for protecting and sustaining the broader environment that encompasses transboundary waters” (Eckstein et al., 2010, p. 59). Such initiatives have been seen in the United States, Europe, Asia and Africa (Erdem, 2013).

However, there is also a growing body of scholarship that seeks to review the adoption and implementation of EA, and which has raised some heated debates. This literature has identified a variety of issues including: friction between EA and International Environmental Law (IEL), where the latter has been adopted in various international environmental agreements (De Lucia, 2019a; Lee, 2013; McIntyre, 2014); different countries’ approaches to resource governance (Tarlock, 2014); the feasibility of achieving sustainable development of ecosystems (Platjouw, 2016); and other contextual factors arising from the promotion of EA (McIntyre, 2017). The purpose of this article is to examine in detail whether EA has been effective in transboundary water contexts and to identify problems that arise from its implementation. The reason for the focus on the transboundary context is that the protection of the ecosystem in this context is much more complicated given the existence of different state interests, rules, traditions, cultures, water management practices, communities, and so on. Hence, while the ecosystem is a whole element, political boundaries make its management much more difficult which is why global regulatory frameworks such as IEL and International Water Law (IWL) are addressing it (Zeitoun & Mirumachi, 2008).

The article is structured as follows. First, we point out the general weaknesses in the formulation of EA. These factors can be linked to the sector specific approach of IEL, whereas, in contrast, EA cannot be satisfactorily regulated through one specific sector such as IWL. We then examine some cases from the Global South (lower income countries) where EA has been applied, including the Syr Darya River basin in Central Asia (CA), and discuss the challenges that can be identified as arising from the implementation of EA in transboundary water contexts, including upstream/downstream dynamics, the focus of basin countries on other competing needs, and practical difficulties facing the implementation of the approach itself. Finally, taking account of the issues raised here, policy recommendations are made to address the matter of how EA can be best applied to contexts involving transboundary freshwater systems in the Global South.

It is worth noting in this context that the effectiveness of the application of EA in practice is beyond the scope of this article, given that the nations have either only recently dealt with EA independently or consider it as part of a general approach that includes other elements such as competing water uses. Moreover, it is also important to mention that EA has many positive aspects that are also beyond the scope of this article, especially for instance when it comes to reconciling different global regulations frameworks where EA is included (De Lucia, 2015; McIntyre, 2004; McIntyre, 2019).

2 | A GENERAL CRITIQUE OF ECOSYSTEM APPROACH

The adoption of EA in international law has been discussed extensively in different domains of natural resource governance, such as the Antarctic (Redgwell, 1999), the oceans (Schøning, 2020), as well as in the context of countries’ sharing freshwaters (McIntyre, 2019). Accordingly, this section reviews the formulation of EA and the problems it faces when being adopted in the context of transboundary water resources.

2.1 | The conceptualization of ecosystem approach

Different terminologies have been used over the years to refer to EA (De Lucia, 2019b), including “ecosystem services” (UNEP, ), “ecosystem management” (Lackey, 1998), and “eco-service provision” (Platjouw, 2016). When incorporating
EA in water management, a range of management objectives can be identified, including, for instance: ecosystem vitality, which is defined by water quantity and water quality; basin condition (which focuses on land coverage); and biodiversity (Wen et al., 2020). Similarly, a nexus approach has been established that emphasizes building synergies and improving governance across sectors relating to water, food, energy, and biodiversity (Allouche et al., 2015; Hoff, 2011). Different terms have been raised under the nexus umbrella, including Water–Energy–Food–Ecosystems (WEE) Nexus (UNEP, 2012), or Water–Energy–Ecosystems (WEE; Chen et al., 2020). The importance attached to EA becomes blurred in these different concepts. WEE highlights EA’s value to human wellbeing, especially the livelihoods of the poor (IWMI/UNEP, 2011); hence it is suggested that EA is more inclusive and consists of food, animal feed, biofuels, wood, and fiber (UNEP, ). In a WEE, EA is more likely to have a narrower focus such as ecosystem conservation (Chen et al., 2020) or biodiversity protection (Wen et al., 2020).

Considerations of how the water sector can best be weighed up within EA have raised further questions. McIntyre (2017) positions water as the fundamental element in natural systems, highlighting that the goal of EA is to ensure the protection and preservation of shared watercourses by addressing a range of issues, especially the protection of water quality by reducing river pollution. Others see water as an integral part of ecosystems but insist on formulating EA as an extended system inclusive of other natural systems such as wildlife habitats and biodiversity (Dugan, 2010; Intralawan et al., 2018; Kummu & Sarkkula, 2008). According to this formulation of EA, the management principles of water resources should be slightly tilted toward the conservation of ecosystems vitality and thus take on a wider range of objectives, including the management of land coverage and biodiversity, which need to be considered apart from the conservation of water quantity and quality (Lackey, 1998; Wen et al., 2020).

A further source of heated discussions has been the matter of how to appraise the value of EA. Competing views exist about whether it is appropriate to conduct economic valuations of ecosystems when applying EA. Some have recommended the use of integrative, multimetric indices to measure the complexity of water resource sustainability (Pires et al., 2017; Wen et al., 2020). The idea is to develop a framework and accompanying tools that draw attention to the relationships between healthy freshwater ecosystems and the ways in which they are governed by stakeholders, as well as the benefits they provide to industry, agriculture and households, and for the purposes of ecological protection (Liu et al., 2019; Vollmer et al., 2018). Nevertheless, such efforts to place economic valuations on ecosystems have been questioned, especially given the inherent challenges in balancing conflicting priorities for such calculations.

EA is also seen as having cultural meanings because it “serves to enhance awareness of the nature and value of socially beneficial services provided by natural ecosystems” (McIntyre, 2019, p. 144), thus providing non-use values such as the simple satisfaction one enjoys from the knowledge that a natural resource exists. More specifically, interdisciplinary scholarship reminds us that understandings of shared transboundary waters are not completely dominated by the scientific aspect of how water resources are managed; rather, socio-political processes also help to shape the various interpretations (Brugnach & Ingram, 2012). Thus, across different cultures a variety of understandings will develop about what water is and how it ought to be valued (Freyfogle, 1996; Groenfeldt & Schmidt, 2013). The “existing theory and scientific practice for linked systems of nature, economies and societies are still too partial and fragmented” (Hartje et al., 2003, p. 14) and may lead to different interpretations of EA, “ranging from an anthropocentric perspective to an ecoregional or ecocentric perspective” (Hartje et al., 2003, p. 12).

Therefore, given the issues arising from EA—the broad definitions, disagreements over position in the natural system, and economic and cultural values—it is not clear how it can make the mission of policymakers easier, especially since these actors are looking to adopt clear regulations that can be easily and consistently interpreted by different administrations. In such conditions, it is challenging for countries to develop international agreements based on the different values that EA provides in transboundary contexts.

### 2.2 The application of ecosystem approach within International Environmental Law

Although EA highlights the need to regulate ecosystems holistically, the fragmented structures of IEL are not appropriate for addressing this task. This is because complex interconnections exist between its various components, which are regulated separately, such as water conservation, pollution control, biodiversity protection, wetland protection, and so on. In the field of environmental law, the obligation to preserve the ecosystems of international watercourses has been addressed by water instruments and treaties as well as other general environmental treaties and mechanisms (Lee, 2014). For instance, the Convention on Biological Diversity (CBD) provides a broad scope that is less constructive because it does not explain how states should navigate their different interests while attempting to realize the CBD’s
various objectives (Raum, 2017), namely: “conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources” (CBD, 1992, Art. 1). Further, it is not clear whether these objectives are designed to be achieved simultaneously. The practical implementation fully depends on individual member institutions and their own policies, which may have specific foci such as using resources for the benefit of citizens, water conservation, and protecting ecological systems. Achieving the three objectives together requires a widening of the perspectives of each institution to include other issues that were not originally covered. In this context, EA, given its holistic nature, is seen as a means for the implementation of the CBD’s objectives. However, even when EA is adopted, there is great uncertainty about ecological matters such as the capacity of an ecosystem that is not easy to determine, causing considerable controversy (Hartje et al., 2003). Therefore, efforts to formulate EA are faced with complex environmental problems as well as the different values and expectations of stakeholders (Hartje et al., 2003).

2.3 The application of ecosystem approach under International Water Law

Water-based ecosystems are extremely complicated to manage in an effective manner since water has multiple anthropogenic uses (Voigt, 1997). The governance of transboundary river systems also poses challenges for countries wishing to develop sector-specific international agreements to regulate the use of transboundary waters. IWL is one tool available for the implementation of EA. It has been described as “a channel-based legal regime, as opposed to a watershed or ecosystem-based legal regime and this focus is inherently biased toward development and against ecosystem protection” (Tarlock, 1996, p. 199). EA does not match with the existing practices of countries managing domestic water resources shared with neighboring states. For instance, traditional regulatory and policy instruments, despite their importance, are not sufficient to address ecosystems from a holistic approach (Hack, 2015), as “the concept remains vague, controversial, and very difficult and costly to integrate into existing management regimes” (Tarlock, 1996, p. 197). More specifically, knowledge and financial resources are lacking for the application of EA. Ecosystem structures are very complicated as “not much is known about the changes in ecosystems’ functions and services that have taken or will take place on different scales due to human interference” (Hartje et al., 2003, p. 13). This is mainly due to a lack of data about anthropogenic impacts on ecosystems, and the difficult mission of making a distinction between natural variations and trends resulting from human actions (Hartje et al., 2003). Further, a lack of technical capacity to effectively manage water resources has also been identified as a problem for countries in the Global South (Jia et al., 2016).

Similarly, efforts to apply EA can be hindered by a lack of willingness among individual riparian states to conduct the required water management practices. For instance, since they do not control the flow of international rivers, downstream states are vulnerable to a lack of compliance from their upstream neighbors over issues such as the prevention of pollution. Further, since many states remain heavily reliant on water for both economic development and industrial and domestic consumption (Fox & Sneddon, 2007), it is difficult for them to entirely avoid water pollution and degradation of the environment of their shared rivers.

In addition, international water agreements have been noted to be overly rigid when addressing issues arising from the management of the ecosystems of transboundary rivers (Jafroudi, 2018; McCaffrey, 2003; Uprety & Salmann, 2011), where instead there is a need for adaptive management due to constant ecosystem changes. IWL is still underdeveloped when it comes to adopting new mechanisms that can adapt to changing conditions, especially human activities, which are also affecting ecosystems (Tarlock, 1996). For instance, the requirement to restore degraded rivers is very challenging because “new flow regimes may conflict with entitlements built up under the equitable apportionment rules” (Tarlock, 1996, p. 203). There are no signs that existing legal frameworks have shown sufficient flexibility to accommodate such changes (McIntyre, 2019), which is one of the issues facing water agreements and international agreements in general given the current focus on stability and predictability while the flexibility part is neglected (McCaffrey, 2003).

2.4 Ecosystem approach’s shortcomings affect states’ involvement in environmental governance

EA supports the principle that individual nation states are naturally endowed with water rights, meaning that they are in possession of water rights when allocating environmental flows that run across their territories. This also means that states are naturally obligated to exercise their water rights in ways that comply with the environmental requirements
placed upon them by EA (McIntyre, 2017). An international case has helped to further develop understanding of the duty of states to protect ecosystems as embodied within EA. In 2012–2013, a Kishenganga Hydro-Electric Project Arbitration took place between India and Pakistan, during which India sought to divert water for a hydroelectric project in accordance with the Indus Water Treaty. The panel “allowed the diversion, but held that downstream Pakistan had a right to minimum flows for hydroelectric energy and irrigation and the protection of the river’s aquatic environment” (Tarlock, 2016; p. 274). This case supports that states are obligated to exercise their water rights in ways that comply with the environmental requirements placed upon them by EA because the decision sought to protect the river’s aquatic environment and the rights of Pakistan.

In sum, the formulation of EA is facing a dilemma given the need to balance holistic environmental governance while, at the same time, involving people and institutions whose activities and interests do not concern entire basins (Hartje et al., 2003).

3 | THE APPLICATION OF ECOSYSTEM APPROACH IN THE GLOBAL SOUTH: A REVIEW

This section will examine the implementation of EA in Central Asia (CA) and other southern countries where it has proven very influential in recent years, with many states attempting to adopt it into their policy making. The objective here is to provide understanding of the factors that influence the implementation of EA and whether such implementation can be successful.

3.1 | A more advanced application of ecosystem approach in Central Asia

3.1.1 | Background

The ecosystem of freshwater resources in Central Asia is under threat as water resources in the region have been exploited in an unsustainable manner to satisfy the demands of agriculture, energy, and raw materials, as well as population growth. As a result, both surface and groundwater bodies of the region have been left heavily polluted. Changes in water quality and quantity as a result of the competing needs of Central Asian countries have negatively affected the aquatic and riparian ecosystems. This problem, among many others, has received growing attention from the international community as well as policy-makers, government bodies and stakeholders at local, national, and regional levels (Karthe et al., 2017). Central Asia’s basins, such as the Amu Darya, Kura, Syr Darya, Razdan, and Ural rivers, are facing an emergency situation given “a reduction in the volume of intradelta water bodies, an increase in their water salinity levels, and a decline in biodiversity and bioproductivity of the deltas as a whole, as well as losses and a reduction in the number and diversity of natural habitats” (Yessekin et al., 2008, p. 47). These are among the many consequences of ecosystem destruction and negligence in the region.

Given its potential to form the basis of regional inter-state collaboration, EA has been widely recognized by the countries of Central Asia (i.e., Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) which have mostly subscribed to the approach. Indeed, various arrangements for interstate institutional cooperation have emerged in this regard, thus highlighting the significance for Central Asian countries of protecting ecological systems as part of their management of water resources (Yessekin et al., 2008). Confirmation of this trend can be found as early as 1992 in the CIS Agreement on Environmental Interaction, which stated: “based on understanding of the integrity and indivisibility of the environment … the contracting parties within their territories shall establish science-based norms for the inclusion of natural resources in economic and other activities and shall limit their irretrievable [consumptive] withdrawals, taking into account the need to ensure a universal ecological security and wellbeing” (Article 2). Later, the 1998 CIS Agreement on Transboundary Waters obliges its parties “to refrain from water management activities that may cause negative impact on the environment, including water bodies” and “to take measures in order to prevent and eliminate surface and ground water pollution and depletion” (Article 2). Similarly, individual countries like Kazakhstan have also emphasized the utilization of EA, as seen in the early 2000s (McKinney, 2004) when it began to be incorporated into national laws, such as the 2003 Water Code which emphasizes the protection of environmental flows to balance protecting the ecosystem with the need for water (Global Water Partnership, 2014).
In recent years, the United Nations Economic Commission for Europe (UNECE) has developed a “water–energy–food–ecosystems nexus” (WEFE) approach, emphasizing the interdependencies across water, ecosystems, energy, and food in the context of transboundary river basins. The nexus has then been applied to different transboundary basins including the Syr Darya, which is shared by Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan (De Strasser et al., 2016). Although some Central Asian countries have joined international water conventions, which highly emphasize the protection of ecosystems, so far the region’s upstream countries, Kyrgyzstan and Tajikistan, are not part of the international water treaties and it seems unlikely they will follow suit in the near future. Hence although each individual country in Central Asia has acknowledged the importance of protecting ecosystems, there is uneven adherence to water conventions (Janusz-Pawletta & Gubaidullina, 2015). Without the effective participation of upstream countries in the protection of the ecosystems of the region’s shared rivers, the effects of the water agreements that have been signed are bound to be weak (Janusz-Pawletta & Gubaidullina, 2015; Ziganshina & Janusz-Pawletta, 2020).

3.1.2 | Challenges in the implementation of ecosystem approach

Central Asian countries have agreed to cooperate to protect the ecosystems of their shared rivers. This is reflected in a number of regional water agreements. More specifically, these agreements include the Agreement on Cooperation in Joint Management, Use and Protection of Water Resources of Interstate Sources (Almaty Agreement of 1992), the Agreement on Joint Activities in Addressing the Aral Sea and the Zone Around the Sea Crisis, Improving the Environment and Ensuring the Social and Economic Development of the Aral Sea Region (1993), the Agreement on the Use of Water and Energy Resources of the Syr Darya Basin (1998), and the Framework Convention on Environmental Protection for Sustainable Development in Central Asia (2006; Ibrahim, 2020). However, the actual implementation of these water agreements has not been successful (Janusz-Pawletta & Gubaidullina, 2015). Therefore, the adoption of the WEFE approach, an UN initiative in the Syr Darya basin, was intended to provide more opportunities for countries to collectively identify the issues and problems facing them across different sectors on an international level; however, its implementation has also been limited (De Strasser et al., 2016). Two key issues can be identified as factors that affect the implementation of EA in the context of Central Asia’s transboundary waters.

The first key factor is the complicated relations between upstream (Tajikistan and Kyrgyzstan) and downstream (Uzbekistan, Kazakhstan, and Turkmenistan) states affect how water is managed. Over two-third of the region’s surface water resources are possessed and controlled by upstream countries, while downstream countries share the remaining one-third. Each country relies on the shared water differently (Guo et al., 2016). Acute competition for water quantity, as well as various other diverging interests, has resulted in numerous conflicts due to this uneven water distribution. While upstream countries are rich in hydropower and water resources, in contrast downstream countries have a wealth of land, oil, gas, and other energy resources (Xenarios et al., 2021). Since they lack fossil fuels and other natural resources, upstream countries treat water as a strategic commodity to be exploited for purposes such as hydropower generation, and so to that end change the patterns of transboundary rivers to generate electricity and store water. These activities affect the amount of water available for irrigation downstream, negatively impacting on farmland and agricultural output in downstream countries, not to mention living conditions, and also cause ecological deterioration (Abdolvand et al., 2015). Furthermore, there is a lack of political willingness among Central Asian countries to share water, especially given that the upstream countries are poorer than their downstream neighbors and also less powerful politically (Zhupankhan et al., 2017). Despite the existence of various treaties and agreements restricting water consumption and resource development projects in upstream countries, they have not abided by those agreements and thus ended up in conflicts with downstream countries, exacerbating the existing political tensions in the region (Berndtsson & Tussupova, 2020; Bichsel, 2011).

An important reason for non-compliance with these agreements is that the provisions they make for matters such as energy generation or water resources development are seen as unfairly providing advantages to specific countries, be they on the upstream or the downstream (Guo et al., 2016). Accordingly, there is a lack of willingness among Central Asian countries to share water (Zhupankhan et al., 2017).

In order to resolve all these competing issues, an effective international legal framework needs to be in place, along with a strong political will to uphold that framework; something that is currently absent (Zhupankhan et al., 2018). Although some Central Asian countries have joined international water conventions, their attempts to comply with international water norms have not yet yielded the expected results (Janusz-Pawletta & Gubaidullina, 2015; Ziganshina & Janusz-Pawletta, 2020). International water scholars have tried to find ways to resolve the problems resulting...
from the diverging interests of upstream and downstream states. For instance, they have advocated for additional agreements that could help to address the accompanying environmental problems identified (Hrkal et al., 2006; Karatayev et al., 2017), and ultimately lead to adjustments in interstate relationships that could improve transboundary water management (Menga, 2018; Zhupankhan et al., 2017). However, there are additional factors frustrating the implementation of the agreed terms or rules, including, for instance, the absence of compatible needs or a common language and culture, legacies of mistrust, and the presence of political instability (Chenoweth & Feitelson, 2001).

The second key factor affecting the implementation of EA is the understanding of the WEFE Nexus developed by the UNECE secretariat that has led to disagreements among countries subscribing to it. The main objective of the nexus is to collectively address water-related issues, including energy, food, water quality, and the environment (De Strasser et al., 2016). It was seemingly effective in encouraging collective action among Central Asian countries to cooperate over their usage of transboundary rivers in the region, while preventing further fragmentation, because “policies would be decided and adopted by all four sectors in order to eliminate the possibility of non-intended negative environmental externalities” and enable a fast and efficient collective response to any potential crisis (Gasperri, 2018, p. 12; UNECE, 2017). Conceptually, the WEFE Nexus methodology has led to further calls for inter-state cooperation (Rysbekov, 2010). The countries involved (Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan) had favorable views of the methodology, and the recommendations and conclusions reached (De Strasser et al., 2016). Their subscription to the Nexus thus confirms that the approach adopted by the UNECE Secretariat was appropriate because it connected ecosystems to water, energy, and food, thus sending a clear message that EA places equal value on resource development, be it water, energy, or food. However, it remains unclear to what extent each country has prioritized protecting ecosystems. Some critics argue that the protection of ecosystems is of fundamental importance that it should be prioritized before incorporating other related objectives such as water, energy and food (McCaffrey, 2003; McIntyre, 2018).

Different values and expectations exist among stakeholders and individual state representatives. In fact, Central Asian countries find it hard to reach agreement about equitable and reasonable use of freshwater to satisfy their existing needs—mainly irrigation and hydropower generation—thus affecting the adoption of agreements addressing competing needs and the implementation of existing agreements (Zinzani & Menga, 2017).

Implementing the recommendations made through the Nexus methodology requires huge coordination between the various authorities and sectors of the countries sharing the basin to ensure “the development and coordinated implementation of a national policy on water resources, food production, energy, and the environment” (UNECE, 2017, p. 11). While it has been noticed that mechanisms for intersectoral cooperation exist in some of the basin’s countries, adjustments have not been made to strengthen those countries’ procedures to take account of the environmental and social impact of each development plan. In addition, even though these countries have national environmental regulations, strategies, programs, and action plans, the implementation of these domestic mechanisms is difficult due to financial limitations, and the absence of affordable technologies and up-to-date environmental information (Janusz-Pawletta & Gubaidullina, 2015; Ziganshina & Janusz-Pawletta, 2020). In this context, the implementation of international instruments and regional environmental plans remains at a very low level (UNECE, 2017):

3.2 Challenges in applying ecosystem approach among southern countries sharing river basins

The findings mentioned above are not specific to Central Asia, since similar situations recur elsewhere. Where EA is placed as a secondary concern in the governance of transboundary river systems. Accordingly, this section considers the findings above in a broader context in order to highlight the challenges faced by countries when applying EA. Globally, there are a growing number of cases where tensions are rising over the upstream/downstream dynamics of shared transboundary waters, thus highlighting the complicated task of managing relations between upstream and downstream countries. In contexts where cooperation between upstream and downstream countries is extremely complicated due to competing and diverging water interests, not to mention other national differences (Petersen-Perlman et al., 2017), ecosystems are not considered top priority issues despite their importance.

Along the Mekong river, despite the fact that environmental concerns are important and that civil society organizations have repeatedly highlighted that reality, the countries sharing the river are primarily concerned with the construction of various dams which would affect water allocation (Dore, 2014), and, to a lesser degree, issues such as fish migration, electricity generation, and flood control, especially during the Monsoon season. Even though the ecosystem covers all these elements, negotiations address each of these topics either independently or jointly with the objective of
making compromises or trade-offs, instead of emphasizing the protection of the ecosystems (Ibrahim, 2020; Xie & Jia, 2018).

Another relevant case is the Brahmaputra river, where water quantity is a primary consideration in the management of shared water resources. Here, both China and India have shown great interest in building hydropower stations, while non-state actors have expressed various concerns about such projects in response. For instance, Indian communities and environmentalists have highlighted the potential harm that hydropower stations could do to the ecology of the Brahmaputra (Ho et al., 2019). Furthermore, Indian academics have raised concerns about water quality, criticizing the Indian national government for affording it low priority in its political and management agendas (Pandit & Biswas, 2019). Nevertheless, it is also evident that for both India and China, any national political will to engage in hydrodiplomacy is likely to be linked to broader geopolitical concerns (Xie & Jia, 2017), such as border disputes (Xie et al., 2018).

Finally, the Nile river basin also exhibits similar dynamics. For instance, in the dispute over the Grand Ethiopian Renaissance Dam (GERD), Ethiopia, Egypt, and Sudan have focused not on the ecosystem, but rather the potentially positive and negative impacts of the dam on each country. Whereas Ethiopia is seeking to benefit as an upstream country, Egypt, as a downstream country, sees the dam as reducing its share of the water resources of the Nile. Meanwhile, Sudan has changed its position more than once depending on how it weighs up the potential pros and cons for itself. While initially supporting the Egyptian stance, Sudan later changed its position when it saw benefits in the project, such as reducing the risk of flooding in its own territories (Kitaw & Yitayew, 2014; Mbaku, 2020; Salman, 2014).

None of the negotiations occurring in the three case studies discussed here directly involved EA. Instead, these cases highlight how interstate interactions primarily focus on the different competing needs of each party. Competing needs do not only occur between upstream and downstream countries but also between downstream countries or between upstream countries (Ibrahim, 2020). Still, the upstream/downstream dynamic remains the primary hindrance to the formation of cooperative agreements and the effective implementation of existing ones over the management of shared transboundary waters.

For example, in the Mekong river case, a clash of interests is taking place between the upstream (China and Myanmar) and downstream states that established the Mekong Agreement in 1995. Although China has taken the initiative to play the role of a responsible regional power in this case (Shen & Xie, 2018), resolving the tensions between upstream and downstream countries remains an extremely complicated challenge (Ibrahim, 2020; Xie & Jia, 2018). China is also an upstream state regarding the Brahmaputra river, which it shares with India and Bangladesh as downstream states. The completion of the Zangmu dam by China on the river in 2014 complicated relations between China and India, especially because all riparian states in this context are suffering from water shortages driven by rapid economic and population growth (Zhang, 2016). Lastly, the Nile river basin represents an even more complicated case given the number of countries sharing it and the growing challenges facing its management. Such problems are being exacerbated by the inability of upstream and downstream states to come to a cooperative agreement over the basin’s management (Kitaw & Yitayew, 2014).

As tensions increase between upstream and downstream states (Zeitoun, 2015), it remains to be seen whether IWL can contribute to resolving conflicts among them (Salman, 2010). Hence, in a situation where upstream and downstream states are looking to find the best ways to secure their interests, as shown by the Central Asian case, EA does not necessarily help to facilitate the development of cooperative agreements between them. EA is currently not yet important in negotiations between countries seeking more effective management of shared freshwater resources. Nevertheless, since EA holistically acknowledges such needs, as well as many other elements of transboundary water contexts, it may potentially have useful applications in these and other cases. Therefore, much work is needed to evaluate how EA can play a practically important role in resource governance, especially regarding the management of transboundary freshwater resources.

4 | CONCLUDING REMARKS

This article has reviewed the formulation of EA and the issues that hinder its successful implementation. In the context of transboundary water sharing in the Global South, the efforts to implement EA encounter problems that are rooted in upstream/downstream dynamics, other needs conflicting with ecosystem protection and an inability to implement the approach in practice, as highlighted by the Central Asia case study. The challenge of implementing EA should not be underestimated, as the existing literature has clearly highlighted the substantial obstacles in the way. This is
particularly the case in the Global South where economic and sociopolitical conditions also impinge on the decision making of countries attempting to reach agreements about how EA should be applied to their shared transboundary waters. Moreover, academics and legal and policy practitioners may be overly optimistic about the application of EA in its current form. Accordingly, based on the above review of the issues arising from the application of EA, we can make the following policy recommendations.

Firstly, further research and analysis should be conducted on the constituting elements of EA, as well as how it can be implemented in practice, through specific case studies to ensure a deeper understanding of all the issues surrounding this topic. Currently states are starting to realize the importance of having a holistic approach to transboundary water management where EA can help adopting such a holistic approach to water management. However, despite the importance of regulating freshwater ecosystems in water management, the conceptual and practical incorporation of EA within existing water management remains ambiguous, even in the domestic context. Much clarification of EA is needed to facilitate countries’ efforts to develop practical and effective frameworks incorporating EA within water management. This is a challenge particularly pertinent for countries in the global South that strongly relies on water resource.

Secondly, resolving the challenges facing the implementation of EA in transboundary water contexts requires a multilayered approach that can acknowledge the existence of various actors, institutions and processes involved in negotiations over the sharing of freshwater resources. Accordingly, an improved multilevel governance approach is needed to address the challenges of governance at the local, national, and transboundary levels.

Significant challenges exist for the successful implementation of EA. This results partly from the fact that EA has not been extensively applied in practice where its application or the recognition of its practical application is only emerging. As countries rely on shared water differently and have shown different focuses and priorities in water management domestically, more work is needed to understand how EA can be incorporated in countries’ existing transboundary water management without generating discord and conflicts therein. In this context, this article calls for further research on the topic from both theoretical and practical perspectives and, moreover, a combination of theory and practice for tangible outcomes that can be presented to states that are seeking to enhance sustainable and peaceful transboundary water management.

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CONFLICT OF INTEREST
The authors have declared no conflicts of interest for this article.

AUTHOR CONTRIBUTIONS
Lei Xie: Conceptualization; formal analysis; funding acquisition; project administration; resources; writing-review & editing. Imad Ibrahim: Data curation; investigation; writing-original draft.

DATA AVAILABILITY STATEMENT
Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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