



(De)constructing meanings and pathways of water and peace

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ABSTRACT

Water as an entry point for peace is increasingly highlighted in global policy discourse; however, the scientific evidence supporting this connection has not been systematically established or explored, in contrast to the extensive literature on water and conflict. This systematic review examines the literature on the relationship between water and peace from 2015 to 2022, utilizing the ROSES methodology for systematic reviews. Our findings indicate that while conceptual advances and empirical evidence demonstrate that water can serve as a vector for broader peace, this knowledge is dispersed across various epistemic communities, hindering the systematic accumulation of insights. To address this fragmentation, we unpack the different meanings of and linkages between water and peace and identify seven water-to-peace 'pathways' from an inductive analysis of the literature. We propose that the pathways can provide structure and shared language for future research on water and peace, aimed at fostering interdisciplinary collaboration and enhancing understanding of this critical relationship.

1. Introduction

Managing and sharing freshwater can become a source of tension between communities, particularly as societal demand for water grows and supply becomes unpredictable due to over-abstraction, poor governance, degradation and climate change (Michel, 2020; Buhaug et al., 2023; Gleick and Iceland, 2018). Some recent studies suggest that water-related conflicts are on the rise globally, particularly in Africa and Asia (Kåresdotter et al., 2023). Certainly, water is being used as a weapon or target in armed conflicts – as witnessed in the ongoing wars in Ukraine and Gaza – with devastating consequences (Hapich et al., 2024; Zeitoun et al., 2024; Gleick and Shimabuku, 2023).

At the same time, water has long since been a source of collaboration, cooperation and peace between communities and states around the world. Its life-giving and irreplaceable characteristics give us a uniquely shared dependence. At the international level, a large body of research demonstrates the propensity for inter-state cooperation in terms of the signing international agreements and treaties over shared waters (Dinar et al., 2015; Klimes et al., 2019; Wolf, 2007; Ide and Detges, 2018; Warner and Vij, 2022). Water-related cooperation has been important in promoting peace and stability in several transboundary river basins, including Senegal and the Sava (Niassé et al., 2022; Aolakhodzi et al.,

2014). Research from the environmental peacebuilding field suggests that water can provide a technical entry point for dialogue and negotiation across contact lines in conflict settings, and can lead to wider demilitarization, reconciliation and societal cohesion (Dresse et al., 2018; Krampe, 2017; Conca, 2018). On the more local level, there is evidence that communities with long-term exposure to water scarcity demonstrate a high preference for water cooperation (Döring, 2020; Nie et al., 2020; Haseeb, 2020), and that water can provide opportunities for peaceful coexistence through fostering collaboration and sustainable development (Sabin et al., 2019; Cunningham, 2016; Kuzdas et al., 2016; Shoko and Naidu, 2020).

In this article, we focus specifically on this end of the spectrum: the relationship between water and *peace*. We think this is important for two main reasons. First of all, whereas the literature on water conflict and water-conflict pathways have taken form and structure, the same cannot be said for understanding the relationship between water and peace. Peace is a rather elusive outcome of study and has not yet been systematically assessed in relation to water; more often, water *cooperation* is studied by means of treaties signed, agreements made, statements issued, etc. While treaties often play normative and stabilizing roles in shared basins, they remain only proxies for peaceful relations; at worst they mask significant tension or underlying conflict at various scales

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(Mirumachi, 2015; Vij et al., 2018). Peace on the other hand is about not only the absence of violent conflict (known as ‘negative peace’), but also about the presence of structures, conditions and attitudes that promote human security and social justice, drawing on the notion of ‘positive peace’ (Diehl, 2016; Galtung, 1969). This makes water and peace an inherently more nuanced and complex object of study. The challenge of defining peace in relation to water is part of the interest in the present study, in addition to exploring some of the mechanisms or pathways that link them together.

Secondly, deconstructing the study of water and peace seems like a timely endeavor, as it has become an increasingly popular policy narrative: that addressing shared water challenges can be a vector for peace and prosperity in society (UNESCO, 2024; Zhang & Borja-Vega, 2024). In 2015, fifteen states came together to form the Global High-Level Panel on Water and Peace, recommending that “the time is ripe to consider, at the global level, a set of strategies to address water matters as issues of peace and security, and to leverage water as a driver of peace” (Geneva Water Hub, 2017, p.16). In the years following this initiative, there have been five discussions on water and peace at the United Nations Security Council (UNSC)¹ and several Foreign Affairs Ministries have used water peace and diplomacy as a clear strategic focus (notably Senegal, the Netherlands, Switzerland, Finland, Slovenia, Tajikistan). The water and peace theme continues to gain traction on the global policy agenda, notably through the 2023 UN Water Conference (with a specific interactive dialogue on water for cooperation), and as a thematic heading for international events and reports such as the World Water Forum (2022 and 2024), the World Water Development Report (2024), UN World Water Day (2024) and the annual Stockholm International Water Institute World Water Week (2024). This significant political and policy momentum on the topic provides a strong rationale for the relevance of this systematic literature review, aiming to explore and deconstruct the meanings and pathways on water for peace.

Against this background, our objective is to explore and consolidate what recent scientific literature says about the interlinkages between water and peace. While the policy discourse generally promotes the notion that well-designed water interventions can lead to more peaceful relations, its mechanisms have not been clearly (de)constructed and studied on an evidentiary basis. This gap in the literature is even more problematic because the relationship between water and *conflict* has been much more thoroughly unpacked and analyzed (e.g. Michel, 2020; Buhaug et al., 2023; Gleick and Shimabuku, 2023). To begin to address this gap, we ask the question: what notions of *peace* exist in the literature in relation to freshwater, and what pathways of change are proposed to explain the relationship between water and peace?

To answer these questions, the remainder of the article is structured as follows: Section II will explain the systematic literature review methodology, through which we consolidate the English-language scientific and grey literature on *water* and *peace* published between 2015 and 2022, with 2015 marking the beginning of significant policy interest in the topic. In Section III we present the results of the analysis: firstly, in terms of publication types, geography, scale, actors as well as the meanings and definitions of peace used and a discussion on the direction

¹ UNSC, An Open Debate on ‘Water, peace and security’, 7818th meeting, S/PV.7818, 22 November 2016; UNSC, Arria-Formula Meeting on ‘Water, peace and security’, convened by Senegal, 22 April 2016; UNSC, Arria-Formula Meeting on ‘Water, peace and security’, convened by Belgium, Bolivia, Cote d’Ivoire, Dominican Republic, Germany, Indonesia, Italy, Netherlands, 26 October 2018; UNSC, Arria-Formula Meeting on ‘Achieving a better protection of water-related essential services and infrastructure for the civilian population during armed conflicts’, convened by Switzerland and Mozambique 22 March 2023. UNSC, Arria-Formula Meeting on ‘Freshwater Resources and Related Infrastructure Under Attack: Protecting Water in Armed Conflict – Protecting Civilian Lives’, convened by Slovenia, Algeria, Panama and Sierra Leone, 23 May 2025.

of the linkages. Secondly, based on an inductive analysis of the literature, we propose seven water-to-peace pathways in order to categorize some of the specific mechanisms that authors have identified to connect water to peace. Finally, in Section IV we make some further observations on the state of the literature and make suggestions for future research, including on the use of the water-to-peace pathways to build a more cohesive literature.

2. Methods

To (de)construct water and peace meanings, we followed the systematic literature review (SLR) methodology, enabling us to conduct a formal, transparent and standardized review of the English language literature. This SLR aims to provide descriptive information about the “state of the art” on our research question. The authors consulted and used numerous systematic mapping and review articles (e.g. Vij et al., 2021; Garrick et al., 2019) while designing this research study and followed this methodological approach’s ‘best practices’. The web-based search engines Web of Science and Google Scholar were used to identify scientific articles; two comprehensive databases for social and environmental sciences articles.

We used the ROSES (Reporting standards for Systematic Evidence Syntheses in environmental research) protocol to conduct this study (Haddaway et al., 2018). ROSES was designed specifically for systematic reviews in the field of environmental sciences, to accommodate the inclusion of different types of environmental evidence. The protocol provides guidelines and checklists on the steps required for the data collection such as inclusion and exclusion criteria, search strategy and search terms.² ROSES helped in conducting the meta-analyses and organizing the flow of inclusion and exclusion rounds. ROSES is particularly useful for harnessing social science insights on environmental problems, which can provide a useful summary for policy makers or decision makers in synthesizing the evidence from diverse methods (Maki et al., 2018).

In this study, the SLR followed four key steps (Fig. 1). The first step was to run initial search queries to identify potential synonyms of peace, water, transboundary waters, conflict and cooperation to recognize relevant literature. Search terms were then determined by using our keywords and their synonyms. Instead of focusing on the different means through which states or actors might realize peaceful relations (i. e. agreements, treaties, cooperation – as are abundant in the literature) we sought to focus on the relationship between water and peace at a more conceptual level. For “peace” we therefore also used the following synonyms in the search: “harmony”, “non-violence”, “disarmament”, “ceasefire”, “law AND order”, “reconciliation”, and “friendship”. For “water” we also used the synonyms “freshwater”, “transboundary”, “hydro”, “aquifer”, “groundwater”, and “wetland”. We excluded the term “blue” as the term brought in too many references to the UN Peacekeeping Force (Blue Helmets). Based on this, we ensure a transparent and rigorous selection of review articles on *water* and *peace*. The databases were searched using the title, abstract and/or keywords of published articles for different Boolean configurations (see [Supplementary Materials](#) for the full list of combinations).

This first step of our search included both peer-reviewed and grey literature (the latter via Google Scholar only), published in English between January 2015 and December 2022. The chosen period reflects significant policy-level momentum, where the link between water and peace was part of the global political agenda. All different research methodologies were included (qualitative, quantitative, mixed methods, case studies, narrative analysis, conceptual or theoretical developments etc.).

After the first query search, a total number of articles were identified

² Guidelines and Checklists are available online at: <https://www.roses-reporting.com/about-roses>

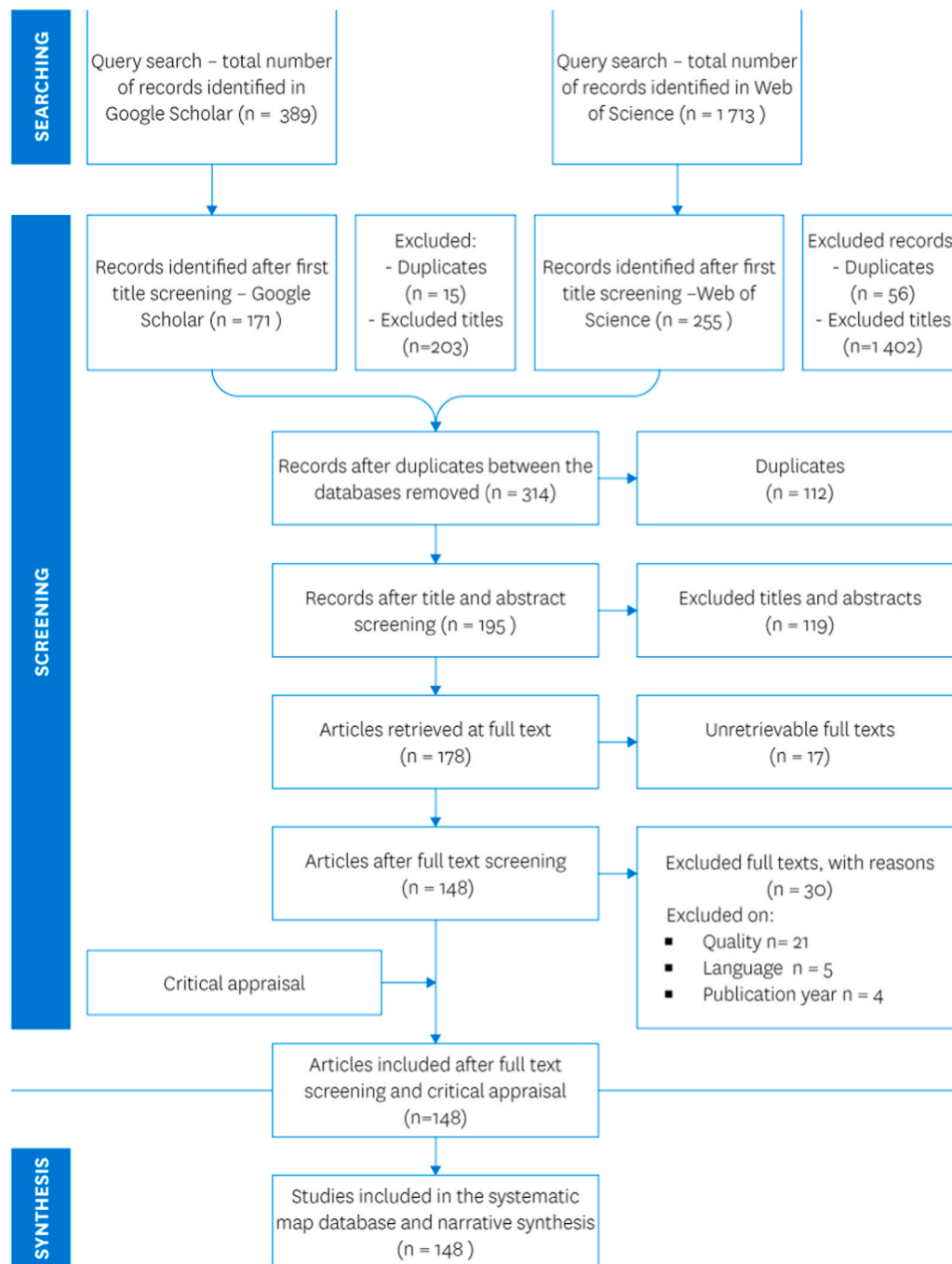


Fig. 1. Steps involved in Systematic Literature Review (template from Haddaway et al., 2017).

for consideration in the review (Google Scholar = 389, Web of Science = 1713). We then screened these articles by title and excluded them for relevance to the specific topic, while also removing duplicates from the two databases at this stage, which resulted in 314 articles for further screening. In the second screening step, based on a reading of abstracts and keywords, we further eliminated articles for relevance, scope, language and again duplication, resulting in 195 articles. In the third step, based on the full-text reading, the tally came to 148 articles once unretrievable texts were removed, as well as eliminations based on quality (i.e. notably from the gray literature sources, such as blog entries), language and publication year glitches. In the last step of ‘critical appraisal’ suggested in the ROSES protocol, we shared and validated the final list of 148 articles with an external expert.

Once the final list of articles was stabilized, the author team read and

manually analyzed the articles, controlling for interpretations through intercoder reliability checks and discussions. The full content of each article in the final database was manually analyzed in order to respond to the research questions. Articles were coded in an Excel database across a range of variables including geographical region, scale of analysis, actor-type etc. (see [Supplementary Materials](#)). In a second round of analysis, inductive and iterative coding was undertaken to classify and code the different definitions of peace mobilized in the articles, the types or directionality of the linkage being established between water and peace, and to cluster articles based on the different types of water-to-peace *pathways* they describe.

2.1. Limitations

Several limitations of the SLR should be acknowledged, particularly regarding the completeness and type of data collected, and its implications for our results and findings. First, the SLR method explores the theme of water and peace, and although we have carefully crafted the keywords and search queries for the two search engines, there is a possibility that some relevant articles might have been omitted the search queries. While the two search engines are among the most comprehensive databases for social and environmental sciences, other domain-specific databases could have yielded additional studies. We also used only two search engines, reflecting constraints in time and available research resources available to conduct the study. Secondly, the two search engines only allowed us to search for English language articles, thereby excluding literature published in other languages and introducing a potential linguistic bias. Finally, the inclusion of articles using all diverse methods and approaches in the SLR (i.e. case studies, conceptual articles, large-N quantitative studies, meta-analyses etc.) implies that our results and discussion on water-peace connections are derived from a wide spectrum of conceptual and scientific inquiries – reflecting heterogeneous body of evidence – not all of which is based on original empirical evidence on the topic.

3. Results

3.1. Publication trends, geographic coverage, scale and actors

The frequency of publications on water and peace remained constant over the period of analysis, with an average of 18 articles per year (Fig. 2). Although this SLR included grey literature, it ultimately represented only a small portion of the final list of articles at 13 publications compared to 118 academic (peer reviewed) articles. The remaining 17 articles comprise books and book chapters, as well as doctoral theses and working papers. As for the areas of disciplinary focus, what stands out is how dispersed the topic is across a spectrum of journals – ranging from social and natural sciences, disciplinary and interdisciplinary journals, as well as geographic-specific journals. Table 1 summarizes the 18 journals that published at least two articles on the topic in our time frame. This represents about one-third of the literature, whereas two-thirds of the literature related to water-peace only appeared only once in that journal during our time frame. It is also noteworthy that most of the articles are from the water and environment journals and not peace or conflict studies.

In terms of geographic coverage, Fig. 3 summarizes the distribution of the literature based on the region being studied. A large majority of the articles on water-peace dealt with the Middle East (46 articles or a third of the total), a region that includes Israel, Palestine, Jordan, Turkey, Iraq, and Syria (the full list of countries per region can be found in Supplementary Materials), and river basins such as the Jordan, and the Tigris-Euphrates. This was followed by Eastern and Southeastern

Table 1

Journals publishing >1 article on “water” and “peace” or its synonyms between 2015 and 2022.

Journals	Number of articles
Water Policy	5
Water	4
Journal of Hydrology; International Environmental Agreements-Politics Law And Economics; Environmental Science & Policy; Sustainability; Geoforum; Journal of Peace Research	3
International Journal Of Water Resources Development; Water Resources Management; Forests; Hydrological Sciences Journal; Cooperation And Conflict; Water International; Political Geography; Frontiers In Environmental Science; Review Of European Comparative & International Environmental Law; World Development	2

Asia (25 articles), notably comprising the Mekong River basin countries Vietnam, Lao, Thailand, Myanmar, and China. Then Sub-Saharan Africa (24), a region including the major watersheds of the Senegal, Niger, Lake Chad, Congo and Orange rivers. It must be noted that there is some double counting of regions (19) in cases where articles examined more than one region. A total of 37 articles either undertook global analyses, or considered a wide array of globally diverse cases in the context of one study.

If we consider geographic scales, the literature on water and peace tracks to four different levels: local, regional, basin and global (Fig. 4). The basin scale is the one most frequently used by researchers (42). Next comes the global scale of analysis (36), either because the topic is approached in a general way, or because the article addresses several diverse regions or basins in one study. The regional scale (35) are those articles concerned with analyzing the link between water and peace in a region or between neighbouring countries, but that do not necessarily share a basin. Finally, the local scale (24) captures dynamics between communities or individuals within a country, whereas the national scale (11) reflects those studies that use the country unit as the level of analysis.

We coded the articles for the types of actors considered in the study, including public/ state actors, private-sector actors and civil society actors. The vast majority of the literature refers to a state actor (134), and in approximately one third of the literature, the state is the *only* actor concerned (57). Half of the scientific literature refers to at least one civil society actor (71) or private actors (58) in combination with others, but very few articles consider only civil society actors (7) or only private actors (1). All three actor categories together are only present in 20 of the articles.

3.2. Water and peace - deconstructing meanings and linkages

One of the objectives of the systematic review was to examine the different meanings of ‘peace’ in relation to water. Seminal definitions of

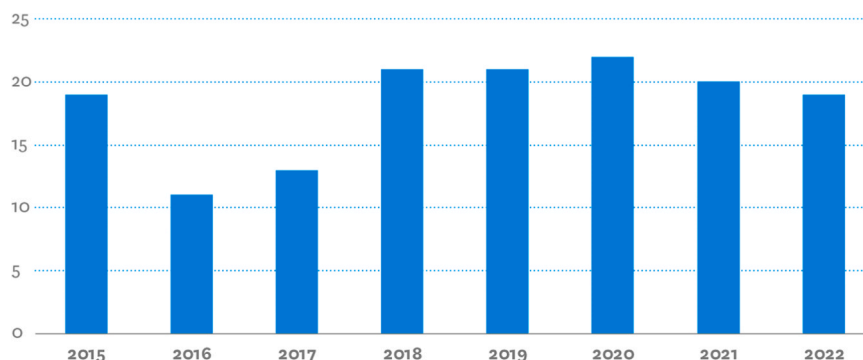


Fig. 2. Occurrence by year of articles on water and peace.

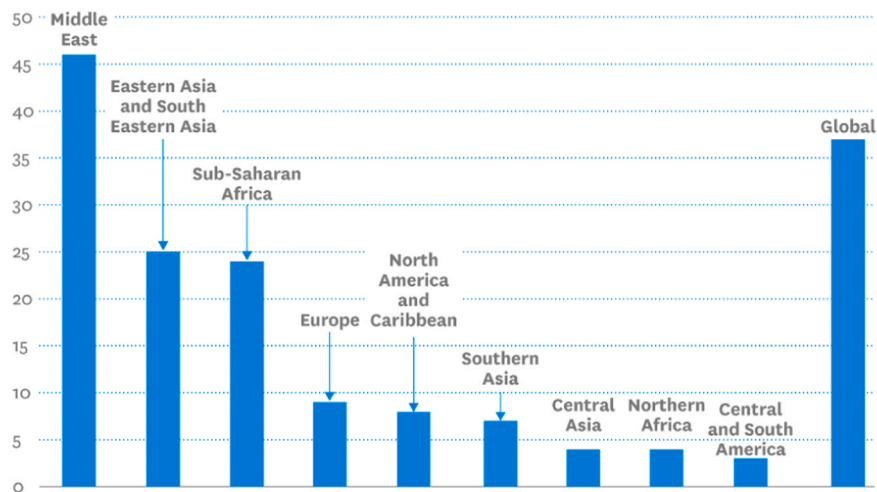


Fig. 3. Geographic distribution of the literature on water and peace.

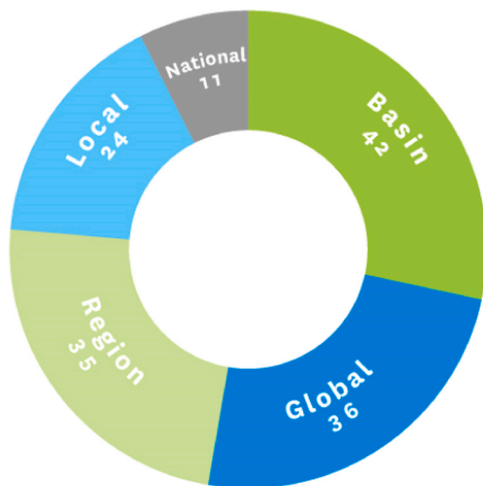


Fig. 4. Occurrence of scientific literature by scale of analysis.

peace come from the ‘Peace and Conflict Studies’ field, most commonly tracing back to Galtung’s notions of ‘negative peace’ as the cessation of war or physical violence, and ‘positive peace’ that goes further to emphasize social justice, equality, and the structural transformation of society to address the root causes of conflict (Galtung, 1969). Building on this, peace is widely understood to be an ongoing, dynamic process involving conflict management, reconciliation, and the cultivation of relationships at the individual, community, and societal levels (Lederach, 1997). Together, these perspectives frame peace not merely as a static state, but as a continuous effort toward justice, security, and sustainable coexistence.

To understand the use of the term peace used in relation to water, and as described in the methodology section, we undertook an inductive coding of the 148 articles in the database and categorized the various meanings of peace used, first by identifying whether the article provided an explicit definition, and then by grouping them according to the substance of the definition or the implied meaning (Fig. 5). Fig. 6 indicates the number of articles that fell into each category of the analysis, and Tables 2a and 2b provide examples of definitions directly from the articles for each category.

First and foremost, it should be noted that there is a lack of explicit theorization of peace in relation to water. Overall, most articles included in the review ($n = 97$) did *not* provide an explicit definition for peace, and those that have either explicit or implicit definitions vary widely in

their conceptualizations (Fig. 6). Many definitions were unique, and it was not possible to neatly classify them. While this poses a challenge for inductive research, we nonetheless aimed to capture this diversity while not forcing any articles’ peace notions into boxes.

For the articles that did provide an *explicit* definition ($n = 51$), many indeed used the well-established notion of positive peace (PP, $n = 9$), bringing attention to the need to address structural injustices, inequalities and barriers to water access. Others drew on closely related definitions of peace from the environmental peacebuilding field (EP, $n = 4$) where peace exists on a spectrum and where water can contribute to building resilient societies in post conflict settings. The term ‘sustainable peace’ (SP, $n = 4$) was proposed in some articles as a bridge between positive peace and the role of the environment in ensuring long term sustainability. Additional explicit definitions came from the synonyms used in the search of ‘harmony’ (HR, $n = 6$) and ‘reconciliation’ (RC, $n = 9$), with the former often reflecting Chinese scholarship on human–water harmony and the latter reflecting North American or Australian literature on reconciliation between Indigenous peoples and colonial governments.

Many of the other articles propose unique definitions for peace, as reflected in the ‘other’ category (Other, $n = 20$) to capture culturally specific or original conceptualizations (and that merit further investigation in future studies). These included often rich notions of peace such as “imperfect peace,” which emphasizes incremental steps toward peaceful environments and the fulfillment of basic human needs; “aesthetic peace,” referring to the splendour of uncontaminated water; and multidimensional definitions that combine several elements (See Table 2a for references).

Again, the majority of the articles in the database ($n = 97$, or 65 %) did not define peace explicitly but instead used it in a rather vague or aspirational sense. A substantial number of these ($n = 32$) used the term in a way that offered no clear analytical meaning. Within the remainder of articles, however, *implicit* definitions or meanings of peace could be identified and coded for. These implicit meanings include ‘inter-state cooperation’ (I-ISC, $n = 28$), reflecting the extensive literature on international water law, diplomacy, and governance, with a focus on cooperation and treaty-making; case-specific definitions (I-SPC, $n = 23$), tied to particular regional conflicts, settlements, or projects; and negative peace (I-NP, $n = 13$), where peace was not defined per se but was implicitly understood as limited to the cessation of violent conflict or demilitarization.

3.3. Direction of linkage between water and peace

In addition to the different definitions and meanings of peace used in

Mapping Definitions of Peace in Relation to Water

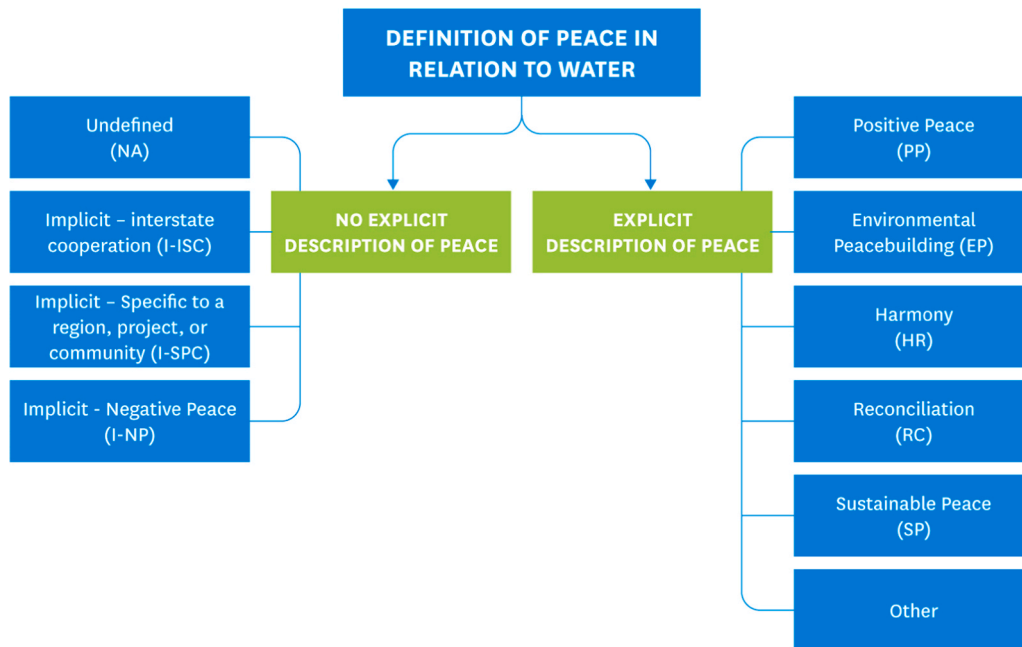


Fig. 5. Mapping the definitions of ‘peace’ in relation to water in the literature.

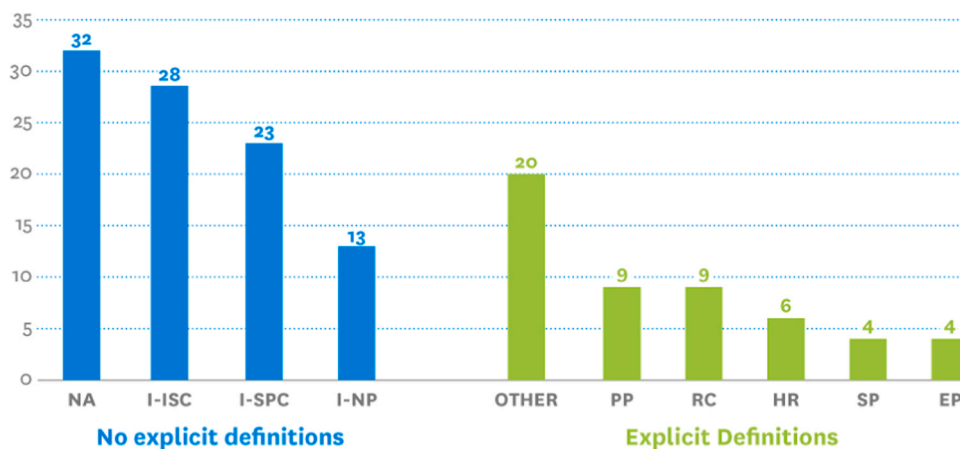


Fig. 6. Prevalence of peace definitions in the literature on water and peace.

the literature, we also coded the articles based on the direction of the relationship being described. Our database revealed at least four broad types of linkages between water and peace or their synonyms: positive, negative, reverse, and null. It must be recalled that our search terms only included *peace* and its synonyms and not *conflict* and related terms, so these results do not reflect any wider trends in the literature or in terms of evidence on whether water issues lead to peace or conflict.

In this review, focused on the *peace* dimension, most of the articles (n = 103) unsurprisingly show a positive directionality, whereby some water-related intervention leads to greater peace. An example is [Krampe et al. \(2021\)](#) who find that natural resource management, particularly through community participation, can reduce political fragility and bring peace in conflict-affected states. Another example is the review by [Johnson et al. \(2021\)](#) who find evidence that water management can support peace through enhancing livelihoods and by addressing the equitable distribution of resources. A large-n study by [Döring \(2020\)](#) of local cooperation-conflict dynamics found that cooperation is more likely in contexts where water resources are scarce, and in areas where

groundwater is difficult to access, with a history of violence. The study also finds that the relationship between water scarcity and water cooperation is conditional on levels of democracy. [Walschot \(2022\)](#) finds that where there is water scarcity, technology such as desalination can contribute to hydropolitical flexibility of the state and support inter-state peace, though actual outcomes will depend on broader geopolitics. These and other examples of a ‘positive’ direction of water leading to peace are further unpacked and described in the following section.

Despite using key words focused on peace and its synonyms only, a portion of articles (n = 20) nonetheless discuss a negative relationship between water and peace. For instance, [Dell’Angelo et al. \(2018\)](#) point out that while in *theory* virtual water trade might be understood to contribute to peace, in fact the hidden social and environmental costs for communities can lead to conflict. Similarly, a study by [Suazo \(2021\)](#) explains that in New Zealand an abundance of freshwater resources poses the theoretical possibility for sufficiency for all individuals and groups and thus for positive peace, however unchecked industrial

Table 2a
Explicit definitions and meanings of ‘peace’ (and synonyms) found in the systematic literature review.

Label	Examples of explicit definitions
Positive Peace (PP)	<p>Positive peace definitions tend to rely on Galtung’s (1969) seminal definition of positive peace: “the absence of structural violence and the prevalence of social justice in a society.”</p> <p>Positive peace is understood as preventing violence through structural and social justice reform that addresses the inequitable distribution of power and resources (e.g. Smith and Winterman, 2022; Krampe et al., 2021).</p> <p>The Positive Peace Index (PPI) covers “the elimination of indirect or structural forms of violence, such as racial discrimination, economic disparities, gender inequality, and lack of access to health services and education, among other structural conditions that inhibit people’s full potential” (Simangan et al., 2022).</p>
Environmental Peacebuilding (EP)	<p>Literature from the environmental peacebuilding field tends to reference the seminal peace definition by Conca (2002, p.9): “Peace can be thought of as a continuum ranging from the absence of violent conflict to the inconceivability of violent conflict” (e.g. Ide, 2019, 2017, Dresse et al., 2018).</p>
Harmony (HR)	<p>The concept of harmony focuses on the mutual adaptation processes among stakeholders, rather than one party adapting to others; Protected water systems and human development must be in a state of “balance” (Zuo et al., 2020); Restoring ‘balance’ between opposing camps (Batterbury et al., 2015).</p> <p>Balanced and cooperative relationship between human beings and water resources, harmonious coexistence, decommodification of water (Zuo et al., 2016; Zuo et al., 2020).</p>
Reconciliation (RC)	<p>“The use of reconciliation encompasses truth-telling and acknowledgment, coupled with restorative actions and empowerment of the peoples treated with injustice” (Bryan, 2021).</p> <p>“Integrative approaches between sciences and indigenous knowledge to transform relationship with water, for more equitable relationship to water for everyone” (Castleden et al., 2017).</p>
Sustainable Peace (SP)	<p>“Sustainable peace as an approach to not only facilitate good relationships between divided human communities, but also resolve the human-nature conflict” (Hwang, 2022).</p> <p>Combination of the traditional concept of peace with ecological aspects and the aim of achieving sustainable development in the affected region (Dietz, 2018).</p> <p>Sustainable peace to focus on peace agreements as both means to end violence and create resilient societies (Dam-de Jong, 2020).</p>
Unique definitions (Other)	<p>Peace in three dimensions: peace as the absence of conflict, peace as a symbolic rapprochement, peace as substantial integration of communities/ states in terms of institutions and/or trans societal (e.g., economic or civil society) links (Ide, 2019).</p> <p>‘Imperfect peace’ in which small-scale peaceful interactions and regulations (...) are acknowledged at multiple levels (...) Every small step made towards establishing a peaceful environment and helping humans fulfil their basic needs, even in a conflictive environment, (...) even if these small steps do not radically transform the conflictive nature of the relations between the actors (Kibaroglu and Sayan, 2021).</p> <p>“Aesthetic peace” defined as “preservation of the splendour of water sources, by way of non-contamination thereof, as well as inculcating habits that promote the overall outlook of their water sources” (Shoko and Naidu, 2018).</p> <p>“Wa” — a spirit of harmony, peace, and calm. The disparities between wealthy cities downstream and poor communities upstream threaten this “wa”, which is addressed through upstream downstream reciprocity (Cunningham, 2016).</p>

Table 2b
Implicit definitions and meanings of ‘peace’ (and synonyms) found in the systematic literature review.

Label	Examples of implicit definitions
Inter-state cooperation (I-ISC)	<p>Articles using ‘peace’ to imply cooperation between neighboring or riparian states (e.g. Pratap, 2018; Lee and Mitchell, 2019; Mirumachi, 2020), for instance through the signing of river agreements (Bobekova, 2015), or in terms of international law (Schmeier, 2021), in several cases related to Transboundary Peace Parks (Linell et al., 2019; Pouya et al., 2017).</p>
Case specific (I-SPC)	<p>“Peace water project” between Turkey and Cyprus referring to an underwater pipeline from Turkey to Cyprus reservoir (Hoffmann, 2018).</p> <p>Solving of the ‘Kurdish question’ through water, in part, to “bring irrigation-based agriculture to the region, facilitate its integration to the markets, bring a new and modern lifestyle, eliminating feudal and tribal relations therein, increase the overall living standards, remove regional disparities, and, thus, create a positive and peaceful atmosphere that would prevent future secessionist movements” (Bilgen, 2018).</p> <p>Social contract between the political regime and the people in which rules (and rule transgression) are exchanged for ‘peace’ – referring implicitly to the absence of violent protests and civil disobedience (Houdret and Amichi, 2022).</p>
Negative peace (NP)	<p>Articles using term ‘peace’ to imply the absence of war, inter-state conflict, inter communal violence, or social tensions (e.g. Sharifi et al., 2021).</p> <p>The cessation of hostilities and demobilization (Landry, 2015).</p> <p>Peace in the context of peaceful resolution of conflicts (Mogomotsi et al., 2020).</p>

farming and commercialization erodes this potential. In a different vein, Krampe (2017) explains that in post-conflict Kosovo, the overly technical framing of water in the peacebuilding processes clashed with political realities, leading to continuous tensions and impeding the peace process rather than supporting it.

In a small number of articles (n = 6) the direction of the linkage being described in the article is reversed, wherein a peace agreement (not necessarily related to water) has implications on water resources. For instance, the 2016 peace agreement between the government of Columbia and the Revolutionary Armed Forces (FARC) resulted in new dynamics in access and use of land and water, through which landless peasants actually lost water access and livelihood options (Betancur-Alarcon and Krause, 2020). In another example, the 2020 mediated peace negotiations between Armenia and Azerbaijan did not take water management issues into account, which had subsequent negative implications for drinking water and irrigation supply (Manukyan and Isayev, nd). From a more historical perspective, Landry (2015) describes how at the end of World Water II, the Treaty of Versailles had significant implications for water resources in Europe, specifically the need for Germany to develop its hydropower capacity.

Finally, in a subset of articles (n = 19), no discernable explanation or attempt to describe the linkage between water and peace is developed. In general, these articles mention peace in passing, focusing instead on water cooperation, diplomacy, multi-track processes etc. (e.g. Bobekova, 2015; Yasuda et al., 2020; Mirumachi, 2020). Other examples are articles that make general calls for more water and peace, for more policy integration of water adaptation and peace (Okpara et al., 2018) or more human water harmony (e.g. Zuo et al., 2016) without describing any specific linkage or directionality.

3.4. Seven water-to-peace pathways

The research question we set out to address is: what notions of *peace* exist in the literature in relation to freshwater, and what pathways of change are proposed to explain the relationship between water and

peace? In the previous sections, we responded to the first part of the question by mapping the different notions of peace, exploring definitions, developing a categorization of definitions, and exploring the direction of the linkage being described (positive, negative, reverse and null). We also mapped the ‘water and peace’ literature more generally, in terms of publications, journals, geography, and types of actors involved.

In this section, we turn our attention to unpacking the second part of the question, namely: what pathways of change emerge from the literature that connect water or a water-related intervention to some sort of peaceful outcome? To respond to this query, we focus on the sample of articles from the systematic review that revealed a positive association between water and peace ($n = 103$), and through an inductive coding and analysis of these cases, cluster them into seven potential pathways that indicate some of these potential mechanisms (Table 3).

The notion of pathways can be a useful heuristic tool and is used here to indicate and categorize the different means through which water or water related interventions can support peace or transitions to peace. Exploring this relationship through pathways allows us to condense complexity into different chains of relation, to demonstrate linkages, recognize the multiple pathways that can intervene or overlap, and to encourage creative solutions. Pathways are not, on the other hand, used here to describe causal chains or to make strong causal claims. In many of the articles, the relationship between water and peace is mediated by important intermediary variables such as geopolitics, level of democracy, and historical access (e.g. Walschot, 2022; Döring, 2020; Johnson et al., 2021). Moreover, if we have learned anything about water governance in past decades, it is that context matters, global paradigms rarely transfer well to local contexts, and that perverse or unintended impacts effects of interventions can exist (Meinzen-Dick, 2007; Ingram, 2013). Therefore, pathways should be interpreted neither as direct causal chains nor as independent from the broader political, social and environmental contexts in which the studies were conducted.

The pathways presented below provide insights on what water-peace relationships have been observed and documented in the literature. They also may provide specific variables that could give shape to a more cohesive and comparable literature on ‘water and peace’ moving forward. This seems particularly relevant and timely given that there have been several studies that outline ‘pathways’ linking water to conflict

particularly through climate change, environmental degradation and resource scarcity (e.g. Gleick and Iceland, 2018; Michel, 2020; Buhaug et al., 2023). On the other hand, there are few or no studies that compile the evidence on water for peace in a global and systematic manner and we propose this is also a value-added contribution regarding water-to-peace pathways.

The first pathway identified is the fundamental way in which water is required for healthy and dignified life. Authors discuss how taking steps towards meeting basic human needs and ensuring wellbeing can be an effective pathway to peace (Bruch et al., 2020; Kibaroglu and Sayan, 2021). Authors also mention the link between mental wellbeing and water security for peace (Mushavi et al., 2020). Walz (2020) proposes that focusing on the human right to water can be a long-term strategy for conflict resolution and peace, when there are established mechanisms for monitoring; however, the challenges of implementation and ensuring civil society participation at the national level impedes progress. In a similar vein some, authors highlight the essential link between water and socio-economic development (Beck, 2015), with livelihood security (Bruch et al., 2020) and capabilities (Johnson et al., 2021) that contribute to human well-being.

Related to this, the second pathway refers broadly to the ‘services provision’ hypothesis, which proposes that through the provision public services, particularly in conflict and post-conflict settings, the instrumental needs of communities are addressed, and therefore their belief in, and legitimacy of, the state increases, which can support peace (or at a minimum reduce rioting and protests) (Krampe et al., 2021). More specifically, through the provision of reliable water services, the state can build and maintain its legitimacy, signify a ‘state of normalcy’, and support peaceful relationships. Bilgen (2018) explains how the Turkish state has used irrigation projects to build their legitimacy and try and resolve conflicts. Similarly, Houdret and Amichi (2022) describe how in Morocco and Algeria, the state finances ‘social peace’ through rural subsidies for water and land access but note that this is not sustainable in the long term due to the environmental devastation it engenders. Kooy et al. (2015) argue that the way in which water and sanitation services are delivered (actors, processes etc.) is more important than the delivery of those services *per se* for peacebuilding, and they identify specific mediating factors that influence outcomes.

The third pathway refers to the diffusion of international norms, meaning the spread of ideas, practices and values in water governance that can support human empowerment and strengthen civil society (Krampe et al., 2021). Examples are norms such as human rights, enforcing access to water and sanitation (WASH), participation, gender mainstreaming, and the need to tackle inequalities and discrimination. Döring (2020) argues that the effectiveness of water norms in fostering cooperation depends on the broader political and social conditions, such as the level of democracy within a state; democratic systems are often better equipped to internalize these norms, as they provide channels for public participation and accountability. In contrast, more authoritarian regimes may resist the diffusion of external norms, viewing them as a threat to domestic sovereignty. Orlando (2015) discusses the role of transboundary civil society linkages in spreading water governance norms and building regional integration for peace. Mirumachi (2020) describe the role of informal water diplomacy in sharing knowledge and ideas over shared rivers.

Fourth, several articles focus on the value of involving local communities in water interventions to foster peace (e.g. Krampe et al., 2021; Sabin et al., 2019; Orlando, 2015). Local-level water diplomacy is thought to promote intercultural understanding (Farnum, 2018), and intergroup cooperation can reduce bias and prejudice (Krampe et al., 2021). Some argue that when water issues are dealt with at the local level, using local institutions (including customary regulations) to create spaces for the collective resolution of conflict, it can foster peace (Shoko and Naidu, 2020). Some authors refer to the value of the ‘localization’ of cross border management as a way of doing so (Altingoz and Ali, 2019).

Fifth, authors propose that shared interdependency on biophysical

Table 3
Seven possible water-to-peace pathways.

Water-to-Peace Pathway	Subset of relevant articles
1. Ensuring basic health, wellbeing and livelihoods	Mushavi et al., (2020); Walz, (2020); Kibaroglu and Sayan, 2021; Bruch et al., (2020); Beck, (2015); Johnson et al., (2021)
2. Building state legitimacy	Krampe et al., (2021); Houdret and Amichi, 2022; Bilgen, (2018); Kooy et al., (2015)
3. Diffusing international norms	Krampe et al., (2021); Orlando, (2015); Döring, (2020); Mirumachi, (2020)
4. Involving local community participation and using local institutions for conflict resolution	Krampe et al., (2021); Sabin et al., (2019); Shoko and Naidu, (2020); Altingoz and Ali, (2019); Orlando, (2015); Altingoz and Ali, 2019; Famum, (2018)
5. Leveraging shared dependence to build trust, dialogue and justice	Beck, (2015); Johnson et al., (2021); Dresse et al. (2018); Dam de Jong, 2020; Bryan, (2021); Castleden et al., (2017); Bruch et al., (2020)
6. Developing and using of shared international water institutions	Ide and Detges, (2018); Schmeier, (2021); Vishwanath et al., (2015); Ide, 2018; Smith and Winterman, (2022); Venturi, (2020); Tignino and Kebebew, 2022; Cosens et al., (2018)
7. Leveraging material (economic) and symbolic benefits of joint projects	Frey, (2020); Cunningham, (2016); Salmoral et al., (2019); Waxman et al., (2015); Huda and Ali, (2018)

systems, such as water, make it a potentially effective entry point for dialogue, trust building and justice (e.g. [Dresse et al., 2018](#); [Johnson et al., 2021](#)). [Beck \(2015\)](#) refers to the potential of water in post-conflict reconciliation to be harnessed to build trust, confidence and cooperation between groups and between states, giving the example of river basin authorities as a platform for dialogue. The search term ‘reconciliation’ brings up references to ongoing water justice processes, such as in Canada and Australia, where reconciliation between colonial governments and aboriginal populations have focused on the topic of water, and sometimes on combining western and indigenous knowledge to address past injustices ([Bryan, 2021](#); [Castleden et al., 2017](#)). In a similar vein, [Dam de Jong \(2020\)](#) and [Bruch et al. \(2020\)](#) each make a case for strong environmental provisions in peace agreements, to restore the resource base, redistribute access fairly, and address future hydrological extremes such as floods and droughts that will pose a particular challenge for fragile states. Although not included in this review, recent research by [Magalhaes Teixeira \(2024\)](#) robustly demonstrates that the natural resources, particularly their *distribution*, is essential to understanding the structural conditions allowing for both conflict and peace in society.

The sixth pathway is the role of building *and* using a shared institutional regime for water cooperation. This pathway was supported by many articles in the review as a way to foster more peaceful riparian relationships ([Schmeier, 2021](#); [Smith and Winterman, 2022](#); [Venturi, 2020](#); [Ide, 2018](#); [Vishwanath et al., 2015](#); [Tignino & Kebebew, 2018](#)). In particular, the way that international water law principles can provide a framework for negotiations and also be a focus of the negotiations themselves ([Schmeier, 2021](#); [Tignino & Kebebew, 2018](#)) and the law-making function which can serve both *ex-ante* to design good institutions and *ex-poste* to judge cases ([Schmeier, 2021](#)). Some authors discuss specific design features of treaties that can promote peace, such as information exchange, enforcement measures and monitoring ([Mitchell et al., 2015](#)). Others highlight the value of multilateral platforms, third parties ([Smith and Winterman, 2022](#); [Grech-Madin et al., 2018](#)), river basin organizations ([Mitchell et al., 2015](#)), and bridging organizations ([Cosens et al., 2018](#)). [Kibaroglu and Sayan \(2021\)](#) argues that even without comprehensive treaties, there can still be joint mechanisms or Memoranda of Understanding (MoUs) for specific aspects of water governance that result in a sort of ‘imperfect peace’ that is partial but pragmatic. Others emphasized trust, identity-building and participation that can come with building institutions ([Ide, 2018](#)) or focus on how policies and laws are implemented – advocating for implementing water policies collaboratively can be linked with more peaceful outcomes ([Shoko and Naidu, 2018](#)).

Finally, there is a pathway related to the material and symbolic benefits that can come from shared or joint water projects, which in turn can foster improved riparian relations. Technical projects such as water-energy/ water-energy-food nexus projects, or desalination and hydro-power infrastructures can sometimes lead to greater efficiencies through multipurpose water use, or through introducing new unconventional water sources, in a way that can support inter-state peace ([Waxman et al., 2015](#); [Huda and Ali, 2018](#)). In some contexts, the water-energy nexus can lead to shared commerce or economic opportunities, and therefore entry points for improved relations or communications ([Salmoral et al., 2019](#)). Moreover, the *symbolism* of joint projects can sometimes be just as significant as the benefits themselves for peace. Shared hydraulic infrastructure, for instance, can provide symbolic cooperation, which in turn can facilitate greater cooperation between riparian states even if limited to a specific sector or sub-region ([Frey, 2020](#)). Similarly, at a more local level, water sharing in a basin has both material and symbolic implications, and exchanges between upstream-downstream users of culturally meaningful sentiments of reciprocity can support more harmonious relationships ([Cunningham, 2016](#)).

As presented in the preceding Results section, definitions of peace found in the articles included in this SLR varied extensively. Some were

explicit and drew from the language of positive peace, reconciliation and harmony, while in most articles peace was not explicitly defined but could nonetheless be inferred as relating to interstate cooperation, project-specific peace arrangements or negative peace, for example. The seven water-to-peace pathways (and the articles that support them) necessarily also represent a broad spectrum of how ‘peace’ is conceptualized as an outcome. Some preliminary trends emerging from the analysis suggest that pathways related to health, livelihoods, and international norms (Pathways 1 and 3) tend to define peace and the presence of conditions needed for humans to thrive, such as basic sanitation and water access, dignity and human rights – characteristics of positive peace definitions. Pathway 2 on state legitimacy touches on some of these notions of positive peace, but in certain cases is limited to negative peace by focusing on the ways in which reliable service provision can prevent violent protest and reactions in conflict and post-conflict settings. Pathway 4 and 5 on local community participation, use of local institutions and building trust and dialogue relate mostly to definitions of peace emphasizing reconciliation, harmony, and post conflict dynamics, with peace ranging on a spectrum from the absence of violence to the inconceivability of violence. Finally, Pathways 6 and 7 have clear connotations (through often implicit) to interstate cooperation through the development of shared institutions (e.g. water treaty with conflict resolution mechanisms) and joint projects with material and symbolic benefits (e.g. shared dam). Future research can further refine and unpack these categories further, which brings us to the final discussion and concluding remarks.

4. Discussion and conclusion

Whereas research spanning the water conflict-cooperation spectrum is extensive, with many academics, NGOs and think tanks dedicating extensive resources to theorizing, predicting, and anticipating the next water conflict ‘hotspots,’ there has been significantly less attention on water and *peace* – both in terms of theorizing, empirical studies and meta-analysis. To address this gap, this SLR assessed 148 articles written between 2015 and 2022, eight years marked by key policy initiatives, high-level political debates, and the consolidation of several research centers focused on this topic. The contributions of the article have been to (de)construct the different meanings and definitions of peace used in relation to water in the literature, and to propose seven water-to-peace pathways through an inductive analysis of the articles reviewed.

In this final section, we bring together some general observations on the literature on water and peace, and offer some additional avenues for future research.

Firstly, although our systematic review search terms explicitly excluded terms “agreement”, “cooperation” and “treaty” in order to move away from the more established water *cooperation* literature, it is interesting to note that, in terms of volume, much of the research linking water and peace continues to draw primarily from the literature on institutional water cooperation and international water law (Pathway 6 above). This might reflect the fact it is relatively straightforward to study the presence and content of water agreements, whereas broader ‘positive peace’ outcomes exist along a broad spectrum ranging from the absence of violent conflict to the realization of equitable and sustainable governance at nested scales. There is clearly an established and active scholarly community employing the shared language of international water law that has succeeded in building a substantial body of knowledge. However, there remains significant space and need for additional empirical evidence across the other pathways identified in this article.

Secondly, and related to the first point, is that much of the literature on water and peace focuses on the inter-state level, reflecting this wider trend of studying water cooperation as the presence of international treaties or basin agreements. Some authors argue this focus is to the detriment of better understanding more local level cooperation-conflict dynamics ([Döring, 2020](#); [Grech-Madin et al., 2018](#)). In addition, there are calls to question the very use of specific spatial and temporal scales,

and what these choices imply for the actors and issues are being included and/or marginalized in the analysis scales of reference (Ide, 2017). To address this, some authors suggest that water-peace research would benefit from more explicit engagement with Peace and Conflict Studies in order to bring in other scales of analysis and better address politics (Döring et al., 2024; Grech-Madin et al., 2018). In terms of methodological approaches there are call for more ethnographic research, more inventorying of norms, and the disaggregation of geospatial data for understanding local dynamics (Grech-Madin et al., 2018; Ide and Fröhlich, 2015). We concur that future research must continue to capture critical issues of power, politics and scale – using diverse methods – in the study of water and peace (Mirumachi, 2015; Barua and Vij, 2018; Döring and Swain, 2024).

Third, the current discourse is led by primarily Western research communities and could benefit from expanding to diverse contexts and alternative understandings of social reality. For instance, the concept of human-water ‘harmony’, coming mostly from Chinese scholars, asserts that harmony requires a coordination system linking the natural water system to the human system, and that both the human system and water system components need to be in a healthy, developed and balanced state (Zuo et al., 2020a; Zuo et al., 2020). In Japan, “wa” refers to a spirit of harmony, peace, and calm; the disparities created between wealthy cities downstream and poor upstream communities upstream threaten this “wa”, which can be redressed through upstream-downstream reciprocity (Cunningham, 2016). These and other non-Western concepts could offer valuable insights into water and peace from different cultures and perspectives.

Finally, as outlined in the previous section, our analysis found the literature to be highly dispersed and without a clear disciplinary home base. This indicates interest from a wide audience and range of scientific disciplines, but also poses a challenge for building up robust and empirically-grounded research and evidence-based policies on how water interventions can contribute to more peaceful relations and societies. The many different epistemic communities and research clusters engaged with these topics suggests that there could be value in compiling a more cohesive body of knowledge moving forward, using shared terms and testing different intermediate factors and variables. For this, we propose two directions: 1) researchers should continue to use clear definitions of peace, with particular promise in building on the existing use of ‘positive peace’ in relation to water, given its emphasis on root causes and structural aspects of inequitable water access; 2) researchers should test the seven water-to-peace pathways with new empirical cases and data, and reflect on the role of supportive and hindering intermediary factors.

In conclusion, we propose that the seven water-to-peace pathways identified in this article may help structure future research and support shared terminology and understandings across epistemic communities moving forward. The pathways are neither guaranteed causal relationships, nor can they be removed from their social, political and environmental contexts. Nonetheless there are clear clusters of mechanisms identified here that can provide future research avenues or entry points to better grasp empirical realities of the complex relationship between water and peace. Furthermore, if policy makers and advocacy groups are to continue advancing the message of water for peace, leveraging the water-to-peace pathways may bring further precision to policy choices, their intended impacts, all while appreciating how the wider context might influence results.

CRedit authorship contribution statement

Sumit Vij: Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Christian Bréthaut:** Writing – review & editing, Supervision, Resources, Investigation, Conceptualization. **Laura Turley:** Writing – original draft, Project administration, Investigation, Formal analysis, Data curation, Conceptualization. **Quentin Parent:** Validation, Data curation. **Muscas Irene:**

Validation, Formal analysis, Data curation. **Aline Wambüi Stüdeli:** Validation, Formal analysis, Data curation.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2025.104270.

Data availability

Data will be made available on request.

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