



Decolonising hydrology: Reflecting on positionalities for sustainable and just futures

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ABSTRACT

Colonialism continues to have an enduring impact on hydrological research, practice, and education. This paper examines the colonial legacy in hydrology and highlights the need for decolonisation to achieve justice, inclusivity, and sustainability in water management. Through tracing the development of hydrology research and examining stories from Canada, Indonesia, India, West Asia, and Africa, the paper uncovers the different ways colonial-era policies that have shaped contemporary water challenges. Findings indicate that colonial hydrological practices have led to significant ecological and social impacts, disrupted Indigenous knowledge systems, and intensified transboundary water conflicts. We advocate for considering, when desired by communities, place-based and Indigenous knowledge into the sciences, practices, and outputs of hydrology, revisiting ownership practices, and addressing neo-colonial influences through co-creation and inclusive learning. By reflecting on our colonial past, we propose pathways through reflective questions and a decision tree to guide future water knowledge generation and support local water management.

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1. Introduction

Hydrology, the study of water in the Earth system, and hydraulics, the applied engineering of water flows and structures, are distinct yet deeply interconnected fields. Both trace their roots to early water management practices, from irrigation canals to qanats in civilisations such as Mesopotamia, Egypt, Persia, and China, and continue to evolve through modern methodologies such as rainfall–runoff modelling, groundwater simulation, and remote sensing, shaping global water management and education (Johnston, 2003; Sarisen et al., 2022). Yet, the trajectory of this evolution has not been neutral. While hydraulics as infrastructure was central to colonial control through dams, canals, and irrigation schemes (Mathur and Mulwafu, 2018), this paper focuses on hydrology as a scientific discipline and its entanglement with colonial and neo-colonial power structures.

During the past centuries, water science and infrastructure were often deployed to serve colonial interests, giving rise to what has been termed “colonial hydrology” (D’Souza, 2006; Van Stan and Simmons, 2024); see and in relation to Climate Change, (Sultana, 2024). Colonial water-related initiatives were not neutral technical enterprises but instruments of rule. Mapping rivers, channelising flows, and constructing irrigation and flood-control works enabled extraction, settlement, and the disciplining of labour while legitimising state presence on appropriated land. Whether framed as hydrology or hydraulics, the technical vocabulary served to naturalise administrative authority, translate diverse waterscapes into governable units, shaped by colonial backgrounds that privileged Western epistemologies and marginalising Indigenous and local knowledge systems. These interventions reordered access and priorities, privileging colonial cropping systems, mining, and urbanisation, while embedding racialised hierarchies into everyday infrastructure. Such legacies remain visible in modern capitalism and neoliberalism or so-called neo-colonialism (see, e.g., (Achterhuis et al., 2010; Underhill et al., 2023; Boelens et al., 2019; Menga, 2025)). The development of technical standards, such as standards for dam building in the early 20th century (Strube and Thomas, 2021), further consolidated epistemic authority, making colonial water knowledge appear universal and self-evident. What emerges, therefore, is not simply a debate between subfields but a colonial regime of water science whose legacies rule how water is allocated, hazards are borne, and governance is conducted.

Water governance and environmental management are inherently political processes, shaped by colonial histories and power dynamics that continue to dictate how water resources are distributed and controlled (Whaley, 2022). This becomes particularly critical when realising that hydrological research significantly shapes transboundary water diplomacy through the production of data, models, and expert assessments that underpin river-basin treaties and negotiations (Nagheeb et al., 2025). Such scientific outputs influence how states and international agencies (including academics) define problems, allocate flows, and frame cooperation and conflict over shared waters, which constitute approximately 60 % of the world’s freshwater resources (Nagheeb and Amezaga, 2023). These actors, in turn, embed agendas and hierarchies that privilege certain knowledge and silence others, resulting in the dispossession of Indigenous peoples’ water rights under colonial rule to the persistence of colonial practices (e.g., parachute science) (see (Hart et al., 2021); (Tozzi et al., 2022)).

Importantly, colonial powers such as France, Britain, and the Netherlands even created specialist higher education institutions to train engineers and geoscientists for service in their (former) colonies like India and Indonesia (Ruddell and Wagener, 2015; Talling, 2004; Ward, 1979). In France, for example, the Société Française des Ingénieurs Coloniaux (1895) and the École Spéciale des Travaux Publics (1898) were established explicitly to prepare engineers for overseas work, teaching them to adapt metropolitan engineering knowledge to colonial conditions such as unfamiliar climates, geographies, and workforces. These institutions reinforced imperial control over water

through the alignment of education, finance, and infrastructure projects, embedding the idea that railways, ports, and irrigation schemes were instruments of domination as much as of development (Vacher, 1999). Hydrological science has historically privileged Western technocratic approaches, devaluing community-driven, socio-ecological understandings of water (see, among many, (Linton, 2008; Boelens et al., 2019)). These dynamics illustrate why hydrology, as a scientific discipline, must be critically re-examined through a decolonial lens.

Recognising this, we understand decolonisation as the historical and ongoing struggle through which the oppressed becomes “independent, recognised, respected, particular and conscious” (Van Amstel, 2023), p.69; see also (Nagheeb et al., 2025). In hydrology, this involves confronting entrenched inequalities, opening space for diverse knowledge systems, and challenging neo-colonial practices that shape both research and education. We use *decolonial principles* to refer to efforts that challenge dominant technical paradigms, centre ethics and justice, and foster participatory knowledge co-production across different contexts (Boelens et al., 2018; Nagheeb et al., 2025). Although the ecological and social consequences of colonial governance are increasingly documented, explicit discussions on decolonising hydrology remain limited (Tozzi et al., 2022). A decolonial approach requires challenging entrenched technical paradigms, incorporating Indigenous and local water management practices, and redefining hydrology education to centre ethics, socio-political, and ecological justice (Acharibasam et al., 2024; Johnston, 2003). Through this paper, we aim to shed light on this critical yet often overlooked topic, acknowledging that for some, it may seem unfamiliar, but it represents a daily struggle deeply rooted in lived realities.

Recent agendas of decolonisation in environmental studies (Gibbs, 2009; Hartwig et al., 2022; Taylor et al., 2020) and global frameworks such as the Sustainable Development Goals (Fund, 2015; Mdee et al., 2024) provide opportunities to reflect on their implications for hydrology (Mathur and Mulwafu, 2018). The current hydrological agendas, such as UNESCO’s Intergovernmental Hydrological Programme and the International Association of Hydrological Sciences (IAHS) HELPING (Hydrology Engaging Local People IN one Global world) Science for Solutions Decade (2023–2032), emphasise co-production of knowledge, inclusive governance, promoting global south participations, and localised solutions. For readers unfamiliar, IAHS “scientific decades” are ten-year global research initiatives designed to set hydrological priorities; however, these societies – even unintentionally – have historically privileged Western paradigms and risk perpetuating neo-colonial dynamics if they fail to critically engage with decolonial principles (Arheimer et al., 2024; Castelli et al., 2025). By co-examining decolonisation efforts within this wider discourse, this paper examines how global and regional initiatives can meaningfully engage with decolonisation efforts in both research and education.

We conducted a documentary analysis complemented by bibliometric methods to examine how decolonisation can shape hydrological knowledge and systematically analyse the progress of hydrology as a research field since its formalisation (cf. (Rosbjerg and Rodda, 2019)). This analysis allows us to trace the development of hydrological research and education and to assess how these have evolved within the broader decolonisation discourse as a starting point in this paper. We then explore the role of research-informed education in shaping hydrological knowledge across different regions, identifying both barriers and facilitators to integrating pluralistic perspectives in hydrological curricula.

We present five case studies from India, Canada, West Africa, Indonesia, and West Asia (or in colonial language, the “Middle East”) to ground these discussions in practice. Each case offers insight into diverse regional contexts and how decolonisation pathways are being navigated in hydrological research and education. The five case studies deliberately span the 18th to 21st centuries, illustrating how long-standing infrastructural and epistemic choices continue to shape current water governance. The key takeaways from these stories, along with the

limitations of this analysis, are summarised by reflecting on infrastructure settings, specificities, Indigenisation opportunities, unconscious biases, and the ongoing struggle of neo-colonialism and decolonisation.

We work across several, partly overlapping layered temporal framework that trace the evolution of hydrology and its enmeshments. (i) The disciplinary history of hydrology: from late 19th to early 20th century institutional foundations (e.g., IAHS founded in 1922) to the present. (ii) Bibliometric corpus and keyword-trend analysis (1941–2023) for decadal counts (Fig. 3 and Fig. 5 respectively), reflecting Scopus coverage and the reliability of abstracts/keyword. (iii) Decolonisation scholarship discussed (1970–2025) with acceleration post-2000, and finally, (iv) Case studies with context-specific historical arcs from the 1700s to the 2020s, to capture how colonial and neo-colonial dynamics unfolded locally. These horizons are used intentionally: the institutional history of hydrology begins earlier than the searchable, keyword-based bibliometric record while case narratives reach further back to illuminate path-dependencies established under colonial rule.

Through an examination of knowledge production, communication, and practice, this paper seeks to contribute to the creation of more just, inclusive, and sustainable hydrological futures. By aligning with the IAHS's HELPING agenda, we highlight how hydrology can move beyond technical solutions to engage meaningfully with Indigenous and local knowledges, ensuring that water management strategies are both culturally resonant and socially just. The empirical evidence and theoretical arguments presented here help undo ongoing inequitable systems stemming from colonial histories, including unsustainable resource extraction and the systemic exclusion of equity-deserving communities from water governance.

Finally, while we engage with decolonial perspectives in this paper, we do not claim neutrality or detachment; rather, we recognise our positions as diversely identified beneficiaries within systems where certain ways of knowing have been privileged over others. Our collective work aims to critically examine these structures while centring knowledge systems that have long been dismissed or excluded. This approach reflects an ongoing effort to challenge the hierarchies embedded in hydrological research and education. Fig. 1 provides the analytical framework that guides our examination of colonial influences across the four interconnected dimensions of historical, structural, epistemic, and ethical practice. In organising these considerations into a cyclical process, the figure illustrates how past legacies, institutional arrangements, knowledge hierarchies, and moral responsibilities shape contemporary hydrology. We use this framework throughout the paper to interpret the five case studies and to ground our reflections on decolonising hydrological research and education.

2. Methods

This paper brings together a diverse group of researchers to co-create a series of case studies and a guiding framework involved a structured yet flexible collaborative process. Through this process, participants collectively refine research questions, identify relevant empirical or theoretical inputs, and jointly analyse the outcomes (Snyder, 2019). While *co-production* is more commonly rooted in the sustainable development literature (e.g., (Norström et al., 2020)), we argue that our approach is more accurately positioned within the realm of *co-creation*. Following Brandsen and Honingh's (Brandsen and Honingh, 2018) distinction between both approaches—where *co-production* involves participants mainly during the delivery or implementation stage and *co-creation* emphasises collaboration from the early, strategic phases such as planning and design—our collaborative process is characterised by iterative interactions that began at the very inception of the project. Furthermore, *co-production* may at times follow more hierarchical structures with uneven stakeholder influence, whereas *co-creation* emphasises equal and inclusive partnership, fostering deeper engagement and greater potential for innovation (Bandola-Gill et al., 2023; Castelli

et al., 2025).

In terms of the writing process, we follow a collaborative approach, which is validated as a robust methodological approach for transdisciplinary, post-humanist research. This approach reduces hierarchical power dynamics, embraces diverse forms of knowledge, and generates emergent meanings through collective, inclusive, and synchronous writing processes (Cranham et al., 2024; Diversi et al., 2021). Our co-creation process is summarised in Fig. 2. First, the Decolonisation Working Group of the IAHS convened an interdisciplinary team that articulated a shared focus—advancing hydrological practices via provision of tools to support decolonisation—through iterative dialogue, agenda-setting, and monthly online meetings. Next, we conducted a bibliometric analysis, focusing on the development of hydrology research since the 1970s and exploring scholarship on the decolonisation of hydrology. The findings informed our next steps in developing detailed case studies that reflect geographically diverse and discipline-specific methodologies, contextual challenges, and insights, as recommended by mixed-methods scholars (Creswell and Plano Clark, 2018). We then co-authored an integrative review that situates these cases within a broader theoretical framework, allowing for triangulation of findings, identification of key themes and needs, and the formulation of prescriptive recommendations for practice (Patton, 2015). The review and framework were co-presented during the online IAHS HELPING Conference for feedback in November 2024, leading to additional authors co-writing and contributing to the manuscript. Finally, this co-creation approach culminated in a collaboratively authored framework that not only synthesises knowledge across the authorship team's disciplines but also offers a template for other hydrological scientists, researchers, and collaborators to critically reflect on and adapt their practice in diverse environmental contexts.

2.1. Bibliographic analysis

To understand the development of hydrological research, we conducted a bibliographic analysis by focusing on articles published in the top ten hydrology and water resources journals indexed in the Scopus database (Fig. 3). The journal ranking was based on the h5-index values.¹ The article search encompasses works published from the earliest records in the 1970s up to August 2023, the time of analysis. This search yielded 77,764 documents. To ensure manageable data handling, data related to abstracts and keywords were downloaded by decade, from 1941 to 1980–2021–2023. There was only one article in the 1940s, and most hydrology journals started in the 1960s. We grouped the early research data as 1941–1980.

We acknowledge the limitations of focusing exclusively on the top 10 hydrology journals indexed in Scopus, as this selection may reinforce bias towards the historical and ongoing dominance of Western institutions in academic publishing, overlooking valuable contributions from non-Western scholars and Indigenous knowledge systems. However, focusing on these journals enables the tracking of mainstream research trends over time. Nonetheless, we remain reflective in our approach and interpretation and we encourage future work to incorporate a broader range of sources to better capture diverse epistemologies and regional perspectives in hydrological research.

An additional literature search was conducted to explore the body of work within the hydrology decolonisation scholarship. Following the scoping review methodology (Arksey and O'Malley, 2005), a search on Scopus using the query string (TITLE-ABS-KEY (decolon*) AND

¹ We used the h5-index as the metric for ranking journals, which is available in the Scopus database. The h-index of a publication is defined as the largest number h such that at least h articles in that publication have each been cited at least h times. The h5-index applies this concept to articles published within the last five complete calendar years. It helps identify recent influential work and trends in a field.

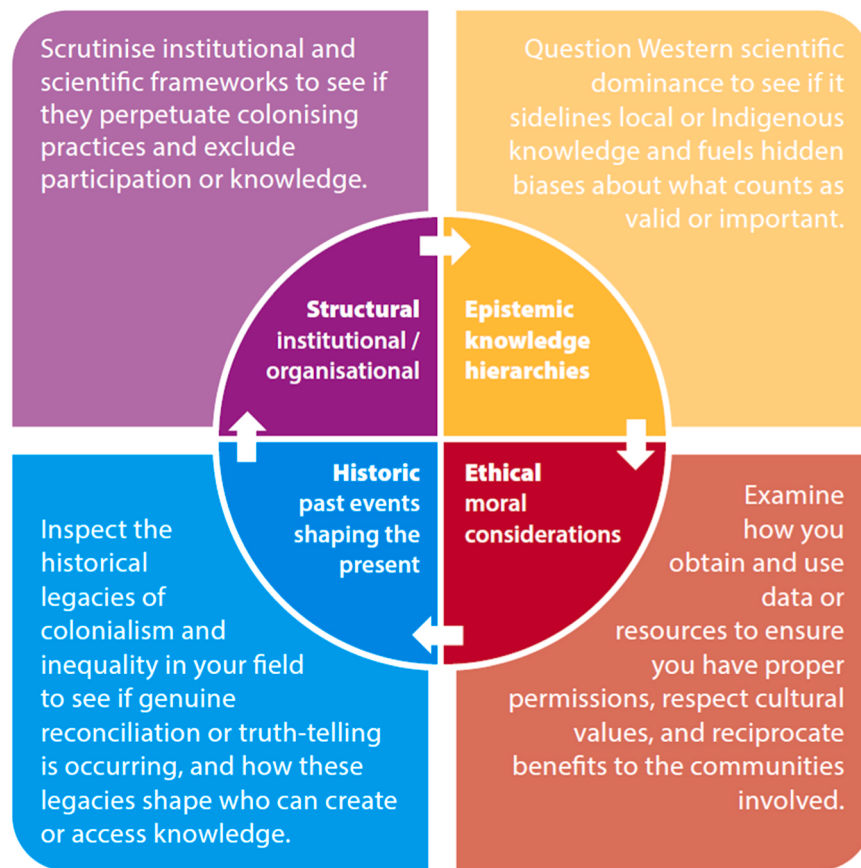


Fig. 1. The guiding framework used to: inspect the historical; scrutinise the structural; questions the epistemic; and examine the ethical dimensions of the case studies (evolved from (Clancey, 1997); (Fox, 2016); (Yang, 2024)).

TITLE-ABS-KEY (hydrol*) returned 23 publications. However, 13 of these publications were related to colonisation and hydrolysis of bacteria, rather than hydrology and decolonisation. From the remaining 10 publications, seven full articles, two books, and one abstract were reviewed. In addition, two journal articles related to *Decolonising Social Work: From Theory to Transformative Practice* (Kleibl et al., 2024) and *Decolonising Water—Decolonising Personhood—Decolonising Knowledge: A Tlingit and Tagish Perspective* (Hayman et al., 2021), which are included in the Scopus results, were reviewed. Findings from this literature search are discussed in the following section.

3. Our hydrological past and present

3.1. Research and education in hydrology during the colonial and postcolonial era

In the 20th century, the decolonisation movement begun with power transfer from European nations to their former colonies. Key milestones include the independence of the India and Pakistan from Britain in 1947, Indonesia from the Netherlands in 1945 and Sudan and Ghana from Britain in 1956 and 1957 (Ward, 2016). However, while decolonisation in Asia proceeded rapidly after World War II, in Africa, colonial powers reconfigured colonialism as development, including through the field of hydrology (Koponen, 2016). Hydrology research accelerated due to colonial powers' growing awareness of the importance of water resources as population growth and industrialisation in postcolonial regions increased pressures on water systems and availability (Fig. 4). Challenges of water scarcity, driven by increased demand, drought, and water pollution, heightened the need for effective water resource management. The development of new technologies for environmental monitoring and data collection, such as automatic and remote sensing

and geographic information systems, enabled large-scale data collection and analysis. Additionally, increased computational power allowed for the development of complex numerical and computational models to understand processes and predict hydrological hazards, including floods and droughts.

Hydrology as an academic field thus took form in a colonial context after World War II. Of the five scientists credited by McCulloch (McCulloch, 2022) with establishing hydrology on a firm basis in the United Kingdom in the 1960s and 1970s (Howard Penman, Charles Pereira, Jim McCulloch, John Moneith, and Donald Maclean), Pereira and McCulloch spent much of the 1950s and 1960s in British colonies in East and Central Africa, especially at the East African Agriculture and Forestry Research Organisation headquarters at Muguga near Nairobi, which opened in 1952 (now the Kenya Agricultural Research Institute) (McCulloch, 2022). This transition from conducting research in colonised territories to returning to university research and teaching in Europe after independence matches larger patterns across research disciplines in the 1960s, especially pertaining to fields related to natural resources (Hodge, 2010).

This colonial legacy continued to shape hydrology even after decolonisation gained momentum, with the adoption of United Nations General Assembly Resolution 1514 in December 1960 and the independence of many African territories by 1965. This year was also the beginning of the International Hydrologic Decade (1965–1975), launched under the auspices of UNESCO and the International Association of Scientific Hydrology (now known as the International Association of Hydrological Sciences). The Decade was a global effort to promote research and cooperation in hydrology. It differentiated between specific research programmes in North America and Europe and those in low- and middle-income countries. In the former, the emphasis was on sophisticated projects, while in poorer nations, the focus was on

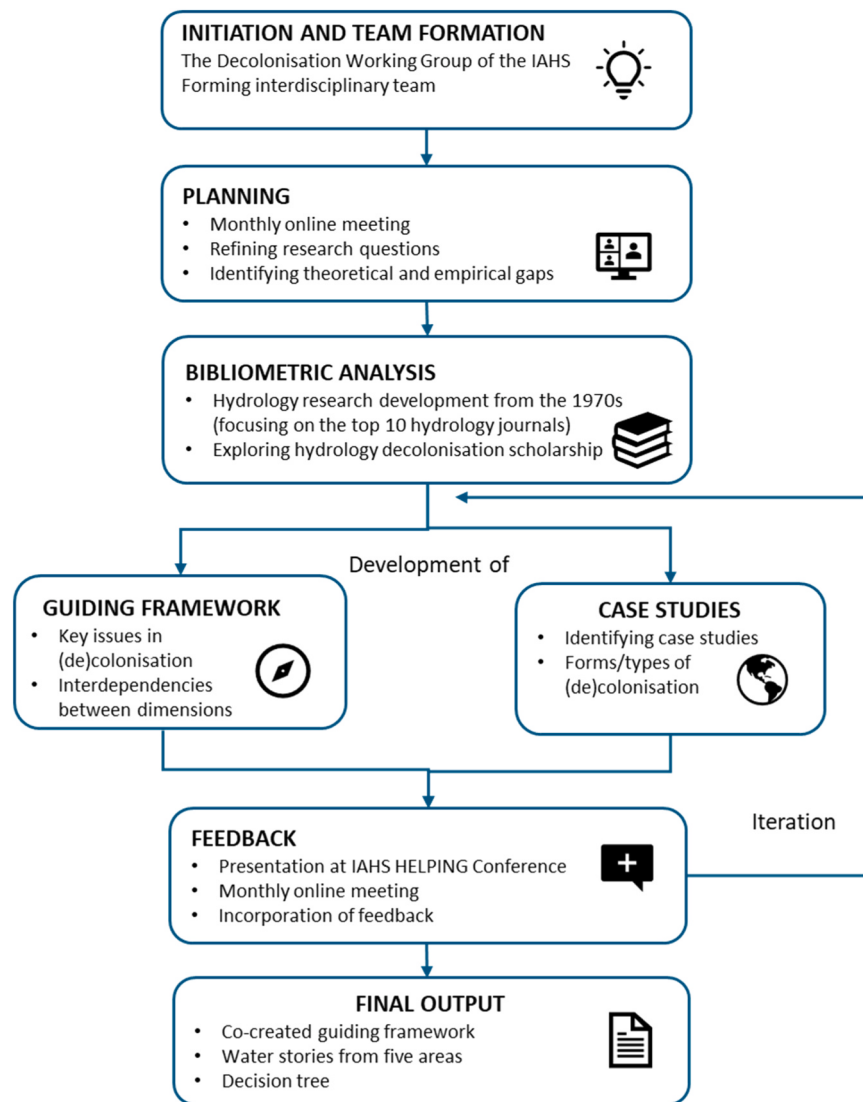


Fig. 2. Co-creation process of this study.

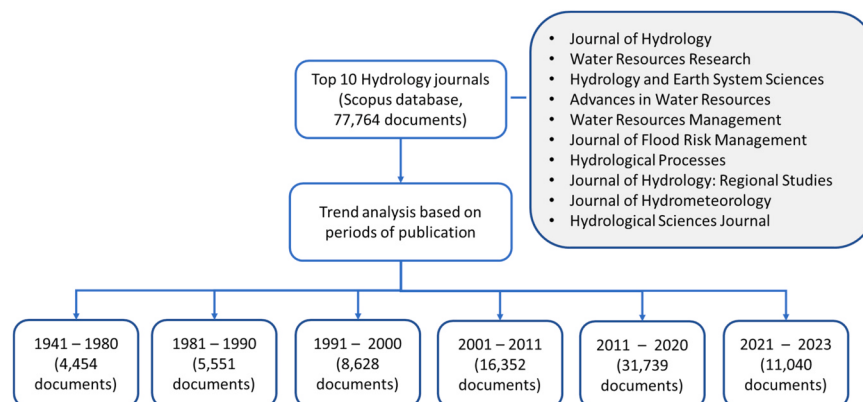


Fig. 3. The number of searches by decade in the top 10 hydrology journals in the Scopus database in August 2023 (abstracts/keywords reliably indexed from 1941).

systematic and continuing measurement of streamflow and groundwater levels to draw up water budgets based on available resources (Anon. 1965). The use of computer models, which used the vast quantities of new data provided by the International Hydrologic Decade, revolutionised hydrology after 1970 (Bras, 1999).

With the acceleration of decolonisation in the 1970s, hydrology research communities focused on establishing global data networks to enable sharing and collaboration, and to use the new data to develop, calibrate, and assimilate global hydrological models. At that time, hydrologists developed their community through the UNESCO and WMO

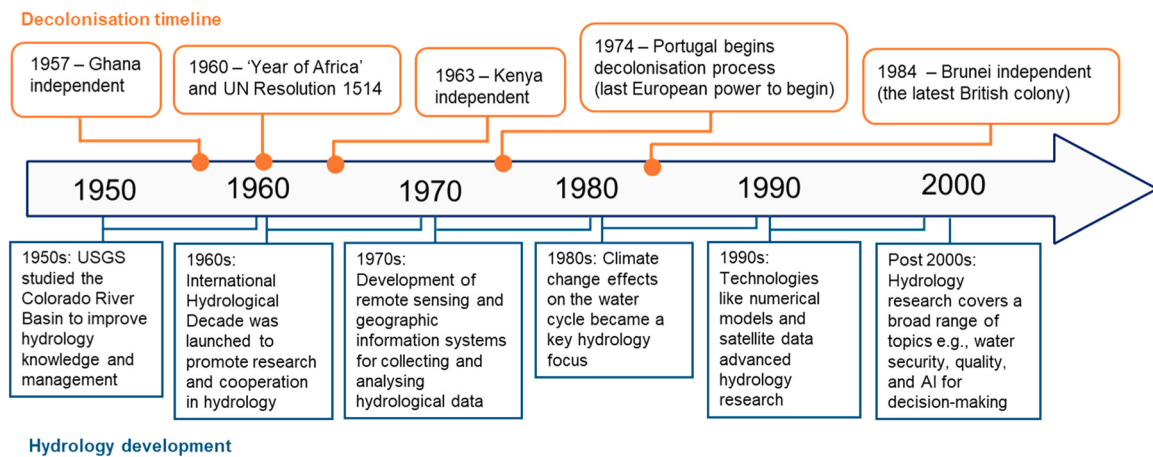


Fig. 4. Key decolonisation timeline and development of hydrological research between 1950s and 2000s.

hydrology programs. IAHS has since evolved from a Eurocentric scientific body into a globally inclusive platform that actively supports hydrologists from underrepresented groups. From the 1980s through the 1990s, hydrological research shifted to focus on the impacts of environmental change, especially climate change, as intense debates took place within the field about hydrology's place between engineering approaches and geophysical sciences. Emerging from this debate was a strong bridge between fundamental earth process research and applied engineering contributions to societal problems. Just as IAHS began focusing on how to bridge scientific research and social responsibility in the 1980s and 1990s, it also began broadening its reach to include the Global South.

Correspondingly, the IAHS initiated a programme in 1991 to transfer knowledge via its Task Force for Developing Countries, primarily by mailing the organisation's data publications to libraries in poor countries (Rosbjerg and Rodda, 2019). Around the turn of the millennium, heated debates regarding first, the place of the cryospheric sciences in the association, and second, the commission structure of the organisation, pushed the association into adopting a new, project-driven approach with the goal of attracting new members. In the 2000s, this emerged as a structured decadal science agenda, with each decade focusing on a specific challenge through global collaboration. The first

IAHS scientific decade, "PUB – Prediction in Ungauged Basins" (2003–2012), was initiated in response to growing concerns about the limitations of hydrological models in data-scarce regions. Emerging from discussions at IAHS meetings, PUB aimed to improve predictive capacity in basins with limited observations, and this was partly driven by the desire to understand the effects of climate change. Building on its success, the "Panta Rhei – Everything Flows" (2013–2022) decade was launched following recognition that non-stationarity in hydrology—driven by climate change and human activities—required an integrated, human-centred approach that emphasised human needs for water (Rosbjerg and Rodda, 2019). A focus on human-centric hydrology emerged in the 2010s, incorporating greater social and economic considerations linked to sustainable development. It now plays a prominent role in integrated water management and decision making (Fig. 5).

3.2. Scholarship on hydrology decolonisation

Recent scholarship on hydrology decolonisation highlights the need to address the discipline's historical power structures and epistemic biases. Selected literature on hydrology decolonisation is summarised in Table 1, offering a general overview of the current landscape rather than an exhaustive review of literature. The intention is to present relevant

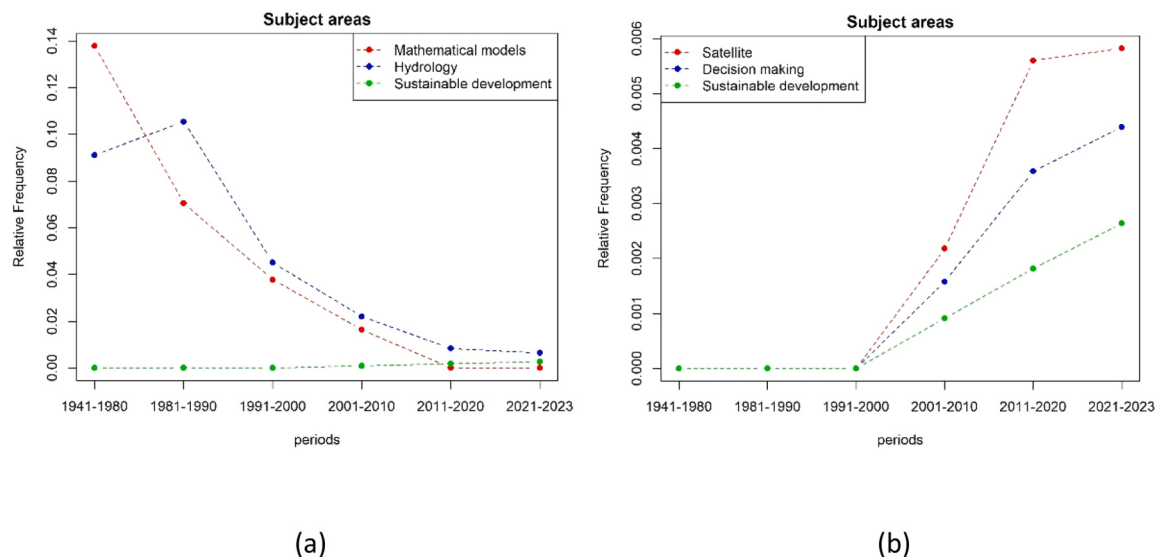


Fig. 5. Changing research trends in hydrology from the 1941–2023: (a) a decreasing trend of traditional observation and measurement, and (b) emerging themes related to satellites, decision making and sustainable development. Trends were calculated by analysing keywords from publications in top 10 hydrology journals. "Sustainable development" is shown twice across the two panels to highlight the relative scale differences between the vertical axes of the figures.

cases of decolonisation to initiate a perspective discussion grounded in stories and our co-creation. Overall, Table 1 includes ten publications from the Scopus search, along with two journal articles identified as relevant additional literature during the case study analysis, revealing that hydrology and decolonisation intersect across diverse global contexts. Through critiques, counter-mapping, feminist and Indigenous frameworks, and pluralistic approaches, these studies advocate for equitable, community-driven hydrology.

Together, these cases call for a transformation of water governance that centres justice, sovereignty, and relational care, challenging dominant paradigms and advancing decolonial water futures. However, it is recognised that these cases differ in geography, focus (law, art, activism), and approach—some resist, others reform; some centre Indigenous, others feminist epistemologies. Therefore, their generalisation is not straightforward and requires cautious, reflective perspectives.

Recent developments in international hydrological agendas and scientific discourse reflect a growing alignment with broader movements toward science decolonisation in the water sector. The United Nations (UN), UNESCO's International Hydrology Programme (IHP), and IAHS now address global water challenges through sustainable and inclusive approaches (Arheimer et al., 2024; Howard et al., 2025). The UN, which has framed decolonisation as a foundational mandate since its inception, continues to articulate this through initiatives such as the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and the International Decades for the Eradication of Colonialism (<https://www.un.org/dppa/decolonization/en>). It's Water Action Agenda, emerging from the 2023 Water Conference, emphasises accelerated implementation and improved impact towards achieving Sustainable Development Goal 6 (SDG 6) and other water-related goals, including through capacity development, governance, data and information, financing, and innovation. UNESCO's IHP currently in its ninth phase (IHP-IX), operationalises these priorities through working groups, regional perspectives, flagship initiatives, and cooperation with other UNESCO programmes, while supporting the Integrated Monitoring Initiative for SDG 6 and the system-wide strategy on water and sanitation.

During the International Association of Hydrological Sciences (IAHS) "HELPING" (Hydrology Engaging Local People IN one Global world) Science for Solutions Decade (2023–2032), IAHS is reshaping hydrology to be more equitable, diverse, and community-engaged through travel awards, open access, dedicated committees, and decolonial working groups. For example, IAHS has established the History of Hydrology Working Group to foster reflection on the historical roots and epistemologies shaping the field (Beven et al., 2025); <http://www.history-of-hydrology.net>.

In governance, the OECD Principles on Water Governance have been mobilised in decolonial analyses of water management systems, such as in Canada, where McKibbin (McKibbin, 2023) examines lessons from Indigenous-led approaches. Across the sciences, there is a growing call for more ethical engagements between Western and Indigenous knowledge systems (Stein et al., 2024), which reinforces the relevance of science decolonisation to water research, governance, and practice. Though not without flaws and mistakes, there is a growing decolonisation movement in water sciences and management that overall represents a positive shift towards more equitable and ethical practice. However, this movement must confront and dismantle entrenched systemic inequities rather than resorting to tokenistic gestures or symbolic performances that leave underlying power structures intact. From this historical understanding and global initiatives, we will now examine how colonialism shaped water practices and their lasting impacts at the local and regional levels.

3.3. Stories: counter-narratives

In order to compare our methods to existing discourse that dominate the water management narratives, which justify specific practices

Table 1

Cases of decolonisation in hydrology.

Articles	Insights
Moving the Rain: Settler Colonialism, the Capitalist State, and the Hydrologic Rift in California's Central Valley (Claire and Surprise, 2022)	Based on the article, hydrology and decolonisation intersect through: • Historical: Disruption of Indigenous water systems • Ethical: Critiques of capitalist water control • Structural: Reshaping of watersheds for settler benefit • Epistemological: Challenges to colonial water knowledge systems
A hybrid approach to decolonize formal water law in Africa (Van Koppen and Schreiner, 2018)	This International Water Management Institute (IWMI) report explores hydrology and decolonisation through: • Historical: Colonial water laws dispossessing African communities of water rights • Ethical: Permit systems criminalising small-scale users and perpetuate inequality. • Structural: Legal frameworks favouring large-scale formal users over informal ones • Epistemological: Customary water knowledge being marginalised, needing equal recognition
Mapping Resistance: Environmental and Postcolonial Critiques in the Graphic Narratives River of Stories and All Quiet in Vikaspuri (Akhter and Islam, 2025)	The graphic narratives River of Stories and All Quiet in Vikaspuri critique colonial hydrological mapping and postcolonial development. • Historical: Exposing cartographic erasure of indigenous ecologies • Ethical: Highlighting displacement and injustice • Structural: Challenging extractive infrastructure • Epistemological: Reclaiming relational water knowledge through counter visual storytelling and decolonial cartographies
Introduction: History of Science, Technology, Environment, and Medicine in India (Sarkar, 2022)	This book explores how colonial hydrology shaped India's environmental and technological landscape. • Historical: Critiquing imperial water mapping • Ethical: Highlighting displacement and ecological harm • Structural: Revealing state-driven control over rivers • Epistemological: Challenging Eurocentric science by recovering indigenous water knowledge, advocating for decolonised, pluralistic understandings of hydrology
Woman, Water, Freedom: Climate Justice, Women's Liberation, and Territorial Sovereignty in Iran-Iraq Borderlands (Jafari, 2024)	This work links hydrology and decolonisation by exposing • Historical: Violence of colonial water projects • Ethical: Neglect of women's water rights • Structural: Dispossession through dam-building and sanctions • Epistemological: Erasure of indigenous water literacy It advocates rematriation of rivers as feminist, ecological, and territorial liberation.
A transdisciplinary engagement with Australian Aboriginal water and the hydrology of a small bedrock island (Hayashi et al., 2021)	This study explores Aboriginal Yolŋu water knowledge and Western hydrology on Milingimbi Island.

(continued on next page)

Table 1 (continued)

Articles	Insights
	• Historical: Honouring ancestral water governance • Ethical: Resisting epistemic erasure • Structural: Challenging centralised water management • Epistemological: Promoting transdisciplinary collaboration without hybridisation, advancing decolonial water stewardship rooted in Indigenous sovereignty and relational care
Dams, displacement, and the delusion of development: Cahora Bassa and its legacies in Mozambique, 1965–2007 (Isaacman and Isaacman, 2013)	This book A Companion to American Environmental History explores how environmental history intersects with race, class, gender, and colonialism. • Historical: Critiquing settler land use • Ethical: Highlighting environmental justice • Structural: Examining power in resource control • Epistemological: Challenging dominant narratives, supporting decolonial hydrological perspectives
Colonizing the rains: Disentangling more-than-human technopolitics of drought protection in the archive (Tozzi et al., 2022)	This paper reveals how colonial drought-protection policies in India redefined hydrology by privileging irrigation over rainfed systems. • Historical: Tracing irrigation's rise as a colonial tool • Ethical: Critiquing marginalisation of rainfed farmers • Structural: Exposing canal-based control • Epistemological: Challenging irrigation-centric water ontologies, advocating decolonial, plural hydrological imaginaries
Vulnerability reduction and adaptation to climate change through watershed management in St. Vincent and the Grenadines (Enríquez-de-Salamanca, (Enríquez-de-Salamanca, 2019)	This paper links hydrology and decolonisation by showing how colonial land use and urban expansion in St. Vincent exacerbated flood risks. • Historical: Critiquing colonial settlement patterns • Ethical: Highlighting vulnerability of low-income communities • Structural: Promoting watershed zoning • Epistemological: Valuing local knowledge and anticipatory land management over reactive engineering fixes
A Deep Chart (the Aqua-Face of Deep Mapping): Collaborative water research with Carcross/Tagish First Nation, Shaanakhéeni headwaters, Yukon Territory/British Columbia, Canada (Hayman et al., 2017)	This counter-mapping project with the Tlingit and Tagish peoples reclaims Indigenous hydrological knowledge. • Historical: Resisting colonial cartographies • Ethical: Empowering Indigenous sovereignty • Structural: Challenging dominant water governance • Epistemological: Promoting aqua-centric deep mapping, preserving cultural memory and offering a decolonial framework for global water ethics
Decolonizing Social Work: From Theory to Transformative Practice (Kleibl et al., 2024)	From this book, Chapters 6 and 7 relate hydrology and decolonisation by highlighting Indigenous commons and ecological justice. • Historical: Resisting colonial land dispossession

Table 1 (continued)

Articles	Insights
Decolonising Water—Decolonising Personhood—Decolonising Knowledge: A Tlingit and Tagish perspective (Hayman et al., 2021)	• Ethical: Affirming reciprocal stewardship of water and land • Structural: Challenging capitalist extractivism • Epistemological: Centring Indigenous water knowledge, such as Buen Vivir, as alternatives to Western hydrological paradigms This work links hydrology and decolonisation by foregrounding Tlingit and Tagish water epistemologies. • Historical: Resisting colonial water abstraction • Ethical: Affirming reciprocal relationships with sentient waters • Structural: Challenging Western legal frameworks • Epistemological: Centring Indigenous aqua-centric knowledge through oral histories, counter-mapping, and evolving water legislation

according to region, five stories are presented here from India, Canada, Western Africa, Jakarta and West Asia. These stories span various contexts and scales, provide valuable insights into decolonisation pathways that promote equity in knowledge generation and dissemination. The stories from India illustrate how the spatial and temporal natures of water from different parts of rivers served various classes of society even before colonisation. The Canadian stories bring us to the moment when settlers arrived in the colonised land, focusing on their interactions with water and revealing their efforts to control and manage water resources, at the expense of Indigenous practices and knowledge. The stories from Jakarta reveal how the city's water infrastructures have been shaped by colonial powers' perceived competence, often influenced by unconscious biases about their technological superiority. The African stories tell of both tangible infrastructure and invisible socio-economic structures that continue to facilitate inequalities, showing how post-colonial urban planning frameworks maintain established power dynamics, oppressing certain areas and communities. The water stories from West Asia discuss neo-colonisation, emphasising the ongoing power struggles over water resources and highlighting the need to negotiate sustainable water practices through the decolonisation of water generation and exchange, aiming for more equitable and just management of water resources. Efforts towards decolonisation should be viewed as a continuous process (Ahmed-Landeryou, 2023), assessing progress for negotiation between neo-colonialism and decolonisation.

3.3.1. Water from different parts of river serve different classes of society in pre- and post-colonial India

The Indian case study exemplifies the exceptionally long history of trying to control access to and use of 'water' that predates European colonialism but continues through and beyond it. Puttacherril (Puttacherril, 2022) categorises these into a pre-colonial approach (where states continue to legislate on water matters) or a colonial-informed centralised decision-making approach where the central government has a critical role in shaping the control of water resources. Pre-colonial water management was influenced by both Hindu texts and Islamic law, where the former dictated control and access based on social identities, whereas the latter promoted universal access to water (Cullet and Gupta, 2009; Naff and Dellapenna, 2002). British colonial practices from the 1860s onward, linked water ownership to land ownership and introduced further legislative controls that favoured a 'centralised approach' to water management (Dellapenna, 2001). D'Souza (D'Souza, 2006) discusses three types of colonial

impacts on hydrology in India, specifically influences on: (1) irrigation systems; (2) water harvesting techniques; (3) what is referred to as strategies for 'hydraulic endowments' (p.621) and includes approaches to flood management, urban water supply, water legislation etc. The third is difficult as D'Souza notes, as it spans inter-state boundaries and with multi-faceted impacts.

Colonial practices from 1860 onwards created extensive canal networks and legislative frameworks like the Canal and Drainage Act of 1873 to control water flow and access (Sattar, 2022). Recent efforts reimagine India's waterscapes by emphasising 'river literacy' and decolonising waterscapes to reconnect communities with their water environments, fostering ownership and empowerment which can be central for achieving equitable water practices (da Cunha, 2019; Curley, 2019). This process, which is termed 'Indigenisation,' reflects a movement towards reclaiming and revitalising Indigenous cultural roots and traditions that were suppressed during colonial rule. In some states like Kerala where is a revival of traditional water systems such as surangas (water tunnels), the experience with colonial ecological imperialism highlights the lasting impacts on local water availability and agricultural practices (Navath, 2012). In other states like Rajasthan, there has been active involvement of NGOs to restore traditional water systems such as Johads (dam like structure) (Singh, 2016).

Water management in India has evolved significantly. Since independence in 1947, state governments have controlled water resources, with the central government intervening in inter-state disputes (Cullet and Gupta, 2009) resulting in the development of trans-boundary disputes between states. Comparative lessons can be drawn from other federal contexts with a colonial past such as Canada, where debates around strengthening indigenisation practices and local-centre responsibilities in water management overlap.

3.3.2. Perpetual colonialisation impact on water management in Canada

The colonisation of Turtle Island, known as North America, by Europeans, particularly driven by the fur trade, significantly altered the natural landscape and water systems (Barker, 2021). One of the clearest examples of these transformations is found in the Saskatchewan River Delta, where European settlement and fur trade activities converged with state-led water control projects, reshaping Indigenous livelihoods and hydrological systems. This particular Canadian story was selected because the Saskatchewan River Delta is the largest inland delta in North America and has been a site of sustained colonial intervention in water management for over 250 years (Goulet, 2021). The delta surrounds Cumberland House, Saskatchewan, which is the oldest permanent European settlement in western Canada (1774), although it has been continuously inhabited by the Swampy Cree for millennia (ibid, 2021). The site illustrates the entanglement of hydrology, colonial trade economies, and Indigenous livelihoods, offering a sharp example of how water has been controlled, commodified, and contested in ways that resonate with other colonial contexts.

Early fur trade economies depended on waterways as transport corridors, with the Hudson's Bay Company post at Cumberland House operating as an administrative and trading centre until 1965. Interventions with the Saskatchewan River Delta by the Hudson's Bay Company, Prairie Farm Rehabilitation Association and Ducks Unlimited engineered flows through small dams and channelisation, especially during the droughts of the 1930s–1950s (Delta N-90 Trappers and Ducks Unlimited, 2021). Later, larger scale interventions including Gardiner Dam which altered seasonal flooding patterns; EB Campbell Dam which disconnected and degraded wetlands, and reduced fish and bird recruitment disrupting long-established Swampy Cree subsistence practices (Jardine et al., 2022; Waldram, 1993). At the same time, colonial education policies including residential schools separated youth from land- and water-based knowledge systems, compounding ecological disruption with cultural dispossession (Wilk et al., 2017).

Indigenous knowledge in this region is deeply relational, expressed in Swampy Cree language terms such as *Kitaskinaw* (our land) and

ceremonial practices that connect water, land, and community health. These systems emphasise stewardship, interdependence, and respect for ecological cycles, in sharp contrast to the technocratic and profit-oriented water governance imposed by colonial authorities. The persistence of these values has informed contemporary declarations and acts of resurgence. A landmark example is the January 27th, 2021 Declaration on Natural Resources on Treaty 5 Territory, which recognised the Saskatchewan River Delta as a sacred place to be governed under Cree law in perpetuity (Cumberland House Cree Nation, 2023, October 4).

Efforts at decolonisation in Canada include incorporating Indigenous worldviews into hydrological curricula (Bradford et al., 2019; Neape-tung et al., 2019), participatory water management experiments that create space for plural knowledges (Andrews et al., 2018; Bradford et al., 2019), and research led by Indigenous women that centres relational responsibilities to water (Chen, 2022; Ragsdale and Shew, 2023). These efforts show both the potential and the fragility of shifting from colonial "management" of water toward Indigenous "responsibility" for water.

3.3.3. Western African regional story: water infrastructure legacy

Colonial interventions in Africa embedded structural inequities into water infrastructures, privileging European settlers while sidelining Indigenous practices that had long governed water relations (Acey, 2007). The Berlin Conference of 1884–1885 formalised European colonialisation, partitioning Africa with little regard for ecological, cultural, or ethnic boundaries. This restructuring prioritised resource extraction and economic dominance (Lee, 2006), with lasting consequences for urban and hydrological systems (Yao, 2022).

European authorities reorganised African cities to favour settler neighbourhoods, ensuring privileged access to resources such as water while relegating African communities to underserved zones (Acey, 2007). In Lagos, for example, the Iju waterworks (1915) explicitly catered to British residential quarters, leaving local populations to rely on informal systems. Similarly, in Kinshasa, Belgian colonial authorities concentrated services within European quarters while exploiting Congolese labour in mining operations (Buelens and Cassimon, 2013). These infrastructures hardened spatial and social inequalities that persisted after independence, as postcolonial governments often reinforced colonial patterns by extending existing systems rather than restructuring them (Akpabio et al., 2017).

Before colonial rule, water in many African societies was managed through kinship-based and spiritual practices rooted in reciprocity, seasonal rhythms, and collective stewardship. Colonial administrations undermined these systems, imposing bureaucratic permits, private property logics, and rigid infrastructure that criminalised informal or small-scale water use.

The legacy of unequal development continues today, with informal settlements often excluded from urban water planning. Addressing these disparities requires integrating informal areas into service networks and challenging the colonial infrastructures embedded in African cities. Current reforms and activist movements are attempting to decolonise water governance by recovering customary water rights, pursuing hybrid legal frameworks that recognise both statutory and customary systems, and promoting more inclusive urban planning (Uitermark and Tieleman, 2021; Sood et al., 2017).

3.3.4. Jakarta's flood policies: unconscious bias

In Jakarta, colonial hydrology imposed Dutch engineering models onto tropical ecologies, creating infrastructural lock-ins that still shape flood governance today (Octavianti and Charles, 2019). The transplantation of European water science to Indonesia exemplifies how epistemic hierarchies devalued local adaptations and produced enduring social injustices (Caljouw et al., 2005). This case illustrates how colonial infrastructures and epistemologies continue to define hydrological futures.

When the Dutch East India Company conquered Batavia (now

Jakarta) in the early 17th century, they transformed it into a trading hub with geometric canals, a reproduction of the Netherlands' water management systems. These designs were poorly suited to tropical environments, leading to sediment clogging, disease outbreaks, and periodic floods (Van den Brug, 1997).

The West Flood Canal, completed in 1911, was deliberately built to protect elite zones—such as the Presidential Palace, government offices, wealthy neighbourhoods, and foreign embassies—reinforcing spatial inequities in flood protection. In contrast, poorer communities were left more exposed to flood risks. Later, the East Flood Canal was proposed by Dutch consultants (NEDECO) in the 1970s and only completed in 2010 (Adhi Ksp, 2010), further cementing the legacy of large-scale, foreign-designed infrastructure. More recently, a consortium of Dutch consultants proposed a 32-km giant seawall after major floods in 2007 and 2013, but construction stalled during COVID-19 in its early stage.

Infrastructures are important flood mitigation measures. However, overreliance to them, without significant diversification of strategies, has led to an unequal distribution of harms and benefits in the society (Octavianti and Charles, 2019). The fact that most of these measures are proposed, designed, constructed and operated with significant involvement of foreign entities—often linked to superior empirical science—add complexity to the approach, marginalising local knowledge and perspectives.

Prior to colonisation, communities adapted to seasonal flooding through stilt houses, agro-ecological practices, and mobility strategies that accepted water as a cyclical force rather than a hazard to be conquered. These relational approaches emphasised coexistence with flood regimes and embodied a socio-ecological resilience that colonial hydrology dismissed as unscientific. Recent projects, such as the development of the new capital, Nusantara, show greater involvement of Indonesian experts and local knowledge. The extent to which these initiatives represent genuine structural change rather than token inclusion remains to be assessed.

3.3.5. Neo-colonial struggles in West Asia for water

The hydropolitics of West Asia reveal how colonial-era boundaries and Western educational frameworks continue to shape water knowledge, governance, and conflict across the region (Nagheeb and Amezaga, 2023). This case was selected because the hydrological landscape of West Asia particularly over transboundary waters like Tigris, Euphrates, and Jordan rivers is deeply influenced by colonial-era boundaries and ongoing geopolitical conflicts. The region's colonial and neo-colonial water regimes transformed relational water practices into state-controlled commodities, with lasting structural, epistemic, and ethical consequences (Selby et al., 2022).

Historically, colonial powers introduced centralised irrigation projects, transforming traditional, community-based water management systems into state-controlled ones with the aim of enhancing agricultural productivity for export markets. These projects supported colonial economies by enabling cash crop production, increasing local dependency on imported food, and disrupting local water rights and ecological balance (Selby et al., 2022). This legacy continues to impact water and food security in the region. In the post-colonial era, hydrological boundaries became entangled in broader geopolitical disputes, exemplified by conflicts in regions such as Palestine, Kashmir, and Afghanistan (Nagheeb and Warner, 2018).

Neo-colonial influences persist through international projects and financing structures, often mediated by international lending institutions. The World Bank and the International Monetary Fund (IMF) have promoted market liberalisation and export-led growth in post-colonial states. For example, in the 1980s and 1990s, structural adjustment programs (SAPs) in Sub-Saharan Africa required countries to reduce public spending and promote exports to service their debts (Harrison, 2010). Countries like Iraq and Syria face water management challenges rooted in historical changes and agreements influenced by colonial power dynamics. In Syria, French-imposed agricultural policies

(similar to the British colonial rule in Sudan) prioritised cash crops like cotton, laying the groundwork for current dependencies and contributing to the country's role as a leading net exporter of virtual water, which in turn has super-exploited its water resources. The colonial-imposed social hierarchies have fuelled tribal conflicts over land and water, leading to civil wars (see e.g., (Selby et al., 2022)). This external influence was protected by mainstream academic and policy discourse, framed as “security and peace”, to whitewash the root causes, limit local autonomy and perpetuate dependence on foreign technology and expertise (Nagheeb and Amezaga, 2023).

Epistemically, hydrology education in West Asia often follows Western frameworks, focusing on technical and engineering approaches. These curricula, shaped by Western institutions or local elites educated abroad, frequently overlook local ancestral knowledge. These educational approaches depoliticise water, framing it predominantly as a transactional and de-historicised commodity, which disregards complex societal, ecological, and cultural relationships (Dajani, 2024). Ethically, colonial and neo-colonial power dynamics have consistently marginalised and portrayed local populations – e.g., Bedouin communities – as obstacles to environmental sustainability (Chatty, 2000; Chatty, 2003). This portrayal, rooted in orientalist and colonial attitudes, frames Indigenous peoples as environmentally destructive, thereby justifying external interventions and marginalisation. Resource management policies often dispossess Indigenous communities under nationalist narratives of conservation or economic development, resulting in ecological harm and social exclusion (Dajani, 2020; Mason and Riding, 2023). Examples from Jordan highlight how conservation policies prioritise economic interests rooted in colonial-era treaties while ignoring Indigenous ecological practices and knowledge (Mason and Riding, 2023). Recent scholarship and activism seek to counter the depoliticisation of water in hydrological education and policy. Dajani (2020), (2024) documents efforts to revitalise ancestral water literacy and highlight the “slow violence” of colonial infrastructures that continue to shape everyday life. Efforts to decolonise hydrology in the region include challenging imported technical curricula and foregrounding ethical and justice-based approaches that re-centre community stewardship.

4. Synthesis stories for our hydrological futures

The examination of hydrological research and practices in Canada, Indonesia, India, West Asia, and West Africa reveals the profound and lasting impacts of colonialism on water management and the ongoing struggle for decolonisation. These stories highlight the structural, historical, epistemic, and ethical dimensions that must be addressed to achieve equitable and sustainable water management.

In Canada, the Hudson Bay Company's historical role in water resource management prioritised economic gain over sustainability, leading to significant modifications of the natural water landscape. This legacy has had lasting impacts on ecosystems and Indigenous communities, particularly in areas like the sturgeon spawning grounds at Old Woman Rapid. Respecting Indigenous perspectives is crucial for understanding and managing water resources. The Canadian case also highlights themes visible across the other stories. Like India, legal reforms linked water rights to land tenure, erasing more collective and relational systems. Like Jakarta, hydrological expertise was cast as external and superior, marginalising local capacities. And as in West Asia, Western-style hydrology education in Canada continues to dominate, though new work increasingly recognises Indigenous epistemologies. By situating the Cumberland House story within these broader patterns, it becomes clear that decolonisation is not a single event but a multi-scalar process of resisting dispossession, revitalising knowledge systems, and asserting sovereignty over hydrological futures.

Jakarta's hydrological landscape continues to be influenced by the legacy of the Dutch colonial government. Colonial construction of the city, such a channelised river course, has shaped modern flood management. Policies, developed through top-down approaches, often

overlook the needs and perspectives of local communities. Moving forward, a shift from one-way consultation towards capacity building and meaningful co-creation is essential. This approach helps identify what truly needs to be reclaimed for sustainable development. Jakarta's story resonates with Canada's in that large-scale colonial interventions disrupted ecologies and livelihoods, and with West Asia's in its reliance on foreign-trained consultants. Its explicit protection of elite enclaves through flood infrastructure parallels African cases, where waterworks privileged settler communities. The persistence of unconscious bias in favour of imported expertise underscores the ongoing challenge of decolonising hydrological knowledge and practice in Indonesia.

India's relationship with water has deep historical roots, with sophisticated water management systems dating back to 2500 BC. However, colonial practices in the 1900s led to the extinction of many local water management strategies and the commodification of water resources. Post-independence, India has faced structural challenges, including the management of monsoon-dependent water systems, exacerbated by climate change, and disputes over water ownership and usage. Ensuring fair access to water requires revisiting and potentially restructuring ownership and management practices to honour both historical and contemporary needs.

West Asia's hydrological landscape is deeply influenced by colonial-era boundaries that ignited ongoing geopolitical conflicts. Colonial powers introduced centralised irrigation projects that transformed and degraded traditional, community-based water management systems into state-controlled ones. This legacy continues to impact water and food security in the region. Neo-colonial influences persist through international projects and financing structures, often mediated by international lending institutions. Hydrology education in West Asia often follows Western frameworks, focusing only on technical and engineering approaches while frequently overlooking local ancestral knowledge. Decolonising hydrology involves integrating region-specific water management practices and addressing the geopolitical influences on hydrological data and knowledge.

The West Asia story aligns with Canada's in how Western education models and imported curricula displaced Indigenous epistemologies. It resonates with Africa's colonial infrastructure legacies, which continue to privilege certain groups while marginalising others. The restructuring of African urban centres favoured European settlers, granting them privileged access to essential resources like water, while African communities were relegated to underserved areas. Like India, West Asia reveals how colonial irrigation reconfigured agrarian societies; but unlike the other cases, its hydropolitics are tightly bound to global geopolitical disputes, making water both an ecological resource and a security instrument. The region emphasises how epistemic colonialism in education and neo-colonial finance remain as powerful as physical infrastructure in allocating water across users.

The persistence of colonial-era pipes, dams, and urban planning reveals how water infrastructures continue to serve as instruments of inequality, echoing the impact of irrigation schemes in India and West Asia on agrarian societies. In British India, the Punjab Canal Colonies, constructed from the 1880s to the 1930s, transformed arid land into irrigated farmland; however, this transformation was racialised and class driven. Canal irrigation enabled the colonial government to favour certain groups, consolidate revenue, and create a loyal elite while marginalising smallholders and pastoralists (Gilmartin, 1994). The Sukkur Barrage on the Indus River, completed in 1932, similarly restructured Sindh's agrarian order, favouring large landowners tied to the British, while pre-colonial flood-based agriculture was replaced by bureaucratic control (D'Souza, 2006; Mustafa, 2001). By the mid-twentieth century, such canal systems in northern India and Pakistan caused salinisation and waterlogging, undermining their promised productivity (Mollinga 2003). In addition, irrigation projects, such as the Iraq Scheme (1919–1932), favoured large commercial estates at the expense of small farmers (Beaumont, 2013).

The parallels with colonial water infrastructures in West Africa are

striking. From the Niger irrigation schemes in Mali and Nigeria to dam and piped-water projects in Senegal and Ghana, colonial hydrology similarly prioritised export-oriented agriculture, urban elites, and European settlers, all while overshadowing local systems of water stewardship and the gendered knowledge related to wetlands and wells (Linton and Budds, 2014).

From these case studies, we conclude that colonial hydrological practices manifest in contemporary post-colonial nations in various ways:

- Those that were never effective due to unsuitability to context, non-acceptability by people, or poor understanding of environmental conditions;
- Those that were effective at some point but are no longer viable under changing environmental conditions and population increases;
- Those that delivered benefits for some (i.e., colonialists, contemporary powerful) but not others, creating and perpetuating deep inequalities;
- Those that were effective for economic gain but were unsustainable, causing environmental or social degradation.

Institutionalised hydrological science focuses on the accuracy of natural system representation but may overlook the challenge of power struggles related to decision-making in the post-postmodern paradigm. The technological superiority of entities like the Hudson Bay Company in Canada and the Dutch East India Company often prioritised economic gain over sustainable practices, impacting local communities' rights and choices. Although the colonial powers have left, the phantom of colonial power still lingers in the current global nexus of power, along with our inner biases that continue to benefit the establishment.

Epistemically, revisiting social constructs and questioning the status quo can help to integrate indigenous knowledge systems, leading to more equitable practices. Diversifying our ideals and democratising access to water resources are crucial for addressing historical and contemporary inequalities. Recent successful examples include the resurgence of radical Indigenous practices around water management, such as the June 2021 declaration by Cumberland House Cree Nation that the Kitaskinaw (part of the Saskatchewan River Delta) is formally protected under their laws as a sacred place that they will continue to look after forever; and the Fitzroy Declaration in Western Australia (Cumberland House Cree Nation, 2023, October 4; Lim et al., 2017).

The pathways of decolonisation of water need to be place-based. These colonial legacies have entrenched power structures that marginalise local voices, necessitating a reimagining of future ideals for inclusive and sustainable water management. Moving forward, reflecting on inner transformation through **Indigenisation**, reclaiming ownership for fair access by **challenging unconscious biases**, and promoting co-decision-making processes based on **specificities** are essential steps towards more inclusive **infrastructure** environments for water resources management, addressing **the dual struggle of neo-colonialism and decolonisation**.

5. Concluding remark

By examining the development of hydrology scholarship and water stories across five locations, this paper has highlighted how hydrological knowledges and practices remain shaped by colonial legacies in terms of structure, ethics, and epistemology. While international initiatives such as UNESCO's IHP and IAHS science agendas have advanced hydrological knowledge and global collaboration, they often reproduced Western epistemic dominance and overlooked local and Indigenous understandings of water. Emerging decolonial movements now challenge these hierarchies, advocating for more inclusive, participatory, and justice-oriented approaches. Recent efforts, including the IAHS HELP-ING Decade and the UN Water Action Agenda, signal a shift toward pluralism and co-production of knowledge. Realising this

transformation, however, requires confronting the discipline's historical power imbalances and genuinely integrating diverse epistemologies to reimagine hydrology as both scientifically rigorous and socially equitable.

Acknowledging historical exploitation and control of water resources is part of recognising how inequalities continue to emerge in present water sciences and management. Reflecting on these legacies also requires acknowledging the partialities in current knowledge systems and the need for steady, critical self-assessment. From a material and political perspective, the stories illustrate how past structures are embedded in present decisions on studying water and recommending adaptations to water systems. They also suggest the value of inclusive decision processes that bring different knowledge systems into dialogue. The place-based examples underline the significance of practice and culture, showing how Indigenous knowledge and co-creation principles can be considered in rethinking water governance. To support this work, a set of reflective questions is offered below. They are phrased in ways that different groups of readers may find relevant. These are reflection prompts that can be adapted to specific professional or institutional settings.

For hydrological scientists, at the scale of research design, analysis, and teaching:

- In what ways could Indigenous and local knowledge be examined within your modelling, statistical, or field-based research, and how might you treat this engagement as more than symbolic acknowledgement of difference?
- Which of your current assumptions about “best practices” may be shaped by colonial or technocratic histories, and how might you make those assumptions visible and open to discussion in your research outputs or in classrooms?

Emerging challenges, such as globalisation and new waves of migration, require interdisciplinary research, for which the field of hydrology is uniquely placed because it inevitably creates opportunities for integrating ecology, toxicology, and social sciences. New technologies like AI necessitate ethical considerations from social sciences and humanities. Co-creation, dialogue, and giving voice to marginalised groups are essential for hope and optimism (Castelli et al., 2025). Recognising how colonial beliefs and practices can become embedded in institutional policies and international agreements helps to explain many of the challenges hydrology faces today. This paper has traced those historical and structural dynamics through the case stories and organised them within a framework that highlights historical, structural, epistemic, and ethical dimensions. The reflective questions and the decision tree build on this framework, offering readers a practical way to connect the lessons from the stories to their own research, teaching, and project work.

For hydrological engineers and water practitioners at the stage of project planning and infrastructure design:

- When new technologies, such as AI, remote sensing, or large water works are considered, what criteria could you use to assess whether these solutions respond to the cultural and social settings of local communities?
- How might you build processes where people most affected by engineering decisions are involved beyond consultation, for example through co-design or shared responsibility?

When designing a project, a multifaceted approach that acknowledges the historical and ongoing impacts of colonialism is required. Such an approach should blend specificities through local or indigenous adaptation and foster meaningful collaboration by challenging unconscious biases and establishing fair infrastructure among all rights- and stakeholders. Only through such efforts can we hope to achieve a more equitable and sustainable future for water management in the dual struggle against neo-colonialism and for decolonisation.

For water scientists and members of IAHS at the scale of professional societies and multi-year initiatives:

- At what points in IAHS scientific decades, working groups, or other collective projects could we question colonial legacies and highlight Indigenous knowledge systems more explicitly and effectively?
- Which measures might help scientific associations create spaces where different epistemologies can be present without being subordinated, such as revised funding structures, open authorship practices, or leadership roles for local researchers?

Decolonising hydrological curricula and research based on lived experiences and integrating social sciences and other disciplines in hydrology offers a more comprehensive understanding of hydrologic knowledge. The International Partnership Programme in world education and the exposure to diverse languages enable people to use the language they feel comfortable with. It is important to acknowledge benefit from colonial pasts, but framing a future without colonial legacies will open opportunities for a fair and sustainable future. Telling stories and acknowledging clashing viewpoints opens dialogue of balanced perspectives.

For research managers, funders, and those working with scientists and engineers, at the stage of funding calls, project oversight, and evaluation:

- How might grant and contract language be adjusted so that project ownership is shared more equitably with communities most affected by hydrological interventions?
- What practical steps could be taken in training or evaluation processes to make visible the ways that neo-colonial influence persists in water governance, and to encourage projects that explore different pathways?

Across all audiences, the case studies demonstrate that addressing water security in the Canadian Saskatchewan River Delta, Jakarta, India, West Asia, and West Africa involves more than technical solutions. It involves recognising how colonial legacies shape current conditions and considering place-specific knowledge in future decisions.

To support readers in thinking about how this might apply in practice, the decision tree in Fig. 6 provides a simple tool for checking alignment with decolonial principles. It is intended as a starting point rather than a final model, encouraging users to adapt the steps to their own disciplinary, institutional, or community contexts. The flow of the tree mirrors the historical, structural, epistemic, and ethical dimensions introduced earlier in the paper, making those abstract layers more concrete in everyday project work. It guides users through steps, such as recognising positionality, examining historical awareness, and questioning methods and outcomes. The tree is not meant to be definitive. It is offered as one way to help individuals, projects, and organisations move from intention to responsibility in hydrological work that respects and includes Indigenous and community-based knowledge.

This paper is part of an ongoing conversation supported by the IAHS HELPING Decade. We invite hydrological scientists, engineers, water researchers, professional associations, and funding bodies to consider these reflections, adapt them to their own contexts, and contribute further insights to the discussion on decolonising hydrology.

CRediT authorship contribution statement

Albert Nkwasa: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Giulio Castelli:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data

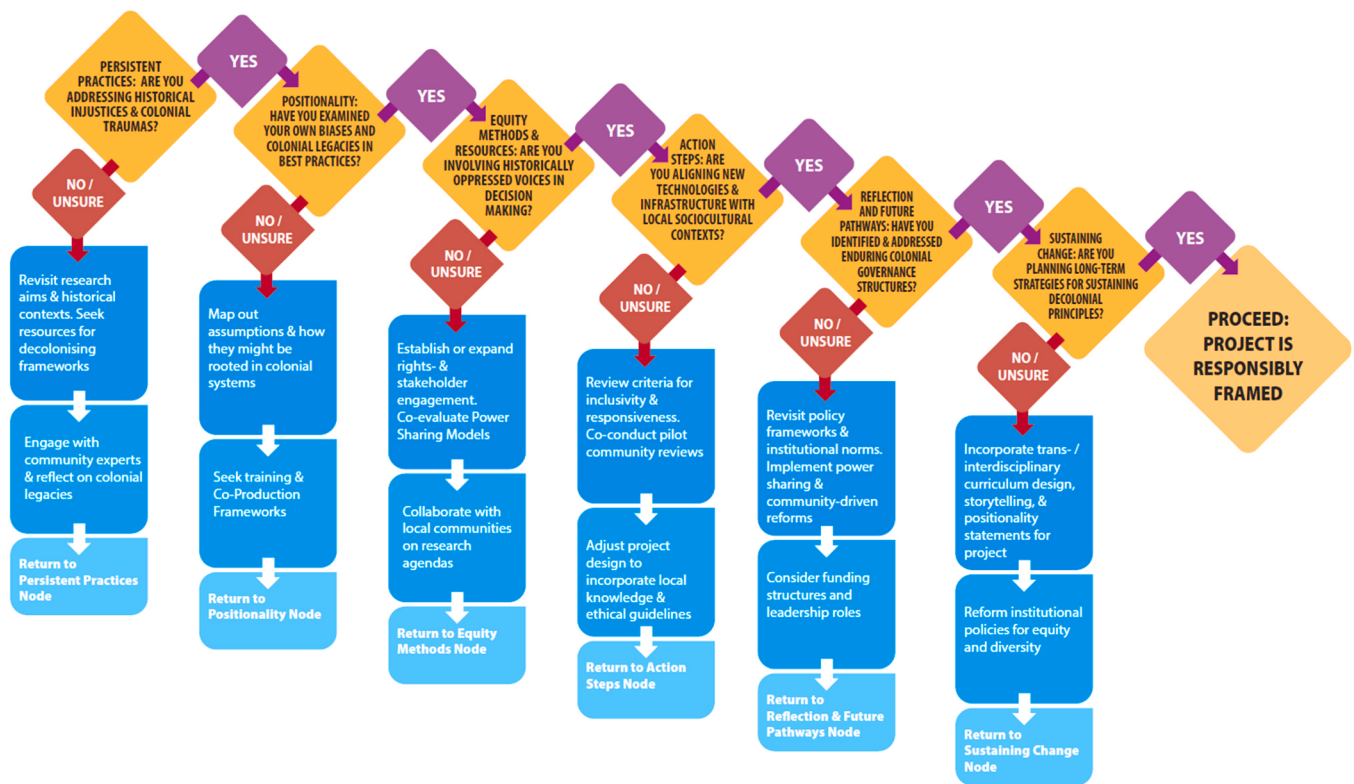


Fig. 6. A decision tree to help hydrologists assess how their work aligns with decolonial principles.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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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.2026.104340](https://doi.org/10.1016/j.envsci.2026.104340).

Data availability

Data will be made available on request.

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