Supplementary material

Article

Cultural values in water management and governance: Where do we stand?

Danielle. H. Heinrichs [1] and Rodrigo Rojas [2, *]

S1. Bibliometrix analysis of the database used for analysis

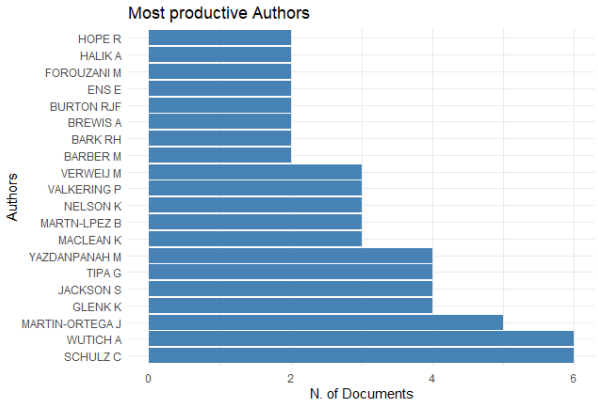

Figure S1. Most productive authors in the database.

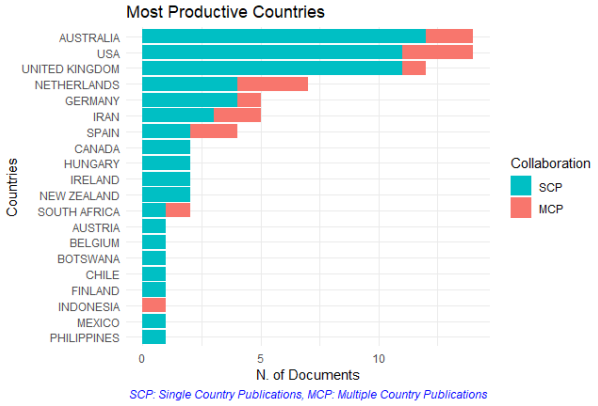

Figure S2. Most productive countries in the database.

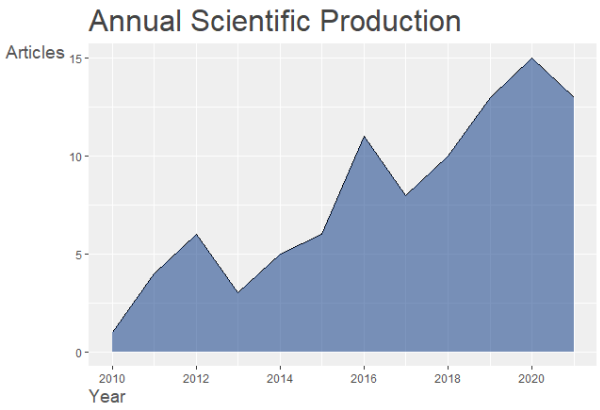

Figure S3. Publication year production in the database.

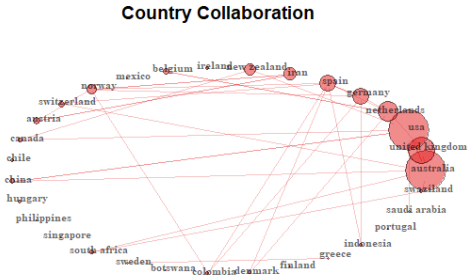

Figure S4. Country collaboration in the database.

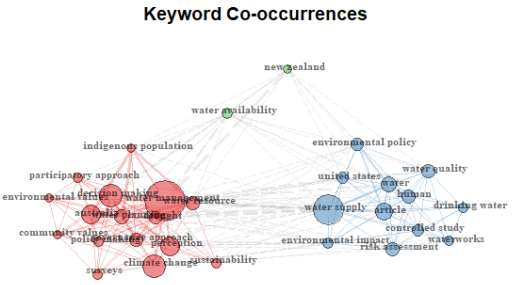

Figure S5. Keywords co-occurrence clustering in the database.

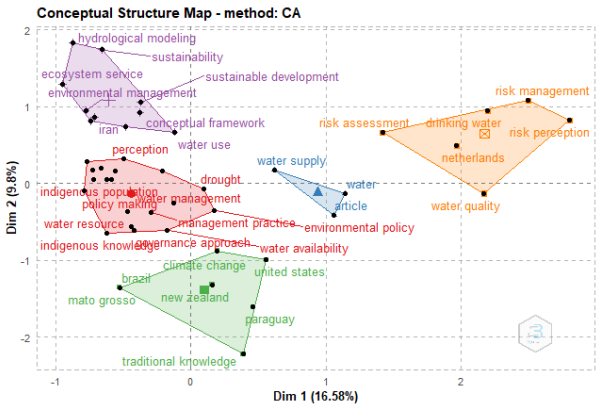

Figure S6. Conceptual structure map (two-dimensions) in the database.

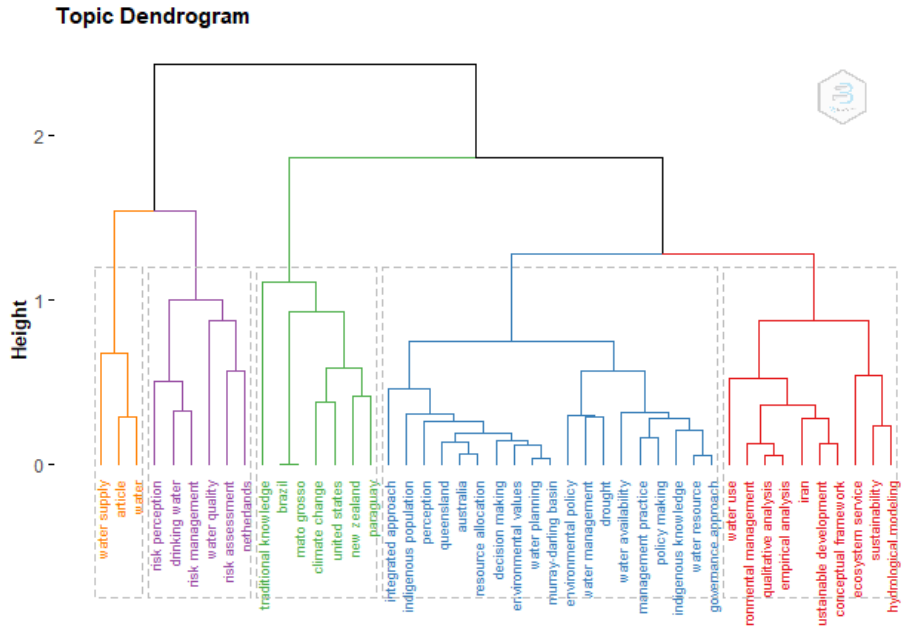

Figure S7. Topic dendrogram in the database.

S.2. List of individual cultural values identified in the literature

1. Scepticism
2. Local factors
3. Denial and blame
4. We (communitarianism)
5. Dialogue
6. Holistic
7. Connection to the past
8. Collective
9. Intergenerational
10. Spiritual
11. Intellectual
12. Physical
13. Emotion
14. Country
15. Culture
16. Kin
17. Institutional cultural capital
18. Objectified cultural capital
19. Embodied cultural capital
20. Individualist
21. Fatalist
22. Hierarchist
23. Egalitarian
24. Activity
25. Aesthetic
26. Employment
27. Existence/ bequest
28. Identity
29. Inspiration
30. Knowledge
31. Material
32. Option
33. Place/heritage
34. Social capital and cohesion
35. Activity (binational cooperation & exercising a bilateral agreement)
36. Existence/ bequest
37. Well-being
38. Basic materials for a good life
39. Health
40. Security
41. Freedom of choice and action
42. General life satisfaction
43. Local ecological knowledge
44. Recreational hunting
45. Attracting game (hunting activities)
46. Provide locations that serve as environmental education
47. Attract researcher
48. History and tradition of the region
49. Create spots for physical well-being
50. Contribute to psychological well-being
51. Increase the region's beauty
52. Provide spots for wildlife watching
53. Provide areas where people meet
54. Attract tourists/visitors

55. Provide water for touristic infrastructure
56. Provide water for luxurious touristic infrastructure
57. Whakapapa (genealogy)
58. Manaakitanga (show kindness and respect to, look after, entertain)
59. Rangatiratanga (chieftainship, decision-making rights)
60. Kaitiakitanga (the exercise of customary custodianship, in a manner that incorporates spiritual matters, by those who hold mana whenua status for a particular area or resource
61. Kotahitanga (unity, working together as one)
62. Hauora (holistic health and wellbeing)
63. Whanaungatanga (kinship, familial relationships)
64. Mauri (essential life force or principle; a quality inherent in all things both animate and inanimate
65. Cultural use
66. Wai
67. Cultural landscape
68. Health and well-being
69. Water as life
70. Hydrolatry
71. Proverbs
72. Taboo
73. Folktales/ oral traditions
74. Supernatural powers
75. Ceremony
76. Reconciliation
77. Local languages
78. Sense of place
79. Bureaucratic (Heirarchist)
80. Community (Egalitarian)
81. Bureaucratic (Heirarchist)
82. Community (Egalitarian)
83. Resources
84. Views
85. Heritage (pearling)
86. Technology
87. Economy
88. Politics
89. Holistic community well-being
90. Subsistence economies
91. Traditional ecological knowledge (TEK)
92. Water lily yarlbun cover
93. Grass cover
94. Ground surface cover
95. Religious
96. Land as culture
97. Social
98. River is our life blood
99. Economic
100. River as our supermarket and chemist
101. Heritage
102. Creative and sustaining
103. Socially unifying
104. Ethics and reciprocal responsibility
105. Rights and ownership
106. Interconnectedness
107. The nature of water
108. Sacred: ‘water is the giver of life’, the main priority of the Kuku Nyungka
109. Powerful: water in permanent water holes and rivers is healing for both young and old

110. Ancestors: healing quality of water comes from blessings bestowed by ancestors at waterfalls
111. Water places
112. Rivers, waterfalls, permanent waterhole
113. Sacred men and women's sites
114. Rivers act as corridors fo Guryulla (the Rainbow Spirit) to travel the landscape. Guryulla protects people and aquatic species. But it must be respected in cultural lore or it may cause harm
115. Some rivers designate clan boundaries
116. Cultural lore and protocol
117. Values ascribed to special water places are determined by cultural lore and expressed by cultural protocol
118. Cultural lore may be place specific
119. Certain waters places are inhabited by totem species: protection of totem species ensures water quality and quantity. Serious ramifications occur if totem species are killed (eg flooding)
120. Cultural and recreational visits
121. Knowledge sharing: Youngers learn stories, Lore and Protocol from Elders
122. Culture camps: troubled youth learn from Elders. Reconciliation between Aboriginal and non-Aboriginal youth
123. Cultural re-invigoration: a space to reconnect with ancestors, country and culture, to develop a sense of wellbeing and self-empowerment
124. Fishing, hunting, swimming, body painting with locally sourced ochre, photography, camping, cooking with certain river rocks, place specific storytelling (need to be at particular places to be able to talk about them)
125. Economic benefit
126. Fishing supplements weekly income towards end of income payment cycle
127. Management (via the ILUA, Ranger Group) of water places and freshwater country provides sustainable livelihood development option
128. Potential ecotourism venture on freshwater country
129. Functional values
130. Sacredness
131. Supernatural agency
132. Respect
133. Caring for land
134. Story sharing/ Collaboration
135. Physical presence
136. Indigenous languages
137. Listening
138. Interconnectedness (human - non-human relationships, ancestors and the living)
139. Nature's contribution to people (ecosystem goods and services, nature's gifts)
140. Good quality of life (human well-being, living in harmony with nature, living-well in balance and harmony with Mother Earth)
141. Basis for education
142. It gives life to festivities and traditions
143. Traditional knowledge source
144. It configures a unique landscape
145. Stories
146. Symbols
147. Power structure
148. Organisational structure
149. Control systems
150. Rituals and routine
151. Dominionistic
152. Ecologistic-scientific
153. Humanistic
154. Moralistic
155. Naturalistic
156. Negativistic

157. Symbolic
158. Utilitarian
159. Aware and committed
160. Down to earth and confident (fatalist)
161. Egalitarian and solidary (egalitarian)
162. Quality and health concerned
163. Costumbres (costumes)
164. Ritual technology
165. Pagos (payments)
166. Abuelos (ancestors)
167. Limpias (clean)
168. Right to subsistence
169. Norms of reciprocity
170. Cultural heritage
171. Spirituality
172. Ceremony and tradition
173. History
174. Local identity
175. Personal experience of place
176. Human right to water
177. Water governance
178. Water access
179. Environmental stewardship
180. Aspects of water markets
181. Aspects of water quality and health
182. The scriptures are in agreement regarding the value of water as the first matter to exist and of the fact that God was the first one to separate and exercise control over water.
183. Water has an intrinsically spiritual value and is a sign reminding humans of spiritual realities that are beyond the physical world.
184. One of the roles of water as provided by God is for production agriculture. Water is given by God to produce provisions for man in the form of food.
185. Humans are assigned to be regents of God in their rule over the earth and should act as righteous rulers in their treatment of nature, including water.
186. Humans should not waste or be given to excess in their use of natural resources. In the context of agricultural water use, humans should work towards efficiency (i.e., not wasting or applying excess) when applying limited natural resources such as extracted fresh water for irrigation and when seeking to distribute and consume what has been produced.
187. Private entities (individuals, communities, and nations) have the right to exercise control over sources of fresh water within their allotted domain. Fresh water can be bought and sold among these parties
188. There are multiple solutions to disputes over water. Such solutions may include dialog, treaties, and certain parties moving on to other sources of fresh water. In all cases, individual parties are expected to use what has been given to them rather than taking what belongs to others. Over and above this, individual parties are expected to be generous towards and show love for others (including even enemies) with what resources they have been given.
189. Construction of water works for distribution, storage, and/or purification of water is a good and acceptable practice for meeting human consumption and agricultural needs
190. Attachment
191. Dependence
192. Experience
193. Existence
194. Bequest and moral
195. katom save (traditional knowledge)
196. Respect (collective action, enforcement of customary rules and reciprocity)
197. Christian religious values
198. Forward planning (futja lukluk)

199. Human-environment relations
200. Traditional lifestyles
201. Festivities
202. Cultural water values
203. Aesthetic values
204. Traditional Festivities
205. Ecological importance
206. Subsistence fishing
207. Economic water values
208. Aquaculture
209. Tourism
210. Agriculture
211. Navigation
212. Social justice
213. Conservation tradition
214. Solidarity
215. Equity
216. Order
217. Pragmatism
218. Development
219. Efficiency

S.3. Mapping of individual cultural values found in this literature review to Schwartz's model

Schwartz's Model		Cultural values found in water management/governance literature review
Openness to Change	Hedonism	• Objectified cultural capital • Individualist • Material • Basic materials for a good life • General life satisfaction • Provide spots for wildlife watching • Recreational hunting • Resources • Cultural and recreational visits • It gives life to festivities and traditions • Naturalistic • Personal experience of place • Festivities • Aesthetic values
	Stimulation	• Activity • Attract researcher • Attract tourists/visitors • Fishing, hunting, swimming, body painting with locally sourced ochre, photography, camping, cooking with certain river rocks, place specific storytelling (need to be at particular places to be able to talk about them) • Experience • Tourism
	Self-direction	• Scepticism • Identity • Inspiration • Option • Freedom of choice and action • Creative and sustaining • Stories • Egalitarian and solidary (egalitarian)
Self-Transcendence	Universalism	• Holistic • Country • Culture • Aesthetic • Knowledge • Place/heritage • Local ecological knowledge • Attracting game (hunting activities) • Provide locations that serve as environmental education • Increase the region's beauty • Kotahitanga (unity, working together as one) • Mauri (essential life force or principle; a quality inherent in all things both animate and inanimate • Cultural use • Wai • Cultural landscape • Water as life • Proverbs • Sense of place • Views • Water lily yarlbun cover • Grass cover • Ground surface cover • Land as culture • River is our life blood • Interconnectedness • The nature of water • Sacred: 'water is the giver of life', the main priority of the Kuku Nyungka • Water places • Rivers, waterfalls, permanent waterhole • Knowledge sharing: Youngers learn stories, Lore and Protocol from Elders • Respect • Caring for land

		• Interconnectedness (human - non-human relationships, ancestors and the living) • Nature's contribution to people (ecosystem goods and services, nature's gifts) • It configures a unique landscape • Eco-logistic-scientific • Symbolic • Aspects of water quality and health • Humans are assigned to be regents of God in their rule over the earth and should act as righteous rulers in their treatment of nature, including water. • Humans should not waste or be given to excess in their use of natural resources. In the context of agricultural water use, humans should work towards efficiency (i.e., not wasting or applying excess) when applying limited natural resources such as extracted fresh water for irrigation and when seeking to distribute and consume what has been produced. • Existence • Forward planning (futja lukluk) • Human-environment relations • Cultural water values • Ecological importance • Aquaculture • Navigation • Social justice • Equity
	Benevolence	• Dialogue • Emotion • Embodied cultural capital • Egalitarian • Manaakitanga (show kindness and respect to, look after, entertain) • Kaitiakitanga (the exercise of customary custodianship, in a manner that incorporates spiritual matters, by those who hold mana whenua status for a particular area or resource • Hydrolatry • Supernatural powers • Community (Egalitarian) x 2 • Religious • Sacred men and women's sites • Rivers act as corridors fo Guryulla (the Rainbow Spirit) to travel the landscape. Guryulla protects people and aquatic species. But it must be respected in cultural lore or it may cause harm • Certain waters places are inhabited by totem species: protection of totem species ensures water quality and quantity. Serious ramifications occur if totem species are killed (eg flooding) Supernatural agency • Moralistic • Humanistic • Spirituality • Local identity • The scriptures are in agreement regarding the value of water as the first matter to exist and of the fact that God was the first one to separate and exercise control over water. • Water has an intrinsically spiritual value and is a sign reminding humans of spiritual realities that are beyond the physical world. • There are multiple solutions to disputes over water. Such solutions may include dialog, treaties, and certain parties moving on to other sources of fresh water. In all cases, individual parties are expected to use what has been given to them rather than taking what belongs to others. Over and above this, individual parties are expected to be generous towards and show love for others (including even enemies) with what resources they have been given. • Attachment
Conservation	Conformity	• Intergenerational • Fatalist • History and tradition of the region • Ancestors: healing quality of water comes from blessings bestowed by ancestors at waterfalls • Aware and committed • Abuelos (ancestors) • History • Order • Pragmatism • Efficiency

	Tradition	• Local factors • Connection to the past • Spiritual • Existence/ bequest x 2 • Taboo • Folktales/ oral traditions • Ceremony • Local languages • Traditional ecological knowledge (TEK) • Heritage • Sacredness • Traditional knowlede source • Costumbres (costumes) • Ritual technology • Pagos (payments) • Limpias (clean) • Cultural heritage • Ceremony and tradition • Bequest and moral • katom save (traditional knowledge) • Christian religious values • Traditional lifestyles • Traditional Festivities • Conservation tradition • Symbols
	Security	• We (communitarianism) • Collective • Physical • Kin • Hierarchist • Social capital and cohesion • Activity (binational cooperation & exercising a bilateral agreement) • Well-being • Health • Security • Create spots for physical well-being • Contribute to psychological well-being • Provide areas where people meet • Whakapapa (genealogy) • Hauora (holistic health and wellbeing) • Whanaungatanga (kinship, familial relationships) • Health and well-being • Bureaucratic (Heirarchist) x 2 • Politics • Holistic community well-being • River as our supermarket and chemist • Socially unifying • Ethics and reciprocal responsibility • Powerful: water in permanent water holes and rivers is healing for both young and old • Some rivers designate clan boundaries • Cultural lore and protocol • Values ascribed to special water places are determined by cultural lore and expressed by cultural protocol • Cultural lore may be place specific • Culture camps: troubled youth learn from Elders. Reconciliation between Aboriginal and non-Aboriginal youth • Cultural re-invigoration: a space to reconnect with ancestors, country and culture, to develop a sense of wellbeing and self-empowerment • Story sharing/ Collaboration • Listening • Good quality of life (human well-being, living in harmony with nature, living-well in balance and harmony with Mother Earth) • Basis for education • Quality and health concerned • Norms of reciprocity • Respect (collective action, enforcement of customary rules and reciprocity) • Solidarity

Self-Enhancement	Power	• Denial and blame • Institutional cultural capital • Provide water for touristic infrastructure • Provide water for luxurious touristic infrastructure • Rangatiratanga (chieftainship, decision-making rights) • Reconciliation • Heritage (pearling) • Economy • Subsistence economies • Social • Economic • Rights and ownership • Economic benefit • Fishing supplements weekly income towards end of income payment cycle • Functional values • Physical presence • Indigenous languages • Power structure • Organisational structure • Control systems • Rituals and routine • Dominionistic • Utilitarian • Right to subsistence • Human right to water • Water governance • Water access • Environmental stewardship • Aspects of water markets • One of the roles of water as provided by God is for production agriculture. Water is given by God to produce provisions for man in the form of food. • Private entities (individuals, communities, and nations) have the right to exercise control over sources of fresh water within their allotted domain. Fresh water can be bought and sold among these parties • Construction of water works for distribution, storage, and/or purification of water is a good and acceptable practice for meeting human consumption and agricultural needs • Dependence • Subsistence fishing • Economic water values • Agriculture
	Achievement	• Intellectual • Employment • Technology • Management (via the ILUA, Ranger Group) of water places and freshwater country provides sustainable livelihood development option • Potential ecotourism venture on freshwater country • Negativistic • Down to earth and confident (fatalist) • Development