

Review

# Natural Resources Conflicts on Borderlands by the Five Spheres of Earth System

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**Abstract:** Border regions face challenges managing natural resources, which include forests, wildlife, air, and rivers. This study aims to provide an overview of research on various natural resource conflicts and cooperation in borderlands worldwide, considering the five spheres of the Earth system, namely the atmosphere, lithosphere, hydrosphere, biosphere, and anthroposphere. The type, scope, and place of natural resource conflicts in the borderlands were examined and key findings for clarifying the conflicts, cooperation, and geographical characteristics were derived using a systematic review methodology. The results indicate that over the last two decades, the conflicts over the hydrosphere are the most dominant. In the following order, conflicts over the biosphere have been frequently dealt with in transboundary areas. In Africa, dams (the anthroposphere) related to the hydrosphere especially influence and cause conflicts as well as cooperation for benefit-sharing among riparian countries. In North America, governance along the transboundary areas has been developed. "In Asia, several neighboring countries are linked through various types of associations ranging from multilateral organizations to sub-national administrations in order to effectively manage the long and wide-ranging natural resources that exist beyond the borders of the countries". In Europe, numerous protected areas related to the biosphere have been designated. Therefore, this research helps better understand transboundary conflicts based on natural resources and could contribute to designing natural resource management strategies or models in borderlands.

**Keywords:** conflicts; natural resource management; transboundary conservation; international partnerships; systematic review



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## 1. Introduction

Numerous scholars have examined increasing disputes over natural resources such as air, minerals, water, forests, and lands in the current global setting of expanding consumption, growing populations, climate change, technological development, environmental conservation, and the dwindling availability of natural resources [1,2]. Conflicts over natural resources take different forms based on the intensity, duration, and scope of the dispute [3]. Globally, more than 70 million people have been affected by their interconnections with nature conservation across the conflict life cycle, involving war and pre- and post-war processes [4]. In particular, developing countries have been facing challenges in managing their natural resources concerning social restrictions, unstable governance, and economic growth [5,6].

Natural resource conflicts among neighboring countries occur at political borderlands. For example, the border regions between China, Thailand, and Myanmar have conflicts regarding timber trade and agricultural land [7]. Diverse conflicts occur worldwide, encompassing the tropical forests bordering Malaysia and Indonesia as well as Peru and

Ecuador; river systems shared between northern European countries, Spain and Portugal, and mainland southeast Asian countries; and economic interests in fish stock and sea turtles shared between Indonesia and the Philippines [8]. There are four characteristics of natural resources in borderlands. First, the exploitation of natural resources significantly contributes to border dynamics, often causing extensive changes in both the frontier and core polity [9]. Second, as the natural resources of border regions become difficult to distribute, regardless of accessibility, the regimes on both sides of the border become competitive in their degree of power relations. For example, a zero-sum game is evident when one country occupies resources while the other does not. Third, areas remote from the central region are often rich in natural resources such as wood in forests, fish in seas, and oil on the lands because of restricted development. Finally, flora and fauna, which have a crucial role in food and ecosystem, do not recognize national boundaries, and can thus migrate beyond the border [10]. With such issues surrounding natural resources, the border regions of countries can act as a double-edged sword: conflicts and cooperation. Cooperation regarding natural resources in border regions can facilitate peace-building and environmental conservation.

While borderland studies dealing with natural resources are limited mainly to case studies focusing on specific border regions or one natural resource, this study aims to provide a research overview of various natural resource conflicts and cooperation in borderlands worldwide. To achieve this aim, the following research question is addressed: what are the overarching characteristics of transborder relations regarding natural resources? The type, scope, and place of natural resource conflicts in the borderlands are examined, and their characteristics are identified in this study.

## 2. Theoretical Background

### 2.1. Border Regions in Area Studies

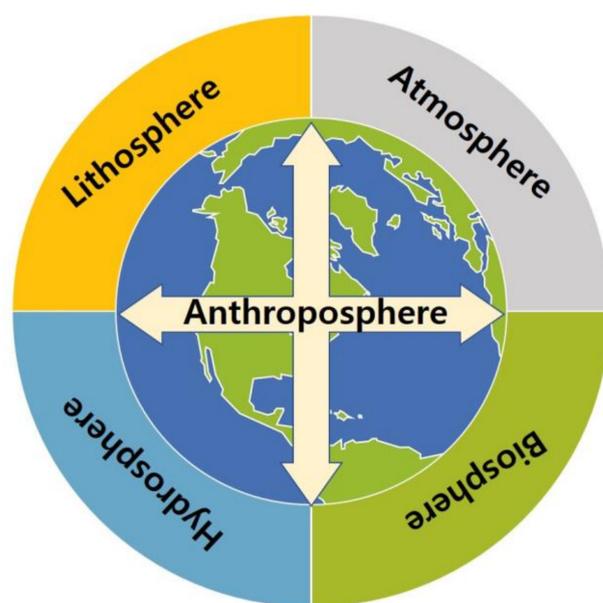
Academic discussions on borders are often ambiguous because of the lack of conceptual consensus [11]. The terms such boundaries, frontiers, borders, and borderlands explain the marginal lines defining a country's sovereignty or territories. Therefore, several studies clarify various meanings of these terminologies to ensure theoretical understanding. "Boundary" is a comprehensive term describing a division between territorial, demographic, economic, political, and cultural groups. Thus, it is more distinctive than "frontier" and "border" [9]. A "frontier" is a softer-defined place or shift zone located between two opposing political, institutional, or ethnic units or between one such unit and a hinterland, where no other policies exist or such policies do not come into physical interaction [12]. This implies that there could be more static and restrictive types [13]. Contrarily, a "border" is a permanent dividing line in a specific place that identifies the distinction between political and/or administrative units [12]. "Borderlands" are defined as areas surrounding or between political or cultural entities where physical, governmental, sociological, historical, and economic factors or processes combine to form borders or frontiers [13]. Cultural anthropologists define borderlands as regions where new societies emerge or have emerged within current international borders [14–16]. Based on the abovementioned definitions, this study adopts the concept of a "border" between countries and regions, for example, the United States and Mexico, India and Pakistan, and South Korea and North Korea have a sharp line to divide as two countries along with their territories. Moreover, the term "borderlands" is the main subject regarding the international context, which deals with circumstances cross-cutting or surrounding a country's natural resources.

### 2.2. Natural Resources and Five Spheres of the Earth System

Natural resources are the essential components of the Earth. These include tangible and intangible materials, including the air, rivers, forests, and rocks. To understand natural resources as elements of the Earth's system and their interaction, this study categorizes them into four spheres: the atmosphere, lithosphere, hydrosphere, and biosphere [17]. These four spheres interact in various ways [18]. The atmosphere is a gaseous mass that surrounds

our planet and is maintained in place by gravity [19]. Our planet's air comprises 79% nitrogen, slightly less than 21% oxygen, argon, carbon dioxide, and other trace gases [17]. Acid rain, haze, fine particles, and air pollution have negatively impacted human health, social conflicts, biodiversity, and climate change in the transboundary regime [20]. The lithosphere comprises the crust and upper mantle and acts fluidly over thousands of years [21]. From the border conflict perspective, the extraction and trade of soil, gold, oil, copper, rocks, and natural gas from the lithosphere are the biggest issues concerning their economic value [22]. The hydrosphere encompasses all sorts of water on Earth, including water in liquid and frozen forms in aquifers, seas, lakes, rivers, and streams [23]. Scarcity and the diverse use of freshwater have led to frequent tensions over water resources among countries. Besides, the water flow makes it difficult to define boundaries. Finally, the biosphere is the totality of all ecosystems on Earth and is known as the domain of life. This global ecological system integrates all living creatures with the other components of the atmosphere, lithosphere, and hydrosphere [24].

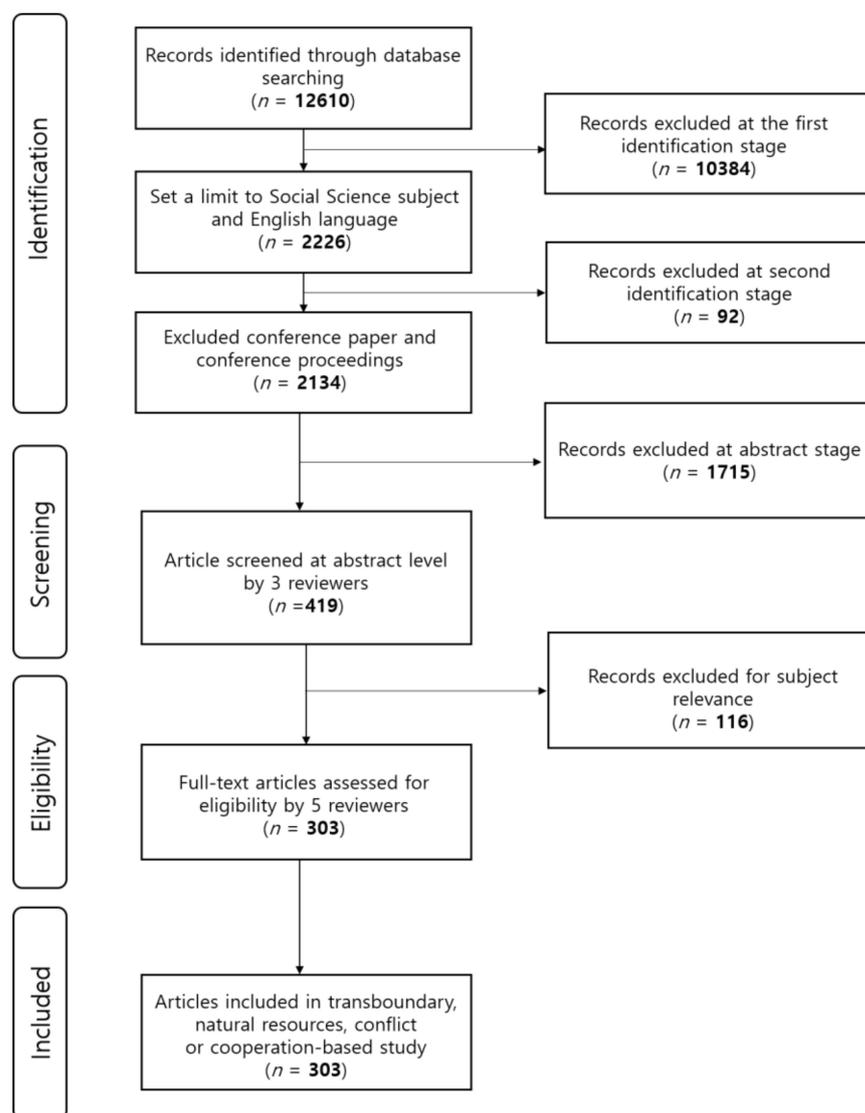
In addition, the relatively new concept of the "anthroposphere" was employed in this study to describe how human-made resources affect conflicts or management in the border region. The anthroposphere has evolved into a vital component of the Earth's ecosystem, heavily influencing and influenced by the other four Earth systems [25]. Figure 1 shows each sphere's interconnection with its concepts.



**Figure 1.** Five spheres of the Earth system.

### 3. Methodology

A systematic review with the following advantages is applied to this study: (1) it provides a comprehensive understanding of a relevant topic; (2) it is more reliable and accurate than an individual study; (3) it organizes the previous research; and (4) identifies areas of future study [26]. This section explains how a representative sample of previously investigated conflicts over natural resources and the management thereof in transboundary regions was selected and analyzed through a thorough and unbiased examination of the scientific literature. The flow guideline recommended the preferred reporting items for systematic review and meta-analyses (PRISMA)) [27,28]. Following the guidelines, this study analyzed four phases: identification, screening, eligibility, and included articles. Figure 2 provides an overview of the search and screening stages to create a data set to be included in the final analysis.



**Figure 2.** Process overview of the systematic review.

Articles were selected by inputting keywords related to natural resource conflict or management in border areas into the internationally specialized academic database SCOPUS. Scopus, officially known as SciVerse Scopus, was launched in the information market by Elsevier (Elsevier B.V. Registered Office: Radarweg 29, 1043 NX Amsterdam, The Netherlands, Registered in The Netherlands, Registration No. 33158992, BTW No. NL 005033019B01) in November 2004. It is the market's largest database of multidisciplinary scientific literature [29], and provides more international content than its closest competitor.

The search period was from 1 January 2001 to 31 May 2021. The timeframe reflected when transboundary conservation issues began attracting attention in international society and when the International Union for Conservation of Nature (IUCN) first offered standardized terminology through Transboundary Cooperation of Nature Conservation guidelines in 2001 [10]. The Transboundary Conservation Areas (TBCA) Specialist Group has led to the development of a new typology, which includes three types of TBCA and a special category. Three types are transboundary protected area (TBPA), transboundary conservation landscape (TBCL) and/or seascape (TBCS), and transboundary migration conservation area (TBMCA). Moreover, a park for peace (peace park) is a special designation to celebrate and promote peace and cooperation in transboundary context.

The search fields contained the title, abstract, and keywords. The search strings were a combination of three primary topics: border, natural resources, and conflict or management

(cooperation) (Table 1). Each search keyword consisted of synonyms, relevant abbreviations, and that cited by the previous literature. Specifically, in the case of border search keywords, this study included the terminologies for transboundary conservation such as “TBPA”, “Peace Park”, “TBMCA”, “TBCL”, and “TBCS” used by the IUCN since 2001 [10]. Table 1 shows the exact search strings used in this study. Note that some articles may have been missed despite our best attempts to include extensive keywords reflecting natural resource management in border regions. Regardless, as a result of the search, 12,610 publications were collected in the first stage. After limiting these to the social science field and literature in English, 2134 articles were ultimately selected in the identification stage.

**Table 1.** Search strings used to retrieve articles from the database.

Key Title	Search Strings Input in SCOPUS
	Keywords
Border	“border *” OR “frontier” OR “transbo *” OR “crossbow *” OR “transfrontier” OR “Protected Area *” OR “TBPA” OR “Transboundary Conservation” OR “Park * for Peace” OR “Peace Park” OR “Migration Corridors” OR “TBMCA” OR “TBCL” OR “TBCA” OR “Transboundary conservation landscape *”
Natural Resources	“natural resource *” OR “air” OR “water” OR “river” OR “basin” OR “sea” OR “fish” OR “ecosystem *” OR “bird *” OR “land” OR “forest *” OR “habitat” OR “timber” OR “non-timber” OR “NTFP *” OR “soil” OR “agriculture *” OR “wildlife” OR “species” OR “oil” OR “coal” OR “gas” OR “metals” OR “stone” OR “petrol” OR “mines” OR “Uranium” OR “copper” OR “iron” OR “gold” OR “silver” OR “diamond”
Conflict or Management (Cooperation)	“conflict” OR “dispute” OR “war” OR “terror *” OR “coordination” OR “collaboration” OR “cooperation” OR “management” OR “violen *” OR “risk” OR “disasters” OR “issue *” OR “armed” OR “acute” OR “Protracted” OR “crisis”

Note: Asterisks (\*) indicate search term truncation. For example, border\* would find borders, borderland, and borderlands. TBPA: transboundary protected area, TBMCA: transboundary migration conservation area, TBCL: transboundary conservation landscape, TBCA: transboundary conservation area.

As the first screening step, three trained coders—whose intercoder reliability was confirmed using Fleiss’ Kappa statistical measure—checked the titles, abstracts, and keywords of the publications to determine if they corresponded to the predetermined criteria. The percentage agreement approach assessed intercoder agreement, which was higher than 90% for around 10% of the articles. In this stage, the intercoder agreement was 91% for the sampled articles. The inclusion criteria for articles were as follows: (1) contents were related to other countries (a clear indication of border areas); (2) the analysis was at the international level (the issues related to two or more countries); and (3) conflicts over natural resources among countries was the main topic. Consequently, 419 studies were left at this point.

The next stage was the full-text review. This process helped further exclude noneligible articles. The five coders reviewed the full text of the selected articles, and finally, the resulting publication dataset comprised 303 articles for further analysis.

Textual information from the selected articles was coded. Table 2 displays a data coding category framework to classify the context of borders and natural resources in the selected publications. To indicate the geographical location, the scope of the research case was classified as national, regional, or global.

**Table 2.** Coding category system.

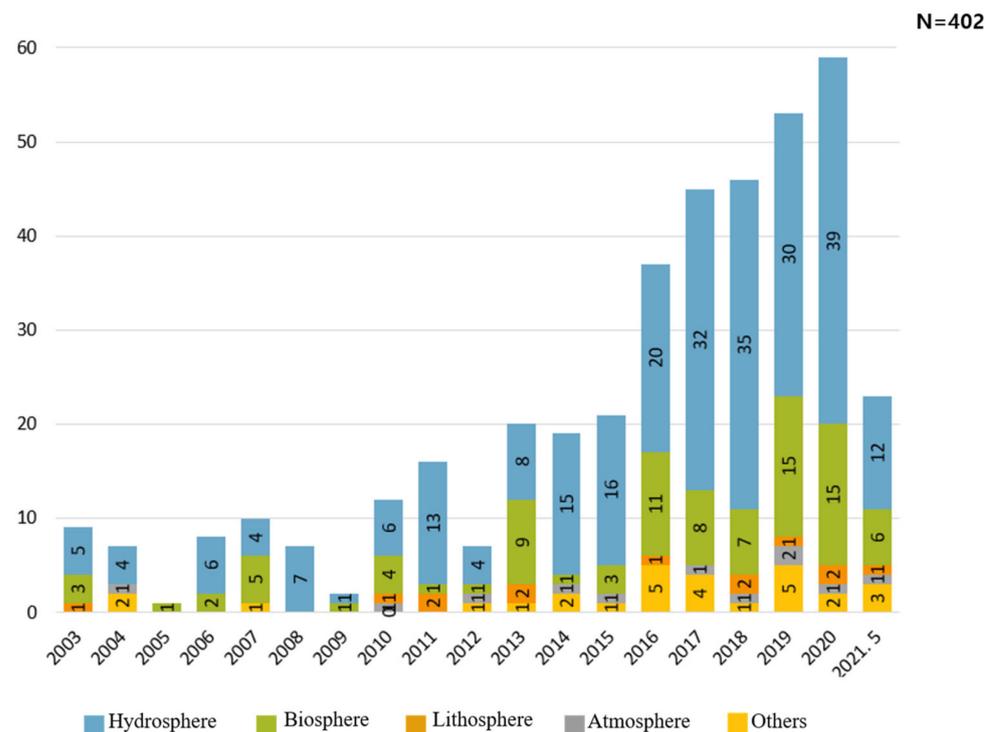
Category	Sub-Category		
Published year	Year		
Scope of the study	Global		
	Regional		
	National		
	Name of country		
	Not recognizable		
Type of natural resources	Atmosphere	Air	
		Rainfall	
		Others	
	Lithosphere	Soil	
		Oil	
		Coal	
		Rocks	
		Others	
		Hydrosphere	Ocean (marine)
			Ice caps and glaciers
	Groundwater		
	Lake		
	River		
	Others (all water)		
	Biosphere	Animal	
		Vegetation	
		Forest	
		Others	
	Anthroposphere		
	Others		
Not recognizable			

Articles dealing with the global level focused on natural resource conflicts or management worldwide, not specific regions or countries. Articles were classified at the regional scale when they referenced specific group affiliations of countries such as the European Union (EU), Mekong River Commission (MRC), and Association of Southeast Asian Nations (ASEAN). Most of these regional-level studies involved more than three nations and included continental dimensions. Finally, articles were considered national-level studies when the research included bilateral relations. For natural resources, a coding category system based on the five spheres of the Earth (atmosphere, lithosphere, hydrosphere, biosphere, and anthroposphere) was designed, which interact in various ways [18]. The anthroposphere, which is human-made, was directly connected with the other spheres. It has evolved into a vital component of the Earth's ecosystem and heavily influences and is influenced by the other four Earth systems [25]. As for the anthroposphere, the coders wrote down each resource while verifying the coding category. If an article covered more than one natural resource, then multiple choices were considered based on the interdependent characteristics of all Earth systems. In the coding process by five coders, the intercoder agreement was 93%.

## 4. Results

### 4.1. Number of Articles

Following the systematic review process, a total of 303 articles were collected. Even though the number of collected articles is three hundred and three, the total number of coded articles is greater, which is four hundred and two. This is because one article can be double-checked following the coding strategy if the article includes more than two types of earth spheres. The articles on natural resource-based conflict or management emerged in 2003. The number of publications has increased since 2015 (Figure 3). Over the last two decades, the articles related to the resources of the hydrosphere, such as rivers, oceans, and lakes ( $n = 257$ , 63.3%), were the most dominant (Figure 4). In the following order, the biosphere, which includes forests, mountains, animals, and vegetation, has also been frequently dealt with in transboundary areas ( $n = 93$ , 22.9%). A few articles include the lithosphere ( $n = 13$ , 3.2%) and atmosphere ( $n = 11$ , 2.7%). The articles from the category of others ( $n = 28$ , 6.9%) have increased steadily. They include conflicts between ecosystems and biodiversity related to several spheres simultaneously, including the biosphere and hydrosphere. According to our research design, the articles related to the anthroposphere ( $n = 91$ ) are linked with the other four types of earth spheres. In particular, dam and hydropower infrastructure (anthroposphere) in rivers (hydrosphere) ( $n = 36$ , 39.5%) and national parks including peace parks and transfrontier conservation areas (TFCAs) (anthroposphere) in forests (biosphere) ( $n = 19$ , 20.9%) were frequently investigated. In some articles, lands for agricultural use, irrigation systems, and diamond smuggling have pushed conflicts or cooperation among border countries.



**Figure 3.** Number of articles on natural resource conflicts by the Earth spheres and published year.

### 4.2. Natural Resource Types in Conflict Cases

Natural resources were classified according to the five Earth spheres in this study (Figure 5). Study cases on rivers ( $n = 147$ ) as a natural resource are the predominant subjects for border regions. Many river conflicts include severe disputes encompassing the river basins, which many countries use simultaneously. Furthermore, the articles on conflicts or the management thereof include the type of natural resources, the ocean ( $n = 48$ ), forests

( $n = 36$ ), and animals ( $n = 32$ ). Moreover, ecosystem and biodiversity gain attention as transboundary environmental conservation context ( $n = 28$ ).

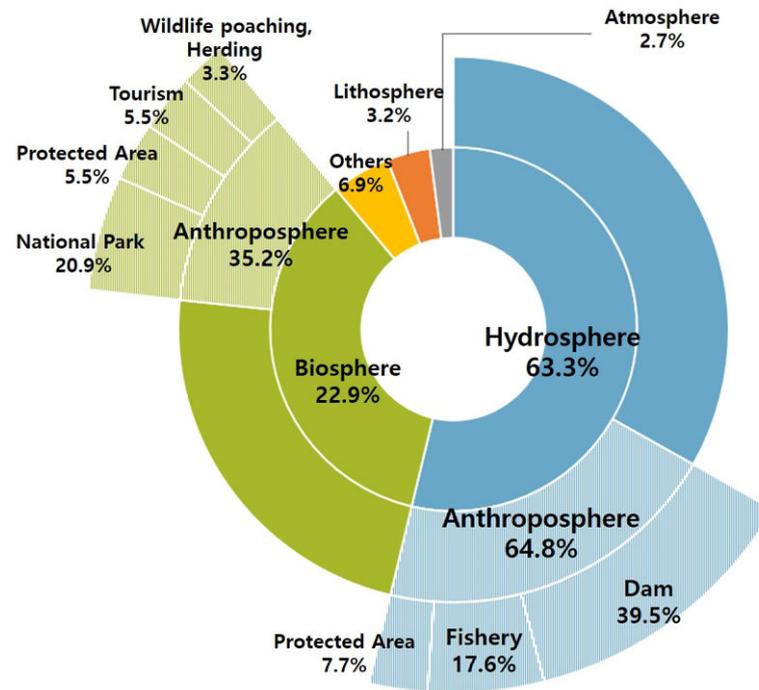


Figure 4. Ratio of the articles related to the Earth four spheres and anthroposphere.

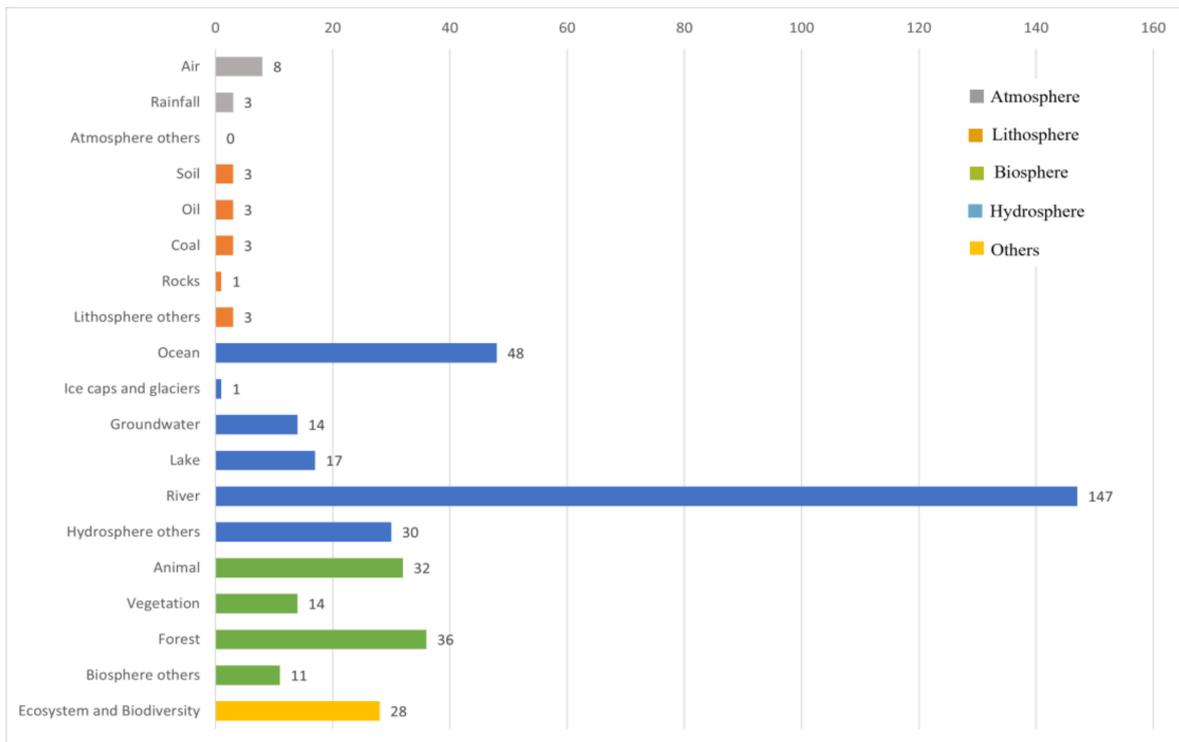


Figure 5. Number of the studies by natural resources.

#### 4.3. Scope of Natural Resource Conflicts in Borderlands

The scope of natural resource conflicts was measured with three levels: regional, national, and global. Binational studies were dominant. Extensive national-level studies

were found on 143 articles, accounting for 47% of total articles. For instance, the conflicts between Norway and Finland due to the transboundary salmon stocks across the Tana river [30]. Furthermore, 36% (108 articles) of the selected articles focused on the regional level, which was defined as articles with more than three involved countries but not on a global scale. For example, regional studies were strongly related to cooperation between neighboring countries through associations and organizations such as the EU, Mekong Institute, Alpine Space Program cooperation area (ASPCA), and so on.

Moreover, conflicts related to specific continents and ocean boundaries are also included in the regional scope. Table 3 displays all of the articles related to continental and ocean levels that were collected for this study. At the continental or oceanic scope, a significant factor regarding boundaries is fisheries [31–34]. Through marine spatial planning, multilateral environmental agreements, and transboundary governance, fishery sovereignty, economic sharing, and protected areas have been promoted across Oceania, including the north Atlantic, western Indian Ocean, North Sea, and western and central Pacific [33–36]. Changing climate is a main conflict factor among the neighboring countries in the region of Antarctic, Arctic, and the Baltic Sea. Specifically, climate change has induced the distribution of fish stocks, increased sea ice melt, and biodiversity [33,37–39]. These conflicts require co-management for sustainable development and nature protection [40–42].

The articles with a global scope focused on more than two regional areas and provided no special statement about the study areas but rather on global initiatives or international laws (52 articles, 17% of total articles). In this case, articles that dealt with global regimes to overcome the world’s common problems, such as climate change, biodiversity conservation, and environmental pollution issues, are included. For example, articles related to the international transboundary legal and institutional framework that includes the governance, agreements, conventions, laws, and policies were investigated in terms of the inclusive watercourse [43–51], air pollution [52,53], wildlife, and protected areas [54,55].

**Table 3.** Regional studies regarding the continental and ocean levels.

Region	Natural Resources	Related Articles
Oceania	Hydrosphere (ocean) Anthroposphere (fisheries)	[31]
Antarctic	Hydrosphere (ocean) Anthroposphere (protected area)	[40]
Arctic	Hydrosphere (ocean) Lithosphere (ironstone, cobalt, diamonds)	[38,39,56]
Baltic Sea	Hydrosphere (ocean) Others (biodiversity)	[35,37,41,57,58]
South China Sea	Hydrosphere (ocean) Anthroposphere (hydropower)	[59–61]
North Atlantic	Biosphere (fish) Anthroposphere (fisheries)	[33]
South Atlantic	Hydrosphere (ocean) Others (Ecosystem)	[42]
Western Indian Ocean	Hydrosphere (ocean) Biosphere (fish) Anthroposphere (fisheries)	[32]
Northern Sea	Hydrosphere (ocean) Anthroposphere (offshore wind energy, fisheries) Others (ecosystem)	[36,62,63]
Western and Central Pacific	Hydrosphere (ocean) Biosphere (fish)	[34]

#### 4.4. A Systematic Map of National-Scale Studies

In total, 128 countries were selected after screening through the systematic review methodology (Table 4). As a result, twenty-seven African countries, forty-seven Asian countries, forty European countries, and sixteen American countries were selected and analyzed in this study. Additionally, the majority of the Asian and European nations were analyzed regarding the context of transboundary conflicts.

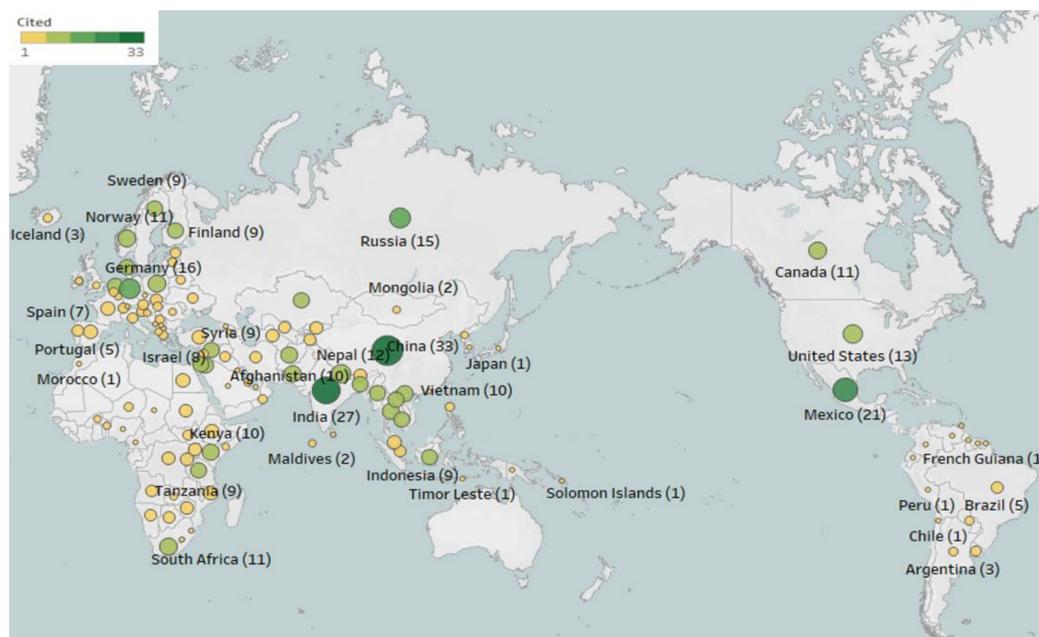
**Table 4.** Collected case countries at the national scale.

Continent	Name of Countries	Number of Case Countries
Africa	Egypt, Sudan, Ethiopia, Benin, Burkina Faso, Niger, Zimbabwe, Mozambique, South Africa, Eswatini, Zambia, Namibia, Angola, Cameroon, Chad, Nigeria, the Democratic Republic of Congo (DRC), Botswana, Lesotho, Uganda, Kenya, Tanzania, Burundi, South Sudan, Rwanda, Somalia, Morocco	27
Asia	Afghanistan, Bahrain, Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lao PDR, Lebanon, Malaysia, Maldives, Mongolia, Myanmar, Nepal, North Korea, Oman, Pakistan, Palestine, Papua New Guinea, the Philippines, Qatar, Russia, Saudi Arabia, Singapore, Solomon Islands, South Korea, Sri Lanka, Syria, Tajikistan, Thailand, Timor-Lester, Turkey, Turkmenistan, the United Arab Emirates, Uzbekistan, Vietnam	45
Europe	Albania, Armenia, Austria, Belarus, Belgium, Croatia, Czech Republic, Denmark, England, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Italy, Kosovo, Latvia, Liechtenstein, Luxembourg, Montenegro, the Netherlands, North Macedonia, Northern Ireland, Norway, Poland, Portugal, Ireland, Romania, Scotland, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine	40
The Americas	Argentina, Brazil, Canada, Chile, Colombia, Ecuador, French Guiana, Guyana, Mexico, Paraguay, Peru, Suriname, Trinidad and Tobago, the United States, Uruguay, Venezuela	16

Figure 6 displays the number of case studies by country. The circles in the map are indicated the number of related studies. China's border region was the most studied ( $n = 33$ ), followed by India ( $n = 27$ ) and Mexico ( $n = 21$ ) (Figure 6). Studies on countries in Africa and North and South America were limited.

#### 4.5. Natural Resource Conflicts in Borderlands by the Spheres of the Earth System

According to the full-text literature review, each of four spheres has distinguishable characteristics of natural resource conflicts in borderlands. During the review process, this study discovered that some articles conducted successful cooperation cases and delivered potential benefits to meet mutual interests among border countries. Some articles, on the other hand, claim that unique conflicts have persisted according to the types of natural resources. In this regard, Table 5 shows the issues, benefits for cooperation, and challenges to be resolved depends on the Earth spheres.



**Figure 6.** A map of distribution of the selected studies by country. Note: The number indicates the number of related studies by country. The studies, numbered from 1 to 33, are indicated as a color (from yellow to deep green) and the size of the circles. The points of the circles are not related to the border locations.

**Table 5.** Characteristics of natural resource management and conflicts in border regions by earth sphere.

Earth Spheres	Issues	Benefits for Cooperation	Challenges to Be Solved
Hydrosphere	<ul style="list-style-type: none"> <li>Ample food resources</li> <li>Transboundary water pollution</li> <li>Hydropower (dam)</li> <li>263 International transboundary river basins worldwide</li> <li>Relatively many international regulations</li> </ul>	<ul style="list-style-type: none"> <li>Food security</li> <li>Adaptation to climate change</li> <li>Economic growth (energy)</li> <li>Enhanced governance and regional cooperation.</li> <li>Ecosystem and biodiversity Conservation</li> </ul>	<ul style="list-style-type: none"> <li>Inequality between upstream and downstream countries</li> <li>Power dynamics</li> <li>Environmental problems (biodiversity and ecosystem)</li> </ul>
Biosphere	<ul style="list-style-type: none"> <li>TFCAs, Peace Park</li> <li>Transboundary mountainous region</li> <li>Wildlife migration and protection</li> <li>Landscape and environment conservation</li> </ul>	<ul style="list-style-type: none"> <li>Long-term persistence of viable populations of species</li> <li>Resolution of conflicts between wildlife and people</li> <li>Encouraging eco-tourism</li> <li>Eco-networks (e.g., IUCN, Natura 2000)</li> </ul>	<ul style="list-style-type: none"> <li>Long-term strategies or plans for sustainability</li> <li>Power asymmetry</li> <li>Community (e.g., indigenous people) oriented plans</li> <li>Ecosystem resilience in the face of climate change</li> </ul>
Atmosphere	<ul style="list-style-type: none"> <li>Transboundary air pollution</li> <li>Transboundary haze from forest fires</li> <li>Carbon sequestration</li> <li>Air and epidemics</li> <li>Monsoon rains</li> <li>Climate change</li> </ul>	<ul style="list-style-type: none"> <li>Joint efforts to tackle the climate crisis</li> <li>Conservation of species in forests from the forest fires</li> <li>Respond quickly to epidemics</li> <li>Forecast precipitation and its impacts</li> </ul>	<ul style="list-style-type: none"> <li>No international regulations or policies on air pollution</li> <li>Need to respond jointly with other nature resources</li> </ul>
Lithosphere	<ul style="list-style-type: none"> <li>Pipeline for natural gas</li> <li>Oil/coal use</li> <li>Land use changes</li> <li>Mineral extraction activity (diamond smuggling)</li> </ul>	<ul style="list-style-type: none"> <li>Development of technology</li> <li>Economic benefit-sharing</li> <li>Network with diverse stakeholders</li> <li>Resolving problems impacting other spheres (water pollution, biodiversity loss)</li> </ul>	<ul style="list-style-type: none"> <li>Armed conflicts</li> <li>Conflict of interests for economic purposes</li> <li>Environmental contamination</li> </ul>

#### 4.5.1. Hydrosphere

The hydrosphere-related conflicts emerged in all continents (Table 6). Worldwide, 263 transboundary waterways cross the boundaries of two or more countries, and even more international groundwater aquifers exist [64]. International organizations contribute to resolving severe water conflicts between countries. The Institute of International Law published the International Regulation Regarding the Use of International Watercourses for Purposes other than Navigation—Declaration of Madrid in 1911 [65]. From then, governments and international organizations consolidated on the benefits of cooperating with water regimes. In 1992, the United Nations Conference on Environment and Development (UNCED) began announcing international water principles and frameworks [66]. In addition, the Sustainable Development Goals (SDGs) include Goal 6 to ensure availability and sustainable management of water and sanitation for all. SDG 6 has a target regarding transboundary water resources. The SDG target 6.5 is “By 2030, implement integrated water resources management at all levels including through transboundary cooperation as appropriate”. For achieving the target, experts have been monitoring and reporting on the collaboration state with adjacent nations. According to the UN, transboundary water cooperation is essential in sustaining broader regional integration, peace, economic growth, food security, sustainable development, following regional security challenges, and supporting adaptation to climate change [64].

**Table 6.** The natural resource conflict cases related to the hydrosphere.

Continent	Study Area	Countries	Anthroposphere
Africa	Nile River Basin	Egypt, Sudan, South Sudan, Eritrea, Ethiopia, Kenya, the DRC, Burundi, Rwanda, Uganda, and Tanzania	Hydro power, dam infrastructure
	Zambezi River Basin	Angola, Zambia, Namibia, Botswana, Zimbabwe, and Mozambique	-
	Lake Chad	Chad, Nigeria, Cameroon, and Niger	-
	Great Lakes	Rwanda, Burundi, and the DRC	Hydro power, dam infrastructure
	Lake Victoria	Rwanda, Tanzania, and Uganda	-
	Kunene River Basin	Angola and Namibia	Hydro power, dam infrastructure
	Limpopo River Basin	Botswana, Mozambique, South Africa, and Zimbabwe	Hydro power, dam infrastructure
	Mombasa Marine Park	Kenya and Tanzania	Marine protected area
Americas	Niagara River Watershed	United States and Canada	-
	Columbia River Basin	United States and Canada	-
	Colorado River Basin	United States and Mexico	-
	Rio Grande/Bravo Basin	United States and Mexico	-
	Cuareim/Quaraí River	Uruguay and Brazil	-
	La Plata Basin	Argentina and Uruguay	Pulp mill
	Pacific Sardine	Canada, United States, and Mexico	Fishery
Asia	Salween River	Thailand and Myanmar	Dam
	Sesan, Srepok, and Sekong River Basin	Lao PDR, Cambodia, and Vietnam	Dam
	Mekong River basin	China, Myanmar, Lao PDR, Thailand, Cambodia, and Vietnam	Dam, fishery

Table 6. Cont.

Continent	Study Area	Countries	Anthroposphere
Europe	Danube River Basin	19 countries	-
	Rhine River Basin	Germany, Switzerland, France, the Netherlands, Austria, and Liechtenstein	-
	Alboran Marine Basin	Spain and Morocco	-

Some cases include sensitive issues in the use of water resources, such as power asymmetries between riparian states and the construction of dams. For example, the Nile Basin, the world's longest river, faces significant problems such as rapid population growth, poverty, environmental degradation, unequal distribution of natural resources, as well as water shortages, since the Nile Basin's neighboring countries are recognized for their dry and semi-arid conditions [67]. Bordering nations on the Nile River are classified as upstream (i.e., Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, and the DRC) and downstream countries (i.e., Egypt and Sudan). The use of water is impacted by the region's location. In the past, Egypt's powerful and influential stand concerning upstream countries, such as its economic prosperity, military strength, political stability, and access to foreign political and financial assistance, historically allowed it to influence and create discourse [68]. However, a significant shift occurred in 2011 with the construction of the Grand Ethiopian Renaissance Dam (GERD), Africa's biggest reservoir, near the Sudan border, which accounts for more than 40% of the country's power generation capacity and produces more electricity than Ethiopia could operate in the medium term [69]. GERD has become a point of conflict nationally and internationally among bordering countries [70]. Not only has tension between Egypt and Ethiopia increased, but other neighboring countries have also reexamined their national policies and international treaties [71]. In addition, Ethiopia has bonded with China for financial and technical support. China has emerged as a vital partner in the GERD's construction and irrigation development, altering the domestic political economy landscape and influencing how African governments interact. Regarding the altering lifetime status quo in the Nile Basin, the involvement of the foreign actor, China, has provided both advantages and challenges for upstream countries [72]. As a result, several articles highlight the need for win-win strategies to obtain water-energy-food resources via the new dam infrastructure beyond power relations or disputes [73]. In another case, due to the stream features of rivers, downstream countries have suffered from the actions of upstream countries. The Limpopo River's watershed encompasses nearly 1.3% of the African continent. The watershed sustains 18.8 million people in South Africa, Botswana, Zimbabwe, and Mozambique, in addition to 102 dams and hundreds of small-scale reservoirs and agricultural projects. Mozambique, being the basin's furthest downstream country, deals with both the water and pollutants from upstream countries. Moreover, South Africa can and has transferred additional water into Mozambique by releasing water from dams during heavy rain seasons, resulting in devastating floods and agricultural loss [74]. Therefore, although dams are a major factor in water quantity, power dynamics between countries continue.

The three river basins, which are the Colorado River, the Tijuana River, and the Rio Grande/Bravo River, cross the border between the United States (U.S.) and Mexico. Historically, there have been tensions and conflicts over limited water resources. Several legal instruments related to transboundary water agreements, treaties, and policies have been addressed to co-manage water resources since the convention that created the International Boundary Commission in 1889 [75]. There are still challenges between current basin management and the regulatory water allocation framework to overcome the environmental flows, but many things can be accomplished through interaction, institutional framework, information-sharing, and the involvement of all stakeholders [76,77].

In Asia, the Mekong River runs from China to Myanmar, Laos, Thailand, Cambodia, and Vietnam. Several actors influence the Mekong, including international organizations

like ASEAN, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), and MRC, as well as six national parliaments and numerous provincial and local government bodies. The change in the Mekong depends on countries continuing to pursue their sovereign power to utilize the river inside their borders. Furthermore, development also benefits from the narrative of a region of “traversed boundaries” in which energy could flow freely from Laos to Thailand or the transmission of state-focused insight through the multilateral MRC to coincide with sustainable development agreements (the MRC comprises Lao PDR, Vietnam, Cambodia, and Thailand). Many organizations provide development assistance [78]. As a historical conflict, India and Pakistan experienced the conflict of the Indus River as a shared resource. Due to difficulty of negotiation, the World Bank initiated a dialogue between two countries that led to the Indus Water Treaty between India and Pakistan in 1960 [79]. This case indicates the key role of the World Bank as an intergovernmental organization in solving transboundary water resource management conflict.

#### 4.5.2. Biosphere

The second-most studied natural resources worldwide are those of the biosphere (Table 7). The history of cooperation to conserve the biosphere, including forests, mountainous regions, and wildlife continues. In 2001, the IUCN developed standardized language for transboundary conservation guidelines, including definitions and regulations for transboundary protected areas and parks for peace. Guidelines were developed through workshops in 2013 and 2014, and negotiations went ahead on broader natural resource management issues across borderlands, including the concepts of “Transboundary Conservation and Development Areas” and “Transboundary Migratory Corridors” [10]. These approaches provided systematic consultation, information sharing, coordinated action, and the management of issues between stakeholders. Through active discussions, the Seventh Ordinary Meeting of the Conference of the Parties to the Convention on Biological Diversity (UNCBD COP7 Decisions) held in 2004 also deliberated on efforts for “establishing and managing the ecosystem beyond boundaries and the various global organizations” to promote transboundary cooperation for the protection of natural resources.

**Table 7.** The natural resource conflict cases related to the biosphere.

Continent	Study Area	Countries	Anthroposphere
Africa	Chimanimani Mountains	Mozambique and Zimbabwe	TFCAs, diamond Smuggling
	Limpopo National Park	Mozambique, South Africa, and Zimbabwe	Peace park
	Mau Mara Serengeti	Tanzania and Kenya	Protected area
	Kgalagadi Transfrontier Park	Botswana and South Africa	National park
	Virunga Massif Mountains	The DRC, Rwanda, and Uganda	Peace park
Americas	Crown of the Continent	United States and Canada	Peace park
	Alfalfa (vegetation)	United States and Canada	-
	Amazonian	Colombia and Ecuador	Tourism
Asia	Kush Himalayan region	Afghanistan, Bangladesh, Bhutan, China, India, Nepal, Myanmar, and Pakistan	-
	Kangchenjunga Landscape	India and Nepal	Poaching
	Natuna Islands	Indonesia, China	-

Table 7. Cont.

Continent	Study Area	Countries	Anthroposphere
Europe	Tatra Region	Poland and Slovakia	National park
	Carpathian Mountains	Poland and Slovakia	National park, Protected area
	Bialowieza Forest	Poland and Belarus	Logging
	Julian Alps	Italy and Slovenia	National park
	Bavarian-Bohemian Forest	Germany and Czech Republic	National park
	Javakheti National Park	Georgia, Armenia, and Turkey	National park, Protected area
	European Boreal Forest	Norway, Sweden, Finland, the Russian Federation, and Scotland	Protected area

Poland and Czechoslovakia signed the Krakow Protocol in 1924, which “pioneered the notion of international collaboration in the establishment of border parks [80]”. At that time, these parks had no goal other than protecting natural landscapes that extended across international borders [10]. The Waterton–Glacier International Peace Park was established in 1932 to celebrate the long and storied history of peace and friendship between Canada and the United States, stressing both nations’ cultural and natural ties [81]. In 1933, transboundary conservation grew further with the European countries. The IUCN launched “Parks for Peace” in 1997 to improve regional collaboration for biodiversity conservation; conflict avoidance, resolution, and reconciliation; and long-term development.

In Africa, the Great Limpopo Peace Park has been dubbed the “African Renaissance” in regional collaboration between South Africa and its surrounding countries. Peace parks promote global peace, regional collaboration, and poverty reduction by encouraging cooperative conservation development in Southern Africa’s neglected border regions [82]. There are, however, publications that critically examine its truth. Peace parks contribute little, if anything, to the accomplishment of African Renaissance objectives. Currently, their advancement has been delayed by the primacy of national interests, inadequate community consultation, and sensitive border conflicts such as illicit commerce and migration between South Africa and neighboring areas. Furthermore, aggravating inter-state inequalities resulting from regional power asymmetries and legal frameworks across borders has become increasingly controversial [83]. Concerning wildlife management, other research has claimed that many protected areas in Africa are now placed in border regions where access to the country has traditionally been prohibited. Consequently, although prohibition was identified as crucial, factors such as empowerment, training, and information sharing were highlighted as critical in ensuring a positive connection between the government and the community [84]. In Southern Africa, the Chimanimani Trans-Frontier Conservation Area (TFCA) along the border of Zimbabwe and Mozambique brought global attention due to the gold and diamond smuggling activities that caused the conflicts [85].

Between the United States and Canada, the Crown of the Continent landscape is placed on the border, which comprises the protected areas of the Bob Marshall Wilderness and Waterton–Glacier International Peace Park. It is an eco-friendly mountain and habitat to numerous endangered species such as grizzly bears, wolves, lynx, and bull trout. Tourism, biodiversity, freshwater, wood extraction, green energy, and fishing and wildlife habitats are all examples of ecosystems maintained for many purposes. The Roundtable on the Crown of the Continent, now in its fourth year, is a collaborative conservation effort that brings together various groups having the basic goal of protecting the environment. This roundtable attempts to bridge the gap between conservation-minded groups, agencies, and people [86].

The Amazonian borders of Colombia (Department of Putumayo) and Ecuador (Province of Sucumbíos) demonstrate that the tourism industry may be resilient when a country faces

global conflicts or pandemic situations. The success of its recovery will be directly related to its capacity to develop policies and strategies that allow it to utilize natural resources and turn them into opportunities for the socioeconomic development of its people [87].

In Asia, the Hindu Kush–Himalaya (HKH) region is well known for its historical, ecological, cultural, and geohydrological worth. Its extensive highlands, basins, and mountains have some of the world's highest peaks, as well as over 60,000 km<sup>2</sup> of glaciers and 760,000 km<sup>2</sup> of snow cover. These ice and snow formations serve as massive freshwater storage, offering resources for energy, tourism, and food sources, among other local needs. Furthermore, they provide products and services directly and indirectly to 1.3 billion people in South Asia, especially including 210 million in the HKH region. However, the joint administration of HKH resources remains difficult. Floods and droughts have become more common, while expanding commercialization and chronic rural poverty have destroyed forests, wetlands, and rangelands, affecting livelihoods and the ecosystem [88]. Because many countries are connected to the HKH region, diverse associations have operated collaboratively to ensure the conservation of the landscapes and resources.

In Europe, compared to the other regions, the greatest focus of the studies on natural resource conflicts was on the biosphere. Specifically, Natura 2000 was referred to multiple times when discussing protected areas. Natura 2000 is the largest network of protected areas globally, and 18% of the EU's land area and more than 8% of its marine territory are managed by it to protect endangered species and habitats. Moreover, cooperation between European countries is typical via agreements. For instance, Bialowieza Forest is in the borderlands, and its resources are managed by Poland and Belarus. It has plenty of natural resources, with various species of mushrooms, plants, and animals. After the World Wars, two governments protected the forest together according to cross-border UNESCO heritage standards [89].

#### 4.5.3. Atmosphere

Pollution from over thirty different countries, such as acid rain, haze, and smoke pollution, is causing environmental damage across national borders via the atmosphere. Although it is critical to reduce pollution through domestic efforts and bilateral agreements, there are constraints to controlling the air. As a result, the international challenge of effectively addressing transboundary air pollution needs to be managed [90] (Table 8). Under the auspices of the United Nations Economic Commission (UNEC) for Europe, the 1979 Convention on Long-range Transboundary Air Pollution (LRTAP) and its protocols offer a legally enforceable framework for managing transboundary air pollution in Europe and North America [90]. Transboundary haze caused by forest fires in Indonesia has damaged the air quality for decades in adjacent Singapore and Malaysia. Once the forest fires caused the haze, smoke lingered for weeks, negatively impacting human health and causing economic damage. Breathing in pollutants from the haze, in particular, causes respiratory illness, and loss of timber, agricultural products, tourism sites, and livelihood has had an adverse financial impact on not only one country, but also neighboring countries [91]. The ASEAN Agreement on Transboundary Haze Pollution was signed in 2002 by ASEAN to implement steps to avoid forest fires that cause haze [92]. However, Indonesia is the only ASEAN member that has not ratified this pact. Haze remained a concern, with severe crises occurring in 2005 and 2013 when Malaysia and Singapore recorded increasingly greater levels of air pollution [93].

The countries in northeast Asia—North Korea, Japan, Mongolia, China, South Korea, and the Russian Federation—differ in size and economic and natural settings. The region is plagued by serious environmental issues, both national and transboundary, such as the long-distance transfer of air pollution. If no efforts are made, the environmental situation will worsen. Another regional concern that may necessitate institutional and financial agreements among countries is transboundary pollution. Apart from political disputes, northeast Asia will require air quality monitoring regarding air contamination, water pollution, forest degradation, biodiversity, dangerous particles, and natural catastrophes [94].

**Table 8.** The natural resource conflict cases related to the atmosphere, lithosphere, and others.

Sphere	Continent	Study Area	Countries	Anthroposphere
Atmosphere	Asia	Haze	Indonesia, Singapore, and Malaysia	-
		Northeast Asia	North Korea, Japan, Mongolia, China, South Korea, and the Russian Federation	-
Lithosphere	Asia	Gomal River	Pakistan and Afghanistan	-
		Zubara	Qatar and Bahrain	-
	Americas	British Columbia and Montana	United States and Canada	Mining
Texas and Tuxpan		United States and Mexico	Pipeline	
Others		Santa Cruz Watershed	United States and Mexico	Ecosystem services
		North Brazil Shelf	Brazil, French Guiana, Suriname, Guyana, Trinidad and Tobago, and Venezuela	Ecosystem services (marine)

Despite considerable advances in improving knowledge and information on atmospheric protection, significant gaps remain in handling air quality. Nowadays, creating a global international policy to combat air pollution is being discussed. In the absence of a worldwide convention governing the preservation of the atmosphere, some efforts should focus on defining rules [20]. The ongoing projects of the International Law Commission, through its special rapporteur on air conservation, should be recognized and maintained in this context. Furthermore, there is a need to manage transboundary pollution caused by air in a more integrated manner that recognizes the dynamic interaction between other spheres to ensure biodiversity conservation [94].

#### 4.5.4. Lithosphere

Compared to other sectors, coal, oil, minerals, and land are conspicuous and prone to price fluctuations, which might destabilize economic repercussions or quickly spur investor interest in other areas [2].

The Gomal River is shared by Afghanistan and Pakistan. Despite dam construction, soil erosion is a severe environmental concern in these regions. Soil erosion may accelerate land degradation and agricultural product loss and disturb the water flow. This not only complicates irrigation system management but also lays enormous demands on the irrigation system's operations and maintenance expenditure. Consequently, the dam construction has negatively impacted both countries [95]. The Qatari–Bahraini conflict over Zubara was one of the Gulf's major border clashes during the oil concession era in 1937. British oil ambitions laid the foundation for this conflict, as much as their colonial politics in the Arabian Gulf fostered a power struggle between the Al Thani and Al-Khalifa eras. Zubara's borders represented not just a transnational relationship between Qatar and Bahrain and British imperialism and oil interests but also the effect of a European-dominated global age of bordering and nationalism [96].

Moreover, the extraction of resources requires technological development and influences environmental pollution. For example, facilitating a pipeline to pull natural gas near border regions could fuel severe conflicts in the rights for use and water pollution from the extraction process between countries [97,98]. Because of natural resources' potentially high economic value in the market, the government is the control tower, but multinational corporations and individuals could still dispute its ownership. Agreements or a cooperating governance structure could help to overcome economic and ecological issues.

#### 4.5.5. Others

Other resources, which are more difficult to categorize in one domain, such as ecosystems and biodiversity, have continuously risen. According to Table 8, for border regions in the Americas, all environmental factors are highly related to simultaneously causing and resolving conflicts. Population growth in multinational communities combines farming, ranching, mining, industry, and trade by sharing water and forest resources. To deal with this scope of environmental impacts, several studies focused on ecosystem service and biodiversity [99–101]. For instance, the administration of the Santa Cruz Watershed is governed by representatives from four nations, namely the United States, Mexico, Tohono O’odham Nation, and the Pascua Yaqui Tribe. The study area is a river, a limited aspect of the hydrosphere. The research emphasizes a comprehensive approach to sustainable development, including land use management, regional precipitation, and human wellbeing. Therefore, an ecosystem service approach can effectively deal with diverse environmental factors and foster cross-culture collaboration [102].

The North Brazil Shelf covers six nations and stretches from the Caribbean Sea in Central America to the Parnaíba River in Brazil. Climate change, dam building, deforestation, pollution, fishing, and tourism pose the biggest threats to ecosystem productivity and habitat quality in this region. In addition, important challenges include a lack of appropriate law, political stability, and corruption control [103]. Due to its location near the border, the most significant obstacles remain in practice, including cultural and political differences among countries, a weakness in enacting a coordinated and scientific-based management strategy, and a lack of appropriate rights-based incentives for fishing communities and other stakeholders [104]. To overcome these various conflicts, an ecosystem-based approach could effectively manage the marine resources shared by these countries.

### 5. Discussion: Regional Characteristics of Natural Resource Conflicts and Management in the Borderlands

Most studies emphasize the importance of comprehending global threats such as population growth, climate change [105,106], biodiversity loss [82,85,107], food security [108], and water scarcity [68,74]. These global issues have caused natural resource conflicts. Conflicts depend on local context, including historical, cultural, and political conditions. The regions sharing the contextual conditions present some regional characteristics of natural resource conflicts.

In the African region, dams (the anthroposphere) related to the hydrosphere (river, lake, and marine) in particular influence and cause conflicts as well as cooperation for benefit-sharing among riparian countries. While joint dam projects have been regarded as symbols of regional cooperation, large-scale dams on transborder rivers have frequently created major national and transnational conflicts. The projects often put people out of work without adequate compensation, significantly impact environmental values, and alter river flow with threatening downstream effects. Moreover, TFCAs and peace parks as the anthroposphere was recently criticized for impacting the biosphere, for example, forest, mountain, and wildlife. The original purpose was to create a peaceful relationship between border countries and increase the national economic and environmental benefits. However, the following issues exacerbate conflicts: (1) a lack of opinions from local communities or the indigenous people directly affected, (2) insufficient sustainable strategies for protected areas, (3) power asymmetries between countries, (4) insensitive policy planning and implementation for each natural resource, and (5) involvement of external stakeholders.

In North America, governance along the transboundary river basin and peace parks has been developed. Disputes on fishing rights, biodiversity loss, and political insecurity have occurred. Most of the literature emphasizes the importance of establishing good governance and eliciting the participation of diverse stakeholders [86,109,110]. Successful and sustainable governance building is highlighted, including equal participation by diverse stakeholders such as international organizations, NGOs, local communities, and governmental administrations. Despite the demographic, historical, economic, and political

divides, the proposed roundtable attempts to bridge the gap between conservation-minded organizations, institutions, and people [86]. In South America, several types of natural resources are managed simultaneously. Climate change, dam building, deforestation, pollution, fishing, and tourism pose the biggest threats to this region's ecosystem productivity and habitat quality. In addition, significant challenges include a lack of the appropriate rule of law, political stability, and corruption control [103]. In particular, an ecosystem-based approach is considered the best for conflict resolution in natural resource management.

In Asia, transboundary haze and air pollution were the major subjects of research on natural resource conflicts in the atmosphere, whereas atmosphere-related studies were more frequently conducted in other regions. Especially in Asian cases, diverse committees operate with several neighboring countries surrounding the natural resources. The long range of rivers (e.g., Mekong River basin) and mountainous regions (e.g., Himalayas) in Asia mean that, typically, two or more countries use the same natural resources. Therefore, establishing a transnational group is necessary. These associations respond to various conflicts together to develop resources, protect the landscape, share information, and build peaceful relationships. There are still severe armed conflicts in southwestern Asian countries around food supply, fresh water, electricity, and land use. If there had been political and historical tensions, the situation would have been more complicated to handle immediately. A comprehensive strategy and multi-lateral governance system will be productive and meaningful.

In Europe, biosphere-related conflict cases have a high proportion of research cases on natural resources. Numerous protected areas were designated by specialized international organizations and agreements. Furthermore, the extent of protected areas has increased over time, including more countries. Therefore, improving the network among these countries is important in maintaining the sustainability of its natural value. The Natura 2000 network played a crucial role in monitoring the status of the protected areas, policy-making, and promoting cooperation. Studies on the Alps, which align across eight countries, Italy, France, Switzerland, Liechtenstein, Germany, Austria, Slovenia, and Hungary, should cover all four spheres of the Earth because of its diverse natural resources on the European continent. In Europe's atmospheric domain, CO<sub>2</sub> emissions and issues on climate change are threats that must be addressed. In the biosphere sector, forest degradation, invading species (flora and fauna), illnesses, timber overharvesting, and landscape devastation have occurred. Regarding the lithosphere, soil sealing land use change has generated tension between bordering countries. Finally, conflict in the Alps is exacerbated by water problems caused by ice caps and river basins. To maintain biodiversity and ecological services beyond the border, countries around should cooperate with and manage natural resources [111].

## 6. Conclusions

To understand the characteristics of natural resource conflicts in borderlands, this study analyzed transboundary natural resource-related articles with five spheres of the Earth: the atmosphere, lithosphere, hydrosphere, biosphere, and anthroposphere. The number of articles related to the natural resource conflicts in the border regions has increased rapidly. Among the types of natural resources, river basins have been studied dominantly; international organizations and neighboring governments are highly involved in managing the common problems surrounding the river, lake, and ocean. In addition, anthroposphere activities such as building dams, fishery rights, making national parks, and poaching wildlife were dealt with as major drivers of conflicts and opportunities to cooperate with [112–116]. The hydrosphere and biosphere have been managed actively by international organizations such as the UN and IUCN by classifying the types of transborder areas, monitoring the current status, and making regulations. However, relatively less research on the atmosphere and lithosphere has been conducted globally.

Although this study provides meaningful findings on natural resource conflicts, it also has some limitations. First, the publications selected for the systematic review in this study had to be in English and within the field of social science. This study focused on

the social effects on and management methods used in the borderlands. Furthermore, publications written in English are important, as they include global-level studies and share the academic findings thereof with relevant stakeholders. However, the possibility arises that significant studies related to conflicts in border regions over natural resources are categorized in other subject areas, such as Earth science, humanities, and environmental science or are not published in English. As such, challenges relating to different languages were difficult to overcome in this study. Second, this study does not include an in-depth analysis of each case study, as the aim was to offer a more comprehensive perspective. However, based on this study, future research could focus on the power relations between specific border regions and conduct interviews with stakeholders to provide practical conflict resolution strategies.

In conclusion, the characteristics of natural resources, conflicts, and cooperation in border regions covered in the extant academic research were identified and described through a systematic literature review. By providing systematic evidence and frameworks, this study may help in developing strategies, scientific studies, effective implementation, and saving time in decision-making. The systematic map, in particular, provides insights into which border region studies have been developed, what natural resources have caused conflicts, and how these have been managed from various perspectives. Based on this study, innovative interdisciplinary research should be conducted to identify global literature trends concerning the issues identified. This research helps better understand the links between conflicts and natural resources in border regions and further identifies gaps to be addressed by additional research and investment.

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## References

1. Green, B.E. A General Model of Natural Resource Conflicts: The Case of International Freshwater Disputes. *Sociologia* **2005**, *37*, 227–248.
2. Brown, O.; Keating, M. *Addressing Natural Resource Conflicts. Working Towards More Effective Resolution of National and Sub-National Resource Disputes*; Chatham House: London, UK, 2015; pp. 1–32. ISBN 9781784130671.
3. Hellström, E. Conflict Cultures: Qualitative Comparative Analysis of Environmental Conflicts in Forestry. *Silva Fenn. Monogr.* **2001**, 1–109. [[CrossRef](#)]
4. IUCN. *Conflict and Conservation; Nature in a Globalised World Report No. 1*; IUCN: Gland, Switzerland, 2021; ISBN 9782831721156. [[CrossRef](#)]
5. Hailu, D.; Rendtorff-Smith, S.; Gankhuyag, U.; Ochieng, C. *Conflict Prevention in Resource-Rich Economies: Toolkit and Guidance for Preventing and Managing Land and Natural Resources Conflict*; United Nations Development Programme: New York, NY, USA, 2011; Volume 1, pp. 1–48.
6. Bavinck, M.; Pellegrini, L.; Mostert, E. *Conflicts over Natural Resources in the Global South: Conceptual Approaches*; CRC Press: Boca Raton, FL, USA, 2014; ISBN 1138020400.

7. Sturgeon, J.C. Border Practices, Boundaries, and the Control of Resource Access: A Case from China, Thailand and Burma. *Dev. Change* **2004**, *35*, 463–484. [CrossRef]
8. De Jong, W.; Snelder, D.; Ishikawa, N. *Transborder Governance of Forests, Rivers and Seas*; Routledge: Oxfordshire, UK, 2012; ISBN 1136538097.
9. Parker, B.J. At the Edge of Empire: Conceptualizing Assyria's Anatolian Frontier ca. 700 BC. *J. Anthropol. Archaeol.* **2002**, *21*, 371–395. [CrossRef]
10. Erg, B.; Groves, C.; McKinney, M.; Michel, T.R.; Phillips, A.; Schoon, M.L.; Vasilijevic, M.; Zunckel, K. *Transboundary Conservation: A Systematic and Integrated Approach*; Best Practice Protected Area Guidelines Series No. 23; IUCN: Gland, Switzerland, 2015; Available online: <https://portals.iucn.org/library/sites/library/files/documents/PAG-023.pdf> (accessed on 20 November 2022).
11. Baud, M.; Van Schendel, W. Toward a Comparative History of Borderlands. *J. World Hist.* **1997**, *8*, 211–242. [CrossRef]
12. Prescott, J.R.V. *Political Frontiers and Boundaries*; Routledge: Oxfordshire, UK, 2014; ISBN 1317601998.
13. Parker, B.J. Toward an Understanding of Borderland Processes. *Am. Antiq.* **2006**, *71*, 77–100. [CrossRef]
14. Alvarez Jr, R.R. Toward an Anthropology of Borderlands: The Mexican-US Border and the Crossing of the 21st Century. *Front. Borderl. Anthropol. Perspect.* **1999**, *24*, 225–238.
15. Donnan, H. Nation, State and Identity at International Borders. In *Border Identities: Nation and State at International Frontiers*; Cambridge University Press: Cambridge, UK, 1998; pp. 1–30.
16. Pavlakovich-Kochi, V.; Morehouse, B.J. *Challenged Borderlands: Transcending Political and Cultural Boundaries*; Routledge: Oxfordshire, UK, 2017; ISBN 1315260700.
17. Rosenberg, M. The 4 Spheres of the Earth. ThoughtCo. 2017. Available online: [Thoughtco.com/the-four-spheres-of-the-earth-1435323](https://www.thoughtco.com/the-four-spheres-of-the-earth-1435323) (accessed on 20 October 2021).
18. Huddart, D.; Stott, T.A. *Earth Environments*; John Wiley & Sons: Hoboken, NJ, USA, 2020; ISBN 1119413257.
19. Pielke, R.A. Atmosphere. *Encycl. Britannica*. 2021. Available online: <https://www.Br.Com/science/atmosph> (accessed on 1 September 2021).
20. Lidskog, R.; Sundqvist, G. Transboundary Air Pollution Policy in Transition. *Gov. Air* **2011**, *1*, 1–35.
21. Artemieva, I. *Lithosphere: An Interdisciplinary Approach*; Cambridge University Press: Cambridge, UK, 2011; ISBN 0521843960.
22. Guo, R. *Cross-Border Resource Management*; Elsevier: Amsterdam, The Netherlands, 2021; ISBN 0323915582.
23. Araya, Y.N. Hydrosphere. In *Water Encyclopedia*; Lehr, J.H., Keeley, J., Eds.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2005. [CrossRef]
24. Gates, D.M.; Thompson, M.B.; Thompson, J.N. Biosphere. *Encycl. Br.* **2022**. Available online: <https://www.britannica.com/science/biosphere> (accessed on 20 November 2022).
25. Manahan, S.E. *Environmental Science and Technology: A Sustainable Approach to Green Science and Technology*; CRC Press: Boca Raton, FL, USA, 2006; ISBN 1420003216.
26. Hearn, J.; Feuer, D.; Higginson, I.J.; Sheldon, T. Systematic Reviews. *Palliat. Med.* **1999**, *13*, 75–80. [CrossRef]
27. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Int. J. Surg.* **2010**, *8*, 336–341. [CrossRef]
28. Shamseer, L.; Moher, D.; Clarke, M.; Ghersi, D.; Liberati, A.; Petticrew, M.; Shekelle, P.; Stewart, L.A. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015: Elaboration and Explanation. *BMJ* **2015**, *349*, g7647. [CrossRef]
29. Chadegani, A.A.; Salehi, H.; Yunus, M.M.; Farhadi, H.; Fooladi, M.; Farhadi, M.; Ebrahim, N.A. A Comparison between Two Main Academic Literature Collections: Web of Science and Scopus Databases. *arXiv* **2013**, arXiv:1305.0377. [CrossRef]
30. Alexandre, E. Transboundary Cooperation for Nature Conservation. 2015. Available online: [https://neaspec.org/sites/default/files/Transboundary\\_Cooperation\\_For\\_Nature\\_Conservation.pdf](https://neaspec.org/sites/default/files/Transboundary_Cooperation_For_Nature_Conservation.pdf) (accessed on 8 August 2021).
31. Dahl, I.V. International Regulations and Guidelines on Transboundary Salmon Stocks: Case Study of the Tana River. *Arct. Rev.* **2020**, *11*, 157–188. [CrossRef]
32. Campbell, B.; Hanich, Q. Principles and Practice for the Equitable Governance of Transboundary Natural Resources: Cross-Cutting Lessons for Marine Fisheries Management. *Marit. Stud.* **2015**, *14*, 8. [CrossRef]
33. Levin, N.; Begeer, M.; Maina, J.; McClanahan, T.; Kark, S. Evaluating the Potential for Transboundary Management of Marine Biodiversity in the Western Indian Ocean. *Australas. J. Environ. Manag.* **2018**, *25*, 62–85. [CrossRef]
34. Østhagen, A.; Spijkers, J.; Totland, O.A. Collapse of Cooperation? The North-Atlantic Mackerel Dispute and Lessons for International Cooperation on Transboundary Fish Stocks. *Marit. Stud.* **2020**, *19*, 155–165. [CrossRef]
35. Seto, K.; Miller, N.; Young, M.; Hanich, Q. Toward Transparent Governance of Transboundary Fisheries: The Case of Pacific Tuna Transshipment. *Mar. Policy* **2020**, *136*, 104200. [CrossRef]
36. Jetoo, S. Barriers to Effective Eutrophication Governance: A Comparison of the Baltic Sea and North American Great Lakes. *Water* **2018**, *10*, 400. [CrossRef]
37. Jentoft, S.; Knol, M. Marine Spatial Planning: Risk or Opportunity for Fisheries in the North Sea? *Marit. Stud.* **2014**, *12*, 13. [CrossRef]
38. Strandmark, A.; Bring, A.; Cousins, S.A.O.; Destouni, G.; Kautsky, H.; Kolb, G.; de la Torre-Castro, M.; Hambäck, P.A. Climate Change Effects on the Baltic Sea Borderland between Land and Sea. *Ambio* **2015**, *44*, 28–38. [CrossRef] [PubMed]
39. Gorkina, T.I. Geopolitical Problems of the Arctic. *Reg. Res. Russ.* **2013**, *3*, 447–457. [CrossRef]

40. Stephenson, S.R. Confronting Borders in the Arctic. *J. Borderl. Stud.* **2018**, *33*, 183–190. [[CrossRef](#)]
41. Gardiner, N.B. Marine Protected Areas in the Southern Ocean: Is the Antarctic Treaty System Ready to Co-Exist with a New United Nations Instrument for Areas beyond National Jurisdiction? *Mar. Policy* **2020**, *122*, 104212. [[CrossRef](#)]
42. Jetoo, S. The Role of Transnational Municipal Networks in Transboundary Water Governance. *Water* **2017**, *9*, 40. [[CrossRef](#)]
43. Marques, M.; Da Costa, M.F.; Mayorga, M.I.D.O.; Pinheiro, P.R.C. Water Environments: Anthropogenic Pressures and Ecosystem Changes in the Atlantic Drainage Basins of Brazil. *Ambio* **2004**, *33*, 68–77. [[CrossRef](#)]
44. Rieu-Clarke, A. Can Reporting Enhance Transboundary Water Cooperation? Early Insights from the Water Convention and the Sustainable Development Goals Reporting Exercise. *Rev. Eur. Comp. Int. Environ. Law* **2020**, *29*, 361–371. [[CrossRef](#)]
45. Jafroudi, M. A Legal Obligation to Adapt Transboundary Water Agreements to Climate Change? *Water Policy* **2020**, *22*, 717–732. [[CrossRef](#)]
46. Conti, K.I.; Gupta, J. Global Governance Principles for the Sustainable Development of Groundwater Resources. *Int. Environ. Agreements Polit. Law Econ.* **2016**, *16*, 849–871. [[CrossRef](#)]
47. Timmerman, J.; Matthews, J.; Koepfel, S.; Valensuela, D.; Vlaanderen, N. Improving Governance in Transboundary Cooperation in Water and Climate Change Adaptation. *Water Policy* **2017**, *19*, 1014–1029. [[CrossRef](#)]
48. Earle, A.; Neal, M.J. Inclusive Transboundary Water Governance. *Glob. Issues Water Policy* **2017**, *6*, 145–158. [[CrossRef](#)]
49. Hoekstra, A.Y. The Global Dimension of Water Governance: Why the River Basin Approach Is No Longer Sufficient and Why Cooperative Action at Global Level Is Needed. *Water* **2011**, *3*, 21–46. [[CrossRef](#)]
50. Zou, K.; Ye, Q. Interpretation and Application of Article 298 of the Law of the Sea Convention in Recent Annex VII Arbitrations: An Appraisal. *Ocean Dev. Int. Law* **2017**, *48*, 331–344. [[CrossRef](#)]
51. Jenisch, U.K. Old Laws for New Risks at Sea: Mineral Resources, Climate Change, Sea Lanes, and Cables. *WMU J. Marit. Aff.* **2012**, *11*, 169–185. [[CrossRef](#)]
52. Hanasz, P. A Little Less Conversation? Track II Dialogue and Transboundary Water Governance. *Asia Pac. Policy Stud.* **2017**, *4*, 296–309. [[CrossRef](#)]
53. Andrew Kelly, J.; Vollebergh, H.R.J. Adaptive Policy Mechanisms for Transboundary Air Pollution Regulation: Reasons and Recommendations. *Environ. Sci. Policy* **2012**, *21*, 73–83. [[CrossRef](#)]
54. Byrne, A. Trouble in the Air: Recent Developments under the 1979 Convention on Long-Range Transboundary Air Pollution. *Rev. Eur. Comp. Int. Environ. Law* **2017**, *26*, 210–219. [[CrossRef](#)]
55. Zhao, Z.; Cai, M.; Connor, T.; Chung, M.G.; Liu, J. Metacoupled Tourism and Wildlife Translocations Affect Synergies and Trade-Offs among Sustainable Development Goals across Spillover Systems. *Sustainability* **2020**, *12*, 7677. [[CrossRef](#)]
56. Trouwborst, A.; Fleurke, F.; Dubrulle, J. Border Fences and Their Impacts on Large Carnivores, Large Herbivores and Biodiversity: An International Wildlife Law Perspective. *Rev. Eur. Comp. Int. Environ. Law* **2016**, *25*, 291–306. [[CrossRef](#)]
57. Edwards, R.; Evans, A. The Challenges of Marine Spatial Planning in the Arctic: Results from the ACCESS Programme. *Ambio* **2017**, *46*, 486–496. [[CrossRef](#)]
58. Gänzle, S.; Stead, D.; Sielker, F.; Chilla, T. Macro-Regional Strategies, Cohesion Policy and Regional Cooperation in the European Union: Towards a Research Agenda. *Polit. Stud. Rev.* **2019**, *17*, 161–174. [[CrossRef](#)]
59. Koivurova, T.; Rosas, A. The CBSS as a Vehicle for Institutionalised Governance in the Baltic Sea Area, in Comparison with Its Two Sister Organisations in the North. *Mar. Policy* **2018**, *98*, 211–219. [[CrossRef](#)]
60. Hoi, N.C.; Dang, V.H. Building a Regional Network and Management Regime of Marine Protected Areas in the South China Sea for Sustainable Development. *J. Int. Wildl. Law Policy* **2015**, *18*, 128–138. [[CrossRef](#)]
61. Bateman, S. Building Cooperation for Managing the South China Sea without Strategic Trust. *Asia Pac. Policy Stud.* **2017**, *4*, 251–259. [[CrossRef](#)]
62. Zhao, S. China’s Global Search for Energy Security: Cooperation and Competition in Asia-Pacific. *J. Contemp. China* **2008**, *17*, 207–227. [[CrossRef](#)]
63. Platjouw, F.M. Marine Spatial Planning in the North Sea-Are National Policies and Legal Structures Compatible Enough? The Case of Norway and the Netherlands. *Int. J. Mar. Coast. Law* **2018**, *33*, 34–78. [[CrossRef](#)]
64. Roeben, V. Governing Shared Offshore Electricity Infrastructure in the Northern Seas. *Int. Comp. Law Q.* **2013**, *62*, 839–864. [[CrossRef](#)]
65. United Nations and UNESCO. *Progress on Transboundary Water Cooperation 2021*; United Nations and United Nations Educational, Scientific and Cultural Organization: Paris, France, 2021; ISBN 9789231004674.
66. Caponera, D.A. *The Law of International Water Resources*; FAO: Rome, Italy, 1980; ISBN 9251010366.
67. Wolf, A.T. *Conflict and Cooperation over Transboundary Waters*; Human Development Report Office (HDRO), United Nations Development Programme: New York, NY, USA, 2006.
68. Kieyah, J. The 1929 Nile Waters Agreement: Legal and Economic Analysis. Retrieved Novemb. **2007**, *25*, 2016.
69. Mahlakeng, M.K. China and the Nile River Basin: The Changing Hydropolitical Status Quo. *Insight Afr.* **2018**, *10*, 73–97. [[CrossRef](#)]
70. Liersch, S.; Koch, H.; Hattermann, F.F. Management Scenarios of the Grand Ethiopian Renaissance Dam and Their Impacts under Recent and Future Climates. *Water* **2017**, *9*, 728. [[CrossRef](#)]
71. Verhoeven, H. The Grand Ethiopian Renaissance Dam: Africa’s Water Tower, Environmental Justice & Infrastructural Power. *Daedalus* **2021**, *150*, 159–180. [[CrossRef](#)]

72. Whittington, D.; Waterbury, J.; Jeuland, M. The Grand Renaissance Dam and Prospects for Cooperation on the Eastern Nile. *Water Policy* **2014**, *16*, 595–608. [CrossRef]
73. Carr, C.J. *River Basin Development and Human Rights in Eastern Africa-A Policy Crossroads*; Springer: New York, NY, USA, 2017; ISBN 9783319504698.
74. Hussein, H.; Grandi, M. Dynamic Political Contexts and Power Asymmetries: The Cases of the Blue Nile and the Yarmouk Rivers. *Int. Environ. Agreements Polit. Law Econ.* **2017**, *17*, 795–814. [CrossRef]
75. Merz, L.; Yang, D.; Hull, V. A Metacoupling Framework for Exploring Transboundary Watershed Management. *Sustainability* **2020**, *12*, 1879. [CrossRef]
76. Maganda, C. Border Water Culture in Theory and Practice: Political Behavior on the Mexico-U.S. Border. *J. Polit. Ecol.* **2012**, *19*, 81–93. [CrossRef]
77. Nava, L.F.; Brown, C.; Demeter, K.; Lasserre, F.; Milanés-Murcia, M.; Mumme, S.; Sandoval-Solis, S. Existing Opportunities to Adapt the Rio Grande/Bravo Basin Water Resources Allocation Framework. *Water* **2016**, *8*, 291. [CrossRef]
78. Plassin, S.; Koch, J.; Paladino, S.; Friedman, J.R.; Spencer, K.; Vaché, K.B. A Socio-Environmental Geodatabase for Integrative Research in the Transboundary Rio Grande/Río Bravo Basin. *Sci. Data* **2020**, *7*, 1–14. [CrossRef]
79. Fox, C.A.; Sneddon, C.S. Political Borders, Epistemological Boundaries, and Contested Knowledges: Constructing Dams and Narratives in the Mekong River Basin. *Water* **2019**, *11*, 413. [CrossRef]
80. Murshed, S.M.; Ward, H.; Dorussen, H. Any Ties That Bind? Economic Diplomacy on the South Asian Subcontinent. *Hague J. Dipl.* **2011**, *6*, 149–169. [CrossRef]
81. Schoon, M. Brief History of Transboundary Protected Areas 2011. Available online: <https://www.tbpa.net/page.php?ndx=17> (accessed on 20 November 2022).
82. Sandwith, T.; Shine, C.; Hamilton, L.; Sheppard, D. *Protected Areas for Peace and Co-Operation*; Best Practice Protected Area Guidelines Series No. 7; IUCN: Gland, Switzerland; Cambridge, UK, 2001; Available online: <https://portals.iucn.org/library/efiles/documents/PAG-007.pdf> (accessed on 20 November 2022).
83. Chitakira, M.; Torquebiau, E.; Ferguson, W. Unique Combinations of Stakeholders in a Transfrontier Conservation Area Promote Biodiversity-Agriculture Integration. *J. Sustain. Agric.* **2012**, *36*, 275–295. [CrossRef]
84. Van Amerom, M.; Büscher, B. Peace Parks in Southern Africa: Bringers of an African Renaissance? *J. Mod. Afr. Stud.* **2005**, *43*, 159–182. [CrossRef]
85. Sjöstedt, M.; Linell, A. Cooperation and Coercion: The Quest for Quasi-Voluntary Compliance in the Governance of African Commons. *World Dev.* **2021**, *139*, 105333. [CrossRef]
86. Kachena, L.; Spiegel, S.J. Borderland Migration, Mining and Transfrontier Conservation: Questions of Belonging along the Zimbabwe–Mozambique Border. *GeoJournal* **2019**, *84*, 1021–1034. [CrossRef]
87. Jedd, T.; Bixler, R.P. Accountability in Networked Governance: Learning from a Case of Landscape-Scale Forest Conservation. *Environ. Policy Gov.* **2015**, *25*, 172–187. [CrossRef]
88. Mestanza-Ramón, C.; Jiménez-Caballero, J.L. Nature Tourism on the Colombian–Ecuadorian Amazonian Border: History, Current Situation, and Challenges. *Sustainability* **2021**, *13*, 4432. [CrossRef]
89. Molden, D.; Sharma, E.; Shrestha, A.B.; Chettri, N.; Pradhan, N.S.; Kotru, R. Advancing Regional and Transboundary Cooperation in the Conflict-Prone Hindu Kush–Himalaya. *Mt. Res. Dev.* **2017**, *37*, 502–508. [CrossRef]
90. Perkowski, M.; Hryniewicka-Filipkowska, W.; Dąbrowska, I. Protection of the Białowieża Forest as a Challenge to Cross-Border Cooperation. *Int. Community Law Rev.* **2018**, *20*, 71–107. [CrossRef]
91. Fraenkel, A.A. The Convention on Long-Range Transboundary Air Pollution: Meeting the Challenge of International Cooperation. *Harv. Int. LJ* **1989**, *30*, 447.
92. Carmenta, R.; Zabala, A.; Daeli, W.; Phelps, J. Perceptions across Scales of Governance and the Indonesian Peatland Fires. *Glob. Environ. Chang.* **2017**, *46*, 50–59. [CrossRef]
93. ASEAN. *ASEAN Agreement on Transboundary Haze Pollution*; ASEAN: Jakarta, Indonesia, 2002.
94. Forsyth, T. Public Concerns about Transboundary Haze: A Comparison of Indonesia, Singapore, and Malaysia. *Glob. Environ. Chang.* **2014**, *25*, 76–86. [CrossRef]
95. Kim, M. Environmental Cooperation in Northeast Asia. *Impact Assess. Proj. Apprais.* **2004**, *22*, 191–203. [CrossRef]
96. Bhatti, M.T.; Ashraf, M.; Anwar, A.A. Soil Erosion and Sediment Load Management Strategies for Sustainable Irrigation in Arid Regions. *Sustainability* **2021**, *13*, 3547. [CrossRef]
97. Polak-Springer, P. Bordering Zubara: Oil Politics, the 1937 Qatari-Bahraini Conflict, and the Making of a Modern Arabian (Persian) Gulf Borderland. *J. Borderl. Stud.* **2020**, *37*, 1071–1095. [CrossRef]
98. Medema, W.; Furber, A.; Adamowski, J.; Zhou, Q.; Mayer, I.; Nava, L.F.; Brown, C.; Demeter, K.; Lasserre, F.; Milanés-Murcia, M.; et al. Framing Scenarios of Binational Water Policy with a Tool to Visualize, Quantify and Value Changes in Ecosystem Services. *Water* **2020**, *8*, 1–14. [CrossRef]
99. Rollag, M. Future of Cross-Border Pipeline Projects in AMLO’s Mexico: What’s the Risk? *J. World Energy Law Bus.* **2020**, *13*, 58–67. [CrossRef]
100. Aburto-Oropeza, O.; Johnson, A.F.; Agha, M.; Allen, E.B.; Allen, M.F.; González, J.A.; Arenas Moreno, D.M.; Beas-Luna, R.; Butterfield, S.; Caetano, G.; et al. Harnessing Cross-Border Resources to Confront Climate Change. *Environ. Sci. Policy* **2018**, *87*, 128–132. [CrossRef]

101. Bagavathiannan, M.; Acker, R. Van Transgenes and National Boundaries-The Need for International Regulation. *Environ. Biosaf. Res.* **2009**, *8*, 141–148. [[CrossRef](#)]
102. Norman, L.M.; Villarreal, M.L.; Niraula, R.; Meixner, T.; Frisvold, G.; Labiosa, W. Framing Scenarios of Binational Water Policy with a Tool to Visualize, Quantify and Value Changes in Ecosystem Services. *Water* **2013**, *5*, 852–874. [[CrossRef](#)]
103. Norman, L.; Tallent-Halsell, N.; Labiosa, W.; Weber, M.; McCoy, A.; Hirschboeck, K.; Callegary, J.; van Riper, C.; Gray, F. Developing an Ecosystem Services Online Decision Support Tool to Assess the Impacts of Climate Change and Urban Growth in the Santa Cruz Watershed; Where We Live, Work, and Play. *Sustainability* **2010**, *2*, 2044–2069. [[CrossRef](#)]
104. Isaac, V.J.; Ferrari, S.F. Assessment and Management of the North Brazil Shelf Large Marine Ecosystem. *Environ. Dev.* **2017**, *22*, 97–110. [[CrossRef](#)]
105. Beddington, J.R.; Agnew, D.J.; Clark, C.W. Current Problems in the Management of Marine Fisheries. *Science* **2007**, *316*, 1713–1716. [[CrossRef](#)] [[PubMed](#)]
106. Grainger, S.; Conway, D. Climate Change and International River Boundaries: Fixed Points in Shifting Sands. *Wiley Interdiscip. Rev. Clim. Chang.* **2014**, *5*, 835–848. [[CrossRef](#)]
107. Mabhaudhi, T.; Mpandeli, S.; Madhlopa, A.; Modi, A.T.; Backeberg, G.; Nhamo, L. Southern Africa’s Water-Energy Nexus: Towards Regional Integration and Development. *Water* **2016**, *8*, 235. [[CrossRef](#)]
108. Moswete, N.; Thapa, B.; Darley, W.K. Local Communities’ Attitudes and Support towards the Kgalagadi Transfrontier Park in Southwest Botswana. *Sustainability* **2020**, *12*, 1524. [[CrossRef](#)]
109. Nhamo, L.; Ndlala, B.; Nhemachena, C.; Mabhaudhi, T.; Mpandeli, S.; Matchaya, G. The Water-Energy-Food Nexus: Climate Risks and Opportunities in Southern Africa. *Water* **2018**, *10*, 567. [[CrossRef](#)]
110. Baird, J.; Plummer, R.; Bullock, R.; Dupont, D.; Heinmiller, T.; Jollineau, M.; Kubik, W.; Renzetti, S.; Vasseur, L. Contemporary Water Governance: Navigating Crisis Response and Institutional Constraints through Pragmatism. *Water* **2016**, *8*, 224. [[CrossRef](#)]
111. Filho, A.G.Y. Multi-Level Water Governance without Integrated Water Resources Management (IWRM): Cooperation in the Columbia River Basin. *Ambient. Soc.* **2020**, *23*, 1–20. [[CrossRef](#)]
112. Vigl, L.E.; Marsoner, T.; Schirpke, U.; Tscholl, S.; Candiago, S.; Depellegrin, D. A Multi-Pressure Analysis of Ecosystem Services for Conservation Planning in the Alps. *Ecosyst. Serv.* **2021**, *47*, 101230. [[CrossRef](#)]
113. Urban, F.; Siciliano, G.; Nordensvard, J. China’s Dam-Builders: Their Role in Transboundary River Management in South-East Asia. *Int. J. Water Resour. Dev.* **2018**, *34*, 747–770. [[CrossRef](#)]
114. Lima, A.; Kim, D.; Song, A.M.; Hickey, G.M.; Temby, O. Trust and Influence in the Gulf of Mexico’s Fishery Public Management Network. *Sustainability* **2019**, *11*, 6090. [[CrossRef](#)]
115. Martin, A.; Rutagarama, E.; Cascão, A.; Gray, M.; Chhotray, V. Understanding the Co-Existence of Conflict and Cooperation: Transboundary Ecosystem Management in the Virunga Massif. *J. Peace Res.* **2011**, *48*, 621–635. [[CrossRef](#)]
116. Singh, S.K.; Jabin, G.; Basumatary, T.; Bhattarai, G.P.; Chandra, K.; Thakur, M. Resolving the Trans-Boundary Dispute of Elephant Poaching between India and Nepal. *Forensic Sci. Int. Synerg.* **2019**, *1*, 146–150. [[CrossRef](#)]

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