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Value landscapes and their impact on public water policy preferences

Abstract

A growing body of research suggests that people's values may be important predictors of their preferences regarding water governance and policy. However, this assertion is rarely tested empirically. The present study summarises the results of a large-scale quantitative study on the link between public water policy preferences and people's values, based on data from a representative sample of the general population collected in a household survey in the Upper Paraguay River Basin, Mato Grosso, Brazil (n=1067). Structural equation modelling is applied to represent the clusters of values, or 'value landscapes', that shape attitudes and water policy preferences, in this case, for or against the construction of the highly controversial Paraguay-Paraná Waterway across the Pantanal wetland. Results demonstrate that opponents of the waterway share a value landscape composed of closely related self-transcendence values, democratic governance-related values, and ecological and cultural water values, whereas supporters hold self-enhancement values, economic governance-related values, and economic water values. Beyond this individual case study, our findings may explain the protracted nature of, and seeming impossibility to resolve, environmental conservation vs. economic development conflicts more broadly.

Keywords

Environmental values; value landscapes; political legitimacy; Paraguay-Paraná Waterway; Pantanal; Mato Grosso; Brazil

1 Introduction

It has been argued that studying values can help to better understand water governance and water policy, may potentially contribute to mitigating conflicts in water governance, and help to assess the political legitimacy of water policy (Bjornlund et al. 2013; Glenk & Fischer 2010; Groenfeldt 2013; Grotenbreg & Altamirano 2017; Hermans et al. 2006; Ioris 2012; Pradhananga et al. 2017; Salvaggio et al. 2014; Sanderson et al. 2017; Schulz et al. 2017a). There are a number of alternative theoretical conceptualisations of values, typically delimited by disciplinary boundaries (Dietz et al. 2005; Ioris 2012; Lockwood 1999; Schulz et al. 2017a).

One of the many existing conceptualisations is associated with environmental and social psychology, where values are understood as abstract guiding principles (fundamental values) that may influence human decision-making, attitudes, and behaviour, such as e.g. biospheric values, which emphasise caring about the intrinsic value of nature and the environment and may be associated with pro-environmental behaviour (Dietz 2016; Fulton et al. 1996; Rokeach 1973; Schwartz et al. 2012; Steg 2016).

Alternatively, values may be assigned to objects and places (Brown 1984; Chan et al. 2012; Ives & Kendal 2014; Lockwood 1999), for example water resources (Seymour et al. 2011), nowadays often conceptualized as water ecosystem services, e.g. water supply or electricity generation (Grizzetti et al. 2016; Hackbart et al. 2017; Martin-Ortega et al. 2015; Small et al. 2017). Assigning values in this way is common to a number of disciplines, including ecological and environmental economics, and human geography, among others (Brown 1984; Chan et al. 2012; Ives & Kendal 2014; Lockwood 1999).

For the applied field of water governance, some scholars have suggested to study a third category of values (Glenk & Fischer 2010; Schulz et al. 2017a; Schulz 2018), i.e. governance-related values, which are those values that express desirable characteristics of water governance, e.g. efficiency or social justice. Such values are currently often the topic of normative work on good governance principles (Akhmouch & Correia 2016; Lockwood et al. 2010; Mostert 2015).

There are relatively few attempts to systematically integrate these different branches of the environmental social science literature, hampered not least by the use of different terminologies and by misunderstandings that can result from the multitude of potential meanings of the term 'value' (Brown 1984; Lockwood 1999; Pascual et al. 2017; Tadaki et al. 2017). In this context, Schulz et al. (2017a) have proposed an interdisciplinary conceptual framework that describes the complex relationships between different types of values and their links with water governance metaphorically as 'value landscapes' (Schulz et al. 2017a, 2017b) that forms the theoretical basis for the present study.

The value landscapes metaphor serves as a short-hand reference for groups of values that are frequently connected to each other in people's minds, i.e. values that should be closely linked to each other cognitively, but less closely to other groups of values, e.g. 'economic efficiency' as a governance-related value might be linked with 'hydro-electrical power production' as an assigned value and 'power' and 'achievement' as fundamental values (Schulz et al. 2017a). Thus, value landscapes simultaneously incorporate the abstract level of fundamental values and principles, the more concrete level of assigned values of water and the environment, as well as the level of values implicit in governance. The conceptual innovation of the Value Landscapes Approach lies in this simultaneous consideration of said three types of values (fundamental values; governance-related values; assigned values), their interrelations, and links to water governance, including water policy preferences, as further explained in section 2.

The water policy case study investigated in this article is the controversy over the Paraguay-Paraná Waterway, a water infrastructure project that would engineer the Paraguay River of Mato Grosso, Brazil, to facilitate year-round aquatic transport with large barges, and to connect Brazil's interior with global shipping routes (ANTAQ 2013; Figueiredo et al. 2012; Hamilton 1999; UFPR/ITTI 2016). In many ways, this project represents a classical environmental conservation vs. economic development conflict, given that it would impact the biodiversity of the world's largest freshwater wetland, the Pantanal (Fearnside 2001; Gottgens et al. 2001; Ioris 2013; Junk et al. 2006), but is advocated to accelerate economic integration of South American countries (Gioia 1987; Pires & da Silva 2009), as well as economic growth in Mato Grosso's agribusiness sector (ANTAQ 2013; Arévalo 2015).

To investigate the relationships between types of values and water policy preferences, we employ structural equation modelling (SEM). SEM is an established method to understand attitudes and behavioural intentions in the context of applied social and environmental psychological studies (see e.g. Kaida & Kaida 2016; Rahnama & Rajabpour 2017; Shin et al. 2017; Toma et al. 2011) and it allows to uncover complex relationships between latent constructs such as values (Garson 2015; Kline 2011).

With regard to water-related issues, a number of studies have focussed specifically on understanding psychological factors motivating support for water conservation and protection behaviour using SEM. These include beliefs and worldviews (Corral-Verdugo et al. 2008), attitudes and awareness (Cooper 2017; Floress et al. 2017; Yazdanpanah et al. 2014), perceptions (Hurlimann et al. 2008; Tang et al. 2015; Yazdanpanah et al. 2014), perceived behavioural control and norms (Cooper 2017; Yazdanpanah et al. 2014), as well as people's values (Pradhananga et al. 2017), within theoretical frameworks including modifications of the Theory of Planned Behaviour (Ajzen 1985, 1991), Values-Beliefs-Norms

Theory (Dietz 2016; Stern et al. 1999), or of the Cognitive Hierarchy model (Fulton et al. 1996; Homer & Kahle 1988; Vaske & Donnelly 1999).

Pradhananga et al.'s (2017) integrated moral obligation model, for example, highlights the positive association of collectivistic values (i.e. prioritising group goals over personal goals, and defining 'self' primarily as part of a group) and biospheric-altruistic values (i.e. of caring about the environment for its own sake as well as for improved human welfare) with people's norms (e.g. "I feel a personal obligation to use conservation practices on my land/property."; Pradhananga et al. 2017: 217) regarding water conservation behaviour. However, beyond the specific issue of water conservation there is a paucity of empirical evidence on the link between values and water policy preferences of the general public. An exception is Glenk and Fischer (2010), who investigated links between fundamental and governance-related values, beliefs, attitudes, and willingness to pay for flood mitigation.

The present study makes an empirical contribution to the interdisciplinary literature on values, water governance, and water policy by presenting the first attempt to test the aforementioned Value Landscapes Approach using quantitative methods. It is also the first large-scale study on people's values and public water policy preferences in Latin America. It builds on previous qualitative research on the value landscapes of major stakeholders from water-related sectors in the area (Schulz et al. 2017b), seeks to operationalise value landscapes for quantitative survey research, as well as to test their impact on water policy preferences using SEM techniques, based on survey data collected in a representative household survey in the Upper Paraguay River Basin, Mato Grosso, between April and June 2016. This article thus shows how the framework can be operationalised, and demonstrates its real-world relevance of providing a better understanding of water-related conflicts, and eventually of pathways for their resolution. By incorporating concepts from a wide range of literatures and disciplines, we also seek to contribute to interdisciplinary scholarship in general, despite the challenges associated with combining thoughts from various research traditions that may have different epistemological backgrounds and terminologies (Lockwood 1999; Norton 2017; Pascual et al. 2017).

2 The Value Landscapes Approach: Conceptual overview

The Value Landscapes Approach was introduced by Schulz et al. (2017a, 2017b) and refers to a conceptual framework that aims at 'mapping' people's values with the objective of achieving a better understanding of their positions and preferences in water governance, including in situations of conflict. The purpose of the Value Landscapes Approach is to systematise our understanding of the role of values in water governance from an interdisciplinary perspective. The metaphor of 'value landscapes' for groups of closely related values does not refer to actual geographical landscapes, but cognitive landscapes of values that are related in people's minds, inspired by the fact that landscapes are typically defined by the features of connectivity and (physical) closeness of various elements, e.g. in ecology (Taylor et al. 1993).

Justification for the introduction of a new conceptual framework were i) that many existing studies apply a single theoretical, monodisciplinary perspective, despite potential additional insights that may arise from combining the findings of multiple disciplines (see also Hermans et al. 2006); and ii) that existing interdisciplinary studies that argue for the need to take values into account for better water governance (e.g. van Schie et al. 2011) have paid limited attention to clearly distinguishing value types. For example, some authors may treat diverse values such as 'equity' or 'economic water values' as if

131 they belonged into one single category of 'values', despite considerable differences in scope and
132 nature of these values, which could be taken into account by distinguishing between fundamental,
133 governance-related, and assigned values (Schulz et al. 2017a).

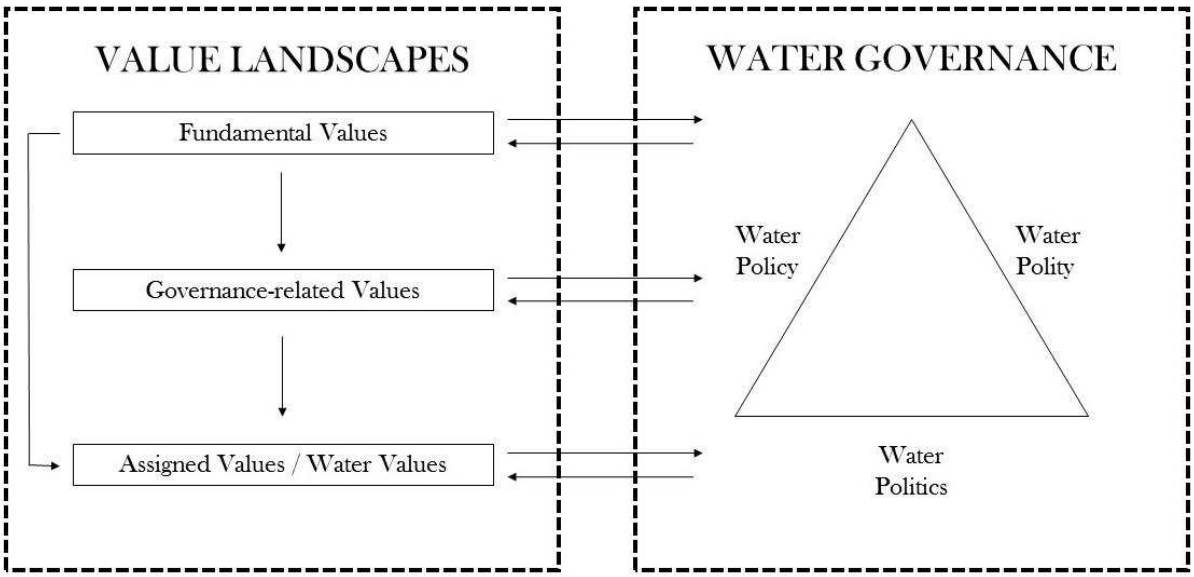

Figure 1: Schematic overview of the Value Landscapes Approach (adapted from Schulz et al. 2017a); arrows represent theoretically expected relationships of influence between variables

134 The Value Landscapes Approach brings together these three types of values (fundamental,
135 governance-related, and assigned values), as well as their interrelationships and impacts on water
136 governance and vice versa (see Figure 1). Arrows in Figure 1 represent theoretically-expected
137 influence of some kind, i.e. the universally relevant fundamental values are expected to influence the
138 more concrete governance-related values and assigned values / water values of people, but not vice
139 versa (see also Brown 1984; Glenk & Fischer 2010; Seymour et al. 2010). For example, people who
140 prioritise 'universalism' as a fundamental value may also favour 'social justice' as a governance-related
141 value and 'ecological values of water' as an assigned value, but we would not normally assume that a
142 preference for ecological water values is the more general cause of prioritising fundamental values;
143 and the concrete context of water governance in a given place and time may also impact on people's
144 values, as experimental evidence shows that interacting within market institutions may erode moral
145 values, for example (Falk & Szech 2013). Similarly, one could expect an increased concern for the
146 governance-related value of 'social justice' in a situation where a concrete water governance project
147 would have strong negative impacts on vulnerable minorities. Here, our focus lies on the impact of
148 values on water policy preferences, however.

149 The definition of water governance is inspired by Treib et al.'s (2007) more general definition of
150 governance as the combination of i) water polity (the institutional framework); ii) water politics
151 (power relations between political actors); and iii) water policy (the mechanisms and instruments used
152 to achieve certain outcomes). While the Value Landscapes Approach covers all three elements of
153 water governance from a theoretical point of view, the present case study will focus on water policy,
154 which we found most suitable for application within a survey with members of the general public.

155 Based on insights from various disciplines, but especially ecological economics, the Value Landscapes
156 Approach i) assumes a strong interconnectedness between water governance and values; ii) analyses
157 values at different levels of abstraction, with influence from more abstract to more concrete values;
158 iii) is based on the idea of value pluralism as an empirical reality that can be studied (Schulz et al.

2017a), i.e., it does not seek to translate values into one ultimate category (Martinez-Alier et al. 1998). Moreover, two broad hypotheses follow from this conceptual framework: i) if we know people's values in a given time and location, this may help to understand their preferences and behaviour in water governance; and ii) if we compare values expressed by actual water governance (e.g. a specific water policy with an implicit value content) with values held by members of the general public (especially governance-related and assigned values), we can assess the political legitimacy of existing water governance in a given time and location (Schulz et al. 2017b). While the Value Landscapes Approach was developed in the context of water governance, it could conceivably be adapted for the analysis of other fields of environmental governance more generally.

The Value Landscapes Approach shares some features with other existing conceptual frameworks. While a full discussion of commonalities and differences would be beyond the scope of the present paper, it should be noted that the Value Landscapes Approach's emphasis on identifying values at different levels of abstraction has similarities with the Cognitive Hierarchy Model (Fulton et al. 1996; Homer & Kahle 1988; Vaske & Donnelly 1999), Values-Beliefs-Norms Theory (Dietz 2016; Stern et al. 1999), as well as the Advocacy Coalition Framework (Sabatier 1988; Sabatier & Weible 2007), which are all based on the analysis of a number of constructs at varying levels of abstraction that are to some degree causally related.

As opposed to the social psychological Cognitive Hierarchy Model and Values-Beliefs-Norms Theory, the Value Landscapes Approach has an explicit interdisciplinary focus that aims to integrate various value concepts from environmental and social psychology and beyond, given the centrality of the concept of value in disciplines such as ecological and environmental economics, human geography, and many others (see details below). Furthermore, it does not aim to represent an exhaustive model of human behaviour which is common to social psychological frameworks, but rather 'zooms in' on the concept(s) of values, and their relationship with governance.

Unlike the Advocacy Coalition Framework, the Value Landscapes Approach aims to understand interlinkages between values and governance as they exist in people's minds in general, beyond those specific actors that might have the opportunity to directly influence policy in their field (as part of an 'advocacy coalition'). In line with Henry and Dietz (2012: 251), it should be noted that despite their common focus on environmental cognition, the various conceptual frameworks listed here should be seen as complementary rather than competing, given that they aim to explain "different phenomena in different contexts".

2.1 Fundamental values

The concept of fundamental values has its origin in social psychological theory; these values are generally defined as abstract goals and principles that guide people's decision-making across situations (Dietz 2016; Fulton et al. 1996; Rokeach 1973; Schwartz 1992; Schwartz et al. 2012; Steg & de Groot 2012; Steg 2016). The label 'fundamental values' is taken from Fulton et al. (1996), but numerous alternative terms exist that roughly fit the same definition, such as 'basic individual values' (Schwartz et al. 2012), 'terminal values' (Rokeach 1973), or 'transcendental values' (Raymond & Kenter 2016).

One of the most popular theoretical frameworks for fundamental values is Schwartz' theory of basic individual values (Schwartz 1992; Schwartz et al. 2012), which in turn was inspired by earlier work of Rokeach (1973; Schwartz & Bilsky 1987). In its original form, Schwartz (1992, 1994) proposed the existence of ten basic values that are universally recognised among humans across cultures, only

varying in the relative importance given to them by different people across different situations. These values are particularly salient in situations of value conflict, i.e. decision-making situations where two alternative choices would reinforce different or opposing values (Schwartz 1992, 1994).

The ten fundamental values are universalism, benevolence, conformity, tradition, security, achievement, power, hedonism, stimulation, and self-determination, arranged in a circular structure that can be subsumed under two broad pairs of opposing higher-order dimensions (self-enhancement vs. self-transcendence and openness to change vs. conservation), which broadly translate into concern about oneself vs. concern for others, and a preference for novelty and innovation vs. preference for keeping the status quo via order, self-restraint and traditions (Schwartz 1992, 1994).

While Schwartz and Boehnke (2004) note that these higher-order dimensions are but one of many possibilities to classify the ten basic values, a large number of empirical studies have found that self-transcendence values tend to be positively correlated with pro-environmental behaviour, norms, and attitudes, whereas self-enhancement values tend to be negatively correlated (Evans et al. 2013; Kilbourne et al. 2005; Schultz et al. 2005; Steg & de Groot 2012). Considerably less consistent empirical evidence has been found for a relationship between pro-environmental behaviour and the dimensions of openness to change vs. conservation (but see Poortinga et al. 2004), although from a theoretical point of view one can easily construct such hypotheses, e.g. assuming that political conservatism goes along with reduced concern for the environment (Dietz 2016).

In the applied field of environmental psychology, the subset of fundamental values that are strongly correlated with environmental concern and pro-environmental behaviour in modified versions of the Schwartz value theory (1992, 1994), such as biospheric or altruistic values (i.e. of caring about the environment for its own sake as well as for improved human welfare) (Steg, Perlaviciute et al. 2014; Stern et al. 1998) are often referred to as 'environmental values' (Dietz 2016; Steg & de Groot 2012). Thus, in environmental psychology, 'environmental values' typically stands for (personally held) 'values and abstract goals that inform pro-environmental behaviour, norms, and attitudes'.

However, it is important to note that the same term can also mean 'values of the environment', i.e. assigned values (see section 2.3), which is a typical use in disciplines such as ecological economics or human geography, or where environmental valuation is concerned (Arias-Arévalo et al. 2017; Norton & Steinemann 2001; Seymour et al. 2011; Spash & Vatn 2006; Tadaki et al. 2017). This polysemy (i.e. multiple related meanings of the same words) may cause some confusion, which we avoid here by using the conceptual framework proposed by Schulz et al. (2017a). Analogous to biospheric and altruistic values as elements of the self-transcendence dimension, a number of individual fundamental values have been identified in the literature that tend to correlate negatively with pro-environmental behaviour, norms, and attitudes. These are egoistic and hedonic values (i.e. a concern about one's personal resources; or for improving one's feelings and reducing effort), which fall into the broader dimension of self-enhancement (Steg, Bolderdijk et al. 2014; Steg & de Groot 2012), although hedonic values are also sometimes categorised as pertaining to the openness to change dimension (Dietz 2016; Schwartz 1992, 1994).

From the perspective of the practitioner in environmental management, research in environmental psychology suggests that better knowledge of environmental values can contribute to better design of incentives for pro-environmental behaviour (Crompton et al. 2010), including environmental policy. For example, the recently proposed 'Integrated Framework for Encouraging Pro-environmental behaviour' (IFEP) outlines multiple pathways for encouraging pro-environmental behaviour, such as the activation of biospheric values via situational cues or the reduction of perceived costs associated with such behaviour (Steg, Bolderdijk et al. 2014). Given the relatively stable nature of fundamental

values across an individual's lifetime (and across generations), their activation via situational cues (e.g. in the context of marketing or information campaigns) seems indeed a much more viable strategy than simply aiming to 'change' values in general.

Value change involves timescales of generations and is thus difficult to control (Manfredo et al. 2017a, 2017b), although Ives and Fischer (2017) suggest that short-term value change is sometimes possible, and that, even if difficult and slow, intentional value change should remain an important priority e.g. for conservationists. Also, it is important to remember that people may hold multiple and competing values that may contradict each other (Schwartz 1992, 1994). Yet, 'value activation' strategies will be more successful with individuals who hold stronger pro-environmental values than others in the first place (Steg, Bolderdijk et al. 2014; Steg & de Groot 2012). In any case, all cited studies emphasise the real-world relevance of research on people's (environmental) values in the context of concrete decision-making situations, as well as their relevance for understanding environmental cognition more broadly (Dietz 2016; Steg 2016).

2.2 Governance-related values

In the Value Landscapes Approach, governance-related values are defined as idealised characteristics or properties of water governance that are expressed as desirable by individuals and groups (Schulz et al. 2017a). The concept is less established as a distinct analytical category than fundamental values (Schulz 2018), although governance-related values themselves, such as equity or sustainability, have been the subject of philosophical and normative debates for centuries (see e.g. Du Pisani 2006; Young 1994). They also frequently appear in the general public administration literature, where a separate body of research on the topic is consolidating (Beck Jørgensen & Bozeman 2007; de Graaf et al. 2016; Rutgers 2015; Tsanga Tabi & Verdon 2015).

Applied to the field of water governance, studies often evaluate the degree of various governance-related values such as sustainability (e.g. Antunes et al. 2009; Iribarnegaray & Seghezzo 2012; Kuzdas et al. 2014; Milman & Short 2008), legitimacy, efficiency and effectiveness (e.g. Lieberherr et al. 2012; Moss & Newig 2010; van Meerkerk et al. 2015) or social justice (e.g. Lukasiewicz et al. 2013; Patrick 2014; Perreault 2014) associated with different governance options. Many of these studies develop sophisticated systems of indicators aimed at measuring and evaluating the level of realisation of such governance-related values in practice (see e.g. van Leeuwen et al. 2012 for a list of 24 indicators measuring the sustainability of urban water governance). In their level of detail, these indicator systems go far beyond the general definition of each respective value, e.g. of sustainability as the possibility for a process to continue within long, potentially indefinite time-scales (Johnston et al. 2007) or the notion of safeguarding natural resources for future generations (Daly 1990). Yet by looking at individual values only, they fail to consider inevitable trade-offs and/or conflicts between various governance-related values (de Graaf et al. 2016; Grotenbreg & Altamirano 2017), such as between social justice and economic efficiency. Nevertheless, the existence of such a large body of literature on individual governance-related values points to high levels of interest in this specific category, and provides additional justification for the inclusion of this type of values into the conceptual framework underpinning our empirical analysis.

Governance-related values may thus serve as abstract guiding principles in decision-making in water governance, or represent properties of water governance that may or may not have been realised yet. They are different from fundamental values as they are located at the intersection of internal, abstract goals, and external values assigned to elements of governance (such as a concrete policy), taking a

middle position between fundamental and assigned values in the Value Landscapes Approach (Schulz et al. 2017a). Sustainability or social justice are both abstract goals as well as properties assigned to elements of governance.

Holders of governance-related values are not only actors and stakeholders within water governance, but also members of the general public (Glenk & Fischer 2010; Schulz et al. 2017a; Schulz 2018). Despite numerous case studies on individual values as cited above, and a number of conceptual overview papers on natural resource governance principles (Akhmouch & Correia 2016; Kooiman & Jentoft 2009; Lockwood et al. 2010; Moreno Pires et al. 2017; Mostert 2015), Glenk and Fischer (2010) note a lack of quantitative research on governance-related values, especially in the environmental economics and psychology literatures. In the absence of an established comprehensive governance-related values theory and associated measurement instruments, it is thus left to individual researchers to define their own set of governance-related values to be studied on a case-by-case basis (Schulz 2018).

2.3 Assigned values / water values

The concept of assigned values refers to the concrete values that people attach to the environment, environmental resources, landscapes and places (Brown 1984; Chan et al. 2012; Ives & Kendal 2014; Lockwood 1999; Schulz et al. 2017a; Seymour et al. 2010). As such, this category of values is the most prevalent type in the environmental valuation literature, although terminologies may vary widely, with the most common conceptualization currently used being the ecosystem services framework (Grizzetti et al. 2016; Hackbart et al. 2017; Martin-Ortega et al. 2015; Small et al. 2017). Here we prefer to use the more open-ended term 'assigned values' as opposed to the more prescriptive term 'ecosystem services', which is associated with a particular normative vision of environmental management and human-nature relationships (Schröter et al. 2014) that may not necessarily match with the normative vision that the average person subscribes to (Braito et al. 2017).

The term 'water values' simply stands for assigned values of water resources. It may refer to their value for irrigation, human consumption, bathing, navigation, or their role in sustaining ecosystems, as well as to more intangible values such as cultural, aesthetic and spiritual values. It is used as a short-hand reference for such assigned values in a significant part of the literature, especially in human geography and related areas (see e.g. Barber & Jackson 2011; Bark et al. 2011; Berry et al. 2018; Euzen & Morehouse 2011; Gibbs 2010; Ioris 2012), but also in environmental economics (e.g. Bjornlund & O'Callaghan 2005; Saliba et al. 1987). Similar terms exist for other important environmental resources, e.g. 'forest values' (Bengston 1994; Brown 2013; Brown & Reed 2000; Manning et al. 1999; McIntyre et al. 2008). Assigned values have been measured using a wide range of methods from focus group research to survey approaches, but due to their variability and context-specific nature (which is typically emphasised by human geographers, e.g. Gibbs 2010; Ioris 2012), their classification and measurement is usually customised to fit the specific research context at hand (Ives & Kendal 2014; Seymour et al. 2010).

Lockwood (1999) noted that assigned values are conceptually close to environmental attitudes (i.e. psychological tendencies to favour or disfavour certain attitude objects) in the environmental psychology literature, e.g. where attitudes towards specific 'environmental objects' such as hazardous waste dumps are concerned (Stern et al. 1995), not least because both assigned values and environmental attitudes are comparatively more concrete than fundamental values (i.e. abstract transsituational goals), and relate to external objects (Lockwood 1999). Nevertheless, here we follow

Dietz et al. (2005) who suggest that attitudes are far more specific than values, giving the example of the (assigned) value of 'wilderness', and the attitude of 'opposing oil development in a wildlife refuge'. We also prefer the terminology of 'values' to that of 'attitudes', given that values are generally seen as more stable than attitudes, which in turn may change more easily (Dietz et al. 2005; Homer & Kahle 1988; Shin et al. 2017).

Another related concept are 'beliefs', which have been defined as "facts as an individual perceives them" (Dietz et al. 2005: 346). Yet, as Schwartz (1992) notes, all (fundamental) values are also beliefs; and in the same way, all assigned values are also beliefs about the particular qualitative importance of an environmental resource (e.g. 'water resources are a source of fish', or of cultural value), which typically go along with a quantitative assessment of the resource's relative importance in comparison with other assigned values (e.g. 'the ecological value of water is more important than its aesthetic value') (Bengston 1994; Ives & Kendal 2014; McIntyre et al. 2008; Seymour et al. 2010). While all assigned values are beliefs, not all beliefs are assigned values, so we prefer to use the term 'assigned value' throughout our analysis, which is more parsimonious and can avoid confusion with beliefs beyond the realm of values. This is not to say that we oppose the simultaneous investigation of values and beliefs-beyond-values, which is established practice e.g. in values-beliefs-norms theory (Dietz 2016; Stern et al. 1999).

3 Applying the Value Landscapes Approach to the conflict over the Paraguay-Paraná Waterway, Mato Grosso, Brazil

In this article, we apply the Value Landscapes Approach to the case study of a conflict over the construction of the Paraguay-Paraná Waterway (*Hidrovia Paraguai-Paraná*) in the state of Mato Grosso, Brazil. This is a typical environmental conservation vs. economic development conflict. The waterway is part of a strategic national plan for Brazil's inland navigation infrastructure and has the objective of facilitating year-round aquatic transport and the export of agricultural products such as soybeans and cotton from Mato Grosso to world markets (ANTAQ 2013). This would reduce transport costs significantly, and likely further fuel the expansion of soybean production in Mato Grosso (Fearnside 2001), already Brazil's leading producer (Arvor et al. 2018; Ioris 2016), with strong trade links to China (Lathuillière et al. 2014; Peine 2013). While the full waterway extends over 3442 km from Cáceres, Mato Grosso, Brazil, to the port of Nueva Palmira in Uruguay, crossing Paraguayan and Argentinean territory further downstream, the main controversy concerns the upriver segment on the Paraguay River in Mato Grosso, near Cáceres, which would run across the Pantanal wetland (da Silva et al. 2004; Figueiredo et al. 2012; Leão et al. 2013; Schulz et al. 2017b).

The Pantanal is often considered a global natural heritage, recognised e.g. by UNESCO or the Ramsar Convention, due to its status as an important refuge for endangered biodiversity (Calheiros et al. 2012; Ioris 2013; Junk et al. 2006). Implementing the waterway there would require major engineering works, such as dredging of shallow sections, removal of rocks, and straightening of curves (Hamilton 1999), which would impact on the hydrology and ecology of the Pantanal, including its characteristic 'flood pulse', with associated repercussions for local biodiversity, flood protection downstream, as well as local people's livelihoods (da Silva et al. 2004; Gottgens et al. 2001; Junk et al. 2006). As of 2016, the project has passed a technical, economic, and environmental impact assessment (UFPR/ITTI 2016), but construction has not yet started, likely due to Brazil's ongoing political and economic crisis. It is chiefly supported by the state government of Mato Grosso and the local agribusiness sector, and opposed by many environmentalists and fishermen who are concerned about impacts on biodiversity and fish stocks (Schulz et al. 2017b).

In a previous study, which laid the foundation for the present study, Schulz et al. (2017b) investigated the controversy over the Paraguay-Paraná Waterway using qualitative research techniques and focussing exclusively on professionals from water-related sectors in the state of Mato Grosso, rather than members of the general public, as is done here. A comparison of the values expressed by supporters of the waterway in the interviews with the values of those opposed suggested that among relevant stakeholders, support or opposition to the project went along with two very different value landscapes.

One value landscape consisted of a cluster of governance-related values such as efficiency, pragmatism, and order (in the sense of legal certainty, security, and the ability to plan more generally), which relate well to a general vision of Mato Grosso as a place of strong economic development and growth. These governance-related values were complemented with assigned values such as navigation, agriculture, tourism, and aquaculture, i.e. mostly economic water values. Values of this first value landscape were typically expressed by supporters of the waterway, especially representatives of the agribusiness sector. A second value landscape emerged with an alternative focus on governance-related values such as equity, social justice, conservation/tradition and solidarity, and assigned values mostly related to culture, such as subsistence fishing, traditional festivities along the rivers, aesthetic values, as well as ecological values of water. This value landscape was closely associated with opposition to the waterway and typically found among traditional fishermen in the Pantanal, as well as NGO activists and academics opposed to the project (Schulz et al. 2017b).

Thus, in line with the Value Landscapes Approach and the previous qualitative work of Schulz et al. (2017a, 2017b), we specifically aim to test the following two broad hypotheses:

H1: We can identify people's value landscapes operationalised as statistically identifiable relationships among the three different types of values (fundamental values, governance-related values, and assigned values), with fundamental values being the most abstract construct 'predicting' both governance-related values and assigned values.

The present study thus serves to test whether the hypothetical relations of influence outlined in the Value Landscapes Approach (visualised by the arrows on the left side of Figure 1) can indeed be identified empirically. Here the various types of values are operationalised via survey statements, with survey results then feeding into the design of a structural equation model (see sections 4 and 5 below). If such a structural equation model cannot be rejected, this could be seen as a form of empirical evidence and validation of the many different conceptual considerations that fed into the development of the Value Landscapes Approach. While a 'cascade' from more abstract concepts influencing more concrete concepts that people subscribe to is the basis of many theoretical frameworks (see e.g. Brown 1984; Glenk & Fischer 2010; Homer & Kahle 1988; Lockwood 1999; Seymour et al. 2010; Stern et al. 1999), no previous empirical evidence exists of the interrelatedness of fundamental, governance-related, and assigned values simultaneously. One study has investigated the link between fundamental and governance-related values (Glenk & Fischer 2010), while there is some limited evidence of systematic links between fundamental values and assigned values (e.g. Hicks et al. 2015; van Riper & Kyle 2014), but not between all three value types at once.

Hicks et al. (2015) suggested that assigned values (referred to as ecosystem services in their study) can be directly associated with certain fundamental value domains (e.g. a preference for fish as an assigned value/provisioning service of a marine ecosystem is an expression of the fundamental value dimension of self-enhancement), which is in line with our conceptual framework; however, the study relied on the researchers to 'match' assigned values with corresponding fundamental values based on qualitative interview transcripts, whereas our study is using more established psychometric

426 measurement instruments to elicit fundamental values (although admittedly such statistical
427 approaches are less suited to detect individual outliers), and the links with further value categories
428 are based on statistical evidence, rather than manual coding.

429 Van Riper and Kyle (2014), in turn, compared how people holding strong pro-environmental
430 fundamental values identified various assigned values in a specific geographical area as opposed to
431 more neutral research participants, using Public Participation Geographical Information System (PPGIS)
432 methods (Sieber 2006) and a Social Values for Ecosystem Services (SolVES) mapping application
433 (Sherrouse et al. 2011). The study demonstrated that those with stronger pro-environmental
434 fundamental values gave much higher importance to various assigned values related to
435 environmentalism, such as the assigned value of biodiversity, visualised in strikingly different maps of
436 assigned values generated by pro-environmentalists' and a more neutral group's answers. These
437 findings are in line with our conceptual framework, but again, our method of analysis is different. Also,
438 neither van Riper and Kyle (2014) nor Hicks et al. (2015) considered governance-related values as a
439 separate category of relevance to water governance / environmental governance more generally.

440 *H2: There is a measurable impact of people's value landscapes on their water policy preferences.*

441 Beyond understanding interrelations between values, we also aim to test the hypothesis that people's
442 values influence their preferences in water governance (in this case, their water policy preferences),
443 which follows from the various conceptual considerations on which the Value Landscapes Approach
444 is based (as visualised by the arrows linking value landscapes and water governance in the middle of
445 Figure 1).

446 This is a relevant hypothesis for multiple reasons; it enhances the real-world relevance of values
447 research, given the applied nature of water governance, and further validates the idea that values are
448 deeply embedded and connected to society and culture in multiple ways (Manfredo et al. 2017a),
449 including in water governance (Groenfeldt 2013); it would demonstrate that values matter for water
450 policy preferences, as opposed to other variables such as interests, which are defined as needs or
451 desires for resources such as time, space, money or natural resources (Kouzakova et al. 2012), which
452 one could expect to have played a larger role e.g. for the stakeholders interviewed by Schulz et al.
453 (2017b). This is especially significant considering that conflicts about values (as opposed to mere
454 material interests) are more likely to turn emotional or escalate (Kouzakova et al. 2012), which makes
455 them much more difficult to resolve (Harinck & Druckman 2017; Illes et al. 2014).

456 Furthermore, measuring the impact of people's value landscapes on their water policy preferences
457 with statistical methods and survey data from members of the general public as opposed to
458 stakeholders is also important given that people may express different values in their capacity as group
459 representatives (e.g. of a certain institution), as opposed to when consulted as private citizens (Cramer
460 et al. 1993; Manfredo et al. 2017a).

461

462 **4 Methodological approach**

463 *4.1 Structural equation modelling*

464 Structural equation modelling (SEM) is a statistical technique that allows empirical testing of complex
465 theoretical relationships between multiple variables, including latent variables such as people's values.
466 Specifically, SEM studies typically combine path analysis (to test hypothesised causal structures
467 between variables) and confirmatory factor analysis (to measure latent variables using several
468 observed indicators) (Garson 2015; Kline 2011). As mentioned earlier, it is an established tool for the

statistical analysis of underlying motivations for people's preferences and behaviour (e.g. Glenk & Fischer 2010; Pradhananga et al. 2017; Toma et al. 2011; Yazdanpanah et al. 2014) and thus very suitable for the analysis of value landscapes and their impact on water policy preferences.

4.2 The sample

Our structural equation model relies on survey data collected among members of the general public (n=1067) in the Upper Paraguay River Basin in Mato Grosso between April and June 2016 with the help of trained local interviewers. The Paraguay-Paraná Waterway would be constructed in this hydrographic area, which also encompasses large parts of the Pantanal wetland as well as major population centres of Mato Grosso, such as the state capital Cuiabá (see Figure 2). The exact boundaries of the river basin were identified using a map from the Brazilian National Water Agency (ANA 2006).

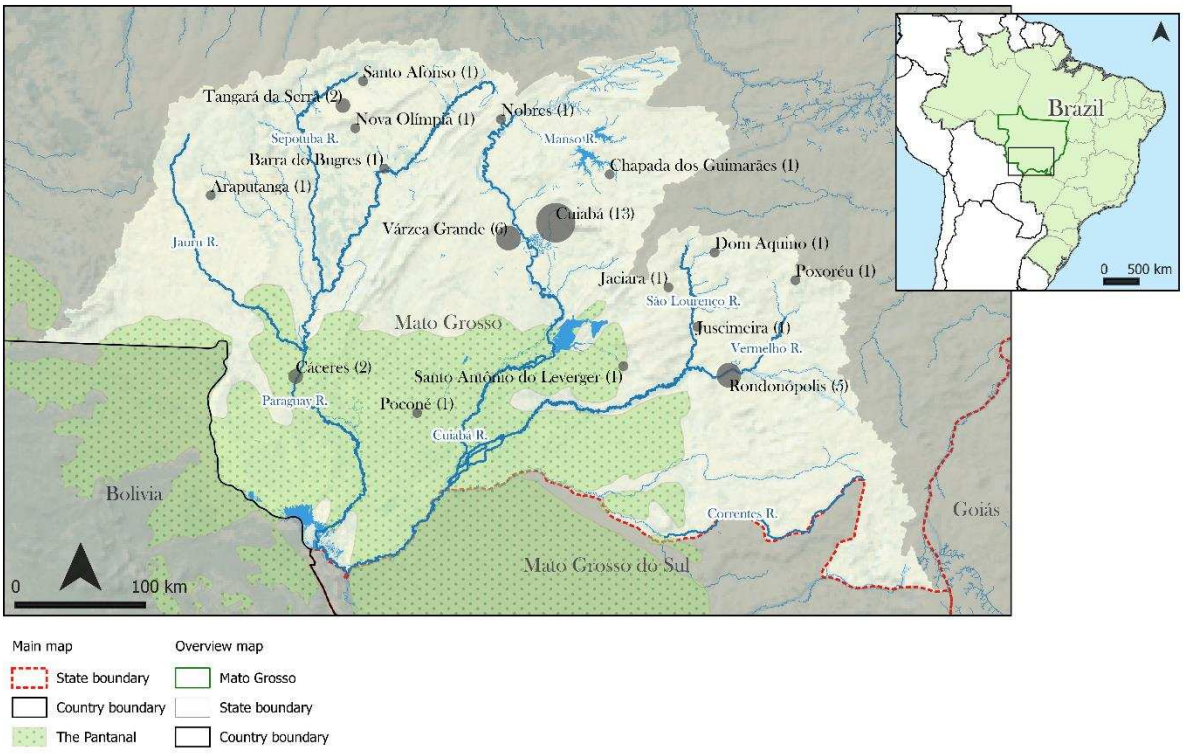

Figure 2: Sampled census tracts in the Upper Paraguay River Basin, Mato Grosso; numbers indicate the number of sampled census tracts per municipality (source of city locations, rivers, waterbodies: © OpenStreetMap contributors) USE COLOUR ONLINE ONLY

Sampling occurred during two stages. First, 40 census tracts (i.e. small geographical units created by the Brazilian Institute for Geography and Statistics, IBGE, to facilitate household sampling) within the Upper Paraguay River Basin were randomly sampled with probability proportionate to size sampling as outlined in Turner (2003), then 30 households within each census tract, using sample frames and address lists from IBGE (IBGE 2011a, 2011b, 2011c) were sampled (see supplementary material S1 for the list of sampled census tracts). Generally at least two attempts were made to interview a member of a specific household that was randomly sampled from address lists. In case of repeated non-response, replacement rules were in place which defined how to randomly select an alternative household from the respective address list. Within-household selection of respondents was determined by the household, limited to adults, as is often done in survey research (Gaziano 2005).

The overall response rate (completed interviews at targeted households divided by number of households approached) was 43.77%, the size of the working sample for subsequent analysis was N=1028 for the full structural equation model (N=1055 (governance-related values) and N=1057 (assigned values) for the confirmatory factor analyses reported in the supplementary material). In case of missing data, cases were deleted listwise, which affected no more than 3.94% of overall observations at any point. This is below the 5% threshold that Garson (2015) recommends for using listwise deletion.

To assess the representativeness of our sample, socio-demographic characteristics of respondents were compared with data from the 2010 IBGE census (see Table 3/Appendix A and supplementary material S2). Our sample approximates representativeness as only the difference in proportions for the variable 'occupational status' is statistically significant, likely in part due to increased unemployment levels in 2016 as a result of economic recession in Brazil.

4.3 Questionnaire design

The questionnaire used in our survey consisted of five sections that were analysed for the present study (socio-demographics; fundamental values; governance-related values; assigned values; water policy preferences regarding the Paraguay-Paraná Waterway). To measure a respondent's fundamental values, we used Schwartz' universal value framework, and specifically, the Portrait Value Questionnaire (PVQ) with 21 items introduced by Schwartz (2001). It has been translated into Portuguese for the European Social Science Survey and was developed precisely to allow easy application to any type of respondent irrespective of age, cultural, or educational background. Furthermore, it has been tested in numerous studies around the globe, including in Brazil (Tamayo & Porto 2009). Another advantage of using the PVQ instead of alternative measurement instruments for fundamental values typically used e.g. in environmental psychology studies is its broad applicability beyond purely environmental topics. While the measurement instruments developed e.g. by Steg, Perlaviciute et al. (2014) or Stern et al. (1998) were explicitly developed to measure values that might influence a person's attitudes towards the environment and pro-environmental behaviour, these instruments do not have any obvious connection with governance and governance-related values. This is why we selected Schwartz' PVQ (Schwartz 2001), which measures very broad personal values that would be equally relevant to both governance-related values as well as specific environmental issues and values. The exact list of the 21 survey items of the PVQ that we used in our study can be found in Schwartz (2001: 284-286).

With regards to governance-related values and assigned values, no existing measurement instruments were readily available. For the case of governance-related values we were not aware of any instrument that would have been widely tested and developed (Schulz 2018), whereas assigned values are too context-specific to be elicited with a standardised measurement instrument (Ives & Kendal 2014; Seymour et al. 2010). Thus we relied on the list of values identified by Schulz et al. (2017b) (and Schulz & Ioris 2017) in an exploratory study with local stakeholders to design our survey items, assuming that these would be appropriate in the local context (see Tables 1 and 2). For both governance-related values and assigned values, respondents first picked their 'most important item', and were then asked to rate the relative importance of remaining items on a scale from 1 to 5, with 5 indicating equal importance, and 1 indicating no importance. This combination of a qualitative value description with a relative rating exercise is in line with the definition of assigned values presented earlier, which combines qualitative and quantitative aspects (Brown 1984; Ives & Kendal 2014;

McIntyre et al. 2008) (see supplementary material S3 where the exact question stems for assigned values and governance-related values are listed).

The items were classified into three factors (i.e. latent variables) each, using exploratory factor analysis (EFA), although one factor within governance-related values was later excluded from the analysis (see supplementary material S4). Respondents were also asked whether they would support or oppose the waterway if a hypothetical referendum was held about its construction. This question was preceded by a brief description of the controversy that aimed to be as neutral and balanced as possible, citing advantages and disadvantages that have been mentioned in the media, academic literature, and in stakeholder interviews (Schulz et al. 2017b) (see supplementary material S5 for the full description of the advantages and disadvantages of the Paraguay-Paraná Waterway that survey respondents were given).

Table 1: Assigned values (i.e. water values): List of items

Cultural water values	Traditional lifestyles, for example artisanal fishing or use of clay for ceramics, depend on rivers.
	Mato Grosso's culture has a strong relationship with the rivers and waterbodies, for example during traditional festivities.
Economic water values	The state's economy depends on water abundance, especially for agriculture and cattle ranching.
	The rivers produce almost all electric energy that is used in Mato Grosso.
Ecological water values	The rivers sustain the nature of the Pantanal wetland.
	The rivers and waterbodies are important for the survival of wildlife, for example jaguars, birds, caimans etc.

Table 2: Governance-related values: List of items

Democratic governance-related values (democratic legitimacy and social justice)	Follow the opinion of the majority of the population.
	Care about the poor and minorities.
Economic governance-related values (economic efficiency and rule of law/order)	Not to waste public money.
	Everyone follows the law.

5 Results and discussion

5.1 Support and opposition to the construction of the Paraguay-Paraná Waterway

Overall, 64.4% of respondents were opposed to the waterway and 33.6% were in favour (while 0.3% refused to answer and 1.7% didn't know), which is in itself an interesting result with clear policy relevance. To ascertain that this result was not driven by a potential implicit bias among interviewers or the description of the project, we also asked respondents, beforehand, whether they already knew about the project (64.8% didn't, 35.2% did). Among those respondents who stated to know about the project, 60.1% opposed it and 39.9% favoured it, which is close to the overall ratio of approval. Assuming that those respondents who knew about the project had already formed an opinion, this suggests that no obvious bias was induced through interviewers or the information provided.

5.2 A structural equation model of value landscapes and their impact on water policy preferences

The 'final' empirical output of the present paper is a structural equation model of our respondents' value landscapes and their impact on respondents' water policy preferences, in this case in favour or against the construction of the Paraguay-Paraná Waterway in the Pantanal wetland of Mato Grosso, Brazil (visualised in Figure 3; full model parameters in Table 4/Appendix B). Due to limitations of space, we cannot outline the entire model development process here, which consisted of exploratory factor analyses (EFAs) for governance-related values and assigned values, confirmatory factor analyses (CFAs) for fundamental, governance-related, and assigned values (to validate the measurement model of our structural equation model), as well as conceptual considerations informing the final structure or path model of our structural equation model. Most details of EFAs and CFAs are instead presented in the supplementary material (sections S5 and S6).

The structural equation model was estimated with the lavaan package within R (v. 0.5-23.1097) (Rosseel 2017). Having ordinal data, we used polychoric correlations for this analysis, which assumes that an underlying continuous variable is measured in a number of discrete categories (Garson 2015); a plausible assumption for people's values. Furthermore, we applied diagonally weighted least squares (DWLS) as a model estimation method, which is appropriate for categorical and ordinal data with sample sizes of around 1000 (Bandalos 2014). To evaluate model fit, we relied on a combination of absolute and incremental fit indexes (RMSEA, SRMR, CFI, TLI, and model χ^2 significance) as is widely recommended in the SEM literature (Garson 2015; Hu & Bentler 1999; Kline 2011). All indexes indicated good fit (i.e. RMSEA<0.06; SRMR<0.08; CFI/TLI>0.95), except model χ^2, which is sample-size sensitive, and according to Garson (2015) may reject most models with a sample size above 200. All factor loadings are 0.45 or higher, indicating that our measurement model is acceptable (Stevens 2009).

From a conceptual point of view, the model was based on the two main hypotheses developed in section 3. That is, it was designed to apply the general framework of the Value Landscapes Approach (see Figure 1, section 2) to the case of public preferences regarding the Paraguay-Paraná Waterway, taking into account previous empirical research findings of the wider literature as well as of Schulz et al. (2017b). Here we discuss our findings regarding each hypothesis and their respective components. Based on ample previous evidence (Evans et al. 2013; Kilbourne et al. 2005; Schultz et al. 2005; Steg & de Groot 2012), we assumed that self-transcendence and self-enhancement would be the main divergent relevant dimensions at the level of fundamental values, informing people's views on environmental issues. We then related these two main dimensions with the more concrete constructs of governance-related values and assigned values, which indeed produced mostly statistically significant links within each value landscape (see Figure 3). Given that Schulz et al. (2017b) had identified two separate value landscapes among their interviewees, we designed our model here accordingly, with no interlinkages between value landscape 1 (consisting of self-transcendence values, democratic governance-related values, cultural and ecological water values) and value landscape 2 (self-enhancement values, economic governance-related values, economic water values).

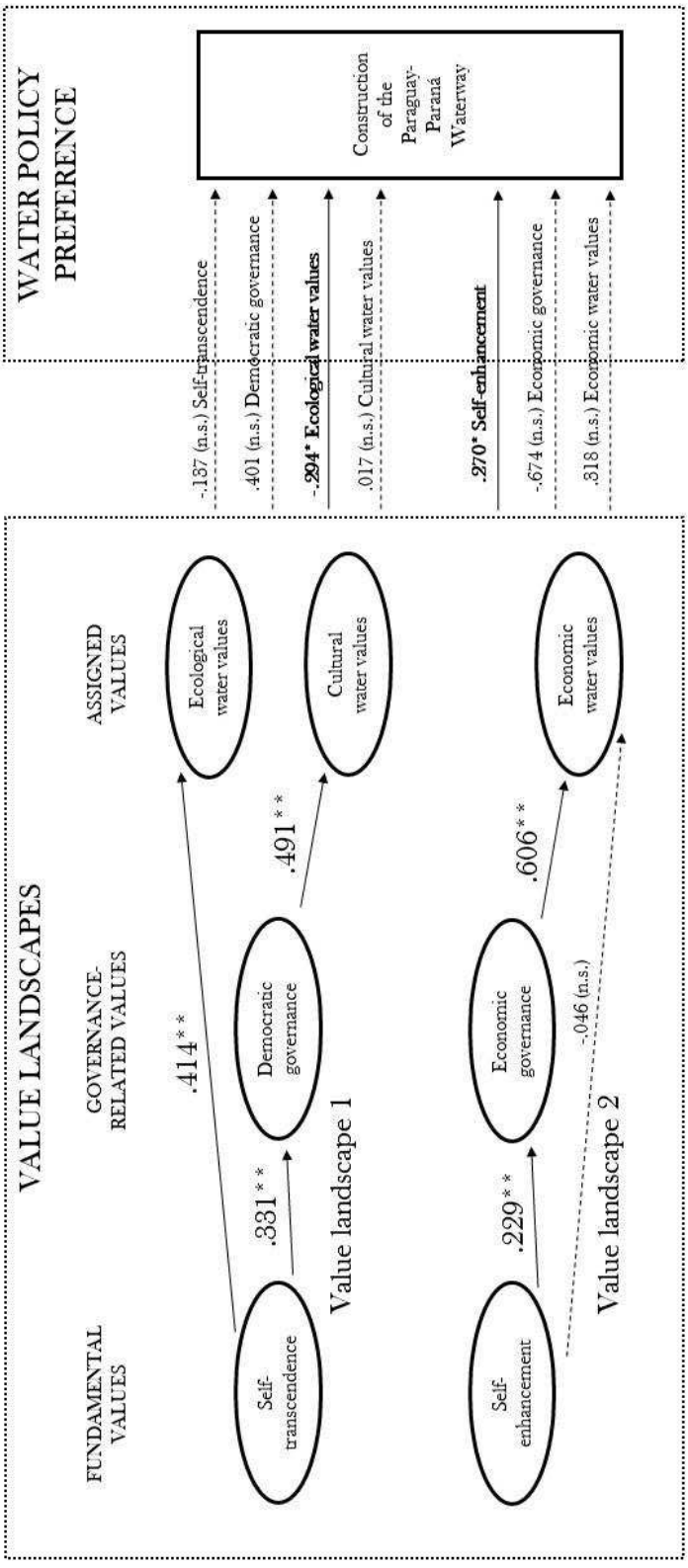

*Figure 3: A structural equation model; dashed paths indicate non-statistically significant relations; * indicates significance at .05 level, ** indicates significance at .01 level.*

609 *5.3 Value landscapes relationships (Hypothesis 1)*

610 Findings with respect to Hypothesis 1 are split up into a number of components below, which all
611 correspond to individual arrows in our structural equation model (see Figure 3).

612 *Finding 1: Self-transcendence values relate positively with democratic governance-related values.*

613 We expected that self-transcendence would have a positive association with democratic governance-
614 related values, given that the survey items measuring this type of values (see Table 2) both emphasise
615 caring about other people and their views, which in turn relates well with the values of benevolence
616 and universalism in the Schwartz survey (Schwartz 1992, 1994, 2001). We did find such a positive link
617 that is statistically significant. This suggests that self-transcendence values are reflected in people's
618 preferences for governance-related values such as social justice and democratic legitimacy.

619 *Finding 2: Self-enhancement values relate positively with economic governance-related values.*

620 We expected the self-enhancement dimension to relate positively with economic governance-related
621 values, due to the emphasis of the related survey items (see Table 2) on efficiency and legality, which
622 could plausibly be associated with the fundamental value of achievement in the self-enhancement
623 dimension. We did find such a positive link that is statistically significant. This suggests that self-
624 enhancement values are reflected in people's preferences for governance-related values such as
625 economic efficiency and rule of law/order.

626 *Finding 3: Self-transcendence values relate positively with ecological water values.*

627 We expected that self-transcendence would relate positively with ecological water values, again in
628 line with previous literature on environmental values more generally (Schultz et al. 2005; Steg & de
629 Groot 2012), as well as specific literature on the link between fundamental values and assigned values,
630 as summarised in section 3 (Hicks et al. 2015; Van Riper & Kyle 2014). This assumption is indeed
631 confirmed by our data and model with statistically significant links.

632 *Finding 4: Democratic governance-related values relate positively with cultural water values.*

633 The status of cultural water values was less clear, but for the concrete case study context, we
634 hypothesised that democratic governance-related values would relate positively with cultural values,
635 given that in the Upper Paraguay River Basin, the conservation of water-related traditions, festivities,
636 and culture rests upon marginalised and poor riparian communities (Schulz et al. 2017b), which in turn
637 are the focus of the survey item for 'social justice', i.e. democratic governance-related values. We did
638 not relate it with either fundamental value dimension in our model, given that we would expect
639 cultural water values to be most closely related with Schwartz' (1992, 1994) conservation dimension
640 (i.e. traditional values), which is not part of our model here. This relationship is found, too. We would
641 be cautious to generalise this finding beyond the context of Mato Grosso, however, given that the link
642 between culture, traditions and marginalisation (which could be addressed by better social justice and
643 democratic legitimacy) is especially strong in this particular geographical area but might be less so in
644 other contexts.

645 *Finding 5: Self-enhancement values relate positively with economic water values.*

646 We expected self-enhancement to relate positively with economic water values. This would be in line
647 with previous findings of e.g. Kilbourne et al. (2005) who found that material values relate positively
648 with self-enhancement (and one could conceive of economic water values produced by agriculture
649 and hydroelectric power as material values). While this relationship does not appear as statistically
650 significant in the full structural equation model presented in Figure 3, we found that this is entirely

due to mediation effects, i.e. a situation where an independent variable has an effect on a dependent variable through a third (mediating) variable (Baron & Kenny 1986; Zhao et al. 2010). It appears that in our model that the effect of the independent variable self-enhancement on the dependent variable economic water values is affected by the mediating variable economic governance-related values. Evidence for that is that if we delete the mediating variable economic governance-related values from the model, the relationship between self-enhancement and economic water values becomes statistically significant (p-value of 0.021), with a coefficient of 0.119. This is in line with our assumption that fundamental values may have an impact on both governance-related values and assigned values.

Finding 6: Economic governance-related values relate positively with economic water values.

The link between economic governance-related values and economic water values would be in line with the findings of Schulz et al. (2017b), where stakeholders typically expressed a preference for both efficiency and legality, as well as economic water values. This relationship was found and thus confirms the qualitative research of Schulz et al. (2017b). This link is especially significant given that it relates the level of governance-related values and of assigned values (as Finding 4), suggesting that these do indeed combine in value landscapes, as proposed in the Value Landscapes Approach of Schulz et al. (2017a).

5.4 Impact of people's value landscapes on their water policy preferences (Hypothesis 2)

Finding 1: Self-transcendence and ecological water values of value landscape 1 relate negatively with support for the Paraguay-Paraná Waterway (as an example of a water policy preference).

In the preceding qualitative study (Schulz et al. 2017b), stakeholders tended to oppose the construction of the Paraguay-Paraná Waterway when they also emphasised the importance of ecological and cultural water values, as well as governance-related values such as social justice and equity (i.e. democratic governance-related values), which are all related in value landscape 1 here. One could thus plausibly expect a negative link between these values and support for the waterway, not least also in line with environmental psychology literature on linkages between self-transcendence and pro-environmental attitudes and behaviour (Dietz 2016; Schultz et al. 2005; Steg & de Groot 2012) and a study of Bjornlund et al. (2013) who found that pro-environmental fundamental values go along with support for pro-environmental water policies. However, only one value (ecological water values) was found to display a statistically significant relationship with the expected direction in the full model. In this case, mediation effects are only in part responsible for this (i.e. further unknown variables not accounted for in our model may also be relevant) – if one deletes ecological water values from the full model, the negative link between self-transcendence and the water policy preference becomes statistically significant (p-value of 0.037; coefficient of -0.240). No mediation effect was found for democratic governance-related values, despite its strong links to self-transcendence and cultural water values in value landscape 1, which suggests that this value by itself is unrelated to opposition to the waterway. The same applies to cultural water values.

Finding 2: Self-enhancement (of value landscape 2) and economic water values relate positively with support for the Paraguay-Paraná Waterway.

Stakeholders in Schulz et al. (2017b) tended to support the waterway when they also emphasised economic water values and governance-related values such as efficiency and order (i.e. economic governance-related values), which are all related in value landscape 2 here. Thus it seemed plausible that these values would relate positively with support for the project, not least considering the

environmental psychology literature on the negative links between self-enhancement values and pro-environmental attitudes and behaviour (Dietz 2016; Schultz et al. 2005; Steg & de Groot 2012), as well as the findings of Bjornlund et al. (2013) who reported that 'utilitarian values' (with a similar focus on economic aspects) went along with support for water policies aimed at enhancing economic activities in their survey. Again, only one value (self-enhancement) was found to display a statistically significant relationship with the expected direction. Moderator effects (Baron & Kenny 1986) are in part responsible – when deleting the moderating variable of cultural water values (which in line with Preacher & Hayes 2008 was linked to economic water values via residual covariances, see Table 4/Appendix B), the positive link between economic water values and the water policy preference becomes statistically significant (p-value of 0.028), with a coefficient of 0.329.

It seems plausible that, contrary to our initial expectations, economic governance-related values relate negatively to support for the waterway (coefficient of -0.674 with a p-value of 0.093). In practice, that would mean that concern for economic efficiency and legality of governance might combine with opposition to the project, possibly due to a concern with corruption and waste of public funds. The p-value of that link falls below the more lenient 0.1 threshold for statistical significance that is occasionally applied, even if not typically recommended (El-Masri & Tawadrous 2013). While our analysis should thus not be interpreted as conclusive empirical evidence on this specific link, it would resonate with academic literature on the waste of public funds in the context of large infrastructure projects in Mato Grosso (Crabb 2016) and Brazil more generally (Joly 2017; Signor et al. 2016), especially under the centre-left governments of Presidents Luiz Inácio 'Lula' da Silva and Dilma Rousseff (Armijo & Rhodes 2017). This issue was particularly salient during fieldwork in 2016, i.e. when Brazilian news were dominated by the revelations about large-scale corruption following the investigations within 'Operation Car Wash' (Melo 2016; Winter 2017) that eventually resulted in the impeachment of President Dilma Rousseff (Santos & Guarnieri 2016).

6 Implications, general discussion, and conclusions

Implementing a Value Landscapes Approach in empirical research more generally may (i) help to understand people's preferences and behaviour in water governance, including their water policy preferences and (ii) may serve to assess the political legitimacy of water governance in a given place and time by comparing values held by members of the general public with those values expressed in actual water governance. Specific relations between values and water policy preferences were amply discussed in the preceding sections. Here, instead, we aim to situate our research findings in the wider literature. Our finding that preferences for or against the construction of a waterway across Mato Grosso's Pantanal wetland can be linked to people's values is in line with the general environmental psychology literature, which has a long history of establishing linkages between fundamental values, other psychological constructs, and people's preferences (Dietz 2016; Fulton et al. 1996; Homer & Kahle 1988; Steg & de Groot 2012; Steg 2016). Our study confirms what Manfredo et al. (2017a) have called the 'embedded nature of values' in society; values are not just psychometric constructs that can be measured via survey instruments, but are realised in many different ways in society, including in material objects, such as plans to build a waterway in our case.

Understanding conflicts and controversies as conflicts of values is highly significant with practical implications, given that value conflicts tend to activate people's emotions, escalate quickly, and often persist over significant timespans (Illes et al. 2014; Kouzakova et al. 2012). Addressing such conflicts requires particular conflict resolution techniques that go beyond a mere comparison of all stakeholders' interests. Harinck and Druckman (2017) report that using the help of mediators who

affirm the positive qualities of other parties in joint negotiations might be a promising conflict resolution strategy for value conflicts, because this reduces threats to the identity of each conflicting party. Our findings suggest that the conflict around this water project is indeed a conflict of values as proposed by Schulz et al. (2017b). This would explain its long conflict history and the emotional disputes around it, which at an earlier stage attracted attention by local and international NGOs (da Silva et al. 2004; Figueiredo et al. 2012; Leão et al. 2013).

Beyond our individual case study, our findings indicate that other classical environmental conservation vs. economic development conflicts may be rooted in people's values, too. While such a statement is in line with findings by environmental psychologists on linkages between values and environmental attitudes or preferences (Dietz 2016; Schultz et al. 2005; Steg & de Groot 2012) and the finding of Drews and van den Bergh (2016) that self-enhancement (and conservation) values might be correlated with a preference for economic growth, we are not aware of previous research that has sought to interpret these environment vs. development conflicts generally as conflicts of fundamental values. The environment-development interface is more typically discussed from an economics or international development perspective (e.g. Aguilar-Støen et al. 2016; Halkos & Managi 2017; Paavola 2002; Xepapadeas & Stefan 2014) or in the context of localised conflicts between environmental conservation and economic activities (e.g. Arvor et al. 2018; Hoyman & McCall 2013; Martín-López et al. 2011; Rajwade 2015).

Interpreting environment vs. development conflicts as conflicts of fundamental values would explain why these are so widespread globally, including in Mato Grosso and Brazil (see e.g. Arvor et al. 2018; Nascimento & Griffith 2012; Schulz et al. 2015; Zhouri 2010), and why they are so frequently perceived as intractable and difficult to resolve. Moreover, it could explain why attempts to overcome the divide between environmental conservation and economic development ring hollow to many, e.g. when researchers express their discomfort with monetary valuation of the environment (e.g. Harvey 1996; Kallis et al. 2013; Spangenberg & Settele 2010; Spash & Vatn 2006) or when they express their doubts about the adequacy of the 'green growth' concept (e.g. Bina 2013; Death 2014; Schulz & Bailey 2014; Springett 2013). It also suggests that individual cases of environment vs. development conflicts could be addressed with conflict resolution techniques which have proven effective specifically for situations of value conflict (see e.g. Harinck & Druckman 2017; Illes et al. 2014; Kouzakova et al. 2012), even if the broader dynamics of conflict between environment and development dimensions are unlikely to disappear.

Our structural equation model confirmed the existence of links between fundamental values and assigned values that had been identified with different methodological approaches previously (Hicks et al. 2015; Van Riper & Kyle 2014), especially the link between self-transcendence and assigning ecological values to water. Yet, by including governance-related values as well, our study adds a new facet of the value concept to the analysis that is not typically included in environmental psychology research, despite its importance for water governance (Glenk & Fischer 2010; Grotenbreg & Altamirano 2017) and public administration (Beck Jørgensen & Bozeman 2007; de Graaf et al. 2016; Rutgers 2015; Tsanga Tabi & Verdon 2015). Further research on value landscapes, and the role of governance-related values therein, should thus be conducted to evaluate their importance for understanding water governance preferences, based on our initial findings here.

Finally, the empirical evidence presented in this study strengthens the case of political ecologists and critical scholars who claim that water governance in Brazil is driven by elites and ignores preferences of the public and weaker stakeholder groups (e.g. Ioris 2009; Lemos & de Oliveira 2004; Martins 2015; Schmitt 2016; Siegmund-Schultze et al. 2015). The values and preferences expressed by the general public in our survey do not match the values and preferences expressed by Mato Grosso's water

governance, i.e. the plans to build a waterway in the Pantanal wetland, as evidenced by the fact that almost two thirds of respondents opposed it. The economic water values that would be realised through the waterway may thus not align with the predominantly environmental values of water that the majority of the population seems to prioritise. This points to problems with its political legitimacy, if understood as majority support of the population (Bekkers & Edwards 2007). It may also indicate that the pessimism of many water professionals in Mato Grosso about lacking environmental awareness among the general population (Schulz & Ioris 2017) may not necessarily be justified. Rather, environmental degradation would be the result of the disproportional political clout of a minority who prioritise economic water values. Not least, our study also serves to demonstrate that statistical analysis techniques have their place in answering questions of relevance to political ecologists, whose publications are dominated by qualitative and conceptual research approaches.

Conceivably, the research approach adopted here could serve for the analysis of other controversial projects, e.g. the construction of further waterways and large-scale dams in the Brazilian Amazon (see e.g. Fearnside 2015), as well as any other aspect of water governance and environmental governance more generally that may be characterised by conflicting underlying value landscapes.

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Appendix A

*Table 3: Pearson χ^2 test of difference – Sample vs Upper Paraguay River Basin to evaluate sample representativeness; ** Difference between sample and UPRB is significant at the .01 level (2-sided).*

Variable	χ^2	Degrees of freedom (df)	p-value
Location	0.799	1	0.371
Gender	1.672	1	0.196
Age	6.408	12	0.894
Household size	1.839	5	0.871
Formal education	4.405	3	0.221
Occupational status**	**7.133**	**1**	**0.008**
Monthly household income	9.112	5	0.105

Appendix B

1276 *Table 4: A structural equation model of value landscapes and their effect on water policy preferences.*

N (used)	χ^2	df (degrees of freedom)	P-value (χ^2)	CFI	TLI	RMSEA	90% conf. int. (RMSEA)	SRMR
1028	464.808	153	.000	.966	.958	.044	.039, .048	.057

LATENT VARIABLES

Latent variable	Item/indicator	Estimate	Std. err.	z-value	P(>|z|)	Std. est.
Self-transcendence	universalism 1	1 (fixed)				.597
	universalism 2	.964	.056	17.305	.000	.575
	universalism 3	1.224	.062	19.735	.000	.731
	benevolence 1	1.220	.061	19.928	.000	.728
	benevolence 2	1.213	.060	20.198	.000	.724
Self-enhancement	achievement 1	1 (fixed)				.559
	achievement 2	1.137	.065	17.475	.000	.636
	hedonism 1	1.205	.072	16.831	.000	.674
	hedonism 2	1.031	.064	16.140	.000	.576
Democratic governance	democratic legitimacy	1 (fixed)				.636
	social justice	1.176	.107	11.043	.000	.748
Economic governance	economic efficiency	1 (fixed)				.572
	rule of law/order	.832	.107	7.800	.000	.476
Cultural water values	traditional lifestyles	1 (fixed)				.652
	traditional festivities	1.026	.086	11.908	.000	.670
Economic water values	agriculture	1 (fixed)				.655
	hydroelectric power	.871	.107	8.148	.000	.570
Ecological water values	Pantanal's nature	1 (fixed)				.800
	wildlife	.885	.098	9.070	.000	.708

REGRESSION PATHS

Dependent variable	Independent variable	Estimate	Std. err.	z-value	P(>|z|)	Std. est.
Democratic governance	Self-transcendence	.353	.053	6.603	.000	.331
Economic governance	Self-enhancement	.234	.076	3.089	.002	.229
Ecological water values	Self-transcendence	.555	.078	7.123	.000	.414
Economic water values	Self-enhancement	-.053	.080	-0.664	.506	-.046
	Economic governance	.694	.103	6.711	.000	.606
Cultural water values	Democratic governance	.504	.072	6.933	.000	.491
Paraguay-Paraná Waterway	Self-transcendence	-.230	.237	-.968	.333	-.137
	Self-enhancement	.483	.211	2.290	.022	.270

policy preference	Democratic governance	.631	.560	1.127	.260	.401
	Economic governance	-1.178	.701	-1.679	.093	-.674
	Cultural water values	.026	.248	.105	.916	.017
	Economic water values	.485	.262	1.849	.064	.318
	Ecological water values	-.367	.157	-2.343	.019	-.294

COVARIANCE

Latent variable 1	**Latent variable 2**	**Estimate**	**Std. err.**	**z-value**	**P(>|z|)**	**Std. est.**
Self-transcendence	Self-enhancement	.200	.015	13.079	.000	.598

RESIDUAL COVARIANCES

Latent variable 1	**Latent variable 2**	**Estimate**	**Std. err.**	**z-value**	**P(>|z|)**	**Std. est.**
Democratic governance	Economic governance	.278	.032	8.696	.000	.834
Cultural water values	Economic water values	.161	.028	5.809	.000	.539
	Ecological water values	.277	.032	8.586	.000	.669
Economic water values	Ecological water values	.150	.031	4.772	.000	.391

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