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Cultural Values in Water Management and Governance: Where Do We Stand?

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Abstract: Research in water governance and management is a complex subject that involves the appraisal of social, economic, and environmental–biophysical aspects. Cultural and social values are regarded as key drivers in decision-making processes in both domains. Identifying relevant cultural values however is difficult given the interdisciplinary nature of theoretical frameworks and the implementation and operational needs of water governance/management research. In this work, we conduct a systematic literature review and thematic analysis of existing theories of culture (ToC) to identify common cultural values, theoretical frameworks, disciplinary trajectories and implementation trends relevant to water management and governance. Results indicate that the dominant ToC corresponds to Cultural Theory with its four defined categories (Egalitarian–Hierarchist–Individualist–Fatalist). In addition, results show emergent cultural values linked to "local" place-based knowledge perspectives indicating a more pluriversal understanding of cultural values. Cultural values associated with water management revolve around anthropocentrism, whereas values associated with water governance revolve around concepts of provenance/places. Implementation of ToC/cultural values is limited in practical applications, and we provide an example on how to improve on that. We suggest a succinct theory of culture such as Schwartz's cultural values be considered to be an alternative to capture a greater heterogeneity across the breadth of water governance/management-related and basin-specific contexts.

Keywords: water management; cultural theory; social values; Schwartz cultural dimensions; hydro-sociology; socio-hydrology; water governance

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1. Introduction

Water is a fundamental resource for ecological and economic imperatives across the globe, contributing to the sustenance of livelihoods, food production and energy generation [1]. Despite its importance, water resources are increasingly under threat due to overexploitation [2], pollution [3], scarcity [4], depletion [5] and issues of accessibility/affordability [6]. In addition to these threats, competitive water uses and strong interdependencies across different productive sectors (e.g., water–energy–food nexus) challenge the way water resources have traditionally been managed [7,8].

As such, "water crises" have been repeatedly identified among the top five global risks since 2012 [9], with the international community acknowledging that water crises are regularly a crisis of management and/or governance [10,11]. We understand water management as "the application of structural and non-structural measures to control natural and man-made water resources systems for beneficial human and environmental purposes" [12]. This definition presumes deciding on long-term management objectives usually operationalized over short- to medium-term timeframes for multiple uses of water resources [13]. In contrast, water governance is defined as "the set of rules, practices and processes (formal and informal) through which decisions for the management of

water resources and services are taken, implemented, stakeholders articulate their interest, and decision-makers are held accountable" [14]. This definition therefore makes water governance seemingly more amenable to collective and collaborative decision-making processes [15].

Given the multi-dimensionality of water resources (e.g., catchments vs aquifers, consumptive vs non-consumptive uses, water quality vs water quantity, economic development vs environmental sustainability), research on water management has slowly begun to focus on broader economic, social and environmental issues (c.f. triple bottom line (TBL) assessments) [16]. Although this trend has opened research to a broader array of interdisciplinary perspectives, a strong bias towards economic analysis still prevails in the literature [17–19]. Although useful, assuming monetary motivations are central to water management and a key driver of behavioral change in water users will often ignore the role social and cultural values might have in this regard. Recent research has explored ecological values in water management literature; however, these values are rarely acknowledged as part of the social/cultural aspects of water research [20–22].

In comparing the foci of water governance and water management, both paradigms seem to be plagued with complex decision-making processes, which can be closely described as "wicked problems, i.e., problems with multiple dimensions that present unexpected consequences when engaged" [23]. Decision-making in this space is further characterized by contrasting, and often competing, values and interests of multiple stakeholders and a lack of consensus regarding which evidence is required to make effective decisions for water management/governance [24,25]. This reinforces the need to account for more-than-monetary motivations and instead consider additional dimensions of local, social and cultural values into the analysis of both paradigms. More specifically, McIntyre-Mills [26] notes the importance of addressing the values underpinning social life to address water mismanagement and its associated interpretation as a "wicked problem".

Several approaches exploring collective or shared social/cultural values have been proposed to understand the drivers of decision-making in natural resources management [27]. Cultural values have often been subsumed within discussions of social values given their shared nature and relative stability among group members [27]. Yet it is worth acknowledging cultural values specifically as a subset of social values in water research as there may be multiple sets of cultural values within a single society [27]. Therefore, focusing on *cultural values* rather than *social values* more broadly in water management/governance research may offer greater insights into individual/collective values in these domains.

In attempting to better understand the role social and cultural aspects have on decision-making in water research, two broad disciplines have recently emerged: hydro-sociology and socio-hydrology [28,29]. Although hydro-sociology has emerged from critical geography [30] and poststructuralist thinking [31], socio-hydrology is more closely linked to eco-hydrology and socio-technological systems [32]. As a result, hydro-sociology is more reflection of the concerns about power relations and qualitative nature of research more common in water governance [33,34]. In contrast, socio-hydrology is linked to integrated water management with a focus on more quantitative approaches (e.g., statistical analysis and causal feedback) geared towards engineering studies [32]. An important commonality between these two disciplines is the acknowledgment of the role of culture with calls for Cultural Theory to be included [35], greater cultural sensitivity in the approaches used [36], and consideration of cultural relations [37]. It can then be argued that a gap related to the inclusion of cultural aspects in the water management/governance-related research is observed in real-world problems.

Several cultural theories (and associated values) are available in the literature. For example, researchers have explored specific aspects using Cultural Theory/Plural Rationality by Douglas [38] (Cultural Theory and Plural Rationality are both names used to describe the grid-group theory developed by Mary Douglas), behavior phenotypes described by Poncela-Casasnovas et al. [39], and the cultural dimensions described by

Hofstede [40] and Schwartz [41,42] (see Appendix A for other theories). Important steps in closing the gap between theory and implementation in water management and governance research include thus understanding which cultural theories and values are presently explored and used in these domains, their salient features, and the potential for implementation/application across water-related research. This work addresses this gap. Doing so will inform the development of more nuanced and interdisciplinary insights into cultural theories and values with the potential for implementation and operationalization specifically in water research.

In this work we therefore draw insights from the broader water management/governance literature on the role of cultural theories and values as well as key concerns pertinent in the hydro-sociological/socio-hydrological debate. To do that we perform systematic literature review and thematic data analysis. The main objectives of this work are: (a) to provide insights on what cultural theories and values dominate water management/governance literature, (b) explore the degree to which cultural theories and values between water governance and management overlap, and (c) investigate the extent to which these cultural theories/values have been applied in practice to water management tools. The novelty of doing so is to be able to discern whether a common Cultural Theory and set of values can be determined from the water management (or governance) literature for practical implementation in future research. We hypothesize that there will be a tendency in the cultural theories and values to focus on aspects of ecology, environment and economics at the expense of localized and/or Indigenous values. We also hypothesize that there will be limited interdisciplinary influences of theories of culture beyond Anthropology and Sociology, and that current implementation practices will be focused on statistical analyses. Our work therefore presents a novel contribution to setting the context for future applications of cultural theories/values into water management/governance research and specific modeling/management tools, and to defining suitable cultural theories/values for context-specific case studies and modeling applications across the globe.

The following sections describe the methods employed in this work, analysis of literature review, thematic data analysis, discussion and concluding remarks.

2. Materials and Methods

This work followed the guidelines suggested in research across different domains (e.g., conservation management, [43]; ecosystem services, [44]; and public health, [45]) for conducting a systematic literature review (SLR) incorporating qualitative content analysis. We focused on research exploring the intersection of (integrated) water management/governance and cultural theories/values. For the purpose of our SLR, the cultural theories included those theories related to social and cultural life of groups and individuals [46]. To select relevant articles intersecting water-domain and cultural theories, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol [47], and adjusted it for the current study (see Figure 1).

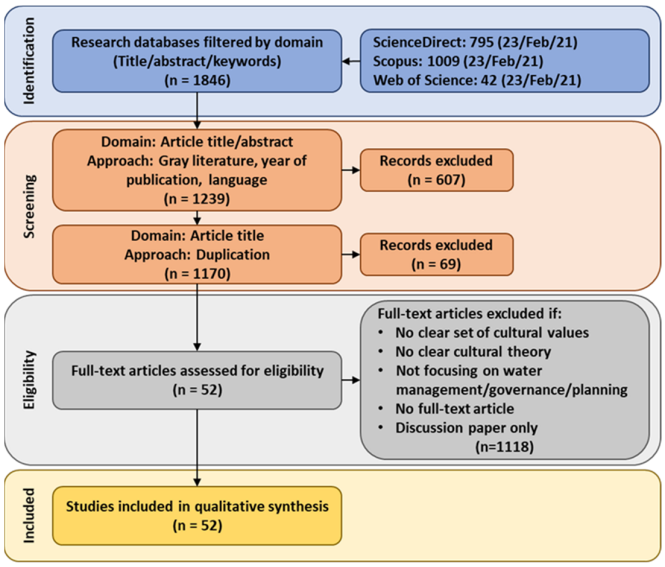


Figure 1. PRISMA protocol for SLR as applied to this study based on combination of search keywords: (e.g., "water management" OR "integrated water management" OR "water governance") AND ("cultural theory" OR "cultural values").

To ensure the accuracy of this work in relation to systematization, exhaustiveness, explanation, and replicability, we drawn on the SALSA framework (Search, Appraisal, Synthesis, Analysis) commonly used in SLRs [44,48,49]. Each step of this approach is developed further in the following sections.

2.1. Search Scientific Databases

In Step 1 (Search) a keyword-based search was conducted using three main scientific databases: Scopus, ScienceDirect and Web of Science. After a pilot search, we incorporated search strings composed of domain-specific keywords such as "water management", "integrated water management", "water governance" as well as "cultural theory" and "cultural values" (among others) to capture the most common terminology used in the field to refer to the concepts under investigation. Figure 1 shows the results of the search performed on a specific date. We sought works published in English, with the items from the search strings in the title, abstracts and keywords published between 2010 and 2021 given this is the period when socio-hydrology and hydro-sociology paradigms incorporating cultural aspects emerged more concretely in the literature [29]. A total of 1846 records were obtained and downloaded into a database (795 from Science Direct, 1009 from Scopus and 42 from Web of Science). The database included the following fields: full reference, abstract, keywords, and language. Next, grey literature, i.e., texts older than 2010 and any texts not in English were eliminated. As a result, 1239 records remained with 607 excluded. We then proceeded to eliminate duplicate records which resulted in 69 records being eliminated, leaving 1170 records. Subsequently, the 1170 remaining records corresponded to English-only works, published after 2010 and were scholarly works (peer-reviewed journal articles, book chapters, conference papers). These were collated into a single database before being subject to further inclusion and exclusion criteria based on the full text of each record.

2.2. Inclusion and Exclusion Criteria

In Step 2 (Appraisal) we examined the full-text articles from each record to determine their suitability for the SLR adhering to four inclusion criteria:

1. Focus on water management/planning/governance or a specific water-related site, e.g., dam, river basin, aquifer, coastal site;

2. Mention of Cultural Theory or an approach that could easily be classified as a Cultural Theory, e.g., Indigenous knowledge;
3. Clear derivation of cultural values from the study either due to the application of an existing set of values or due to the emergence of values through the findings in the study;
4. Access to the full text was provided.

Once all records were examined for the above criteria, 52 studies were found to fulfil the requirements for inclusion. A total of 1117 records were, thus, excluded as there was no full text and/or they failed to include a clear cultural theory, cultural values or a clear focus on water planning/management or governance or a water-related study site.

2.3. Extraction and Preparation for Analysis

In Step 3 (Synthesis) we developed a set of 8 variables of interest to systemize and characterize the content of the 52 studies (see Table 1). We performed a detailed review of the full texts according to these 8 variables of interest that involved manually coding and tabulating the studies. The results from this extraction process were then used for analysis of results as presented in the next sections.

Table 1. Criteria applied for codification of the 52 selected articles.

No.	Variables	Values
1	Study Site	Country/countries in the study
2	Data Type	Primary source in study (interview, focus groups, observation, experiments) Secondary source (document analysis/review, statistics from secondary sources)
3	Cultural theory	Name of theory/theories or not given
4	Cultural values	Values listed or derived from findings
5	Framework/Method	Participants, qualitative, quantitative, mixed-methods, techniques
6	Findings	Treatment of cultural values, cultural values listed in order of importance or not
7	Difficulties	Methodological, theoretical
8	Potential study applications	Modeling, statistical analysis, global dataset comparison, additional cultural values for consideration

2.4. Data Analysis

The analysis phase involved the evaluation of the synthesized data and the extraction of relevant information and conclusions from the records. We classified the records according to the criteria for codification (see Table 1). We focused on the information from the data set coded to country/countries in the study, cultural theory, cultural values, and potential application e.g., implementation strategies. More specifically, we sought to identify the cultural theories and values and compared these between water management and water governance. We analyzed the cultural values and theories to see if they have been considered in current water management tools. This allowed us to identify the dominant cultural theories in the literature of both water management and governance, and overlapping theories.

We employed a word frequency analysis to the cultural values using Voyant (www.voyant-tools.com, accessed on 27 April 2021) to determine the most commonly occurring terms in three categories: overall in the literature, in the water management literature and the water governance literature. Voyant is an open-source, web-based application for conducting text-mining and analysis. These world clouds and frequency analysis allowed us to identify the set of dominant and emergent cultural values in the literature.

A Treemap [50] was developed to summarize the disciplinary origins of the cultural theories/values discussed across the 52 records. In addition, we analyze differences in disciplinary origins for both water management and governance domains, and we employed bibliometrix package [51] to analyze bibliographic information of the database (see Figures S1–S7 in Supplementary Materials Section S1).

2.5. Limitations of Methods

There is a risk that the articles collected underrepresent the broader specialized literature in water management and governance. To minimize this, we have employed the most prominent scientific databases for our literature review (Section 2.1) in a systematic approach using transparent domain-specific keywords. Similarly, there is the possibility of geographical bias as we have selected scientific texts in English, obviating literature published in other languages.

The analysis of specific cultural values is based on the occurrence (frequency) of specific words related to cultural theories. In some instances, specific values can be associated with a specific word that can have a different meaning given its context, for example the term "quality" in Figure 2, could be implied in "quality of life" or "water quality", without more advanced corpus analysis techniques it is hard to disentangle this level of detail. However, as we are interested in cultural values arising from dominant cultural theories in water management/governance, the assumption for these words is of a holistic concept such as "improvement".

Figure 2. Word frequency showing the most frequent terms in all records excluding stop words such as culture, cultural, values, values, water, and good.

3. Results

3.1. Frequently Used Theories of Culture in Water Governance/Management Literature

Table 2 shows the most frequent cultural theories that appeared in the SLR streamed by subdomain (i.e., water management or water governance). The literature on water governance included a total of 15 records referring to nine different cultural theories including one which did not mention a specific cultural theory [52]. The water management literature included a total of 37 references spanning 19 different theories. Both the literature on water governance and water management mentioned five overlapping theories: Cultural Ecosystems Services [53], Cultural Theory [38], Indigenous Knowledges, Moral Economy of Water [54], and Value Landscapes Theory [55,56]. Given the broad array of Indigenous Knowledges, it is not possible nor appropriate to pinpoint a single "key" theorist in this discipline. Indigenous Knowledges are inherently placed-based, so the examples in this paper noted in Table 2 show how Indigenous Knowledges related to water management and governance might be understood. However, it is important to note that these knowledges may change over time, place and between Indigenous even in the same community.

Additionally, Indigenous Knowledges in this paper may encompass ancestral and/or traditional knowledges also.

Within the water governance literature, the most common theories were Indigenous Knowledges (n = 4), Cultural Theory (n = 3) and Values Landscape Theory (n = 2). In the water management literature, the most common theories were Cultural Theory (n = 7), Indigenous Knowledges (n = 5), Country as Culture (n = 4), Cultural Ecosystem Services (n = 3), Kellert's Nature Related Values Typology (n = 2), Cultural Flow Preferences (n = 2) and Perspectives Method (n = 2). Overall, it appears that Cultural Theory by Douglas [38] is most prevalent among the literature closely followed by Indigenous Knowledges.

Table 2. Main cultural theories identified in both subdomains (water governance and water management) and overlapping theories.

Water Governance	Water Management
	Cognitive Filters of Appraisal Model [57]
	Country as Culture (Spain) [58]
	Country as Culture (New Zealand) [59]
	Country as Culture (Mozambique) [60]
	Country as Culture (Finland) [61]
Critical Pedagogy of Hope [62]	
	Cultural Capital Theory [63]
	Cultural Ecosystem Services [65]
Cultural Ecosystem Services [64]	Cultural Ecosystem Services [66]
	Cultural Ecosystem Services [67]
	Cultural Flow Preferences [68]
	Cultural Flow Preferences [69]
	Cultural Lag Theory [70]
	Cultural Materialism [71]
Cultural Web Theory [72]	
	Cultural Theory [76]
	Cultural Theory [77]
Cultural Theory [73]	Cultural Theory [78]
Cultural Theory [74]	Cultural Theory [79,80]
Cultural Theory/Plural Rationality Theory [75]	Cultural Theory [81]
	Cultural Theory [82]
	Cultural Theory [83]
	Indigenous Knowledges [88]
Indigenous Knowledges [84]	Indigenous Knowledges [89]
Indigenous Knowledges [85]	Indigenous Knowledges [90]
Indigenous Knowledges [86]	Indigenous Knowledges [91]
Indigenous Knowledges [87]	Indigenous Knowledges [92]
	Ethnicity as Culture [93]
Fuzzy Set Theory [94]	
	IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services) [95]
	Kellert's Nature Related Values Typology [96]
	Kellert's Nature Related Values Typology [97]
Moral Economy of Water [98]	Moral Economy of Water [99]
	Norms of Justice [100]
	Perspectives Method [101]
	Perspectives Method [102]
	Religion [103]
	Sense of Place [104]
	Value Change Theory [105]
Values Landscape Theory [55,56]	Values Landscape Theory [107]
Values Landscape Theory [106]	

Not mentioned/applicable [52]	
Water governance records (n = 15)	Water management records (n = 37)
Water governance cultural theories (n = 9)	Water governance cultural theories (n = 19)
Total records (n = 52)	
Total cultural theories (n = 22)	

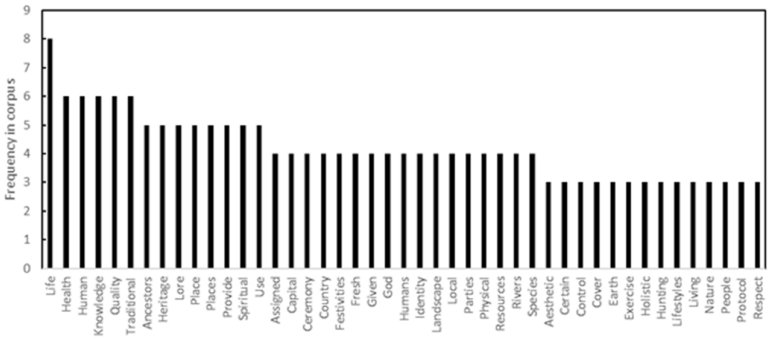
Three additional theories appear in both water management and water governance records including Cultural Ecosystems Services (n = 4), Values Landscape Theory (n = 3) and Moral Economy of Water (n = 2). A total of 22 cultural theories were identified across all records.

3.2. Dominant Cultural Values in the Literature about Water Governance/Management

A total of 219 individual cultural values were identified in the literature (see Supplementary Materials Section S2). Figure 2 shows the most common words in the corpus of cultural values derived from all records in this study. Generic stop words (e.g., and, or, as well as, with) as well as specific terms such as "water", "culture", "cultural", "value", "values", "good" were excluded from the analysis. In general, this figure shows a predominance of the four terms underpinning the Cultural Theory model by Douglas [38], i.e., Egalitarian, Hierarchist, Fatalist, Individualist. This would confirm that Cultural Theory seems to be the dominant framework in the literature related to both water management and governance.

To analyze other emergent cultural theories, the four terms related to Douglas Cultural Theory [38] (Egalitarian, Hierarchist, Fatalist, Individualist) were applied as additional stop words meaning they would not appear as these were clearly the most common in all records. We decided not to include these four terms as Cultural Theory overwhelmingly dominated and therefore skewed the data. Figure 3 shows the 45 most frequent words in the corpus of cultural values derived from theories of culture excluding the four specific terms related to Douglas Cultural Theory [38]. Across all records, we observe a dominance of terms that clearly align with Indigenous Knowledges such as Place(s) (11), Human(s) (10), Life (8), Spiritual (7), Knowledge (7), Traditional (6), Health (6), Heritage (6), Quality (6), Ancestors (5), Lore (5), and Aesthetic (5). The latter agrees with results presented in Table 2, which highlights the emergence of Indigenous Knowledges as a prominent cultural theory in water management and water governance literature.

(**a**)



(**b**)

Figure 3. (**a**) Word cloud and (**b**) absolute frequency showing the most common terms in all literature excluding stop words (Egalitarian, Hierarchist, Fatalist, Individualist) from Cultural Theory [38].

Figure 4 shows the analysis of emergent/dominant cultural values in terms of frequency in the compiled literature for both paradigms (water governance and water management). Figure 4a shows the 45 most frequently words mentioned in the corpus of cultural values for water governance. The most frequently mentioned terms were lore and places, followed by terms such as country, heritage, rivers and species. Other less frequent terms were ancestors, knowledge, protocol, river and traditional. Figure 4b represents the 45 most frequent cultural values in the literature from water management. Human(s) and life were the most frequently mentioned terms, followed by terms such as health, provide and use, as well as local, ceremony, God and parties. It can then be argued that cultural values identified in the literature from water management show a more anthropocentric perspective (human, life, health, use), whereas the literature from water governance shows a more holistic perspective expressed through cultural values revolving around environmental aspects (rivers, species) as well as heritage and ancestral connections (heritage, country, lore, places).

(**a**) (**b**)

Figure 4. Word frequency cloud showing the 45 most common terms in the (**a**) water governance and (**b**) water management literature excluding stop words (Egalitarian, Hierarchist, Fatalist, Individualist) from Cultural Theory [38].

3.3. Disciplinary Origins of Theories of Culture in Water Governance/Management

Figure 5 provides the breakdown of disciplinary origins of the cultural theories in the corpus analyzed. This figure shows the most common disciplinary origin is Anthropology (12), with Cultural Theory (10) dominating followed by Moral Economy of Water (2).

Equally as common is Environmental Science discipline. In contrast to theories of culture emerging from Anthropology, those from Environmental Science are more broadly spread across various theories, for example, Cultural Ecosystem Services (4), Values Landscape Theory (3), Kellert's Nature Related Typology (2), Perspectives Method (2) and IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services) (1). Theories of culture with disciplinary origins in Cultural Studies (11) were also prevalent examples in the records; Indigenous Knowledges (9), Ethnicity as Culture (1) and Religion (1). Four records used four distinct theories of culture drawn from Sociology also.

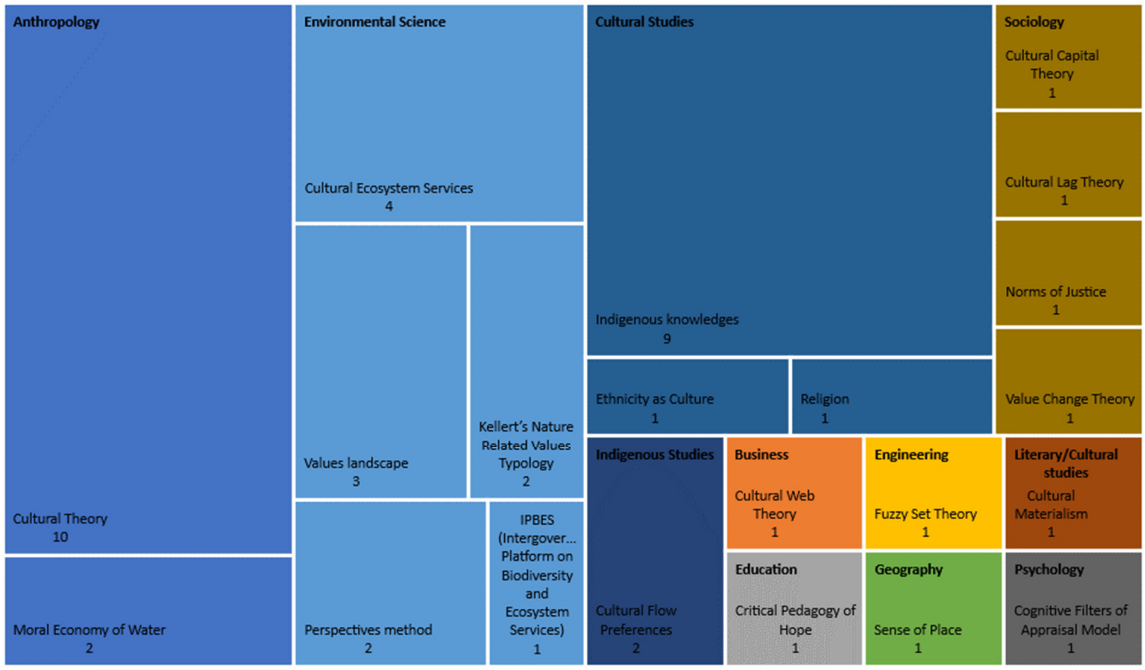


Figure 5. Total number of theories of culture (n = 21) identified in the 52 records by disciplinary origin.

Figure 6a displays the most common disciplinary origins for theories of culture mentioned in the water governance domain. Results indicate that theories of culture emerging from Cultural Studies, Anthropology are most common in the water governance literature closely followed by Environmental Science. A total of six disciplinary origins are identified in the water governance records with a mixture between applied sciences and social sciences. Figure 6b shows the disciplinary origins of theories of culture in records on water management. A total of eight different disciplinary origins were identified. The most common was Environmental Science followed by Anthropology and Cultural Studies. Records with theories with disciplinary origins in Sociology were also common.

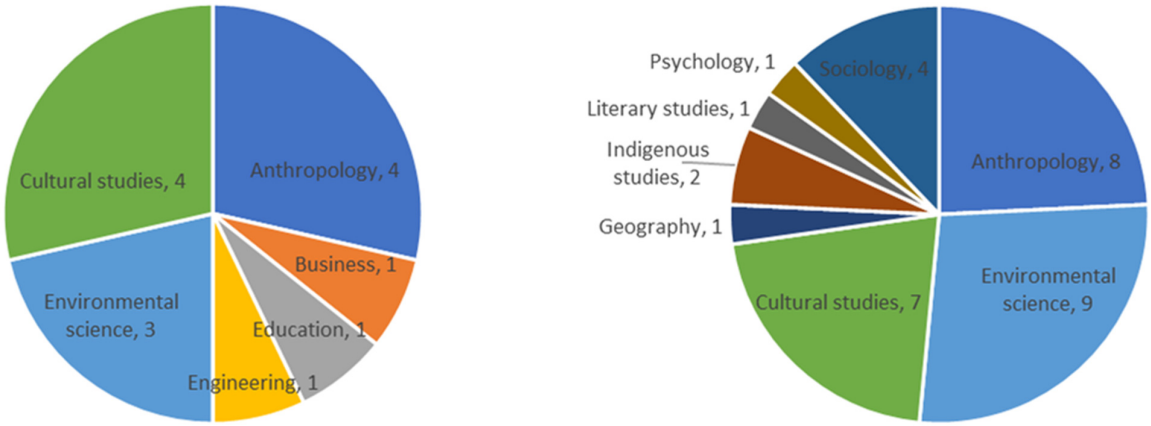


Figure 6. Frequency of theories of culture in (**a**) water governance (n = 14) and (**b**) water management (n = 33).

Figure 6 confirms the somewhat transversal nature of disciplines underpinning research in both water governance and water management domains, e.g., eight disciplines out of 11 are unique to either water-related research domain. This seems in line with the argument of Ross & Chang [32] suggesting that more mixed methodological approaches are required to advance socio-hydrology and hydro-sociology. We observe only three overlapping disciplines (Anthropology, Environmental Science and Cultural Studies), which in terms of proportion show a different relevance under each domain. A statistical test however indicates that the differences in the proportions of these overlapping disciplines for water governance and water management are not statistically significant (Anthropology: p-value = 0.24; Cultural Studies: p-value = 0.22; Environmental Science: p-value = 0.36). Thus, suggesting these three disciplines dominate both the water governance and water management literature analyzed.

3.4. Implementation of Cultural Values in Water Governance/Management

The common implementation strategies of cultural values in water governance and water management varied significantly between qualitative and quantitative approaches. Table 3 shows that 57.6% of the studies included an implementation strategy whereby additional analysis was applied to the cultural values mentioned in the records. Of the studies showing an implementation of cultural values, 25 related to water management (83%) and five to water governance (17%). This highlights a more applied research approach to water management when compared to water governance. Overall, 40% of the studies included a form of statistical analysis with slightly less than half of all studies in each domain (governance and management) using this approach. Another common approach was to compare the prevalence of cultural values in a particular participant group to another. This included for example comparisons between Egalitarian/Hierarchist/Fatalist/Individualist groups drawing on Cultural Theory [38]. Several other studies compared specific cultural values without statistical analysis between various participant groups/stakeholders, religions, case studies, survey versus interview data from the same study, demographic factors, and importance of ecological services or particular theoretical paradigms. Two studies used predictive modeling including an analysis of preparatory steps for game theory and agent-based modeling by coupling socio-economic groundwater systems. From Table 3 we observe that statistical approaches and comparisons between groups/grids/participants are the most common implementation strategies of cultural values in the literature analyzed for water governance and water management.

Table 3. Implementation strategies of cultural values across water governance and water management domains.

Domain	Record	Theory	Implementation/Application of Values
Water governance (n = 5)	Omar et al. (2017) [72]	Cultural Web Theory	Comparison of cultural values to cultural influences, qualitative—co-mapping
	Potter et al. (2016) [94]	Fuzzy Set Theory	Modeling—Fuzzy sets
	Yazdanpanah et al. (2014) [75]	Cultural Theory	Comparison of grid/group clusters
	Schulz et al. (2018) [106]	Values Landscape Theory	Statistical analysis—Structural equation Modeling
	Wutich (2011) [98]	Moral Economy of Water	Statistical analysis—Regression analysis
Water management (n = 25)	Koehler et al. (2021) [82]	Cultural Theory	Comparison of cultural values to handheld water pump usage
	Koehler et al. (2018) [81]	Cultural Theory	Comparison between grid/groups
	Offermans & et al. (2013) [101]	Perspectives Methods	Comparison between grid/groups
	Offermans & Valkering (2016) [102]	Perspectives Methods	Comparison between participant groups
	Oteros Rozas et al. (2014) [77]	Cultural Theory	Comparison of Cultural Theory to New Environmental Paradigm (NEP)
	Wutich et al. (2012) [100]	Norms of Justice	Comparison of cultural values to demographic factors
	Tipa et al. (2012) [68]	Cultural Flow Preferences	Comparison of cultural values to flow preferences
	Iniesta-Arandia et al. (2014) [66]	Cultural Ecosystem Services	Comparison of cultural values against well-being and importance of ecological services
	Kati & Jari (2016) [61]	Country as Culture (Finland)	Comparison between stakeholders
	Lefers et al. (2015) [103]	Religion	Comparison between religions
	Lazrus (2016) [83]	Cultural Theory	Comparison of values from survey to interview data
	den Haan et al. (2019) [76]	Cultural Theory	Game theory (preparatory steps only), Comparison between grid/groups
	Castilla-Rho et al. (2017, 2019) [79,80]	Cultural Theory	Modeling—Agent-based, Comparison—Grid/group
	Ruzol et al. (2017) [78]	Cultural Theory	Social Network Analysis (SNA)
	Ryfield et al. (2019) [71]	Cultural Materialism	Qualitative—Cultural mapping
	Albizua et al. (2019) [95]	IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services)	Statistical analysis
	Alessa et al. (2010) [88]	Indigenous Knowledges	Statistical analysis (Chi-square)
	Maniatakou et al. (2020) [67]	Cultural Ecosystem Services	Statistical analysis (Factor analysis)
	Gondo et al. (2019) [70]	Cultural Lag Theory	Statistical analysis—Multiple regression
	Crow et al. (2018) [59]	Country as Culture (New Zealand)	Statistical analysis (Regression modeling)
	Yan et al. (2018) [93]	Ethnicity as Culture	Statistical analysis (Regression modeling)
	Rahimi-Feyzabad et al. (2020) [63]	Cultural Capital Theory	Statistical analysis—Structural Equation Modeling
	Schulz et al. (2019) [107]	Values Landscape	Statistical analysis—Structural Equation Modeling
	Tapsuwan et al. (2011) [104]	Sense of Place	Statistical analysis—Structural Equation Modeling
	Russell & Ens (2020) [89]	Indigenous Knowledges	Statistical analysis to test accuracy of Western vs Indigenous Knowledges at estimating ecological health

4. Discussion

4.1. Dominant Cultural Theories in Water Governance/Management

Cultural Theory (also known as Plural Rationality) developed by Douglas [38] overwhelmingly dominated studies in both water management and water governance. As a result, the four grid-group categories of Egalitarian, Hierarchist, Individualist and Fatalist dominated the extracted cultural values from the records. Moreover, the Perspectives Method mentioned by Offermans et al. [101] and Offermans and Valkering [102] is derived from Cultural Theory [38], thus contributing to two highly similar cultural theories stemming from anthropological studies. Although we acknowledge that the simplicity of the four grid-group categories offers water researchers a succinct and manageable set of values to implement into applied research (e.g., [79,80]), there are several limitations of such an approach. For example, relying on too few values/categories may fail to capture the localized and evolving nature of cultural values and instead perpetuate an oversimplified model which overlooks more nuanced distinctions between values. Although it is claimed that Cultural Theory can account for individual differences and for individuals to move between the four grid-group categories [78], the theory remains steeped in the assumption that the overarching values themselves are static [38]. This may be explained by the ongoing push for generalizable results rather than localized, contextualized examples exploring nuance in water management [108].

The dominance of Cultural Theory and its anthropological disciplinary trajectory raise questions about the interdisciplinarity capacity of both water management and water governance. It could be argued that the emerging disciplines of hydro-sociology and socio-hydrology are attempting to address this issue by pushing for greater interdisciplinary collaboration and attention to cultural nuances [29,109]. Our results show that Anthropology dominates the literature analyzed for both water governance and water management. Drawing on anthropological cultural theories without recognition of the disciplinary trajectory of the theories, risks undermining hydro-sociology and socio-hydrological imperatives. Without acknowledging the disciplinary trajectory, there is limited opportunity for water researchers to reflect on the paradigm the theory has emerged from (e.g., positivism) and to question the validity of such an approach.

At the same time, it is worth noting that several localized theories of Indigenous Knowledges associated with Cultural Studies were the second most common subset of cultural theories and disciplinary trajectory in the literature analyzed. Contrary to the homogenous approach of Cultural Theory and Perspectives Method emerging from Anthropology, the nine heterogenous Indigenous Knowledges theories appear to be more in line with the goals of socio-hydrology and hydro-sociology. Yet Jackson (2006, as cited in [110]) notes that there has been a tendency for the separate treatment of Indigenous and non-Indigenous values to compound the reification of "cultural values" often perceived largely within the confined of a cultural heritage paradigm. The heritage paradigm focuses on objects, entities and places at the expense of recognition and valuation of relationships, processes and connections between social groups, people and place and people and non-human entities. Therefore, while the prevalence of cultural theories grounded in Indigenous Knowledges presents an opportunity for water governance/management research to broaden its disciplinary connections, it is worth exploring the specific values that have emerged within these theories to better understand if/how they have acknowledged cultural values beyond the heritage paradigm. Additionally, most cultural theories using Indigenous Knowledges have emerged from Australia ([85–87,89,91]), which might result in geographical bias but leaves ample scope for future research including not only Indigenous but other local values from a broader array of geographical locations on a global scale.

4.2. Dominant Cultural Values

Our results show that the overall values represent a generic view of cultural values pertaining to life, health, knowledge and tradition even when the four grid-group categories from Cultural Theory were removed. However, when comparing the cultural values between water governance and water management, there are clear differences. Of the most 15 most common cultural values in water governance, ten have clear links to Indigenous Knowledges (lore, place/s, heritage, ancestors, river/s, country, totem, traditional, Aboriginal). Place/s is the most common values overall in the water governance list of cultural values. Therefore, the results of the cultural values in the water governance records did not show greater attention to relationships, processes and connections as suggested by [110]. This suggests that despite the prevalence of cultural values inspired by a broad array of cultural theories from Indigenous Knowledges, the specific values still maintain a focus on objects, entities and places. This could be explained by the overlap between environmental studies and Indigenous Knowledges which may see discussions of entities (e.g., rivers, country) arise more often.

Similarly, we expected the influence of "environmental concerns" to dominate the cultural values in water management. However, in contrast to the clear links to Indigenous values, most of the most common values in water management align more closely with notions of anthropocentrism (life, health, human/s, exercise, identity) and economic utility (provide, use, given, parties, capital). Water management deals with the operationalization of governance arrangements for the beneficial use of water resources, and therefore values related to economic utility can be anticipated. At the same time, results indicate that intrinsic environmental values are secondary in the water management literature thus contradicting the view suggesting that research in this domain is slowly addressing the so-called TBL assessments ([16]).

4.3. Advancing Cultural Theories and Values for Water Governance/Management

The spread of cultural values and theories in the records offers an opportunity to advance water management research in several ways. Given that the most common cultural theories in both water governance and water management are similar, there is potential for each discipline to learn from the other by looking more closely at the specific values emerging. As the water governance values highlighted local and Indigenous values more distinctly, there is a chance for water management approaches to adopt these values to develop more nuanced sets of cultural values. This is particularly relevant for studies conducted at a global scale (e.g., [111]) attempting to represent multiple values from various geographical, social and cultural contexts (e.g., [80]).

Understandably, this presents a challenge for researchers as they would need to incorporate many values into water management research, which is primarily concerned with operationalizing decision-making processes. This has only been addressed in a few studies, for example from groundwater management using examples such as agent-based modeling [80] or comparisons to hand pump usage [81]. Thus, we see a gap between theory and practice that further intradisciplinary research work between water governance and water management could address. This further solidifies the need for disciplines such as hydro-sociology and socio-hydrology to work together for more culturally sensitive yet operational approaches to emerge in water management.

4.4. Implementing Theories of Culture and Associated Values in Water Governance/Management Research

A key learning from this research is the need for a shift in thinking from cultural theories to theories of culture. It is clear from the studies analyzed that there is no single "best" theory for capturing relevant cultural values in culturally heterogenous and constantly changing environments, particularly at the global/international level, and specifically for water management/governance research. Nor is there a single theory that has

emerged as "best" for incorporating a broad range of cultural values that can also be operationalized for decision-making. Therefore, we argue that a shift in thinking towards theories of culture could offer water governance/management research the chance to adapt and cater the subset of inter/intradisciplinary cultural values used in any project to the specific context that is being examined. In general, it seems that theories of culture developed through bottom-up approaches working with the local communities that research pertain to might best conceptualize the relevant values. Concomitantly, for future research working at the global or international level and hoping to model decision-making processes, a significantly broad yet manageable set of cultural values covering aspects of multiple theories of culture will be required.

An example of an implementation strategy of cultural values at global scale was attempted by Castilla-Rho et al. [79,80] to assess groundwater sustainability in irrigated agriculture. In that work, data from the World Value Survey Wave 6 was used as proxy to parameterize farmers' decision-making process with culturally varying values based on the four grid-group categories (Egalitarian–Hierarchist–Individualist–Fatalist) proposed by Cultural Theory [38]. The specific cultural values of farmers translated into grid-group scores were then used in the following "social sub-model (S)" following a Cobb-Douglas functional form:

$$S = grid^{m} (1 - group)^{n}, \quad (1)$$

where S = social utility function, m = number of times a farmer reports a neighbor taking groundwater illegally, and n = number of times a farmer is seen taken groundwater illegally. Using Cultural Theory's four grid-group categories, Castilla-Rho et al. [79,80] quantified the loss of social reputation and the social costs to farmers (i.e., S in equation 1) when reporting non-compliant neighbors engaged in illegal extraction of groundwater in California Valley (USA), Murray-Darling Basin (Australia), and Punjab (India/Pakistan). We argue that this simple "social sub-model" might be improved in future research by considering other theories of culture embedding alternative cultural values to account for a wider and diverse range of cultural landscapes around the globe.

One potential area in which some of these theories of culture (e.g., [112,113]) are making progress pertains to "relational values" [114]. Such relational values encompass not only anthropocentric values but also those of nature in ways similar to many of the Indigenous Knowledges observed in this research. Schultz [107] however notes that these relational values have received limited recognition in the field of water research. As such, relational values drawn from these theories have been validated less often which makes them more difficult to assess when applied to new research contexts.

Another potential area for improvement (future research) is disentangling the multiple cultural values with the potential for practical implementation in modeling applications. An attractive approach corresponds to the motivational value-based approach organized around four relational models (self-transcendence, conservation, self-enhancement, openness to change) proposed by Schwartz [41,42]. Schwartz's model includes a manageable yet comprehensive set of ten cultural values (self-direction, universalism, benevolence, tradition, conformity, security, power, achievement, hedonism, stimulation) that have been validated in numerous studies in environmental and social sciences [115–117]. Although Schwartz's model has emerged from psychology and business studies, these cultural values are based on extensive research in multiple countries with everyday people unlike other popular theories such as Hofstede [40], which have tended to focus only on managers in international business. Moreover, in a preliminary comparison of Schwartz's values to the values emerging in this research, we have found that it is possible to map all the cultural values in the literature about water resources management/governance into Schwartz's cultural values (see Supplementary Materials Section S3). This suggests that Schwartz's model not only has potential for modeling approaches but also the ability to attend to a broad array of diverse values emerging from water management and water governance studies. However, we recommend that any future research verify

the applicability of Schwartz's cultural values by carefully considering the nature, breadth and context of their projects as well as the validity of this potential mapping exercise.

5. Conclusions

In this research we found that the four groups of Cultural Theory, i.e., Egalitarian, Hierarchist, Fatalist, Individualist, proposed by Douglas [38] dominated the literature analyzed in both water management and water governance domains. By broadening the scope to include other theories of culture we noted a broader array of theories from various disciplinary trajectories in the literature although these trajectories and their implications were not often considered in the research. Contrary to our hypothesis, several theories of Indigenous Knowledges emerged as did various values related to Indigenous cultural values (e.g., lore, place). Although this indicates a shift towards more pluriversal understanding of water, it bears noting that most of these studies came from the Australian context. We also note an anthropocentric bias in many of the values discussed in water management literature, and limited implementation of cultural values beyond statistical analysis into operational tools. Overall, this suggests a need for greater inter/intradisciplinary collaboration to deepen the influence of bottom-up, localized perspectives on cultural values while still considering the need for potential modeling of decision-making processes related to water management. Although a single, "best" theory of culture that is appropriate for all research in water management seems unlikely, we offer Schwartz's cultural dimensions [41,42] as a starting point. By drawing on a broad yet manageable set of cultural values such as this, we suggest that water governance/management researchers can attend to multiple, heterogeneous, local concerns and apply these values to capture a greater heterogeneity across the breadth of water governance/management-related and basin-specific contexts.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/w14050803/s1, Section S1: Bibliometrix analysis of the database used for analysis; Figure S1: Most productive authors in the database; Figure S2: Most productive countries in the database; Figure S3: Publication year production in the database; Figure S4: Country collaboration in the database; Figure S5: Keywords co-occurrence clustering in the database; Figure S6: Conceptual structure map (two-dimensions) in the database; Figure S7: Topic dendrogram; Section S2: List of individual cultural values identified in the literature; Section S3: Mapping of individual cultural values found in the literature review to the Schwartz's model.

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Appendix A

Table A1. Alternative cultural theories from broader environmental sciences research.

Theory	Disciplinary Origin	Values	Environmental Studies Using this Theory
Hofstede's Cultural Dimensions [40]	Business/Management Studies	• Power distance • Uncertainty avoidance • Individualism vs collectivism • Masculinity vs femininity • Long-term and short-term orientation • Indulgence vs restraint	Pelau & Pop (2018) [118] Kaminsky (2016) [119]
Poncela-Casasnovas et al. Behavioral phenotypes [39]	Physics	• Envious • Optimist • Pessimist • Trustful	Kearns et al. (2019) [120] Luceri et al. (2018) [121]
Ingelhart's Cultural Values Map [111]	N/A but drawn from global survey (World Values Survey)	• Traditional vs secular values • Survival vs self-expression	Schulz et al. (2017) [55]
GLOBE (Global Leadership and Organisational Behaviour Effectiveness) [122]	Business Studies	• Uncertainty avoidance • Future orientation • Power distance • institutional collectivism • Human orientation • Performance orientation • Family orientation • Gender egalitarianism • assertiveness	Muralidharan & Pathak (2019) [123]
Pascual et al. Relational Values [112]	Environmental Science	• Non-anthropocentric • Instrumental • Relational	Arias-Arévalo et al. (2017) [114]
Culturally specific relational values [113]	Environmental Science	• Eudemonic (flourishing) as focus • Not specifically listed but some suggestions for guidance include non-western systems such as Buen Vivir/Sumak Kawsay/Tsawalk, Confucianism/Buddhism • Other values mentioned as examples only included: trust in one's neighbor, empathy, purity/sanctity, authority/respect, in-group/loyalty, fairness/reciprocity, harm/care, stewardship, kinship	Brear & Mbonane (2019) [124]

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