Bilalova, S., N. W. Jager, J. Newig, D. Huitema, and J. K. L. Koehler. 2026. Paradigms of water governance: a systematic review. Ecology and Society 31(1):8. https://doi.org/10.5751/ES-16482-310108

Research, part of a Special Feature on The Next Wave in Water Governance

Paradigms of water governance: a systematic review

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ABSTRACT. Water resources face critical challenges globally, and the current water crisis is often described as a crisis of governance, meaning that ideas about water governance matter greatly. We argue that so-called water governance paradigms play crucial roles in shaping policy agendas, influencing decision-making processes, and ultimately determining the success or failure of water management strategies. However, why, how, and where policy paradigms matter remains unclear. To address this research gap, we performed a systematic review of studies focused on water governance paradigms, examining (1) the characteristics of this literature and (2) how and which aspects of these paradigms are studied. An analysis of 100 studies reveals that the "integrated approach to governing/managing water" paradigm is a central concern in academic literature. The role of governmental actors in promoting and implementing paradigms, as well as the existence of imbalances in water governance debates, also features prominently. The studies we analyze highlight a discrepancy between the promoted paradigms and the contextual realities, compounded by the problem of institutional layering, whereby older paradigms persist and influence actual levels of change. Finally, our results show that although many studies adopt a critical perspective, few provide empirical evidence of paradigms' effects, and there is a lack of common terminology. Overall, this review underscores the importance of problematizing water governance paradigms, which serve as a source code for governance arrangements. It also emphasizes the need to consider contextual nuances when engaging with these paradigms.

Key Words: *normative ideas; paradigms; systematic literature review; water governance*

INTRODUCTION

Water resources worldwide face critical challenges due to climate change, environmental degradation, competing human activities, and ongoing global trends such as urbanization and globalization (Cosgrove and Loucks 2015). Contrary to the perception that scarcity results from a physical lack of water (Biswas and Tortajada 2023), the global water crisis is increasingly recognized as a crisis of governance (Global Water Partnership 2000, Gupta et al. 2013*b,* Taylor and Sonnenfeld 2017, Katusiime and Schütt 2020). Understanding this crisis and designing effective management practices require deeper examination of the underlying paradigms shaping the governance of water resources. If the water crisis is indeed a governance crisis, then the paradigms underpinning water governance regimes warrant closer inspection and scrutiny.

We argue that paradigms play a crucial role as the source code of water governance systems. They serve as a foundation, shaping the rules, norms, values, and goals that underpin the entire system (Abson et al. 2017). In this sense, understanding paradigms is essential when considering systemic transformations for robust and effective water governance. Focusing on paradigms is likely to be a promising strategy for understanding how policy actions are structured or constrained, why certain actors are involved, and the strategies they pursue (Hogan and Howlett 2015).

Several publications have explicitly examined water governance paradigms (e.g., Molle et al. 2009, del Moral et al. 2014, Bréthaut and Schweizer 2018, Challies and Newig 2022) or empirically examined certain paradigms (e.g., Lopez-Gunn 2009, Chomba et al. 2017, Warner et al. 2017, Lebel et al. 2020). The findings indicate that paradigms play a significant role in water governance. However, the study of paradigms remains relatively fragmented, with scattered ideas about what paradigms are, which ones exist, and what functions they perform. To our knowledge, no systematic overview exists that provides a structured inventory of this literature, identifies patterns in how paradigms are studied, or synthesizes the key findings. As a result, there is considerable uncertainty about the relevance and impact of paradigms. We lack clarity on which paradigms are studied, how they are examined, and what specific aspects are explored. Additionally, little is known about who promotes particular paradigms and how, how contextual factors influence their application, and what effects are typically achieved, or not achieved, in practice.

Our primary objective is to take stock of what can be learned about water governance paradigms by exploring, through a systematic literature review, how they are analyzed in academic literature. In doing so, we aim to offer core insights that not only deepen our understanding of water governance paradigms but also provide a foundation for further scholarly advancement in this field.

WATER GOVERNANCE PARADIGMS

The term "paradigm" originates from Kuhn's (1962) seminal work, *The Structure of Scientific Revolutions,* where it was used in the context of the development of scientific knowledge. Drawing on Kuhn's concept of scientific paradigms, Peter Hall introduced the notion of paradigms into the field of policy analysis in 1993, as he sought to explain the fundamental changes in British economic policy during the 1970s and 1980s. Introducing the concept of a "policy paradigm," he argued that "...policymakers customarily work within a framework of ideas and standards that specifies not only the goals of policy and the kind of instruments that can be used to attain them but also the very nature of the problems they are meant to be addressing" (Hall 1993:279). In the context of water, Pahl-Wostl et al. (2006:6) introduced the concept of "water management paradigms," defining them as "a set of basic assumptions about the nature of the system to be managed, the goals of management, and the ways in which these management goals can be achieved."

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Building on these works, we understand a "governance paradigm" as "a set of more or less coherent normative ideas, intersubjectively held by groups of actors, about the problématiques that require public intervention, the corresponding governance objectives, and the appropriate means to achieve them" (Bilalova et al. 2025). The literature on water governance has seen the emergence and implementation of numerous paradigms; integrated water resources management (IWRM; Benson et al. 2020), adaptive water governance (Chaffin et al. 2014), the hydraulic mission (Molle et al. 2009), river basin management (Molle 2009), and water security (Bakker and Morinville 2013) are among the most prominent. Whereas some of these paradigms, such as IWRM, the hydraulic mission, and river basin management, are specific to the water sector, others such as market-based approaches to water governance, adaptive water governance, and participatory approaches originate from broader governance discourses that extend beyond water.

Paradigms can be understood as part of the ideational turn that policy science has taken in recent decades, as they constitute a framework of normative-cognitive ideas that shape problem perception, policy goals related to these problems, and the set of instruments used to achieve results (Hall 1993, Challies and Newig 2022). As such, paradigms influence policy choices, ranging from the design of formal institutions to the mandates they pursue (Kern et al. 2014). For example, the paradigm of the hydraulic mission is said to focus the attention of policymakers and water managers on increasing supply and achieving full control over water resources. This often implies the development of large-scale water infrastructure, typically combined with a state-centric and technocratic approach to water management (Molle et al. 2009). Paradigms serve as significant agenda-setters for political action across scales and may better explain the enactment of certain policies than functional necessity or strategic actions by involved actors (Challies and Newig 2022). At the same time, paradigms are instrumental in determining which policy options are prioritized, overlooked, or dismissed, and in identifying which actors are empowered or marginalized (Molle 2008). The notion of "counter-paradigms" has also emerged, highlighting that paradigms often have limitations or inefficiencies, which can trigger the development of alternative approaches and narratives aimed at challenging them.

Actors play an important role in the emergence, promotion, and implementation of paradigms. The role of government actors in advocating and implementing various paradigms is widely recognized in the water governance literature (e.g., Allouche 2017, Mancilla García et al. 2019). Additionally, international organizations (e.g., Allouche 2017), funding agencies (e.g., Meijerink and Huitema 2010), experts (e.g., Valin and Huitema 2023), private actors (e.g., Vatn 2018), and nongovernmental organizations (e.g., Tyagi 2019) are acknowledged as significant players.

Although paradigms have the potential to transform governance structures toward realizing a collective vision (Molle 2008), new policies do not always replace existing ones or get fully implemented, as many adoptions of new paradigms fail to reach that stage (Meijerink and Huitema 2010). Symbolic implementation of paradigms is also common; for example, Biswas (2008) argues that IWRM has been implemented in a symbolic manner by actors in several contexts to secure funding and enhance acceptability and visibility.

METHODS

Search and study selection

We conducted our systematic review following the guidelines outlined in the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) statement (Moher et al. 2009; Fig. 1). We developed our search string through an iterative process involving discussions with water governance scholars and a review of key papers on water governance paradigms (e.g., Molle 2008, Gerlak and Mukhtarov 2015, Franco-Torres 2021). The search string consists of two main components. The first component targets literature on water policy and governance while the second component includes terms related to paradigms. This design aimed to retrieve publications discussing paradigms specifically within the context of water policy and governance: TITLE-ABS-KEY ((water* W/3 (polic* OR govern*)) AND (paradigm* OR idea* OR discourse* OR discursi* OR narrative* OR imaginar*)) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ed")) AND (LIMIT-TO (LANGUAGE ,"English")).

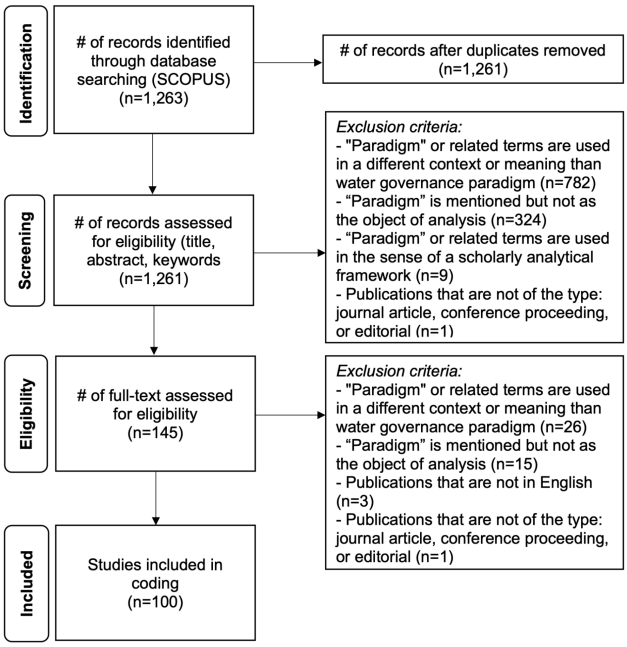
Our search was conducted across titles, abstracts, and keywords of documents and was limited to journal articles, editorials, and conference proceedings available on Scopus, with the last search run in May 2022. Although Scopus does not cover all publications, it is widely regarded as one of the most suitable databases for systematic reviews (Gusenbauer and Haddaway 2020) and offers comprehensive coverage across environmental and social sciences (Frohlich et al. 2018). We limited our search to English-language journal articles, conference proceedings, and editorials. To capture the full scope of the literature, from its inception to the most recent contributions, we deliberately avoided restricting the search to any specific time period.

Our search string yielded 1261 results after removing duplicates. The resulting publication records (including titles, abstracts, and keywords) were then manually screened for suitability. To be included in the data set, the use of the paradigm(s) had to align with the concept of a water governance paradigm, and the (empirical) analysis had to focus on water governance paradigm (s). Records were excluded when "paradigm" or related terms were used solely as a scholarly analytical framework (e.g., Whaley and Weatherhead [2014] analyze the relationship of farmer irrigation groups in England to water resource management through the lens of co-management) or when "paradigm" or related terms referred to a different context or meaning than water governance paradigms (e.g., scientific paradigms, academic discourses, stakeholder narratives). Studies that mentioned paradigms but did not treat them as the object of analysis were also excluded. Following this screening process, we retained 100 articles spanning the years 1997–2022 for subsequent coding and analysis (see Appendix 1).

Coding process and data analysis

To retrieve information from the publications systematically, we developed a structured coding scheme (see Appendix 2). The coding scheme comprised three main sections: bibliographic information, general characteristics of the publication, and the treatment of water governance paradigms. Although some elements were text fields, many were measured on a three-point scale, where 0 indicated the absence of a factor, 1 denoted its presence, and 0.5 represented partial presence.

Fig. 1. PRISMA flow diagram for the systematic literature review.



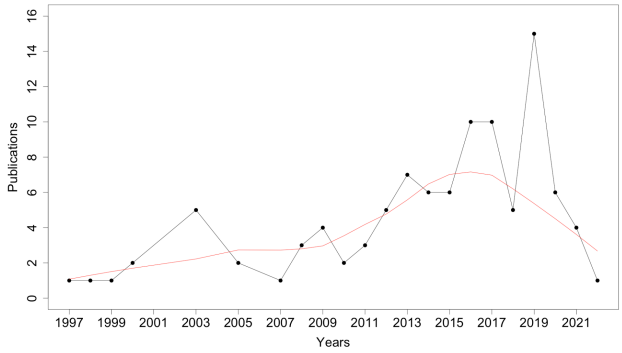
We conducted two rounds of test coding involving all coauthors. This testing phase was essential to resolve minor differences in interpreting coding items, thereby ensuring consistency and reliability in the coding process. Subsequently, each publication was independently coded by two coders, resulting in overall high intercoder reliability. We assessed intercoder reliability using the intraclass correlation coefficient (ICC), calculated on the 93 double-coded papers. The overall ICC was 0.90 (95% confidence interval [CI]: 0.89”0.90), indicating very high agreement. ICC values for individual variables ranged from 0.59 to 1.0, with only 3 of 54 scoring below 0.75. An additional seven eligible papers were identified post hoc and coded by a single coder; these were not included in the ICC calculation but were incorporated into the final data set.

RESULTS

Socio-bibliometric analysis

Within the broad field of water governance, the number of papers addressing paradigms remains relatively small. When applying our search string without restricting it to paradigm-related terms, we identified 17,872 papers. Of these, the 1261 paradigm-related papers accounted for just 7% of the larger water governance literature. We observed a gradual increase over time, with fluctuations in the number of publications, and notable peaks in 2016 (10%; $N = 10$), 2017 (10%; $N = 10$), and 2019 (15%; $N = 15$), alongside considerable year-to-year variability (Fig. 2). As our last search was conducted in May 2022, it is important to note that publications from that year do not represent a comprehensive overview of the entire year.

Fig. 2. Number of water governance publications obtained between 1997 and 2022 using our review criteria.



The studies included in the review were published across 51 different outlets, 4 of which were conference proceedings. Thirty-eight percent of these outlets ($N = 18$) were directly related to water and accounted for more than half of the publications (51%; $N = 51$). The four most frequent sources were *International Journal of Water Resources Development* (9%; $N = 9$), *Water Alternatives* (9%; $N = 9$), *Water Policy* (8%; $N = 8$), and *Water* (8%; $N = 8$). *Environmental Science and Policy* (6%; $N = 6$), *Ecology and Society* (4%; $N = 4$), and *Global Environmental Change* (3%; $N = 3$) were the most common outlets with a stronger focus on environmental issues.

We observed a slight dominance of male first authors, who constituted 61% ($N = 61$) of the studies, whereas female authors accounted for 39% ($N = 39$). The majority of studies were led by authors from the Global North, with 74 of 100 cases (74%). Author locations were assigned based on their primary affiliated institutions. This trend persisted when considering all authors' institutions, with 135 of 204 institutions (66%) situated in the Global North.

Nature of the research

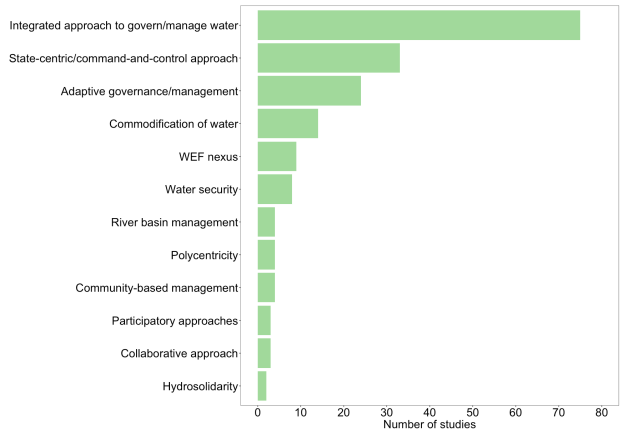
In terms of research methodology, our analysis revealed a predominance of empirical research. Specifically, 69% of the publications were classified as at least partially empirical, with 19% of these ($N = 13$) considered partially empirical, i.e., primarily conceptual but including some empirical illustration. Additionally, notable numbers of publications were classified as at least partially reviews (40%, $N = 40$) or theory development and operationalization (23%, $N = 23$). Conversely, fewer studies were identified as at least partially critiques (16%, $N = 16$) or theory testing/confirmation/disconfirmation (10%, $N = 10$; Table 1). In terms of epistemology, 89% of all included studies were classified as adopting a positivist approach ($N = 89$), whereas only 11% ($N = 11$) were identified as adopting at least a partially constructivist approach.

The included studies covered a variety of research topics. The majority examined the implementation of paradigms and their implications within one or more cases. For example, Tantoh and Simatele (2017) discussed community-based water management in Cameroon, highlighting how such processes were sustained by

Table 1. The nature of the research in the studies included in this analysis.

Nature of the research	Yes	To some extent	No
Empirical research	56 (56%)	13 (13%)	31 (31%)
Review	25 (25%)	15 (15%)	60 (60%)
Theory development and operationalization	12 (12%)	11 (11%)	77 (77%)
Critique	10 (10%)	6 (6%)	84 (84%)
Theory testing/confirmation/ refutation	4 (4%)	6 (6%)	90 (90%)

Fig. 3. Numbers of studies that included each water governance paradigm.



specific actors but challenged by centralized decision-making and cooptation by local elites, thereby exploring the fit of this paradigm within the local institutional and cultural context. Several other studies investigated specific paradigms in relation to the contexts in which they were implemented, focusing on applicability, enabling or hindering factors, and interactions with existing paradigms. For instance, Harsha (2012) studied Indian water policy and the challenges in successfully implementing IWRM and integrated river basin management principles. We also observed a considerable number of studies focusing on the political aspects of paradigms. One example is Molle (2009), who examined the concept of a river basin and how it was used by certain actors to legitimize their agenda. Finally, several papers explored paradigmatic transitions (e.g., Shapiro and Summers 2015, Lee et al. 2022), examined paradigms on a conceptual level (e.g., Mukhtarov and Gerlak 2014, Woodhouse and Muller 2017), or discussed the transformative power of paradigms (e.g., Muskatirovic 1997, Furlong et al. 2016).

Treatment of water governance paradigms in the literature

Our search string included paradigm-related terms such as "paradigm," "discourse," "idea," "narrative," "discursive," and "imaginary." Additionally, a variety of other descriptors were identified in the literature. While nearly 20 different terms were used to denote paradigms in the examined literature, the most frequently used term was "paradigm" itself (78%; $N = 78$). Other common terms included "approach" (50%; $N = 50$) and "concept" (and its derivatives; 40%; $N = 40$). Terms such as "process," "framework," "model," "discourse," "idea," and "tool" were also used in multiple studies to discuss paradigms.

In examining the paradigms discussed in the publications we analyzed, it became evident that certain paradigms have been studied more extensively than others. The results indicate that the "integrated approach to governing/managing water", including integrated water resources management (IWRM), integrated river basin management, integrated lake basin management, integrated coastal zone management, integrated flood management, and others, received the greatest attention, appearing in 75% of all studies ($N = 75$). This was followed by publications on the "state-centric/command-and-control approach" (33%; $N = 33$) and "adaptive governance/management" (24%; n = 24; Fig. 3).

Across all publications, we observed that most studies (71%; $N = 71$) addressed more than one paradigm. For example, 23 of the 75 papers discussing the integrated approach also addressed the state-centric/command-and-control paradigm. While the paradigms were initially coded based on how the authors identified them, we subsequently grouped them according to their conceptual similarities.

Of the publications examined, 22% ($N = 22$) considered "counter-paradigms," at least to some extent. Examples of counter-paradigms identified in the reviewed literature include the rise of "buen vivir" as a counter-paradigm in Ecuador, emphasizing respect for Mother Earth as an alternative to exploitative Western practices (Warner et al. 2017); the emergence of integrated and collaborative approaches to traditional natural resource management (Harrington 2017); and the proposal of an environmental stewardship model as an alternative to the market failure paradigm in the western United States (Supalla 2003).

Furthermore, 82% of the studies adopted an empirical focus, with geographically diverse cases. However, the number of cases from the Global South was almost twice that from the Global North (59 compared to 35). This contrasts intriguingly with the origin of the studies, most of which were led by authors from the Global North (74 compared to 26). Among the cases, the United States ($N = 10$) was the most studied, followed by South Africa ($N = 6$) and Australia ($N = 5$). Geographically, cases were diverse, with the majority addressing sub-national (40%, $N = 33$), local (37%, $N = 30$), and national (18%, $N = 15$) levels. Higher geographical scales, such as transboundary (12%; $N = 10$), global (9%; $N = 7$), international (7%; $N = 6$), and continental (1%; $N = 1$) levels, were comparatively less explored.

As outlined in the definition, paradigms typically highlight a problem and propose ways to address it. Consistent with this, our analysis revealed that in most studies, paradigms articulated an understanding of water-related problems and their underlying causes, while also suggesting governance solutions to address these issues. Specifically, 76% of the included studies ($N = 76$) addressed water-related problems and their causes to some extent. Regarding governance solutions, 57% of the publications ($N = 57$) discussed solutions to these problems, at least partially.

Fig. 4. Percentage of studies analyzing specific water governance modes across the reviewed papers (N = 100). The numbers within the stacks represent the number of papers.

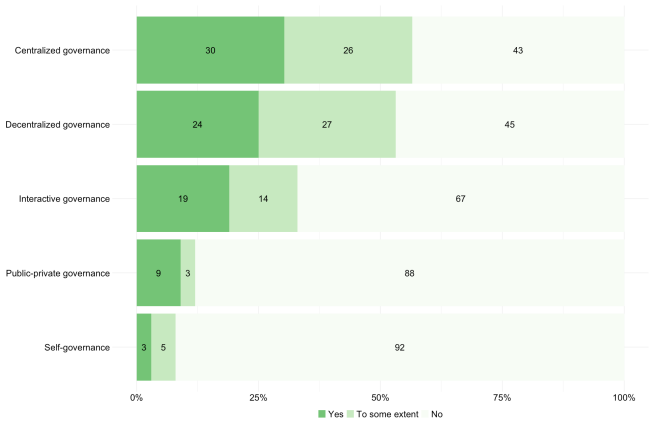


Table 2. The coverage of lifecycle of paradigms in the studies included in this analysis.

Focus of the study	Yes	To some extent	No
Paper studies the origins of the studied paradigms	43 (43%)	13 (13%)	44 (44%)
Paper studies the spread or diffusion of the studied paradigms	20 (20%)	7 (7%)	73 (73%)
Paper studies the implementation of the studied paradigms	72 (72%)	17 (17%)	11 (11%)
Paper studies shift(s) from one paradigm to another (in the given empirical context)	38 (38%)	9 (9%)	53 (53%)
Paper studies significant changes within paradigms	14 (14%)	5 (5%)	81 (81%)

Concerning the impact of paradigms on governance, 67% of the articles (N = 67) focused, at least partially, on concrete changes in governance structures and practices influenced by paradigms. The majority examined certain governance modes in the context of paradigms (85%, N = 85). Among these, most studies considered centralized governance modes (56%; N = 56) to some extent, whereas slightly fewer addressed decentralized modes (51%; N = 51). In contrast, interactive governance, public-private governance, and self-governance modes were identified in only a small proportion of studies (Fig. 4).

Focusing on the most dominant paradigm, the "integrated approach to water governance/management," we observed a prevalence of decentralized governance (52%; N = 12), followed by centralized governance (39%; N = 9), both practiced to some extent.

Regarding the lifecycle of paradigms, the literature offers relatively comprehensive coverage of their origin, implementation, and transitions from one paradigm to another (Table 2). In contrast, the spread or diffusion of paradigms and significant internal changes within paradigms were addressed in only 27% (N = 27) and 19% (N = 19) of the publications, respectively, at least to some extent. This finding suggests that paradigms are predominantly treated as fixed ideational blocks rather than evolving or dynamic constructs.

With respect to the question of which actors are involved in governance, government actors (69%; N = 69) and administrations (50%; N = 50) were the focus of more than half of the included studies, followed by private actors (32%; N = 32), civil society (27%; N = 27), community/citizens (26%; N = 26), and international organizations (12%; N = 12). Actor groups such as science, international nongovernmental organizations, indigenous peoples, and multinational corporations were the focus of < 14% of studies reporting on governance modes (N = 12).

Notably, 71% (N = 71) of the included studies analyzed actors promoting specific paradigms to at least some extent. These actors tend to be the predominant ones, i.e., those already actively engaged in water governance processes. Among studies examining paradigm-promoting actors to at least some extent, government actors and administrations were identified as focal in > 70% of papers (N = 50). Interestingly, international organizations emerged as the second most prominent focal actors, appearing in 49% of these studies (N = 35; Fig. 5).

We also examined the extent to which authors critically engaged with paradigms, for example, by providing normatively informed commentary. In this context, more than half of the studies offered a critical assessment of water governance paradigms and addressed power imbalances. Specifically, 63% of the included studies (N = 63) engaged in critical analysis of paradigms to some extent, while 52% (N = 52) considered issues related to power asymmetries to some extent. Only 11% of the publications (N = 11) discussed the symbolic use of paradigms to some degree.

Despite this notable critical engagement, ambiguity remains across studies regarding whether paradigms are regarded as successes or failures. Only 20% of the included studies (N = 20) presented paradigms as success stories to some extent, whereas 37% (N = 37) addressed paradigms as failures, at least partially. Among the latter, 64% (N = 32) provided policy recommendations to at least some degree, suggesting a relatively balanced discourse overall.

Finally, most studies applied evaluative criteria centered on effectiveness, encompassing dimensions such as environmental sustainability, though these criteria were not typically paradigm-specific (Table 3). While the majority evaluated effectiveness broadly, only a small subset specifically examined the effectiveness and tangible impacts of paradigms themselves. More than half of the included publications did not investigate the social, economic, or ecological consequences associated with paradigm implementation. Nonetheless, social effects received comparatively more attention, with 45% of publications (N = 45) exploring these aspects to at least some extent. Despite the ambiguity surrounding paradigmatic performance and impacts, a majority of studies (57 of 100) offered policy recommendations at least partially.

DISCUSSION

We next discuss several key issues emerging from our results. Specifically, we examine the dominance of certain paradigms in the literature, highlighting imbalances in research focus; the pivotal role of specific actors in promoting and implementing these paradigms; the challenges involved in translating paradigms into practical governance approaches; and the extent to which the literature problematizes these paradigms. We conclude by outlining the limitations of our study and suggesting directions for future research.

Fig. 5. Actor groups involved in the promotion (left) and governance (right) of paradigms. The left plot is based on studies analyzing actors promoting paradigms (N = 71). The right plot is based on studies examining governance modes (N = 87). The numbers within the stacks represent the number of papers.

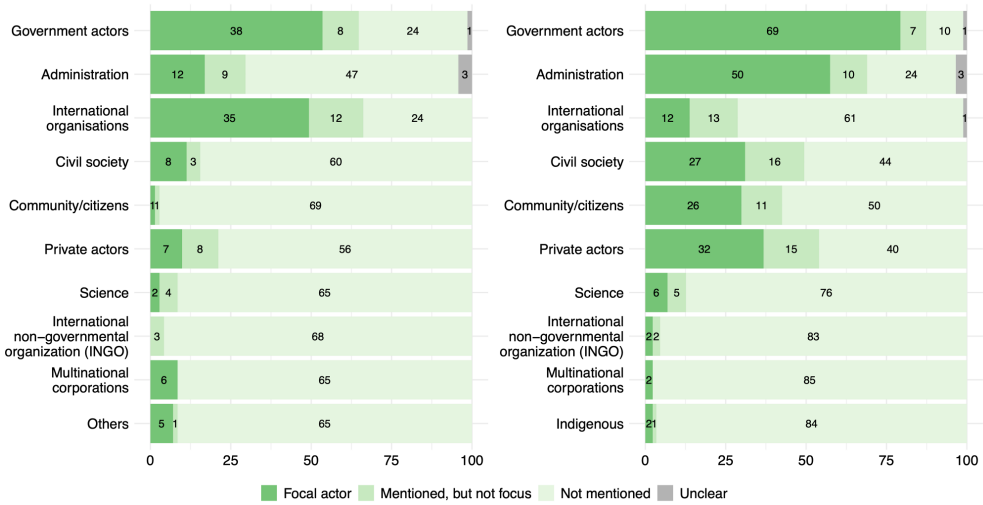


Table 3. Effects of paradigms and criteria used to evaluate them.

Effects or criteria	Yes	To some extent	No
Effects of paradigms			
Social effect	28 (28%)	17 (17%)	55 (55%)
Environmental effect	19 (19%)	9 (9%)	71 (71%)
Economic effect	15 (15%)	12 (12%)	73 (73%)
Evaluative criteria (general)			
Effectiveness (excluding environmental or sustainability aspects)	49 (49%)	13 (13%)	38 (38%)
Effectiveness (as regards environmental or sustainability aspects)	37 (37%)	15 (15%)	48 (48%)
Efficiency/cost-effectiveness	30 (30%)	11 (11%)	59 (59%)
Policy coherence	17 (17%)	15 (15%)	68 (68%)
Other	17 (17%)	14 (14%)	69 (69%)
Justice	19 (19%)	8 (8%)	73 (73%)
Acceptance	15 (15%)	10 (10%)	75 (75%)
Adaptability/adaptive capacity	14 (14%)	10 (10%)	76 (76%)
Accountability	20 (20%)	1 (1%)	79 (79%)
Legitimacy	13 (13%)	9 (9%)	78 (78%)
Resilience/robustness	5 (5%)	4 (4%)	91 (91%)

Imbalances in the research focus

The review reveals imbalances in the research focus within the literature on water governance paradigms. The results show the dominance of the "integrated approach to govern/manage water" paradigm, which is identified in the majority of studies and is the most prominent paradigm in one-half of the publications. In contrast, paradigms such as "collaborative approach," "community-based (natural resource) management," "polycentricity," and "hydrosolidarity" appear in only 13% of the studies.

The large number of studies focusing on the integrated approach may reflect its hegemonic status in governance practice. This paradigm is widely promoted by governments and international development institutions and incorporated into global frameworks such as the Sustainable Development Goals indicator framework under Agenda 2030 (Benson et al. 2015). It has attracted substantial empirical attention, with 52 studies primarily dedicated to it. IWRM, in particular, has been extensively promoted and institutionalized at international and national levels. However, the governance implications derived from this paradigm vary considerably. Studies on this paradigm report that it has been implemented in both decentralized and centralized governance modes with similar frequency. This highlights the flexibility and, at times, the opaqueness of dominant paradigms in water governance.

Although the abundance of research on "integrated approach to govern/manage water" offers opportunities for thorough cross-case comparisons and deeper insights into this particular paradigm, such a strong focus also risks overshadowing alternative ontologies. As paradigms typically envision particular societal realities to be pursued (Molle 2008), they can render alternative paradigms invisible or destabilized (Yates et al. 2017). Therefore, engaging with a diverse range of paradigms becomes crucial. By acknowledging these imbalances and recognizing the overshadowing effects of dominant paradigms, we underscore the importance of fostering diversity in the discourse on water governance. Engaging with a plurality of paradigms, and placing them in dialogue, enables critical reflection on how different paradigms frame water governance problems and the kinds of solutions they propose. Incorporating alternatives also broadens our understanding of water and expands conceptions of what water management and governance can entail (Yates et al. 2017). Thus, promoting diversity within the discourse ensures a more inclusive and comprehensive approach to addressing water governance challenges.

The central role of specific actors in the promotion and implementation of paradigms

Policy changes can be initiated by both governmental actors, including politicians, bureaucrats, and officials at various levels, and nongovernmental entities such as nongovernmental organizations, academics, and individual citizens (Huitema and Meijerink 2010). Although a variety of actors such as private

sector representatives, civil society, and international organizations participate to varying degrees in governance processes, our review reveals the significant influence of governmental actors in both promoting and implementing paradigms. Despite the broad spectrum of stakeholders involved in water governance, state actors (i.e., government and administrative bodies) continue to serve as the central focus in the study of paradigms and their materialization in governance practices.

In addition to governmental actors, international organizations play a crucial role, particularly in promoting specific paradigms. As emphasized by Meijerink and Huitema (2010), international donor organizations such as the World Bank, the International Monetary Fund, and others have been instrumental in shaping water policy transitions, especially in developing countries. These organizations not only provide financial assistance but also impose conditions on national governments, thereby influencing policy directions and implementation strategies. The literature consistently acknowledges the roles of national governments and international organizations in promoting paradigms, particularly IWRM (e.g., Benson et al. 2015, Allouche 2017, Lee et al. 2022).

Paradigms hitting the ground

Our results highlight the predominance of integrated approaches while revealing an almost equal distribution of centralized and decentralized governance modes among the studies that focus exclusively on this paradigm. This discrepancy points to a divergence between the normative aspirations of paradigms and their practical implementation. This phenomenon has been discussed previously in the water governance literature (e.g., Lukat et al. 2022, Rowbottom et al. 2022). For example, Meijerink and Huitema (2010) found that the adoption of new water policies across 16 case studies did not lead to full implementation or the complete replacement of existing policies. A key reason for this discrepancy, as highlighted in several of the reviewed studies, lies in the strong connection between a paradigm and the context in which it is applied. The importance of context in water governance has been widely acknowledged (Armitage 2008, Ingram 2011, Gupta et al. 2013*a*). As Bressers and de Boer (2013) argue, the effective adoption and implementation of a given policy is highly dependent on the alignment between its original context and the environment in which it is introduced.

One way context shapes the translation of paradigms is through institutional layering, whereby new institutional elements are added onto existing ones (Streeck and Thelen 2005). Layering is often influenced by path dependency, which makes systemic change difficult (Rowbottom et al. 2022). An example of such a case could be water governance in Tajikistan and Kazakhstan, as water reforms in both countries face challenges due to traditional and Soviet path dependency, and newly introduced institutions are undermined by old informal institutions (Sehring 2009). Another example comes from Mills-Novoa and Hermoza (2017), who describe the tensions between the IWRM framework and large-scale infrastructure development in Piura, Peru. Despite the introduction of participatory mechanisms and the establishment of the River Basin Council as part of decentralization efforts, these new institutional elements have had limited influence on centralized, state-led decision-making related to large-scale water projects, largely due to the entrenched hydraulic mission legacy. Other studies have highlighted similar dynamics in water governance, including IWRM implementation in Alberta, Canada (Shapiro and Summers 2015) and Water Framework Directive implementation across the European Union (Giakoumis and Voulvoulis 2018), further demonstrating how institutional legacies shape the adoption and adaptation of governance paradigms.

Context also plays a significant role in how paradigms are articulated by different actors, reflecting their political interests as well as their epistemological and ontological positions (Mehta et al. 2016). This is particularly true for paradigms such as IWRM, which, although functioning as a consensual yet ambiguous boundary object, is often appropriated, reshaped, or even applied symbolically by actors to legitimize their agendas (Molle 2008). Several of the reviewed studies address this issue: for instance, Clement et al. (2017) discuss how IWRM discourse in Nepal has been used to obscure questions of social (in)justice related to water resource development, despite not being operationalized; Warner et al. (2017) show how IWRM and River Basin Management have been employed to justify and advance practices associated with the hydraulic mission in Ecuador; and Mehta et al. (2014) analyze how IWRM implementation in South Africa, Zimbabwe, and Mozambique has been shaped by both international donor agendas and domestic policy concerns, resulting in varied implementation practices.

At the beginning of this article, we framed paradigms as the source code of water governance. Our review indicates that attempts to introduce new paradigms into water governance systems, often driven by the aim of achieving more sustainable outcomes, are frequently met with resistance. This is primarily because existing institutions, often rooted in older paradigms, tend to persist and resist change. Furthermore, even when new paradigms are introduced, they may be articulated in diverse ways depending on the political, epistemological, and ontological positions of the actors involved. Although we examined whether the reviewed studies assess the actual outcomes resulting from the introduction of new paradigms, we found relatively few instances in which such evaluations were conducted. This gap in the literature may reflect the practical and political challenges associated with implementing the approaches aligned with new paradigms.

Problematizing paradigms in water governance research

The results of our review reveal that most studies adopt a critical perspective on water governance paradigms, as evidenced by the substantial number of articles offering critical analyses or addressing power imbalances. A small proportion of studies present paradigms as either success or failure stories, suggesting that the overall discourse is not entirely biased for or against paradigms. This indicates a relatively balanced perspective across the literature.

However, we also observe that only a limited number of studies explicitly consider the implications of adopting specific paradigms, as reflected in the small subset of publications that examine their actual effects. Additionally, we identify the lack of a common term to denote a "paradigm," with a wide variety of terms used across studies. As a result, many relevant publications may not have appeared in our search results because they do not explicitly label the concept being studied as a paradigm. In many of these cases, paradigms are implicitly assumed and rarely interrogated, mirroring patterns found in much of the practical discourse.

Problematizing paradigms by bringing them to the forefront of analysis, explicitly questioning their assumptions and implications, exploring viable alternatives, and establishing clearer, more consistent terminology is essential for deepening our understanding of their real-world impacts. Doing so also supports greater reflexivity among both scholars and practitioners engaging with water governance paradigms.

Limitations and future research

One limitation of this study is the restriction to English-language academic articles. We acknowledge that exploring regional debates published in other languages, including those from the Global South, as well as incorporating other forms of literature such as books, book chapters, and gray literature would provide valuable insights. However, such an approach falls beyond the scope of our review. This exclusion may affect the representation of certain paradigms and the frequency with which they are discussed in the broader literature. Limiting our analysis to academic publications also constrains our ability to examine deeper structural factors such as financial flows and power imbalances that influence the emergence and decline of paradigms. We see significant potential for future studies to broaden this scope and offer a more comprehensive understanding of water governance paradigms that may currently be underrepresented.

We also acknowledge a limitation in our search strategy related to the use of terms associated with paradigms. While our review identified a wide array of terminology used to describe paradigms, we deliberately focused on those primarily employed in the governance literature to conceptualize paradigms, for example, "paradigms" (Hall 1993, Pahl-Wostl et al. 2006), "imaginaries" (Jasanoff and Kim 2015), and "policy ideas" (Daigneault 2014). This selective approach, grounded in key discussions within the field, may have excluded studies in which alternative terminology is more common or in which the name of a paradigm is used without reference to any broader conceptual label. Nonetheless, this focus was necessary to maintain coherence with our research objectives and to account for time and resource constraints. Future research could expand on this work by exploring the broader spectrum of terms used across disciplines, thereby capturing a more diverse and inclusive understanding of governance paradigms.

Importantly, our study focused primarily on papers that analyze paradigms as the unit of analysis, rather than directly examining the paradigms themselves. While this approach provided valuable insights into the literature on paradigms, it may not fully capture the nuanced complexities inherent in the paradigms themselves. Therefore, future research could directly investigate the paradigms discussed in these studies, potentially through comparative analyses, to develop a more comprehensive understanding of their characteristics and implications. Our review establishes a repository with significant potential for researchers aiming to conduct more detailed investigations into specific paradigms or particular aspects thereof, such as distinct stages in the lifecycle of paradigms or their effects. Additionally, it offers a valuable foundation for comparative analyses of various paradigms and facilitates the exploration of nuanced dimensions that warrant further examination.

CONCLUSION

This systematic review examines what we currently know about water governance paradigms and how they are studied in the literature. A review of 100 studies reveals multiple paradigms discussed in the literature, with the "integrated approach to governing water" emerging as the most prevalent, followed by paradigms centered on the "state-centric/command-and-control approach" and "adaptive governance/management." This dominance raises questions about the plurality of perspectives in the literature and the overshadowing of alternative ontologies.

The promotion and implementation of water governance paradigms are driven primarily by governmental actors, along with international organizations, which also play important roles in promotion. However, our review highlights the discrepancy between promoted paradigms and contextual realities. Paradigms often disregard the local context in which they are implemented, leading to challenges in effective implementation exacerbated by the problem of layering.

Our review reveals areas for advancing the problematization of paradigms within the water governance discourse. Although many studies take a critical view of paradigms, few studies have examined their effects. Furthermore, the lack of common terminology to indicate paradigms poses a challenge for comprehensive literature reviews.

Moving forward, future research should expand beyond language and publication limitations to explore regional debates and incorporate diverse forms of literature. Furthermore, a direct examination of the paradigms themselves is necessary to gain a comprehensive understanding of their characteristics and implications, thus contributing to a more nuanced discourse on water governance. We hope that this review contributes to an improved understanding of water governance paradigms and will serve as a catalyst for further research in this field, fostering increased scholarly engagement and facilitating additional work on this crucial topic.

Author Contributions:

Shahana Bilalova: conceptualization, data curation, methodology, formal analysis, investigation, visualization, writing – original draft, writing – reviewing and editing. Nicolas W. Jager: conceptualization, methodology, formal analysis, investigation, visualization, writing – original draft, writing – reviewing and editing. Jens Newig: conceptualization, data curation, methodology, investigation, writing – reviewing and editing. Dave Huitema: conceptualization, investigation, writing – original draft, writing – reviewing and editing. Johanna Koehler: conceptualization, investigation, writing – reviewing and editing.

Acknowledgments:

We thank three student assistants, Aimen Abbas, Antonia Polheim, and Josefa Beyer, for their support with the screening and coding of the papers. We also thank the Paradigms group in the NEWAVE project for their help during the test rounds and for providing valuable feedback. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement 861509 - NEWAVE.

Data Availability:

The data and code that support the findings of this study are available on request from the corresponding author.

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Appendix 1. List of included publications

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Appendix 2. Coding scheme

Bibliographical information

1. Title
2. Authors
3. Sex of first author (m / f / neither or unclear)
4. Country of first author affiliation
5. Institution of the first author
6. Year
7. Type (journal article, book, book chapter)
8. Source title (e.g. journal name)
9. Funding (if applicable): Funding organization, project title and grant no.

General characteristics of publication

10. Nature of research (0, .5, 1): theory development and operationalization; theory testing/confirmation/disconfirmation; empirical research; review; critique; other.
11. Epistemological stance: positivist (0...1), constructivist (0...1)
12. Major conceptual basis, if any (e.g. "power dynamics", "post-colonialism", "policy diffusion", "collaborative governance", etc. multiple possible): text field
13. Research aim / question: text field (as succinct as possible. If possible, copy-paste from publication, otherwise paraphrase)
14. Identified need(s) for further research: text field (as succinct as possible)

Water governance paradigm(s)

15. Names of all paradigms addressed in the paper (sorted by relevance, starting with most relevant): text field
16. Term(s) used for treating paradigms (e.g. paradigm, narrative, imaginary, idea, discourse): text field
17. Does the empirical study have a geographical focus relevant to the studied paradigm(s)? yes/no.
18. If the empirical study has a geographical focus, name the relevant geographical scale(s): Local, sub-national, national, transboundary, continental, international, global
19. World regions (governance) (main focus): Select all that apply. For country classification according to World Bank regions, see https://datahelpdesk.worldbank.org/knowledgebase/articles/906519:
    a. Europe and Central Asia
    b. North America
    c. Latin America and Caribbean
    d. Middle East and North Africa
    e. Sub-Saharan Africa
    f. East Asia and Pacific
    g. South Asia
20. Do the studied paradigms, in the light of the publication, clearly mention water-related problems and their causes? 0 = no; 0.5 = to some extent; 1 = yes, clearly mentioned.
21. Do the studied paradigms, in the light of the publication, clearly mention governance solutions? 0 = no; 0.5 = to some extent; 1 = yes, clearly mentioned.
22. Does the paper analyze actors promoting certain paradigms? 0 = no; 0.5 = to some extent; 1 = yes, clearly mentioned.

23. If yes, to what extent does the paper focus on the following actor groups who are promoting paradigms:
    Government actors (0= not at all, 0.5= mentioned, but not focus, 1= focal actor, I do not know /Unclear):
    administration; international organisations; INGOs; civil society; community/citizens; private actors (business, agriculture); multinational corporations; science; others
24. Timeframe of empirical study (begin year; end year); Text field
25. Does the paper study the origins of the studied paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
26. Does the paper study the spread or diffusion of the studied paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
27. Does the paper study shifts of one paradigm to another (in the given empirical context)? 0 = no; 0.5 = to some extent; 1 = yes, with details.
28. Does the paper study significant changes within paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
29. Does the paper explicitly address the issue that a paradigm is only 'used' in a hollow, merely symbolic sense? (0, 0.5, 1)
30. Does the paper study 'counter-paradigms' in the sense that is designed in opposition to another one? 0 = no; 0.5 = to some extent; 1 = yes, with details.
31. Does the paper study how paradigms change concrete governance structures and practices? 0 = no; 0.5 = to some extent; 1 = yes, with details.
32. To what extent are the following governance modes studied? (as defined in Driessen et al. 2012): Centralized governance (0 = no; 0.5 = to some extent; 1 = yes, with details); Decentralized governance; Public-private governance; Interactive governance; Self-governance
33. With regards to these governance modes, to what extent does the paper focus on the following actor groups:
    Government actors (0= not at all, 0.5= mentioned, but not focus, 1= focal actor):
    administration; international organisations; INGOs; civil society; community/citizens; private actors (business, agriculture); multinational corporations; science; Indigenous; extra-terrestrial
34. Does the paper study social effects of paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details (which ones, e.g. social justice, equal access,..); Text field
35. Does the paper study environmental effects of paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details; Text field
36. Does the paper study economic effects of paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details; Text field
37. Does the paper tell a 'success story' of wg paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
38. Does the paper tell a 'failure story' of wg paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
39. Is the paper a critical account of wg paradigms? 0 = no; 0.5 = to some extent; 1 = yes, with details.
40. Does the paper consider power imbalances? 0 = no; 0.5 = to some extent; 1 = yes, with details.
41. Were any of the following evaluative criteria used (0 = no; 0.5 = to some extent; 1 = yes, with details; I do not know/Unclear): effectiveness (as regards environmental or sustainability aspects); effectiveness in a different sense; efficiency/ cost effectiveness; justice; legitimacy; accountability; acceptance; policy coherence; adaptability / adaptive capacity; resilience / robustness; other

42. Does the paper give policy recommendations? 0 = no; 0.5 = to some extent; 1 = yes, with details.