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Valuing water: A global survey of the values that underpin water decisions

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ABSTRACT

Valuing water is gaining popularity among policymakers and academics as a new water management paradigm. However, there is a lack of clarity about how to translate this paradigm into practice. We propose a multifaceted approach to *valuing water* that considers not just the values that people assign to water, such as its uses and benefits, but also broader personal guiding principles (e.g., security) and governance-related values (e.g., social justice) that underpin decision-making about water. Using an interdisciplinary conceptual framework and data from a global survey among water professionals (N = 293), we provide the first empirical evidence showing how preferences among three archetypical perspectives on water management – (1) controlling water flows through engineering solutions; (2) managing water through market-based mechanisms; (3) working with natural water ecosystems – can be explained by different types of values held by respondents, despite the enormous diversity among water management contexts around the world. The *valuing water* paradigm thus has an expressly political dimension to it; applying it makes explicit how water management decisions are informed by and may reinforce some values and weaken others. As such, it can be a useful diagnostic in the context of water conflicts, to help understand how decisions about water are linked to different stakeholder groups' values. *Valuing water* may thus involve balancing conceptually contrasting values and preferences. It also requires the development and application of mechanisms and institutions for effective stakeholder participation in decision-making, especially in the context of significant power differentials between relevant stakeholders.

1. Introduction

Water management is foundational to human civilisation, and human-water relationships have always contributed to shaping how societies operate (Wittfogel, 1957; Yevjevich, 1992; Boelens et al., 2016; Obertreis et al., 2016). In modern times, water management has been dominated by a series of evolving paradigms, including, but not limited to, an engineering paradigm associated with high modernism, an economic paradigm, associated, for example, with the 1992 Dublin principles, the more recent ecosystem services paradigm, as well as Integrated Water Resources Management (IWRM) and water-energy-food nexus thinking (Molle, 2008; Menga and Swyngedouw, 2018; Allouche et al., 2019; Fayiah et al., 2020; Alexandra and Rickards, 2021).

Valuing water – that is, recognising that decision-making about water is shaped by and affects people's plural values – is arguably the most recent paradigm. It is currently being formally endorsed by several international and national organisations (see Box 1) (Government of the Netherlands, 2019; Global Water Partnership, 2021; Stockholm International Water Institute, 2021; UN-Water, 2021). At its most basic level, *valuing water* can be understood as giving importance to water, that is, as a call for action to make decisions affecting water with greater care, in a situation where communities, economic activity, and nature make competing claims on water. However, understanding in what ways values are driving water-related decisions and how this affects water management remains a crucial challenge.

Through its broad appeal, *valuing water* may become a boundary concept, bringing together disparate groups of policymakers and researchers with complementary, and sometimes conflicting, agendas and backgrounds (Mollinga, 2008). Different proposals have already been

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made in the fields of water economics, policy studies, and ethics to respond to this emerging paradigm shift (e.g., Garrick, 2017; Hellegers and Van Halsema, 2019; Koundouri and Rulleau, 2019; Pigmans et al., 2019; Schmidt, 2020). However, there is a risk that *valuing water* does not bring about genuine change in the theory and practice of water policy and management, if it is merely used as a discursive tool to legitimate existing approaches, including the monetary valuation of water resources to determine water allocations (e.g., Koundouri and Rulleau, 2019).

In this paper, we approach the *valuing water* paradigm empirically and in an interdisciplinary way that includes insights from ecological economics and psychology (Maio, 2016; Schulz, Martin-Ortega, Glenk et al., 2017). We present findings from the first global survey of the values of water professionals, who take or influence decisions about water on a regular basis. Building on the *Value Landscapes Approach* (VLA) as our theoretical framework (Schulz, Martin-Ortega, Glenk et al., 2017; Schulz et al., 2018), we show how different perspectives on water management and policy are underpinned by a complex, interrelated set of values.[1]

The VLA is a structured approach that helps understand the *what, how*, and *why* of decision-making about water (see Fig. 1 for examples) (Schulz, Martin-Ortega, Glenk et al., 2017; Schulz, Martin-Ortega and Glenk, 2018). It does so through an analysis of (1) *assigned/water values*, which are concerned with preferences for the substantive outcomes of decisions for water (*what*) (Lockwood, 1999; Seymour et al., 2010); (2) *governance-related values*, which inform views on how (water) decisions ought to be taken (*how*) (Glenk and Fischer, 2010; Schulz, 2019); and (3) *fundamental values*, which are abstract, life-guiding goals of deep, personal importance that inform people's attitudes and actions across all arenas of life (*why*) (Schwartz, 2012; Maio, 2016). Together, these three layers form *value landscapes*, that is, combinations of various values that people endorse, and which shape their decision-making and views on *water governance* (Fig. 1) (Schulz, Martin-Ortega, Glenk et al., 2017; Schulz, Martin-Ortega and Glenk, 2018). *Water governance* is conceptualised here as a combination of water policy, water polity, and water politics, though our study has a primary focus on water policy preferences.

Pilot studies applying the VLA have shown how contrasting value landscapes may explain why some people prefer managing water to support environmental conservation as opposed to economic development, using the construction of physical water infrastructure as a case study (Schulz, Martin-Ortega, Ioris et al., 2017; Schulz, Martin-Ortega and Glenk, 2018, 2019). The present study builds on but goes beyond these earlier applications by (1) applying a global, rather than regional perspective on water governance; (2) considering a wide range of common water policy preferences, beyond the specific case of physical water infrastructure; and (3) using quantitative survey data from water professionals, as opposed to from citizens (Schulz, Martin-Ortega and Glenk, 2018, 2019). This approach thus strongly enhances the geographical and topical reach, as well as the robustness and practical relevance of our findings, since our respondents are involved in taking decisions about water on a daily basis around the globe.

Overall, our study sets out to: (1) identify various types of values that water professionals hold, using a combination of well-established and new measurement instruments, analysed through principal components analyses (PCAs); (2) identify archetypes or higher-order preferences for prominent water policy and management perspectives, using a comprehensive and newly developed list of statements on strategic priorities for the global water policy agenda, analysed using PCAs; and (3) demonstrate how values are interlinked within value landscapes to explain water policy preferences, using regression and mediation analyses. The analysis reveals, for the first time, how various types of values underpin water policy preferences around the world, and, in this sense, promotes an understanding of what *valuing water* means in practice. Data comes from an online survey conducted in 2021 with participants based in 57 countries, and from a diverse range of personal and professional backgrounds (N = 293).

We also discuss our findings in relation to earlier water management paradigms, in particular, the once-dominant engineering paradigm associated with high modernist thinking, the economic water management paradigm often associated with the 1992 Dublin Principles, and the more recent ecosystem services paradigm (see section 3.2). These earlier paradigms broadly mirror the archetypes of water policy preferences identified in our survey, suggesting that *valuing water* does not

Box 1
Valuing water within the global water policy agenda.

Several global water policy organisations have adopted *valuing water* as their management paradigm. They acknowledge that the values that shape and are affected by decisions about water are not adequately captured through monetary assessments underpinned by mainstream economics. A key milestone was the adoption of the "Five Valuing Water Principles" by the UN and World Bank-led High-Level Panel on Water in 2017, with one of its principles calling for "[recognising] and [embracing] water's multiple values to different groups and interests in all decisions affecting water"(High-Level Panel on Water, no date). Building on this, the 2021 UN World Water Development Report focused on the theme of "Valuing Water" (UN-Water, 2021), and the 2022 edition of the World Water Week conference hosted by the Stockholm International Water Institute featured the motto "Seeing the unseen: The value of water" (Stockholm International Water Institute, 2021).

The Global Water Partnership is another organisation that supports this paradigm shift through, for example, the organisation of "Valuing Water regional consultations" in South Africa, Tajikistan, Mexico, Bangladesh, and Peru (Global Water Partnership, 2021). In the Global North, the Government of the Netherlands has been particularly active, launching the "Valuing Water Initiative" at the World Economic Forum in 2019, which aims to "bring systemic change in the way water is valued in policy, practice, finance and behaviour" (Government of the Netherlands, 2019). These developments in the water arena mirror similar trends within wider global environmental governance, with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) developing novel integrated approaches for understanding and assessing diverse values related to the relationship between people and nature (Pascual et al., 2017; IPBES, 2022).

[1] We note that *water management* and *water policy* are often used near-synonymously, though *policy* may be best understood as providing a generic direction for decision-making, while *management* operationalises policy in a specific context.

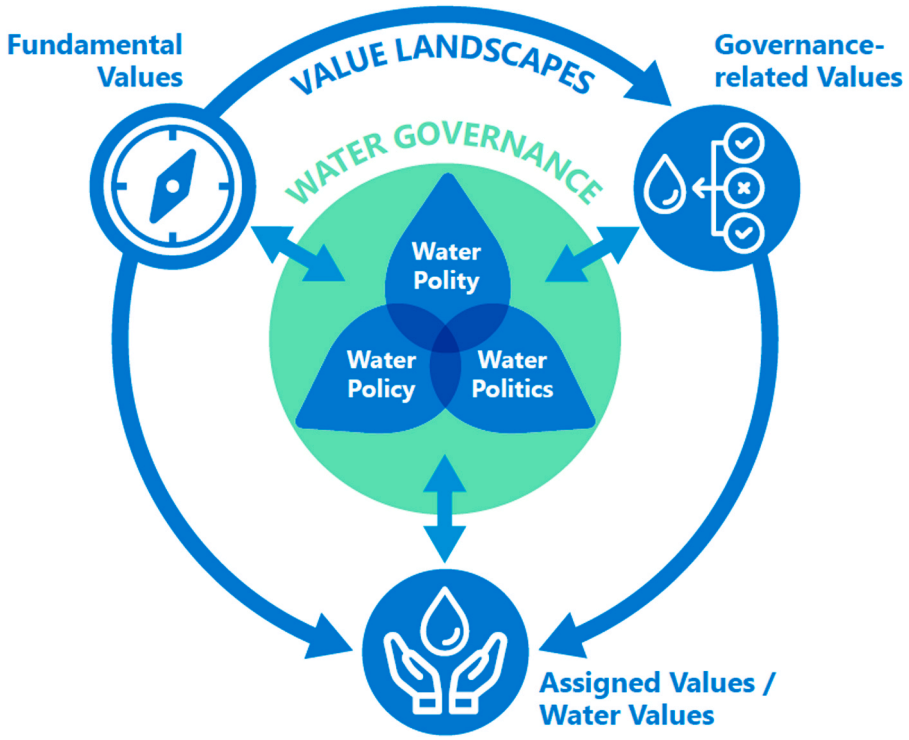

Fig. 1. The Value Landscapes Approach (VLA) for valuing water, adapted from Schulz, Martin-Ortega, Glenk, et al. (2017). *Assigned/water values* are the values that people assign to water, for example, for irrigation, hydroelectric energy, fish, cultural, or spiritual purposes, etc. *Governance-related values* describe desirable characteristics of water governance, such as efficiency, accountability, transparency, social justice, etc. *Fundamental values* include guiding principles that inform decisions across all arenas of life, personal and professional, such as benevolence, power, self-direction, security, etc. *Water governance* is understood as the combination of *water policy* (the content of decision-making), *water politics* (the power play between different actors), and *water polity* (the institutions within which decisions are being taken). *Value landscapes* may influence water governance, but existing water governance may also influence which value landscapes are held by relevant actors in a given context. Note that in this paper, we focus on the water policy component of water governance.

entail rejection of previous water management paradigms, but recognition that these are informed by values and may co-exist.

2. Materials and methods

2.1. Respondents

Participant recruitment occurred between July and November 2021 via open invitations on social media channels with a water focus and professional networks of the research team and their funders, including Stockholm World Water Week and Amsterdam International Water Week, to take part in a 20-minute online survey. The online survey was available to respondents in seven languages: Arabic, Chinese, English, French, Portuguese, Russian, and Spanish, aiming to facilitate global participation. Surveys were professionally translated and proofread by a native speaker with subject expertise. Participants did not receive compensation for their participation. See Fig. 2 for an overview of the geographical background of survey respondents.

Of the 488 responses we received, 300 responses were complete and 293 indicated they have a professional interest in water. We hence conducted all analyses on these 293 respondents (see Table 1 in the supplementary material for an overview of respondent demographics). As estimated in a sensitivity analysis (alpha level.05, two-tailed regression analyses), the sample provided us with 95 % power to detect effect sizes of at least $\beta = .21$ (i.e., small to medium; G*Power) (Faul et al., 2007).

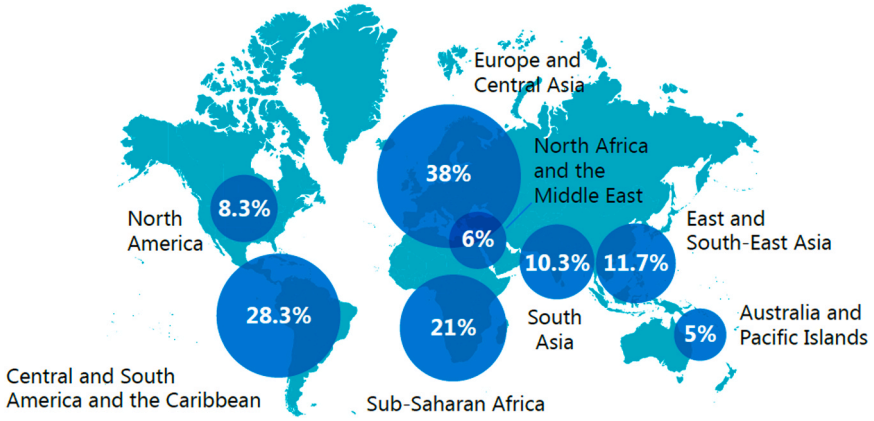

Fig. 2. World regions that respondents have worked in (multiple mentions possible).

After giving informed consent to participating in the study, respondents were asked to confirm their professional interest in water. They subsequently completed a scale assessing the importance of various *assigned/water values*, *governance-related values*, *fundamental values*, and their water policy preferences. The items of these scales can be found in the supplementary material (Tables 2–5). At the end of the survey, respondents indicated their demographic information.

2.2. Measures

We employed a total of 71 items to measure the three categories of values and the water policy preferences (see supplementary material for all items).

2.2.1. Assigned/water values

This scale presented ten items describing "*different uses or values of freshwater resources, rivers, and lakes*". This represents an expanded version of an earlier scale developed to measure *assigned/water values* to operationalise the VLA (Schulz, Martin-Ortega and Glenk, 2018). Unlike the earlier scale, the present scale is not geographically specific and includes four additional items, to allow a more fine-grained PCA. Example items are: "*assets for economic development*", "*places of beauty*", and "*habitats for aquatic animals and plants.*" Respondents indicated how important each *assigned/water value* is to them on a 9-point scale from –1 (*opposed to my views*), to 0 (*not important*), 3 (*moderately important*), 6 (*very important*), and 7 (*of supreme importance*). This response scale was adopted from the Schwartz Value Survey (Schwartz, 1992). See Table 2 in the supplementary material for a full list of items.

2.2.2. Governance-related values

We assessed *governance-related values* using 14 items that described "*14 principles for water governance and management*". This list of items was newly compiled for the purposes of this survey, since previous research on *governance-related values* has been relatively limited (Glenk and Fischer, 2010; Schulz, 2019). The intention was to capture as broad a range of *governance-related values* as possible (while mindful of overall survey length), building on, but going beyond previous applications of the VLA. Example items are: "*Economic efficiency (solutions that offer best value for money)*" and "*Intergenerational justice (prioritise future generations' needs)*". Respondents indicated how important each *governance-related value* is to them on the same 9-point scale as for *assigned/water values*. See Table 3 in the supplementary material for a full list of items.

2.2.3. Fundamental values

We assessed *fundamental values* using a shortened 21-item Schwartz Value Scale (Schwartz, 1992). The items included five *self-transcendence values* (e.g., "*Helpfulness - helping family and friends*"), four *self-enhancement values* (e.g., "*Success - achieving one's goals*"), six *openness to change values* (e.g., "*Curiosity - being interested in everything, exploring*"), and six *conservation values* ("*Social order - having a stable society*"). Respondents indicated how important each value is to them personally on the same 9-point scale as for *assigned/water values*. See Table 4 in the supplementary material for a full list of items.

2.2.4. Water policy preferences

Respondents evaluated 13 pairs of statements about water policy, with statements in a pair addressing one broader issue. The intention was to capture as broad a range of views on strategic priorities for the global water policy agenda as possible, informed by recent research identifying such priorities (Mdee et al., 2022). Topics included common and frequently debated water management strategies such as private versus public provision of water services (Bhattacharyya, Parker and Raffiee, 1994; Estache and Rossi, 2002; García-Rubio, Tortajada and González-Gómez, 2016), approaches to irrigation (García-Ponce et al., 2013; Giannakis et al., 2016; Yedra et al., 2016; Pérez-Blanco et al., 2021), water conservation strategies under conditions of scarcity (Aleisa and Al-Zubari, 2017; Rakotovao et al., 2022; Hirwa et al., 2023), uses of financial incentives (Martin-Ortega, Ojea and Roux, 2013; Yuan, Lo and Chiueh, 2019; Grafton, Chu and Wyrwoll, 2020), construction of water infrastructure (Kay et al., 2024; Rowe, 2011; Schulz and Adams, 2021), addressing runoff and water pollution (Carpenter et al., 1998; Cox, Sarangi and Madramootoo, 2006; Awaleh et al., 2022; Wilkinson et al., 2022), or addressing water-related hazards, including flood risks (McGree et al., 2014; Bark, Martin-Ortega and Waylen, 2021; Roopnarine et al., 2021; Tafel et al., 2022). For example, one statement pair focusing on flood risk management consisted of the statements: "*Flood risk management should focus on nature-based solutions*", and "*Flood risk management should focus on civil engineering solutions.*" No more than two pairs were shown on each page. Respondents answered all items on a 9-point scale from –4 (strongly disagree) to 0 (neither agree nor disagree) and +4 (strongly agree). See Table 5 in the supplementary material for a full list of items.

2.3. Data analysis

We employed three different data analysis methods, that is: (1) principal components analyses (for *assigned/water values*, *governance-related values*, and water policy preferences); (2) regression analyses (to test for associations between values and water policy preferences); and (3) mediation analyses (to test whether associations between *fundamental values* and water policy preferences can be explained by *assigned/water values* and *governance-related values*). Full details for regression analyses and mediation analyses are provided in the supplementary material.

2.3.1. Principal components analyses

For each of the scales assessing *assigned/water values*, *governance-related values*, and water policy preferences, we conducted a principal components analysis with varimax rotation. The purpose of this method is to identify clusters of items that intercorrelate highly, thus helping to summarize or reduce the number of items. These clusters or components can then be understood as conceptual sub-dimensions within each category of values. We used the Kaiser's criterion and inspected the scree plot to determine the number of components for each scale (Costello and Osborne, 2019). Items were included in a component if they loaded at least .40 and had low cross-loadings on other components (>.20 difference in item's loadings).

For *assigned/water values*, the analysis suggests three components that together explain 60.69 % of the variance. Four items load on a *cultural* component, three items load on an *economic* component, and two items load on an *environmental* component. The *cultural* component explains 32.93 % of the variance, the *economic* component explains 17.15 % of the variance, and the *environmental* component explains 10.61 % of the variance. One additional item ("*Sources of livelihoods to people in rural communities*") loads equally strong on the *cultural* and *economic* components and was excluded. See Table 2 in the supplementary material for the item loadings of *assigned/water values*.

For *governance-related values*, the analysis suggests two components that together explain 43.61 % of the variance. Eight items load on a *social justice* component and five items load on an *efficiency* component. The *social justice* component explains 32.20 % of the variance and the *efficiency* component explains 11.41 % of the variance. One additional, item, clarity, loads equally strong on both components and was excluded. See Table 3 in the supplementary material for the item loadings of *governance-related values*.

For water policy preferences, the analysis suggests three components that together explain 32.47 % of the variance. Seven items load on a *mastering nature* component, four items load on a *working with nature* component, and five items load on a *market-based water management* component. The *mastering nature* component explains 13.49 % of the variance, the *working with nature* component explains 10.48 % of the

variance, and the *market-based water management* component explains 8.50 % of the variance. Eight items had loadings below .40, and two items showed cross-loadings; these ten items were dropped from further analysis. See Table 5 in the supplementary material for the item loadings of water policy preferences.

2.3.2. Regression analyses

We conducted nine regression analyses in total, each using one of the three water policy archetypes as the outcome (i.e., *mastering nature*, *working with nature*, or *market-based water management*), and using one of the three types of values as predictors (*assigned/water values*, *governance-related values*, *or fundamental values*). We used simultaneous multiple regression analyses to test whether the water policy archetypes can be explained, in part, by the various categories of values. A detailed overview of regression analyses is provided in the supplementary materials S9-S11.

2.3.3. Controlling for age and gender

We tested whether the inclusion of participant age and gender (restricted to binary) as additional predictors would account for some of the variance explained by the *assigned/water values*, *governance-related values*, or *fundamental values*. All links between the different value types and water policy preferences were unchanged by the inclusion of participant age and gender. Thus, although previous research has suggested that women and younger respondents are more likely to favour more ecologically oriented decisions (Gifford and Nilsson, 2014; Kennedy and Kmec, 2018), according to our data, this pattern does not account for the influence of values on water policy preferences.

2.3.4. Mediation analyses

We conducted mediation analyses using PROCESS bootstrapped models with 5000 iterations (Hayes, 2018). This method allows us to test the interrelationships between multiple categories of values in predicting individuals' water policy preferences, in accordance with our conceptual framework (see Fig. 1). Each analysis tested whether one of the significant links identified between *fundamental values* and water policy preferences was mediated or explained by the potential mediators *assigned/water values* and *governance-related values*, in line with previous applications of the VLA using structural equation modelling (Schulz, Martin-Ortega and Glenk, 2018, 2019). Each analysis included the respective other *fundamental values* as covariates and entered all three *assigned/water values* and two *governance-related values* as simultaneous mediators. A detailed overview of the mediation analyses is available in the supplementary material S12.

3. Results

3.1. Which types of values do water professionals hold?

As per our conceptual framework (Fig. 1), we consider three categories of values in our analysis.

First, *what* values do water professionals assign to water? For such *assigned/water values* (Lockwood, 1999; Seymour et al., 2010), the PCA identifies three main types of values. *Economic water values* include uses of water for economic development or agricultural production. *Environmental water values* encompass the values assigned to waterbodies as habitats for animals and plants or for supporting natural environments. *Cultural water values* include the values assigned to waterbodies as places of beauty and recreation or for shaping our identity. A repeated measures ANOVA finds that *environmental water values* are rated as most important by respondents, with no significant difference between the lower-ranked *cultural* and *economic water values*.

Second, *how* should we take decisions about water? For *governance-related values*, that is, general principles for reaching good water governance (Glenk and Fischer, 2010; Schulz, 2019), findings from the PCA indicate that there are two predominant value types amongst survey respondents. The first type focuses on the *efficiency* of water governance which includes values such as competition, economic efficiency, and simplicity. The second focuses on the *social justice* of water governance, including values such as citizen participation, transparency, and accountability (Fig. 3). A paired-samples t-test shows that *social justice* is attributed with overall higher importance than *efficiency* by respondents.

Third, *why* do water professionals hold certain values and preferences? For *fundamental values*, we employ the well-established Schwartz theory of basic human values, which conceptualises *fundamental values* as abstract, general guiding principles in people's lives, organised along two orthogonal dimensions (Schwartz, 2012; Maio, 2016). In the first dimension, *self-enhancement values* (e.g., power) are contrasted with *self-transcendence values* (e.g., benevolence); in the second dimension, *openness to change values* (e.g., freedom) are contrasted with *conservation values* (e.g., security). We employ these four types as part of our analysis of value landscapes below. Previous applications of the VLA have shown that *fundamental values* are important explanatory variables within value landscapes (Schulz, Martin-Ortega and Glenk, 2018, 2019).

3.2. Which policy preferences do water professionals have?

A PCA identifies three dominant perspectives on strategic priorities for water policy among water professionals. We refer to these as archetypes, and they include: *mastering nature*, *market-based water management*, and *working with nature*.

First, the *mastering nature* archetype refers to a preference for managing water via active interventions, such as technological solutions, civil engineering, new legislation, or payments of financial incentives. This archetype has its roots in the engineering paradigm for water management that has been predominant from the mid-19th century onwards, which also emphasises control over nature through human intervention, informed by compartmentalised expertise in individual disciplines such as hydrology, ecology, and civil engineering (Swyngedouw, 1999; Molle, Mollinga and Wester, 2009).

With a focus on technical solutions, the engineering paradigm closely aligns with visions for the state shaped by high modernism, that is, an indefatigable belief in scientific progress, often realised through grand engineering projects such as large dams and irrigation systems (Wester, 2009; Schulz and Adams, 2022). Recent research suggests that high modernism continues to inform water management particularly in the Global South (Mohamud and Verhoeven, 2016; Sanchez, 2020), while its influence may have declined in the Global North (Randle, 2021).

Second, the *market-based water management* archetype refers to a preference for managing water via payments, private service providers, and water markets, that is, entrusting market mechanisms with water allocation where possible. We argue that this archetype has its intellectual roots in the economic paradigm for water management that has gained ground from the 1980s onwards (Molle, 2008), culminating in the formal recognition of water as an economic good in the 1992 Dublin Principles (Warner, Bindraban and Van Keulen, 2006). The economic paradigm conceptualises water as a scarce resource (in quantity, quality, or access), emphasising that rules about its management need to be established that ensure allocation is efficient (Berbel, Gutiérrez-Martín and Martin-Ortega, 2017; Bajaj, Singh and Nayak, 2022; Grafton et al., 2023).

This economic framing combines well with privatisation, marketisation, and, potentially, commodification of water-related public services (Bakker, 2003; Castro, 2013; Hernández-Mora and Del Moral, 2015), mirroring the *market-based water management* archetype, although it is worth acknowledging the diversity of institutions that may manage water as an economic good, from the state to the commons to markets (Ostrom, Stern and Dietz, 2003). In the present, this archetype may express itself in the increasing use of 'green' financial instruments in the provision of urban water services (Klink, Empinotti and Aversa, 2020; Bayliss, Van Waeyenberge and Bowles, 2023), water-related

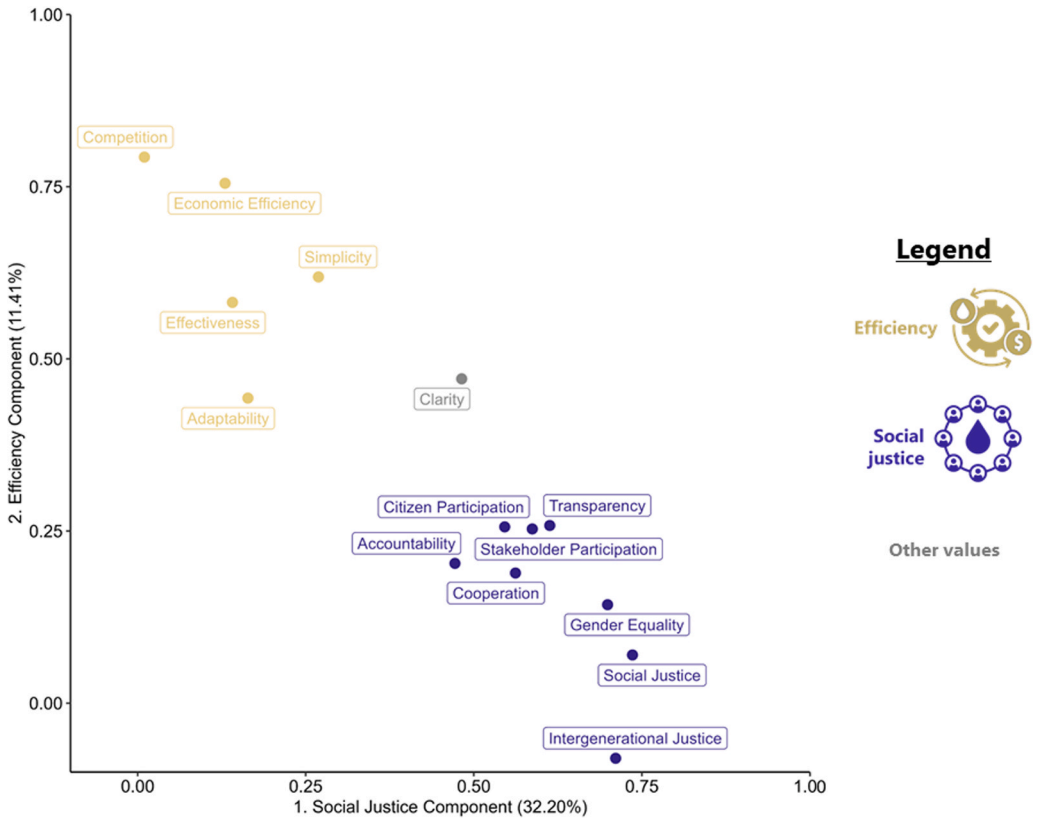

Fig. 3. Principal components analysis (PCA) of *governance-related values*. Each dot represents one *governance-related value*. Entries with the same colour were rated in a similar way by respondents, suggesting that they are conceptually similar. We labelled the two components identified in our survey data accordingly as *efficiency* and *social justice governance-related values*.

ecosystem services (Moxey et al., 2021; Crockford, 2022), or for the construction of irrigation and energy infrastructure (Poberezhna, 2018; Lu et al., 2023).

Third, the *working with nature* archetype refers to a preference for humans to reduce their collective impact on waterbodies, for example, through nature-based solutions, water conservation and energy saving, or creating awareness for best land management practices to avoid, e.g., diffuse water pollution. This emphasis on benefits from water ecosystems is shared with the ecosystem services paradigm, which has become dominant in the global water policy agenda since the early 2000s, following trends in wider natural resource governance, in particular, the publication of the Millennium Ecosystem Assessment report in 2005 (Millennium Ecosystem Assessment, 2005; Martin-Ortega et al., 2015).

The ecosystem services concept was initially employed to demonstrate economic benefits of nature, often in conjunction with monetary valuation techniques, building on the earlier economic paradigm. This has attracted criticism for enabling the development of market environmentalism under a neoliberal agenda (Bakker, 2014). However, the ecosystem services paradigm has also helped shift attention towards the ecological complexity of water ecosystems, water quality, biodiversity, and climate change (Aznar-Sánchez et al., 2019). More recently, there has been exponential growth in research on nature-based solutions and blue-green infrastructure for water management (Quin, Jaramillo and Destouni, 2015; UN-Water, 2018; Oral et al., 2020; Bark, Martin-Ortega and Waylen, 2021). Conceptually, nature-based solutions are typically understood as engineering interventions that work with elements of the natural infrastructure that provides ecosystem services (often combining green and grey infrastructure) (Anderson et al., 2022); this involves a re-orientation towards working with natural features and away from an exclusive focus on civil engineering (Balzan et al., 2021), and can thus be seen as a manifestation of the *working with nature* archetype.

A repeated measures ANOVA shows that the three archetypes differ significantly from each other in mean ratings of preference, with *working with nature* being preferred over *mastering nature* and *market-based water management*. Respondents also give higher preference to *mastering nature* over *market-based water management*. These findings may indicate a preference for *working with nature* as a prominent concept in recent water policy debates (UN-Water, 2018).

3.3. How do values underpin water policy preferences? Configuring value landscapes

Findings from regression analyses demonstrate how the four types of *fundamental values* (i.e., *self-transcendence*, *self-enhancement*, *openness to change*, *conservation*), the two types of *governance-related values* (i.e., *social justice*, *efficiency*) and the three types of *assigned/water values* (i.e., *cultural*, *economic*, *environmental*) serve to explain water policy preferences as represented by the three archetypes (*mastering nature*, *market-based water management*, and *working with nature*) - see Fig. 4.

Regression analyses (Fig. 4) suggest a pattern in which *mastering nature* and *market-based water management* are both explained by similar values: *economic water values*; *efficiency values*; *self-enhancement values*. In contrast, *working with nature* is explained by conceptually contrasting values: *environmental water values*; *social justice values*; *self-transcendence values*. Further, *conservation values* explain a greater preference for *mastering nature*, suggesting that seeking to control water resources is underpinned by a desire of protection and security.

Findings from more complex mediation analyses (Figs. 5–7) complement these results by testing whether *assigned/water values* or *governance-related values* can account for the association between fundamental values and water policy archetypes. The mediation analyses show that water professionals who prioritise *self-transcendence values* support *working with nature* because they focus on *environmental water values*, and because they prioritise *social justice* as a *governance-*

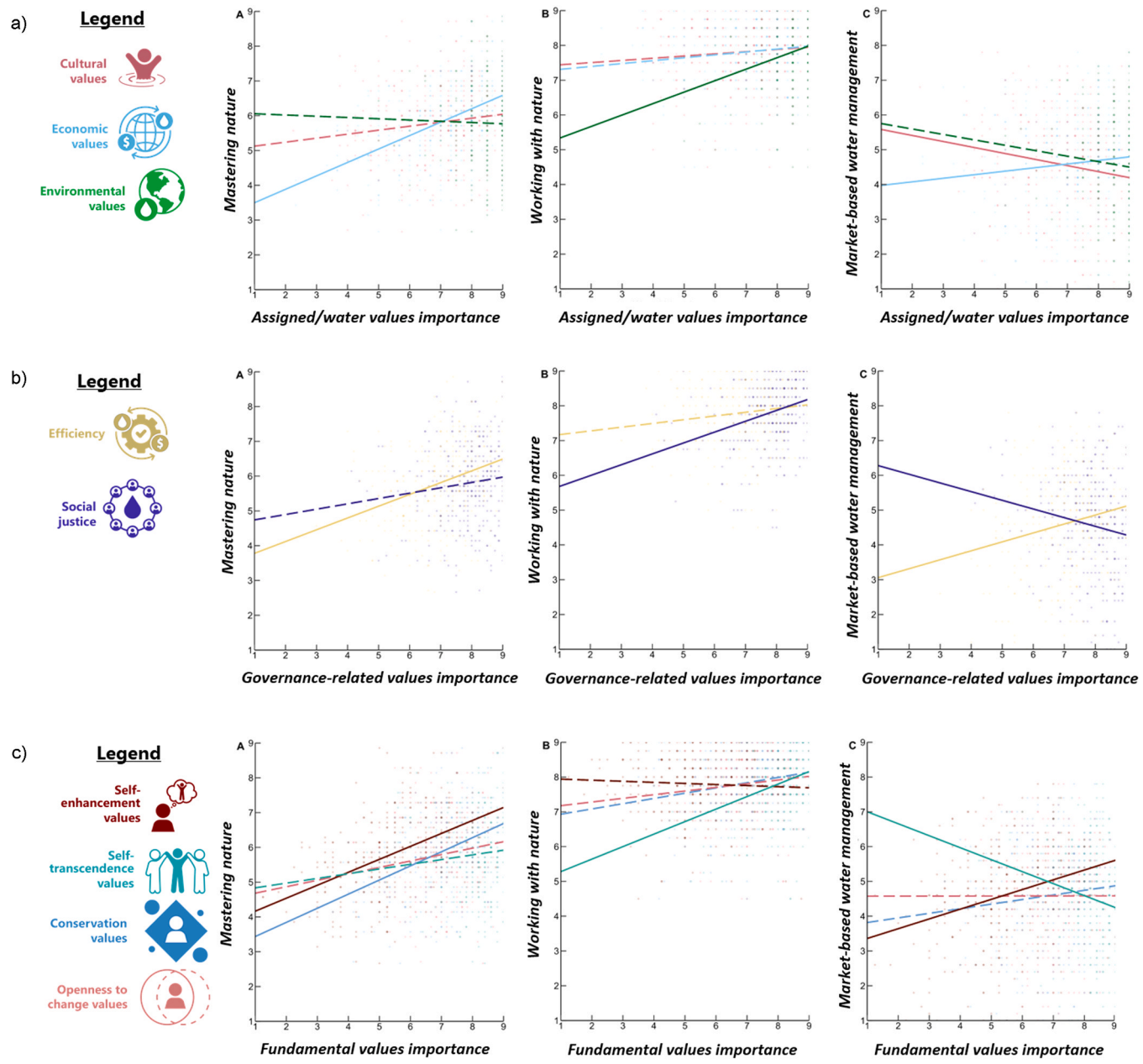

Fig. 4. Regression analyses. Three archetypical water policy preferences identified in our survey (*mastering nature*; *working with nature*; *market-based water management*) are explained by a total of nine value types within three value categories (from top to bottom: a) *assigned/water values*; b) *governance-related values*; c) *fundamental values*). Statistically significant links are shown through solid lines, non-significant links through dashed lines. The pattern suggests some overlap between values explaining support for *mastering nature* and *market-based water management* (both are explained by *economic water values*; *efficiency values*; *self-enhancement values*), while a preference for *working with nature* is explained by conceptually contrasting values (*environmental water values*; *social justice values*; *self-transcendence values*).

related value (Fig. 5). We suggest that these findings for the *working with nature* archetype might be indicative of a value landscape rooted primarily in other-oriented motives, mediated by conceptually related *governance-related* and *assigned/water values*.

Water professionals who prioritise *self-enhancement values* support the *mastering nature* archetype because they focus more on *economic* and less on *environmental water values* (Fig. 6a). Moreover, those who prioritise *conservation values* also support *mastering nature* because they assign *economic values* to water (Fig. 6b). We also find that those who prioritise *self-enhancement values* prefer *market-based water management* because they value *efficiency* (Fig. 7).

We suggest that these findings for the *mastering nature* and *market-based water management* archetypes might be indicative of the existence of a value landscape rooted primarily in self-oriented motives, mediated by conceptually related *governance-related* and *assigned/water values*. Jointly conceptualising the findings shown in Figs. 6 and 7 as one (rather than multiple) value landscapes would be consistent with previous applications of the VLA which found that *self-enhancement* and *self-transcendence values* can be considered as the *fundamental values* that most strongly explain conceptually contrasting *governance-related, assigned/water values*, as well as related water policy preferences (Schulz, Martin-Ortega and Glenk, 2018, 2019).

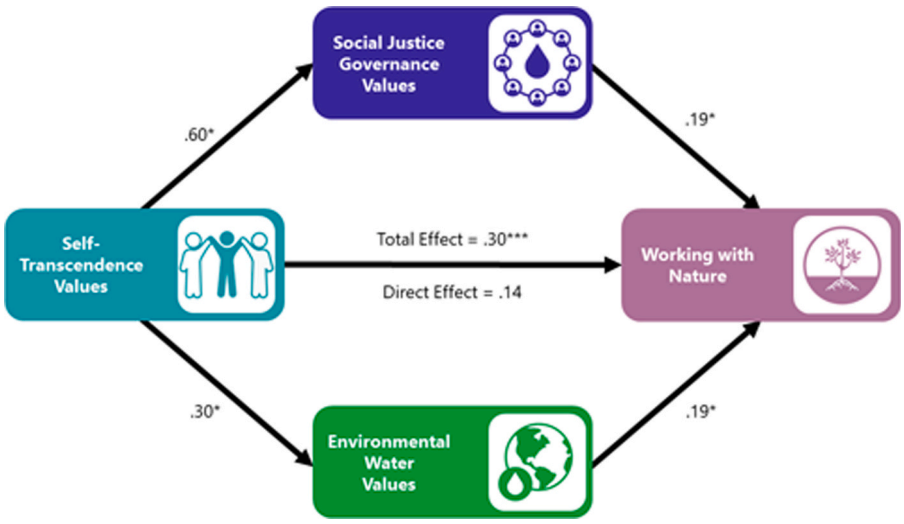

Fig. 5. Mediation analysis showing which values inform a preference for *working with nature*. These findings suggest a value landscape that is rooted in *self-transcendence values*, explaining support for *working with nature* through a concern about *environmental water values* and *social justice*. Only statistically significant paths are shown. Direct effects differ from total effects since they also control for the influence of *assigned/water values* and *governance-related values*.

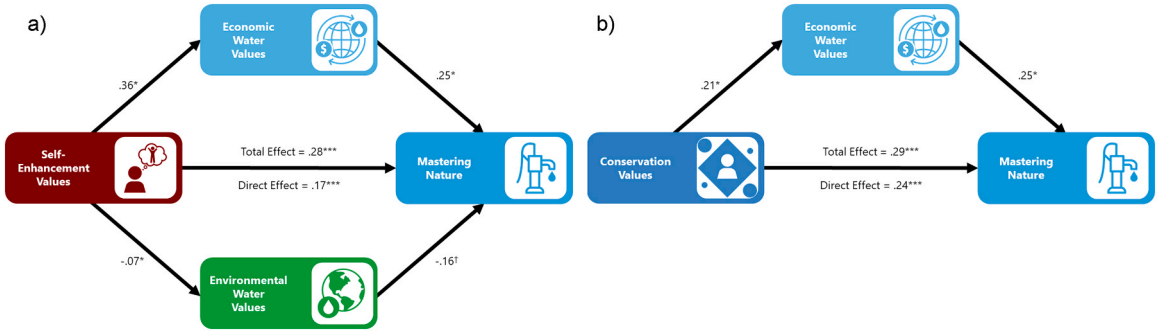

Fig. 6. Mediation analyses showing which values inform a preference for *mastering nature*. These findings suggest a value landscape that is rooted in *self-enhancement* and *conservation values*, explaining support for *mastering nature* through prioritising *economic* over *environmental water values*. Only statistically significant paths are shown. Direct effects differ from total effects since they also control for the influence of *assigned/water values* and *governance-related values*.

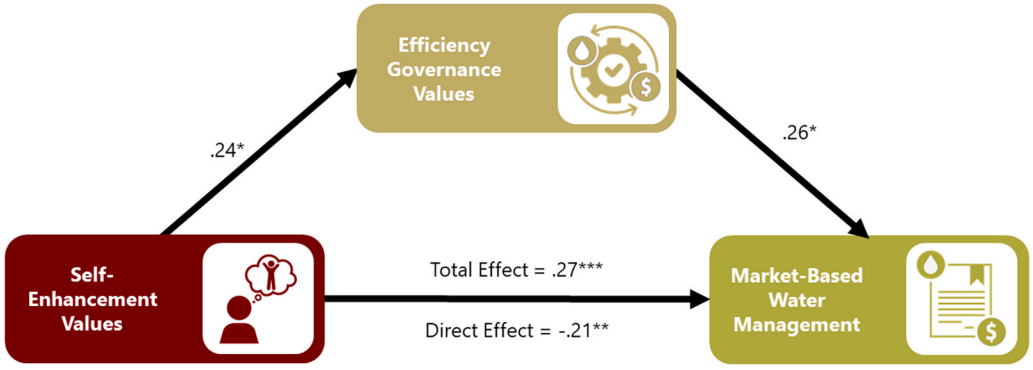

Fig. 7. Mediation analysis showing which values inform a preference for *market-based water management*. These findings indicate a value landscape that is primarily rooted in *self-enhancement values*, explaining support for *market-based water management* through a greater focus on *efficiency*. Only statistically significant paths are shown. Direct effects differ from total effects since they also control for the influence of *assigned/water values* and *governance-related values*.

4. Discussion

4.1. Value landscapes explain water policy preferences

Our findings suggest that despite the enormous variety of locally specific water management contexts, it is possible to identify general patterns with regards to how water is valued and how decisions about water are informed by values. This represents a significant, novel contribution of our research, made possible by the global nature of our sample. Although previous research using survey data from citizens at the river basin level had established that making such links between various layers of values and water policy preferences is, in principle, possible (Schulz, Martin-Ortega and Glenk, 2018, 2019), the survey results presented here are the first empirical evidence of how global

archetypes in the water policy preferences of professional respondents can be explained by their priorities among *fundamental*, *governance-related*, and *assigned/water values*.

In particular, the findings suggest that the contrast between *self-transcendence* and *self-enhancement values* is crucial to the understanding of different water policy preferences, given how *self-transcendence values* inform a preference for *working with nature* whereas *self-enhancement values* explain support for both *mastering nature* and *market-based water management*. While the relevance of such *fundamental values* for understanding decision-making has long been known (Maio, 2016), ours is the first study that shows how their influence on water policy preferences is mediated via other types of conceptually related values (i.e., *governance-related* and *assigned/water values*) among professional respondents.

Previous research on *governance-related values* has been comparatively limited, with one study evaluating the impact of five such values (Glenk and Fischer, 2010) and another evaluating seven (Schulz, 2019). Our study thus represents the most comprehensive assessment of the empirical relationship between various *governance-related values* to date. Our finding that *governance-related values* fall into the two broad types of *social justice* versus *efficiency* is novel and noteworthy. Practitioners will recognise the dilemma between making water governance participatory, inclusive, and socially just, etc. on the one hand, while seeking to maximise its efficiency and simplicity, on the other hand. Organisations such as the Global Economic Commission on Water, which seek to enhance both values simultaneously, will need to consider whether efficiency is always compatible with social justice and whether, as they claim, water markets can indeed lead to enhanced equity and social justice (Global Commission on the Economics of Water, 2023).

Based on the findings from the PCA, we have classified *assigned/water values* as *cultural*, *economic*, and *environmental*, but many other ways of classifying *assigned/water values* exist, including the ecosystem services framework (Martin-Ortega et al., 2015). The classification used here is deliberately broad to match the global nature of our survey, but it is possible to classify *assigned/water values* differently, for example, to match local culture and worldviews or to better account for local physical geographies (Schulz, Martin-Ortega and Glenk, 2018).

4.2. Implications of water policy archetypes for valuing water

The three archetypes of *mastering nature*, *market-based water management*, and *working with nature* broadly align with previous paradigms that have shaped the history of water management but continue to evolve and exert influence until the present day. These overlaps suggest that adopting *valuing water* as a paradigm for water management does not imply rejection of previous paradigms, but rather the recognition that they co-exist and that their application needs to be negotiated within a more comprehensive framework. Such negotiation between coexisting and overlapping paradigms does carry the risk of rhetorical appropriation and manipulation, especially if there has been a history of disputes and water conflicts; it is thus important to acknowledge how certain water management preferences may be invoked as part of such pre-existing conflicts and patterns of interaction within the water politics of a particular location (cf. Alexandra and Rickards, 2021; Middleton, 2022).

Our results show that all three paradigms and/or archetypes have support among the water community and are underpinned by values. They co-exist in the same way that some human values, conflicting or not, are universal; implementing them or making choices between them is thus a form of *valuing water*. In this sense, *valuing water* can be thought of as a metaparadigm – a focus on values requires consideration of all of these evolving paradigms and/or archetypes in any given context. The recognition that *valuing water* requires such choices in the first place is what makes this a new, more expressly political paradigm than previous paradigms. This insight echoes previous research that has suggested that *valuing water* is useful for making explicit the trade-offs in decision-making about water, and thus requires political mechanisms and tools for engaging stakeholders, for example, as part of water diplomacy (Hellegers and Van Halsema, 2019).

Values-informed choices become consolidated through policies and institutions, which implies that the relative political influence of various actors shapes which values are translated into action (Schulz et al., 2018). Previous research on the history of water management paradigms has also pointed to the important role of nation states in shaping preferences among water professionals, for example, for economic or engineering approaches (Molle, 2008; Menga and Swyngedouw, 2018). Likewise, it is important to note that the question of which paradigm dominates professional circles is not determined exclusively in the water sector, but may reflect broader societal patterns, preferences, and ideologies. Our finding that the *working with nature* archetype has the nominally strongest support among survey respondents aligns with a broader trend in public policy towards adopting 'green' or 'sustainable' approaches (Mol, Spaargaren and Sonnenfeld, 2009), while, for example, the earlier dominance of an economic paradigm may have reflected the dominance of neoliberal economic ideas at the time (Molle, 2008).

It is also worth acknowledging that the archetypes represent ideal-type higher order preferences, and that hybrid interventions, which operationalise multiple value landscapes and archetypes at once, are possible in practice. One example may be attempts to merge *market-based water management* with *working with nature*, for example, via payments for water ecosystem services (Martin-Ortega, Ojea and Roux, 2013). Given that these interventions are linked to conflicting underpinning values, they may be controversial and frequently contested between different actors and stakeholders (cf. Bakker, 2014).

4.3. Recommendations for water policy

Understanding value landscapes is necessary to trace the root causes for consensus and conflict among water stakeholders, where matching or conflicting values may translate into shared or conflicting preferences about concrete water-related decisions (Schulz, Martin-Ortega, Ioris et al., 2017). For example, water stakeholders might disagree about which of the three archetypes to prioritise in decision-making. It is important to recognise such conflicts as conflicts of values, since social psychological research suggests that value conflicts can escalate easily, activate people's emotions, and may continue over long periods of time (Druckman and Zechmeister, 1973). Such conflicts cannot normally be resolved through information or trading of resources but require skilled moderation to be addressed (Harinck and Druckman, 2017), which could involve trying to find solutions that partly address various different underlying value landscapes. It may also be helpful for water professionals themselves to be aware of the values that inform their own and others' preferences, to facilitate a shared understanding of each other's motives, which may help reaching agreements in situations of conflict. Making values explicit in this way may also help uncover situations where there is only a *perception* of a polarised value conflict, while stakeholders do, in fact, share underlying values more strongly than they perceive (Hanel, Maio and Manstead, 2019; Wolf, Hanel and Maio, 2021).

Operationalising the *valuing water* paradigm through value landscapes can also help with the evaluation of the political legitimacy of decisions about water and requires explicit consideration of the relative political influence of different stakeholder groups (cf. Saravanan, McDonald and Mollinga, 2009). Political legitimacy may, for example, be compromised if the values of certain groups or stakeholders are systematically ignored. Archetypes can be used as a proxy to establish whether that is the case – for example, if all water management in a given area focuses on building physical infrastructure, it is almost certain that some stakeholders' values are not being acted upon. The VLA thus represents an operationalisation of the *valuing water* paradigm that places emphasis on plural values and diverse strategic priorities for

water, which can underpin a multitude of different water management interventions. This contrasts with panaceas and one-fits-all solutions, which have long characterised the global water policy agenda (Molle, 2008; Ingram, 2011), and recognises that *valuing water* is inevitably a deeply political process.

Addressing value conflicts requires an awareness of power differentials between stakeholder groups. Empowerment of less powerful groups with a distinct values perspective can be a strategy to shift the values footprint on policies and decisions. It is also crucial to avoid simplistic, merely symbolic, bureaucratic, or technocratic exercises in designing participatory mechanisms for *valuing water*, that do not genuinely empower traditionally marginalised groups. This risk has been a common point of contention with regards to the implementation of IWRM and/or nexus thinking, which critics have found to bring about insufficient change on the ground, particularly with regards to social justice and equity (Molle, 2008; Saravanan, McDonald and Mollinga, 2009; Allouche, Middleton and Gyawali, 2019). Likewise, practical mechanisms for *valuing water* should not assume that all participating stakeholders share the same ontological perspective on water (Laborde and Jackson, 2022; Middleton, 2022), another lesson that has been learned, for example, from analysing the politics of the seemingly technical matter of environmental flows (Alexandra, Rickards and Pahl-Wostl, 2023).

5. Conclusions

The history of water management has been shaped by a series of evolving paradigms, which have placed dominant emphasis on interventions informed by engineering, economics, or ecology (cf. Alexandra and Rickards, 2021), as well as technocratic, ostensibly rational, and non-political approaches (cf. Molle, 2008; Saravanan, McDonald and Mollinga, 2009). *Valuing water* has been the latest addition to this list of paradigms and can be interpreted as placing primary emphasis on the political dimension of decision-making about water. Our study contributes to debates on *valuing water* by showing, for the first time, how various water management strategies can be linked with the personal values of professional respondents from the global water sector, making explicit what kinds of values are at stake when decisions about water are made.

To sum up, revealing common patterns in how personal values are linked with water management decisions can be useful (1) to make value perspectives explicit and thus structure communication about water management between various stakeholders and decision-makers; (2) to aid in understanding the motives that underpin conflicts between different stakeholders, potentially helping to address and resolve these conflicts, and (3) to assess whether the values reflected in policies and decisions correspond with the full diversity of stakeholder values or only the dominant values of the most powerful stakeholder(s), thus providing a diagnostic about the political legitimacy of water governance in a given context. Where decisions disproportionately reflect the values of more powerful actors while other water users' values are marginalised, this has clear implications for equity, access to decision-making and social justice more generally; these are increasingly recognised as key challenges for water governance worldwide, in a context where water insecurity constrains progress on Sustainable Development Goals, and equity and social justice remain elusive (Mdee et al., 2022). Good water governance may thus involve balancing competing and conflicting values, archetypes, and paradigms, ensuring that no single value perspective predominates in policies and institutions.

CRediT authorship contribution statement

Schulz Christopher: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Wolf Lukas J.:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. **Martin-Ortega Julia:** Conceptualization, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Glenk Klaus:** Conceptualization, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Gischler Maarten:** Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing.

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.

Data Availability

Data will be made available on request.

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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.2024.103685.

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