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Pitfalls of monetizing relational values in the context of climate change adaptation

Marco Nilgen 🔟, Maximilian Nicolaus Burger 🔟, Ivo Steimanis 🔟 and Björn Vollan 🔟

Research Group for Sustainable Use of Natural Resources, Philipps University Marburg, Marburg, Germany

ABSTRACT

Relational values emphasize the desirable characteristics of nature–society relationships. Unlike instrumental values, relational values have not yet been subjected to monetary quantification, although they may be relevant to environmental policymaking or climate change adaptation decisions which often rely on cost–benefit approximations. This paper explores the quantification of relational values within a contingent valuation scenario both in monetary (one-time donation) and non-monetary terms (Likert-scale, ranking) as well as using a measure that elicits the desired allocation of government budget for adaptation. We conduct two surveys within the context of adaptation projects, aiming to protect the traditional lifestyles of atoll islanders on the Solomon Islands and coastal communities in Bangladesh. In these surveys, we employ two valuation scenarios – one with explicit mention of relational value losses, and one without. Information on relational losses led to no increases in monetary or non-monetary valuation but to a slightly higher allocation of government budget in Bangladesh. We further assess and discuss the validity of our measures, also accounting for respondents' financial situation. Our findings suggest that emphasizing relational losses could significantly increase disaster management funding in Bangladesh, with a potential 55% budget increase based on our treatment effect. We further discuss the difficulties in quantifying relational values in a context with limited ability to pay and the importance of considering deliberative approaches for ensuring that all dimensions of human-nature relationships are adequately considered in adaptation policy decision-making.

KEY POLICY HIGHLIGHTS

- Using different methods, we highlight that monetary quantification, solely through individual willingness to pay, may not sufficiently capture complex relational values.
- We use a monetary measure eliciting individuals' preferences for government budget allocation to environmental and climate change disaster management.
- Economic valuation based on budget allocation preferences yields higher values than 30 traditional willingness to pay methods and correlates stronger with people's stated relational values.

1. Introduction

The concept of relational values – defined as a reflection of preferences, principles, and virtues about the human-nature relationship (Chan et al. 2016) – has garnered considerable attention in environmental sciences after a prolonged period of neglect in scientific discourse (Chan et al. 2018). Relational values encompass the various ways in which people relate to nature, other individuals, and the human collective, as well as the benefits derived from these relations. In doing so, they provide a pluralistic value concept that goes beyond the established dichotomy between instrumental and intrinsic values associated with nature. The concept serves as a gateway for researching environmental values from a more pluralistic and holistic perspective by capturing the non-monetary significance that communities attribute to ecosystems, moving beyond a mere representation of ecosystems as goods and services. Thus, defining relational values as eudaimonic (i.e. values that contribute to a good life based on morals and virtues) and, consequently, non-substitutable (Chan et al. 2018), positions the concept as pivotal for pluralistic valuation, arguing against relying solely on monetary valuations. By shifting the fundamental premise in nature valuation from individual preferences to what ecosystems mean to people, the relational values concept departs from previously established paradigms (Tadaki et al. 2017). This aligns with previous contributions that highlight

how the dominant dichotomy between instrumental and intrinsic values of nature overlooks the ways people assign value to human-nature relationships, thereby neglecting important ethical considerations (Jax et al. 2013). The conceptual proximity to older concepts, such as the social values of nature (as discussed in Kenter et al. 2015), has positioned relational values as a type of nature value that cannot be meaningfully captured in monetary metrics (Stålhammar and Thorén 2019). Thus, the methodological discussion around the measurement of relational values has been dominated by calls for more qualitative approaches characterized by in-depth deliberations about how and why ecosystems matter to people (Klain et al. 2017; Tadaki et al. 2017), thereby making previously implicit values of nature explicit (Kenter et al. 2016).

Still, real-world environmental policy processes frequently rely on monetary quantification of environmental values (Spash and Aslaksen 2015) even where this may be culturally or otherwise inappropriate. Naturally, any quantification, and especially monetization of relational values might open the door to further commodification processes of nature (Smessaert et al. 2020). Monetizing relational values bears the danger of reducing complex socio-cultural, spiritual, and emotional relationships with nature to a single monetary figure, thereby risking that economic efficiency is prioritized over more holistic and context-sensitive environmental solutions (Tadaki et al. 2017). In fact, economic valuation has been argued to favor nature value types that are easily quantifiable in monetary terms, thereby potentially marginalizing traditional and/or indigenous value systems that put a larger emphasis on relational values. By resonating the notion that human-nature relationships have a higher importance if they can be associated with an economic benefit, this can lead to policies that overlook or undervalue the contributions and rights of these communities (Manero et al. 2022). From a behavioral perspective, nature commodification processes can have negative repercussions on social justice and networks within communities, as well as their intrinsic motivation to conserve nature (Rode et al. 2015). However, market-based approaches, if aligned with environmental ethics and distributive justice, can stimulate restoration efforts and promote green entrepreneurship (Ott and Reinmuth 2021).

Carefully designed monetization measures aimed at capturing all possible monetary values of ecosystems can serve potentially beneficial purposes, offsetting the potential downsides to commodification mentioned above: They can provide a somewhat comparable metric, allowing for better evaluation and prioritization of conservation policy interventions. Monetizing relational values can increase their visibility and prioritization in policy-making arenas, especially when decision-makers might find monetary estimates more accessible than complex qualitative accounts (Manero et al. 2022). Similarly, interviews with policymakers revealed that the use of cost–benefit analysis is seen as useful for raising awareness of environmental goods and increasing transparency of the policy-making process. It stimulates a systematic discussion without overemphasizing monetary estimates (Dehnhardt et al. 2022). Thus, including relational values in the valuation process could serve as agenda-setting – especially if the current decision-making is predominantly using monetary metrics. The claim that this will lead to commodification, has to date and to our best knowledge, not been proven true, although it dominates conservation narratives (Maechler and Boisvert 2024). If concerns related to commodification and dilution of the concept turn out to be negligible, monetization can increase their visibility, leading to policy decisions that better align with the values of local populations. While changing the focus and narratives used by policymakers is desirable and beneficial in the long run, careful monetization constitutes a pragmatic ethical approach given current realities.

Acknowledging both theoretical perspectives, we consider it worthwhile to investigate whether relational values can be estimated on a monetary scale in the first place and if so, identify the methodological pitfalls to avoid. If relational values are indeed measurable, meaning that an economic framework would be able to reflect these values, the notion of their non-substitutability would be called into question. In fact, the possibility of measuring relational values and incorporating them into policy decisions would suggest that their monetary measurement could be a meaningful endeavor. Conversely, if relational values are not measurable, the concept of their non-substitutability remains intact. This perspective would support the arguments put forth by Stålhammar and Thorén (2019), emphasizing that relational values cannot be reflected in monetary terms. Furthermore, difficulties in empirically measuring or monetizing these values would alleviate concerns (and opportunities) about the commodification of nature, as such a finding would underscore the unique and irreplaceable nature of relational values.

Naturally, the first question is how to approach such an investigation from a methodological standpoint. While the full magnitude and meaning of non-instrumental nature value types, such as intrinsic or relational values, cannot be captured by stated preference techniques, they can still be proxied. Such proxies, while not providing value estimates on a directly comparable scale, can still help investigate whether preferences for non-instrumental values are present (IPBES 2022). Such investigations can be especially useful if one follows the argument that

diverse values of nature should be accounted for in public policy decision-making, such as in mitigating climate change-induced damages (Rogers et al. 2019; Tschakert et al. 2019). Thus, in this paper, we critically examine the concept of relational values from an empirical perspective and explore whether and how relational values can potentially be captured within a monetary framework. More specifically, we measure the traditional willingness to pay (WTP) estimate in the form of a one-time donation to an adaptation fund and introduce an additional monetary measure that asks respondents to allocate the government budget to specific causes. We discuss some of the advantages this measure has in our setting compared to a standard WTP.

While relational values have been quantified for validating research hypotheses and identifying key relational value categories across cultural contexts (Schulz and Martin-Ortega 2018) its monetary quantification has, to our knowledge, not been tested although the typical workhorse for valuing non-use values, the contingent valuation method (CVM) can potentially be extended to a range of values like stewardship and bequest values (Carson and Hanemann 2005). In contingent valuation surveys, the specific aspects of nature in question and potential benefits like recreation or ecosystem service are described in detail to help respondents make informed decisions about their WTP for its preservation or enhancement. Thus, such a scenario can also be extended to include the emotional, cultural, and spiritual connections people have to nature.

We study the quantification of relational values in two specific settings (Solomon Islands and Bangladesh) of an adaptation project aimed at increasing the resilience of coastal communities, thereby protecting livelihoods and traditional lifestyles that are continuously threatened by the effects of sea-level rise. To investigate in how far relational values can be captured in the CVM scenario, we designed two scenarios in each country: One baseline scenario and one in which we additionally highlight on various occasions the potential relational value losses in case the atolls or coastal areas, and with them the complex human–nature relations they support, become uninhabitable. In line with the recent meta-study by Pratson et al. (2023), surveying 72 academic papers in the last 5 years, we included the most common relational value dimensions, such as identity, social cohesion, livelihood, and connection to place.[1] Comparing scenarios with and without explicit mention of these human-nature relations allows us to test whether highlighting relational values translates into a higher stated WTP for the adaptation project. Such an increase in WTP could be explained by an increase in non-use values originating from altruistic motives, or from the satisfaction of knowing that the donation could potentially ensure the future

existence of the coastal ecosystems – value types the CVM is able to capture. Following the definition of relational values stated at the very beginning of this paper, average WTP increases in response to the treatment could also be understood as individual preferences about the human-nature relations that can be protected by the adaptation project, and therefore as a proxy expression of relational values. Within a specific subsample of respondents who indicated having direct relational ties to the atoll islands, we argue that our treatment could even induce a direct activation of relational values. The prevalence of treatment effects in CVM would suggest that measuring relational values in terms of monetary proxies might be possible – at least to some degree. If, however, the average WTP between the two scenarios remains similar, it would suggest that the CVM struggles to capture these values adequately.

Our study distinguishes itself from the current literature on relational values by specifically aiming to inform adaptation policies on atoll islands. In these regions, both residents and policymakers face the difficult trade-off between remaining in their current locations and relocating to resettlement villages. Prevailing narratives in this context primarily emphasize the cost-effectiveness of adaptation measures, economic damage assessments, and the investment needed for adaptation infrastructure, often leading to resistance from affected populations (Brink et al. 2023). Protecting a relatively small population exposed to potentially high damages on atoll islands is costly. Although policymakers might be aware of the cultural and spiritual values attached to the land by residents, they still must make difficult decisions on prioritizing adaptation efforts. Some communities may possess significantly stronger relational values, making it essential to explicitly highlight these values. This could support efforts to allow people to stay on their land for as long as possible. We believe that making relational values more visible by evaluating them within a monetary framework can be a promising strategy to support at-risk local communities.

By increasing the resilience of coastal communities, the manifold types of relational values associated with the specific lifestyle in their socioecological system can be maintained and preserved for future generations. The Solomon Islands provide a unique environment to investigate the role of relational values in a context where climate change poses a threat to local livelihoods and atoll ecosystems (Storlazzi et al. 2018; Seneviratne et al. 2021). While the country consists of six major and over 900 smaller islands, the educational opportunities and economic activity in the capital Honiara attract people from the surrounding islands, including the two major atoll formations Ontong Java and Reef Islands (Birk and Rasmussen 2014). As of now, much of the migration to Honiara is induced by reasons other

than immediate climate risk, however, smaller low-lying atolls are threatened to become uninhabitable in the future due to a rising sea level (Storlazzi et al. 2018), thereby steadily increasing the necessity of migration as an adaptive response (Black et al. 2011; Birk and Rasmussen 2014; Adger et al. 2020). Sea-level rise hazards in combination with extended periods of drought have severe consequences on water availability and sanitation in the Solomon Islands (Seneviratne et al. 2021). In this context, one specific threat to the fragile socio-ecological atoll system is saltwater intrusion into the freshwater lens, potentially making atolls uninhabitable long before inundation by sea-level rise (Terry and Fong May Chui 2012), as atoll inhabitants livelihoods depend on it. From a perspective of ecosystem conservation, protecting atoll freshwater aquifers from saltwater intrusion is key to maintaining their unique biodiversity – especially sea birds inherent in atoll ecosystems (Wetzel et al. 2012; Courchamp et al. 2014; Reynolds et al. 2015). Likewise, Bangladesh is exceptionally susceptible to extreme climate events due to its flat topography, low-lying coastal plain featuring 230 rivers and river branches, high population density, and challenging socioeconomic conditions in various regions. Throughout the country, sea-level rise is projected to intensify coastal flooding during storm surges (Bhuiyan and Dutta 2012), tsunamis (Li et al. 2018), and accelerate coastal erosion and salinization (Nicholls and Cazenave 2010; Smajgl et al. 2015).

Coastal ecosystems often host diverse and specialized species, some of which are found nowhere else. The cultural practices and traditional knowledge of coastal inhabitants play a role in conserving and coexisting with these species – which local communities have done successfully for a long time. Strengthening the resilience of these communities ensures their indigenous conservation practices and stewardship efforts over natural lands can be maintained. Moreover, displacement from coastal areas due to environmental changes can lead to increased pressures on nearby ecosystems, as people may migrate to other areas with different resource bases and require different types of context-specific knowledge. Such migration can result in habitat degradation and overexploitation of resources in the environment, negatively affecting the local population who rely on these resources. Thus, protecting the ecological systems prevalent in coastal areas serves both sides of the human-nature relationship.

2. Methods

2.1. Sampling

We conducted surveys in the capitals of the Solomon Islands (Honiara) and Bangladesh (Dhaka). A total of 806 people in Honiaria and 302 in Dhaka were selected by convenience sampling to participate in our surveys between February and July 2022. To capture a wide range of relational values to the locations described in the scenario, we aimed to receive a sample containing people who have migrated from places threatened by climate change consequences to the respective capital as well as inhabitants who have not. In Honiara, we surveyed people from an informal settlement where people from the Polynesian atoll Ontong Java live or temporally stay (Lord Howe Settlement, $n = 210$). Second, we surveyed people from an informal settlement where mainly people from Temotu province live, including migrants from the Polynesian atoll formation Reef Island (Henderson Settlement, $n = 194$). Lastly, we conducted surveys with people living in two formal living areas (Mataniko, $n = 245$ and Vura, $n = 157$). Among those, 60% are Melanesians who have been born on Guadalcanal or migrated from other higher-lying large volcanic islands such as Malaita and Choiseul. In Dhaka, surveys were conducted in settlements with high shares of migrant populations based on official statistics: Banani 6%, Dhakshinkhan 4%, Mirpur 7%, Pakuria 18%, Pallabi 8%, Uttara 53%, Uttarkhan 1%, and 3% in other areas. Within our survey, the majority of participants migrated to Dhaka ($n = 263$, 87%) while only a few have lived in Dhaka all their lives ($n = 39$, 13%).

2.2. Survey experimental design

As part of the survey, participants were provided with a contingent valuation scenario. In the Solomon Islands, this scenario contained information on the threats to low-lying islands posed by global warming, as well as the strategies being implemented to adapt to these threats. The information was composed by the use of scientific reports on the subject matter (Terry and Fong May Chui 2012; Storlazzi et al. 2018) and insights gained from previous data collection on the Solomon Islands (Steimanis and Vollan 2022).[2] In Bangladesh, the content of the scenario was adjusted to the local context. Instead of atoll communities being at risk, we showed how communities in low-elevation areas are threatened by rising sea levels and river floods causing soil erosion and threatening freshwater security. Illustrations and photos accompanied the information provided to improve understandability. The full scenarios are available in the Supplementary Section S2.

The contingent valuation scenario was structured in the same way in both studies. First, the impacts of sea-level rise on the local communities in both contexts were highlighted. Second, participants were confronted with actual adaptation initiatives that have been taken or are currently implemented by

the government in cooperation with international organizations in both countries. Lastly, the hypothetical scenario closed with the question of whether and, if so, how much the respondent would hypothetically be willing to pay in the form of a one-time donation to the presented adaptation initiative.

2.2.1. Solomon Islands

We use the 'Solomon Islands Water Sector Adaptation Project' (SIWSAP), which supported communities in freshwater conservation as the adaptation program in our contingent valuation scenario. The project was mainly concerned with the construction of community water tanks, installing and upgrading water reservoirs in residential areas, and protective infrastructure. Apart from infrastructure investments, the project also developed climate change adaptation strategies with the local communities, while developing legislation for water resource management. The costs of the entire initiative (roughly USD 8 million) and the benefits (12,000 people benefitted directly) of the project that concluded in 2019 were highlighted. Last, participants were presented with a hypothetical scenario in which the government intended to set up the so-called 'Atoll Islands Protection Fund', thereby continuing its efforts to increase the resilience of people living on atolls affected by sea-level rise. To provide context for the upcoming valuation questions, respondents were then informed that to support all inhabitants of the still inhabited atoll islands (about 8,000 people) a budget of approximately USD 5 million would be necessary which could be reached if each Solomon Islander would contribute SBD 60 (about USD 7.5).[3]

2.2.2. Bangladesh

We use the 'Adaptation Initiative for Climate Vulnerable Offshore Small Islands and Riverine Charland in Bangladesh' (AICVOSIRC), an initiative supporting communities in freshwater conservation, as the centerpiece of our contingent valuation scenarios. The activities of the AICVOSIRC project were highly comparable to those of the SISWAP project in the Solomon Islands. The costs of the entire project (roughly USD 9.2 million) and the benefits (350,000 people benefitted directly) were highlighted. After the provision of the information, participants were presented with a hypothetical scenario in which the government intended to set up a follow-up program to AICVOSIRC to continue its efforts to increase the resilience of vulnerable communities living in low-elevation areas. On average 5 million people are affected annually due to natural disasters. In line with the costs of AICVOSIRC, supporting the

vulnerable could be realized if every person in Dhaka would contribute BDT 500 (about USD 5.8).

2.2.3. Treatment

All participants received the same information in which the consequences of climate change for local communities and individuals were described in a rather formal manner. We randomly varied for half of the participants whether additional information was shown about human-nature relations and how they are threatened due to the continuous saltwater intrusion (treatment group) – e.g. relating to individual and cultural identities, social cohesion, or stewardship over the natural lands. This information was specifically highlighted in the form of additional text snippets and pictures. The other half of the participants only received the basic information (control group). One exemplary paragraph from the information provision in the Solomon Islands reads:

> As you might know, there is scientific consensus that global warming causes an increase in global sea levels. This was again confirmed in the latest IPCC report of 2021. The low-lying coral atoll islands of the Solomon Islands in the Reef Islands, Ontong Java and Sikaina, are under threat by rising sea-levels, as are many other atoll islands around the Pacific. *Many people around this area indicated to us that the atoll islands of the Solomon Islands are important to who they are as a person.*

While all participants were confronted with the first sentences, the latter (*italics*) highlighting the threat to one relational value category (here atoll identity) was only provided to the treatment group. This was done at six distinct points within the contingent valuation scenario and was intended to cause increased awareness and reflection on the issue among participants assigned to the treatment group. The induced variation allows us to examine the causal relation between highlighting threatened relational values and the individual willingness to contribute to their protection.

2.3. Outcome variables

To estimate treatment effects, we rely on four outcome measures that were directly elicited after respondents were confronted with one of the two contingent valuation scenarios. First, we have a monetary measure in the form of a WTP for protection efforts. Secondly and thirdly, we have two non-monetary measures of relational values, one in the form of a Likert-based index (Klain et al. 2017) and the other being a ranking survey item. Lastly, we elicited participants' opinions about whether the Solomon or Bangladeshi Governments, respectively, should spend more on environmental and climate change disaster management. This last measure circumvents potential problems related to the ability to

pay among respondents, while still presenting people with a trade-off of monetary nature, and also providing direct input for the policy process.

2.3.1. Monetary measure: willingness to pay for the protection of atoll islands

Our main outcome variable is the WTP for the adaptation initiatives presented in the contingent valuation scenarios. After reading through the information section of the valuation scenario, either control or treatment, participants were asked how much they would be willing to contribute to the project. The payment vehicle was framed in the form of a one-time donation payment to be selected from a payment card. We prefer the payment card over alternative types of WTP elicitation questions as they provide respondents with a context regarding the range of reasonable WTP bids.[4] The payment card shown to the participant listed 20 selectable values ranging between SBD 0 and 200 in the Solomon Islands and between BDT 0 to 800 in Bangladesh (see Figure 1). Respondents had the additional option to state a WTP above the highest amount on the payment card. To facilitate the decision, regular consumption goods for both countries were provided as examples in payment equivalents. To make the WTP amounts comparable between both studies, we transform the values in the local currency to purchasing power parity adjusted dollars ($ PPP) using conversion factors from the World Bank.

2.3.2. Non-monetary measures: likert-scale and ranking

After the information provision and the elicitation of the WTP, participants were asked for their agreement to statements relating to relational dimensions of valuing nature. In the first step, participants had to rate their agreement to four statements previously used to characterize their underlying relational values (Klain et al. 2017).[5] To reduce the dimensionality of relational values, the average across the four items was taken. The resulting Cronbach's alpha of 0.73 indicates an acceptable level of internal consistency, supporting the appropriateness of this approach for our analysis. The average across the four relational value items is referred to as relational values index throughout the rest of the paper.

In a second step, we elicited the relative importance of different value dimensions for protecting the environment using a ranking task of four different statements characterizing underlying values. Participants were asked to rank the following reasons to protect the environment from most to least important: "Because …

(1) … it provides us people with clean air and water (instrumental)
(2) … of itself, regardless of its potential use to us people (non-use)
(3) … it is strongly connected with our people's culture (relational: cultural ties),

a Solomon Islands	**b** Bangladesh
One-time payment today (in SBD)	One-time payment today (in BDT)
0	0
5	20
10	40
15	60 1kg Rice
20	80
25 *Packet of Rice*	100
30	120 1kg Lentil (Daal)
35	140
40	160
45	180
50 *Instant coffee*	200 1 Liter Mustard oil
60	250
70	300 400g Powder Milk
80	350
90	400 1kg Rui Fish
100	450
125	500 400g Butter oil
	600
150 *10-20 kg bag of rice*	1kg Barbel(Shing) Fish
	700
200	800
more than the amounts on the card	more than the amounts on the card

Figure 1. The figure shows how payments cards that were used in both studies to elicit the WTP.

(4) … *I feel responsible for it and put active effort into its conservation* (relational: stewardship)".

2.3.3. Intermediate case: government budget spending

Lastly, we apply a measure that could potentially circumvent the two main shortcomings of the monetary WTP and non-monetary measures of relational values. First, the individual WTP measure, although hypothetical, should be limited by individual budget constraints. Thus, while the treatment might increase the salience of human-nature relations, one might not be *able* to contribute more to the project described in the contingent valuation scenario. In addition, participants might think it is not their responsibility but rather something that should be dealt with by the government.[6] The non-monetary measures of relational values do not address these issues, but they lack concrete guidance for policymakers that are used to monetary cost-benefit analysis or budget allocation beyond showing that relational values are important to people. In addition, as highlighted in the previous section, many participants score the highest possible value on the index, where the index fails to measure more nuanced variation, at least in our sample.

Therefore, we developed a survey measure that elicits participants' opinions on whether the national government should spend more resources on adaptation. This measure is similar in nature to alternative elicitation tools for biodiversity preferences, where respondents are asked to state their support for different fields of public policy tasks based on the governmental budget allocation (Meinard et al. 2017), or resulting tax payments (Schläpfer 2016). In our case, research assistants showed participants a pie chart and explained how the development budget was spent and how much was

currently allocated to the management of environmental, disaster, and climate change management, see Figure 2. In the Solomon Islands, 1% of the overall development budget (about USD 5 million) was allocated to the management of environmental, disaster, and climate change management. In Bangladesh, 1.7% were spent on such activities (about USD 906 million). Before participants were asked whether this budget should be increased, it was explained that such an increase would cause a trade-off, i.e. there would be less money available for other causes such as education or infrastructure investment. Participants were not able to specify, however, from which budget category potentially desired increases for environmental and climate change management spending should be sourced.

2.3.4. Solomon Islands: attachment to atoll communities and life depicted in the valuation scenario

In the Solomon Islands, we conducted surveys in settlements where atoll inhabitants and atoll migrants from Ontong Java and Reef Island live, as well as in areas predominantly inhabited by people born in Honiara. This differentiation within our study sample brings about an additional interesting layer of heterogeneity with respect to the relational ties to atoll islands, which in turn affects the relational values associated with these places. In Honiara, people who have relocated from the two atoll formations tend to live together in informal settlements separated from other communities (Christensen and Gough 2012; Birk and Rasmussen 2014). People living in one of the atoll settlements – either being born and raised there or having moved there – still have strong emotional and relational ties to their atoll (Christensen and Gough 2012; McMichael et al. 2021). They

a Solomon Islands (2018)
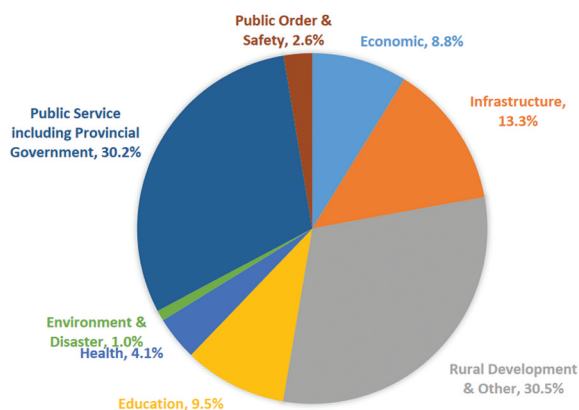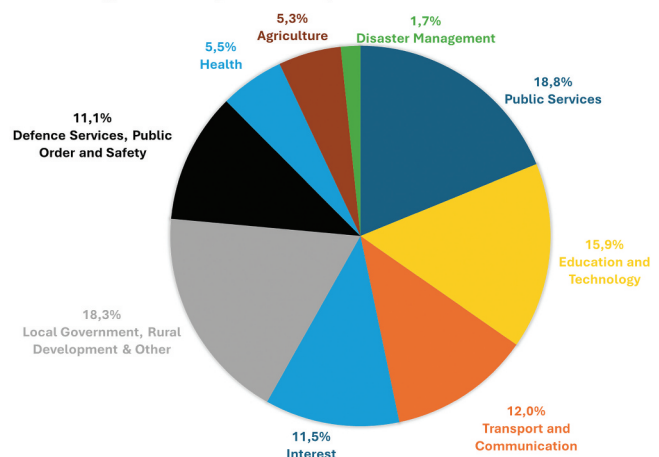
b Bangladesh (2021-22)

Figure 2. The figure shows how the budget spending was illustrated for respondents before deciding on whether the spending on environmental and climate change disaster management should be increased.

frequently visit the atoll, for example on national holidays, and host friends and relatives from the atoll for extended periods when they come to Honiara. On the other hand, such connections are weaker or entirely absent among residents who were born in Honiara or moved there from one of the other large high-lying volcanic islands.

Having first-hand experiences of groundwater salinization or extended droughts makes it easier for people with closer atoll ties to reflect on the information provided in the contingent valuation scenario. Therefore, we elicited participants' ties to atoll islands to be able to identify heterogeneous treatment effects. We asked participants whether they had been living in Honiara all their lives or moved there from somewhere else and, if so, which place they considered home. Based on this information, we classified participants into two categories. The first category is composed of participants who were either born in Honiara or migrated from one of the other higher-lying volcanic islands with no direct relation to one of the atolls (72%, $n = 579$). The other participants (28%, $n = 227$) have some direct connection to an atoll island. They either migrated from an atoll island, have family there, or are currently visiting family in Honiara but still live on an atoll island.

We test the validity of this categorization as a measure of ties to an atoll against further variables relating to participants' ties to an atoll as a place of origin. First, we elicited the language respondents use in their day-to-day lives, as well as their ethnicity. Second, participants were asked whether they perceived it as wrong that migrants adopt the Honiara lifestyle and thereby displace norms associated with life on the islands of origin such as the spoken language, copying lifestyles, or not visiting the island of origin. Last, participants were asked what lifestyle they preferred: having a secure job and earning money in Honiara or living the island life involving fishing and gardening. Having an atoll connection is positively correlated with being Polynesian, using one's mother tongue on a daily basis, or believing that people who move to Honiara forget their traditional language. Jointly, these items predict 71% of the variation in the categorization, highlighting the internal validity of our categorization of respondents (see Supplementary Table S1).

2.4. Data

Table 1 provides summary statistics and balance across treatments in terms of socio-demographics in both studies. We elicited socioeconomic information from participants such as age, education, marital status, and income as important control variables. In the Solomon Islands, respondents were on average 35 years old, 38% of them were female, the majority completed some form of secondary

Table 1. Summary statistics and balance table.

	Control		Treatment		(1)-(3)	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Mean	SD	Mean	SD	Diff	SE
1. Solomon Islands						
Atoll Tie (= 1)	0.29	0.45	0.28	0.45	−0.01	0.03
Female (= 1)	0.38	0.49	0.38	0.49	0.01	0.03
Age	35.47	12.11	35.79	11.24	0.32	0.83
Single	0.36	0.48	0.35	0.48	−0.01	0.03
Highest education completed						
Low: No schooling/primary	0.12	0.33	0.10	0.31	−0.02	0.02
Medium: Form 3 or Form 5	0.46	0.50	0.45	0.50	−0.00	0.04
High: Form 6 or Form 7	0.42	0.49	0.44	0.50	0.02	0.04
Household members	6.41	3.11	6.75	3.03	0.35	0.22
Household income (in SBD)	2802.44	2273.33	3011.72	2268.42	209.27	160.47
Wealth (PCA)	−0.11	2.19	0.12	2.29	0.23	0.16
Observations	434		372		806	
2. Bangladesh						
Female (= 1)	0.62	0.49	0.66	0.48	0.03	0.06
Age	41.49	15.40	38.66	13.19	−2.83*	1.65
Single	0.03	0.17	0.07	0.25	0.04	0.03
Education (in years)	3.37	4.18	3.62	4.34	0.25	0.50
Household members	5.20	2.12	4.62	1.85	−0.58**	0.23
Household Income (in BDT)						
Less than 1,000	0.04	0.19	0.08	0.28	0.05	0.03
1,000 – 3000	0.02	0.15	0.01	0.11	−0.01	0.01
3,000 – 5,000	0.11	0.31	0.13	0.34	0.02	0.04
5,000 10,000	0.32	0.47	0.31	0.47	−0.00	0.05
10,000 15,000	0.24	0.43	0.24	0.43	−0.00	0.05
15,000 20,000	0.17	0.38	0.11	0.32	−0.06	0.04
More than 20,000	0.11	0.31	0.11	0.32	0.01	0.04
Wealth (PCA)	0.02	1.27	−0.01	1.52	−0.03	0.16
Observations	133		169		302	

T-tests are used to identify mean differences of single items between treatment and control. For the joint F-test of orthogonality, we used a linear regression with the dependent variable being whether the participant was assigned to treatment (= 1), or control (= 0) explained by the listed explanatory variables for each sample.

education, and had a median household income of SBD 2,700 a month (mean SBD 2,899). In Bangladesh, respondents were on average 40 years old, 64% of them were female, with 3.5 years of education and household incomes between BDT 5,000 to BDT 10,000. We use joint tests for orthogonality whether randomization was successful in balancing explanatory variables between the treatment and control groups. The test suggests that the random treatment assignment worked to balance out differences in explanatory variable Solomon Islands ($F_{(9, 796)} = 0.76$, $p = 0.76$), with some slight imbalances remaining in Bangladesh ($F_{(12, 285)} = 1.68$, $p = 0.07$).

2.5. Statistical analysis

We preregistered the design of both studies, the hypotheses to be tested, outcome measures, as well as details on our intended analytical procedure (Solomon Islands (click.), Bangladesh (click)). Following our pre-registration, we use ordinary least square (OLS) regression to estimate treatment effects:

$$Y_i = ß_0 + ß_1 * T_i + ß_2 * X_i + \varepsilon_i \qquad (1)$$

The dependent variable Y_i captures the value of our outcome variable of interest of respondent i: (i) amount contributed to the adaptation project, (ii) relational values Likert index, (iii) relational values rank, and (iv) budget spending. β_1 is our estimate of interest capturing the average effect of having been exposed to the information about relational values in the contingent valuation scenario. The vector X_i includes individual characteristics: age, gender, education, marital status, wealth (PCA) and household income. We use robust standard errors.

In the Solomon Islands study, we test for pre-registered heterogeneous treatment effects on all four outcomes by interacting the atoll ties dummy (C_i) with the treatment dummy (T_i). For Bangladesh, we cannot test for these heterogeneous treatment effects, as we have no information on respondents' ties to the place where the adaptation project is implemented. Including the interaction term allows us to test how sensitive the different outcome measures are to the information on relational values across participants that differ in their ties to atoll communities. Participants who have a closer connection to atoll islands and thus knowledge about potential losses of relational values might react differently to the treatment than participants who have no such personal connection and experiences. For those with close ties, the treatment might not be able to make relational losses more salient and thus cannot influence related behaviors and attitudes, i.e. our different outcome measures (Benjamin et al. 2016). Thus, we expect that only those respondents with no atoll connection might react to the treatment, as it offers new insights into additional

relational losses for them. We estimate the following model including the interaction effect of interest ($ß_3$):

$$Y_i = ß_0 + ß_1 * T_i + ß_2 * C_i + ß_3 * (T_i * C_i) + ß_4 * X_i + \varepsilon_i \qquad (2)$$

3. Results

3.1. Descriptive findings

The WTP varied across participants with 86% of participants in both studies being willing to contribute a positive amount to the hypothetical fund presented in the scenario (Figure 3, panel A). On average, participants in the Solomon Islands reported that they would contribute $9.9 PPP dollars (median = 7.4). In Bangladesh, the amount was significantly lower with $4.4 PPP (median = 1.9) than in the Solomon Islands (difference = 5.51, $t_{1106} = 9.53$, $p < 0.01$). Only 19 participants (1.7%, 11 in Solomon Islands and 8 in Bangladesh) stated a WTP amount of more than what was shown on the payment cards with no significant differences between Solomon Islands and Bangladesh (Proportion Test $p = 0.14$, $z = -1.46$). Since these outliers would potentially bias the estimation, we restrict the WTP values of outliers to the highest amount that was shown on the respective payment cards in each study.

Using the Likert-scale index, we find that respondents in both studies score high on relational values of nature with a mean of 4.2 (SD = 0.82, median = 4.25) in Solomon Islands and 3.97 (SD = 0.85, median = 4), see Figure 3, panel B. Respondents in Solomon Islands score higher than those in Bangladesh (difference = 0.26, $t_{1106} = 4.71$, $p < 0.01$).

Figure 3, panel C shows the distribution of the average ranking of relational values (combined cultural and stewardship). In both studies, relational values are ranked in between the other value dimensions (instrumental, intrinsic) with a median position of 2.5. The combined relational values are considered less important than instrumental reasons but more important than intrinsic reasons to protect nature.

Lastly, the increase in budget spending distribution is plotted in Figure 3, panel D. On average, participants in the Solomon Islands reported they would approve an increase in spending by about 10%-points (median = 9), while the amount was significantly lower with 6.1%-points in Bangladesh (difference = 3.75 $t_{1106} = 7.43$ $p < 0.01$). Only 20 participants (1.8%, 15 in Solomon Islands and 5 in Bangladesh) stated an increase higher than 30 pp with no significant differences between Solomon Islands and Bangladesh (Proportion Test $p = 0,82$, $z = 0.23$). There is no overlap of respondents being outliers in the WTP and budget measure. Since these outliers would potentially bias our regression estimation, we restrict the values of outliers to 30 pp.
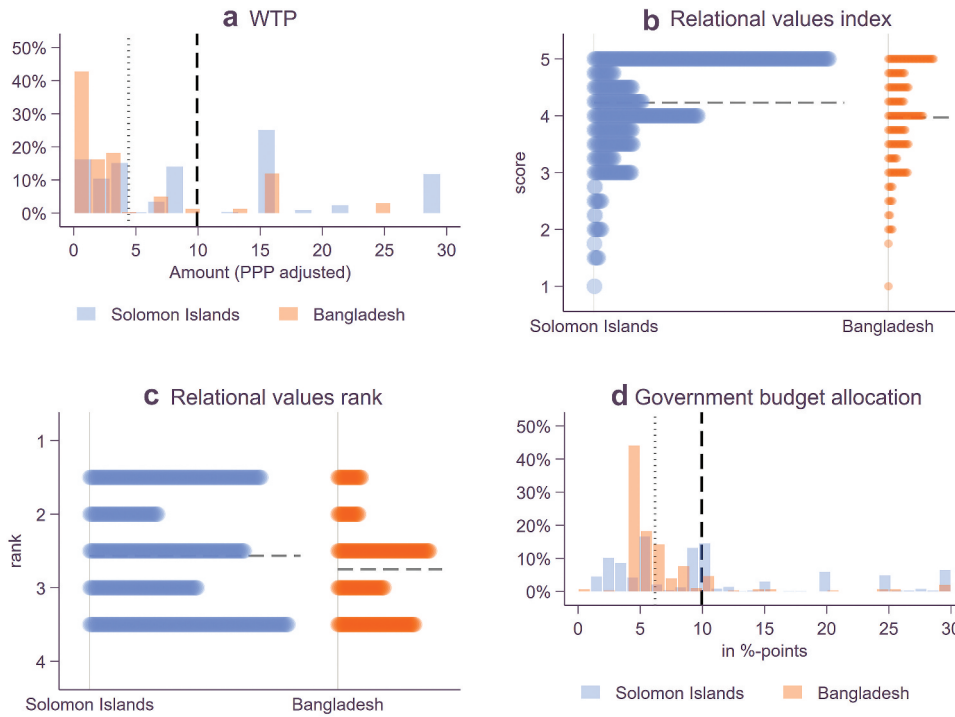
Figure 3. Panel a shows the distribution of the winsorized WTP with the mean for Solomon Islands indicated by the dashed line and for Bangladesh with the dotted line. Panel b shows the distribution and means (dashed line) of the Likert scale relational values index. Panel c shows the same for the average rank of relational values (combined cultural and stewardship rank). A value of 1.5 indicates that cultural and stewardship were chosen as the two 'most important' reasons, while a value of 3.5 indicates cultural and stewardship reasons were chosen to be the wo 'least important' reason. Panel d shows the distribution of the winsorized opinion by how much the spending on environmental and climate change disaster management should be increased by the government in percentage points. The mean for Solomon Islands is indicated by the dashed line and for Bangladesh with the dotted line.

3.2. Treatment effects

We start with estimating the average treatment effects on (i) WTP, (ii) relational values measured via the Likert index, (iii) average rank of relational values, and (iv) the government spending for environmental, disaster, and climate change management. The average treatment effects are plotted separately for the Solomon Islands (blue) and Bangladesh samples (purple), see Figure 4. We find that the relational value information treatment did not significantly affect the WTP in the Solomon Islands (ß=-0.23, p = 0.69, 95 I = −1.38, 0.93) nor Bangladesh (ß = 1.13, p = 0.12, 95 I = −0.31, 2.58). Similarly, we find no significant differences and small point estimates for the treatment on the relational values index and ranking and the government budget allocation items (ß=-0.01, p = 0.99, 95 I = −1.08, 1.07). Only for the budget measure, we find a small increase of 0.9%-points in the Bangladesh sample (ß = 0.89, p = 0.09, 95 I = −0.13, 1.92). Overall, there is little evidence that the treatment caused a higher appreciation of relational values as measured by the four different outcomes.

In terms of the other explanatory variables, we find that wealth is the most important determinant of all four outcome measures. The statistically and economically significant correlation between wealth and WTP suggests that participants answered the WTP scenario adequately despite it being hypothetical. For further details related to the other outcome measures, see Supplementary Table S2 and Table S3.

As described in section 2.3, our sampling in the Solomon Islands allows us to test for pre-registered heterogeneous treatment responses depending on respondents' relational ties with atoll islands which were highlighted in the valuation scenario. To test for heterogeneous treatment responses, we interact our treatment dummy with the atoll connection dummy, see Figure 4. We indeed find evidence that respondents with closer ties express stronger relational values, indicating that these are already very salient for them and difficult to further manipulate. We find that those with a connection have a significantly higher WTP by SBD 34 (ß = 34.20, p = 0.00, 95 CI = 20.42, 47.98) and have stronger relational values by 0.35 SD based on the Likert-index (ß = 0.35, p = 0.00, 95 CI = 0.16, 0.55) than those with no connection. Interestingly, when ranking different reasons for conserving nature, we find no significant difference in reasons for doing so between those with
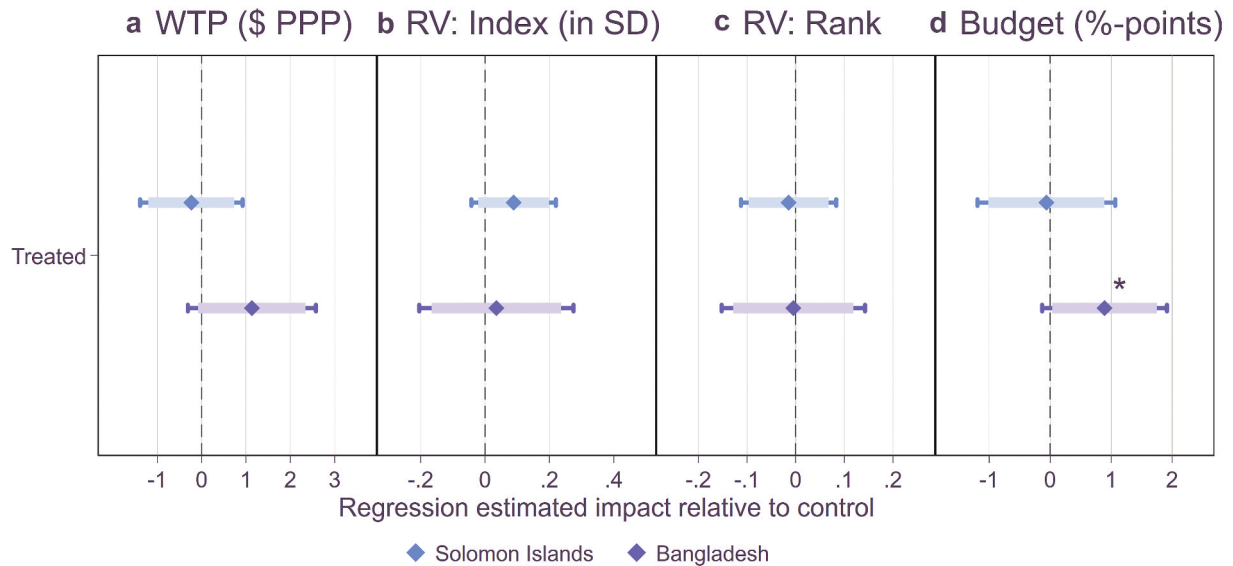
Figure 4. Blue bars represent models estimating the average treatment effect (ATE) for the Solomon Islands sample while purple bars represent ATE for the Bangladesh sample. Panel a shows estimates from models with the WTP amounts for the project as the dependent variable. Panel b shows estimates for the Likert-based relational values index in standard deviations. For Panel c the dependent variable is the average rank of Culture and Stewardship for conservation. Here, a lower rank indicates higher importance attributed to these two relational reasons. Lastly, panel d shows estimates for the government budget spending for environmental and climate change management in percentage points. In all models, we control for age, gender, education, marital status, wealth, and household income. We use robust standard errors: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Full model outputs including the socio-economic controls are reported in Supplementary Table S2 and Table S3.

a connection and those without one (ß = 0.07, $p = 0.36$, 95 I = −0.08, 0.22). Those with an atoll connection, however, state that the government should allocate 2 pp more of their budget to environmental, disaster, and climate change management than those with no connection (ß = 2.00, $p = 0.01$, 95 CI = 0.46, 3.53).

But do people with no atoll connection, where there is room for making relational losses more salient, react differently to the losses of relational values highlighted in the treatment scenario? In the interacted models, the treatment dummy captures the treatment effect of those with no atoll connection. We do not find evidence that there were significant effects on any of our four outcomes for respondents with no atoll connection. For those with closer ties, the treatment even seemed to have some negative effects on their WTP (interaction ß=-14.35, $p = 0.16$, 95 I = −34.34, 5.65) – although not statistically significant.

3.3. Correlation of WTP and budget allocation with relational values

Next, we explore whether respondents who score higher on the relational values index also have (i) a higher WTP and (ii) want their Government to spend more of its budget on climate change management. While the relational values index offers a direct measure of the absolute

importance of relational values for a person, the WTP and budget allocation measures include trade-offs between different uses of available individual or tax money. For the individual WTP, relational values are likely to explain only a small share of the variation in WTP amounts due to both individual ability and perceived responsibility to pay for the adaptation project described in the valuation scenario. Contrarily, stated increases in budget allocations for environmental, disaster, and climate change management are less constrained by individual abilities to pay.[7] Thus, we would expect a stronger correlation between the relational values and the budget allocation measure than for the WTP.

We find that respondents in the Solomon Islands who score higher on the Likert-based relational values index also have a higher WTP for the adaptation project in the Solomon Islands (pairwise correlation ρ = 0.08, $p = 0.03$), while this is not the case in Bangladesh (ρ = 0.03, $p = 0.59$), see Figure 6, panel A. However, 38% ($n = 308$) in the Solomon Islands and 20% ($n = 61$) in Bangladesh are constrained in their expression of the importance of relational values on the index, i.e. full agreement with all four rating items of relational values. In the Solomon Islands, respondents who are constrained have a $1.7 PPP higher WTP than those with low (index 1–3) relational values (difference = 1.76, $t_{395} = 1.87$, $p = 0.06$) and $1.3 PPP more than those with medium scores (difference = 1.28, $t_{715} = 1.81$, $p = 0.07$). There is still substantial variation as amounts contributed by constrained respondents also differ between 0 to $30 PPP (mean of $10.7±

$7.54), see Panel B for the Solomon Islands and panel C for Bangladesh. However, once we include socioeconomic characteristics (gender, age, marital status, education, household size, household income, wealth index) as explanatory variables in the Solomon Island sample, the sign changes. We estimate that those with high relational values contribute about $2 PPP less than those with low relational values (ß=-1.95, $p = 0.03$, 95 I = −3.72, −0.19) and almost 3$ PPP less than those with medium relational values (ß=-2.94, $p = 0.00$, 95 I = −4.44, −1.43). This reversal can be explained by the fact that those with stronger relational values also score higher on our wealth index (pairwise correlation $\rho = 0.34$, $p = 0.00$), which is the main explanatory factor of WTP. Jointly with the other socioeconomic controls, they explain 24% of the variation at the extensive margin (Pseudo $R^2 = 0.24$), an increase in explained variation of about 24 pp compared to the model only including the relational values index (see Supplementary Table S5 for details). For Bangladesh, we find no significant relationship between relational values and WTP (see Supplementary Table S6 for details).

As expected, the correlation between the relational values index and increases in government spending for climate risk management is stronger in Solomon Islands ($\rho = 0.37$, $p = 0.00$) but not Bangladesh ($\rho = 0.06$, $p = 0.29$) compared to the respective correlations between the relational values index and WTP. In the Solomon Islands, those respondents with the maximal relational values want significantly larger increases in government spending than those with low (difference = 7.97, $t_{395} = 7.91$, $p = 0.00$) and medium scores (T-Test diff = 7.60, $t_{715} = 13.42$, $p = 0.00$). In Bangladesh, the differences point in the same direction but are not as strong as in Solomon Islands. Those with high relational values indices report slightly higher budget increases than those with medium scores (difference = 1.45, $t_{244} = 2.11$, $p = 0.04$) but not compared to low scores (difference = 1.22, $t_{115} = 1.32$, $p = 0.19$). Without controls, the relational values index already explains a lot of variation in the budget measurement. In the Solomon Islands, 20% of the variation in budget increases is explained by the relational values index alone, which only increases by 2 pp when also including socio-economic controls (see Supplementary Table S5). For Bangladesh, the overall model explanation is lower (R-squared = 0.02), but we also find no increases when including socio-economic characteristics as explanatory variables in the model (see Supplementary Table S6 for details). Thus, the budget measure correlates more strongly with stated relational values for taking action than the individual WTP.

4. Discussion

Participants in our survey experiment who were confronted with additional information on potential relational losses have, on average, a similar WTP for the adaptation project presented as part of the CVM scenario to those who were not confronted with relational losses. This holds for individuals with varying degrees of connection to the Atoll. In line with qualitative work that highlights the deep connection people have to their land and ancestors (Nunn et al. 2016), we find that participants score high on relational values in both the Solomon Islands (4.2 out of 5) and Bangladesh (3.9 out of 5), as measured by the Likert scale.

4.1. Discussion on the lack of a treatment effect

Given the fact that relational values in our sample are important, the lack of a treatment effect can be attributed to the CVM scenario technique not containing any additional valuable information, the properties of the outcome variables, or a combination of both. Since all outcome measures were not responsive to the treatment information in both studies, we are confident to attribute the lack of treatment effects to the CVM scenario rather than the properties of our outcome measures. This reinforces the point that monetary valuation tools, such as CVM, may fail to fully capture relational values, particularly when socio-cultural and emotional attachments to nature are involved. Given that the Likert scale questions were a bit more responsive to the scenario, there are additional caveats about the use of monetary measuring instruments. Monetary valuation, by its very design, reduces complex socio-ecological systems to a single economic value, which is insufficient in fully capturing relational values that are non-substitutable, as they are tied to cultural, emotional, spiritual, and social connections. This problem might be exacerbated as relational values are postulated to be non-substitutable and tied to cultural, emotional, spiritual, and social connections (Chan et al. 2018). Monetary valuation in its very nature rests on the substitutability between natural values and alternative goods – in this case, a one-time donation to a conservation cause. Respondents might simply not have regarded additional monetary spending as an adequate reaction to the additional information on relational value losses.

Regarding responses to the CVM scenario, there are potential explanations relating to the additional information provided in the scenario. It might be possible that the relational values associated with the threatened atoll islands were already high within our sample. Consequently, the additional treatment information may not have been able to induce a strong reaction on the WTP in the first place (Benjamin et al. 2016). The higher average WTP for continued conservation among those with an atoll connection, despite the place having no instrumental value, illustrates that relational values are indeed reflected in the WTP. However, this reflection

remains partial and may not capture the full spectrum of relational values present, highlighting the limitations of traditional economic tools in monetizing complex, multi-dimensional relationships with nature. This effect is not merely driven by differences in socio-economic status, as it remains significant even after controlling for variations in wealth and income. Another possibility could be that respondents may not have fully grasped or appreciated the implications of abstract concepts like relational value losses due to various biases, cognitive processes, or misunderstandings. One relevant factor might be the warm-glow effect documented by Kahneman and Knetsch (1992) who showed that one good is assigned a lower WTP if it is valued in a bundle of goods instead of on its own. This could suggest that monetary valuations may be influenced by emotions such as altruism or guilt, thus complicating their ability to capture relational values fully. The latter might indicate that people want to support inhabitants on the atoll, but this sentiment might already be factored into their overall valuation, possibly alongside their ability to pay leading to no further treatment differences.

4.2. Advantages and disadvantages of relational value outcome measurement instruments

The findings of our empirical investigation using different means of measurement allow us to discuss the applied instruments regarding their advantages and disadvantages in quantifying relational values (see also S2.5). A minimum requirement for the validity of a relational value measurement instrument should be that it captures variations in relational ties to the socioecological system to be protected by the contingent adaptation cause. Our results show that both the WTP, the budget allocation, as well as the Likert items react sensitively to the atoll island connection (see Figure 5), while this does not hold for the ranking items.

Finally, we investigated correlations of the relational values index with WTP and budget allocations. While WTP estimates offer a comparable and straightforward valuation on a monetary scale, the small correlation between WTP and the relational value index in both studies raises questions about their adequacy in capturing relational values. The WTP had only a small correlation with the relational value index in both studies and we further highlighted that WTP is mainly driven by differences in wealth. This suggests that traditional economic instruments like WTP tend to reflect financial capacity rather than genuine relational attachments to ecosystems. As respondents with ties to the ecosystem and the populations at risk have lower income their interest is largely disregarded using the WTP. While preferences for government budget allocation differ with wealth, the measure is theoretically independent of personal resources as respondents consider the use of public funds rather than their own money. We find that the budget measure correlates more strongly with the relational value index than the WTP is slightly responsive to the induced treatment variation in the Bangladesh study (significant at the 10%-level).

The quantification of natural values in monetary terms comes with additional caveats that have been
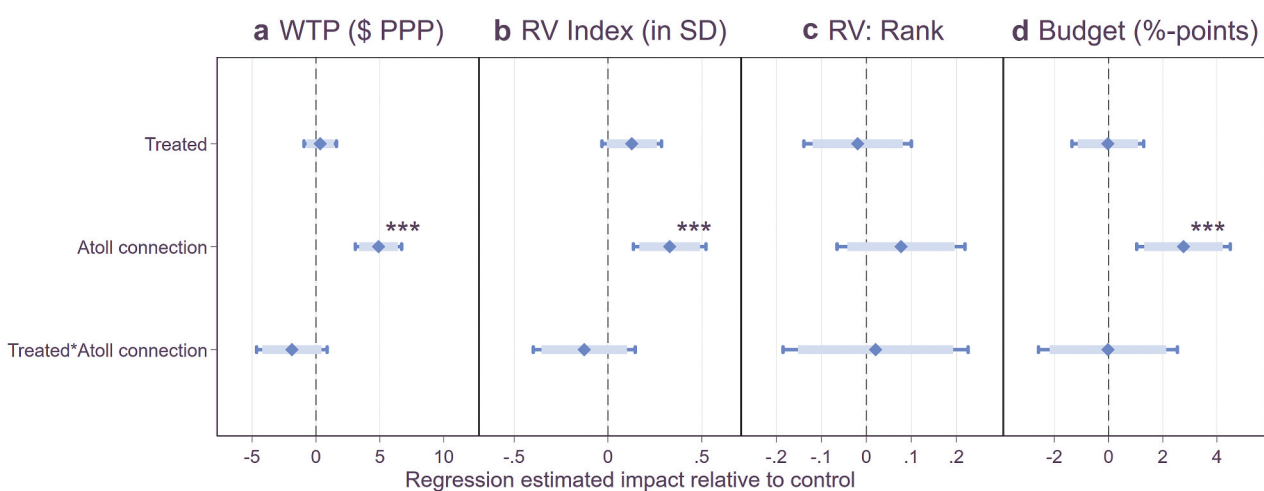
Figure 5. The figure shows heterogeneous effects depending on respondents' connection to the conservation scenario in Solomon Islands. Panel a shows estimates from models with the WTP amounts for the project as the dependent variable. Panel b shows estimates for the Likert-based relational values index in standard deviations. For Panel c the dependent variable is the average rank of Culture and Stewardship for conservation. Here, a lower rank indicates higher importance attributed to these two relational reasons. Lastly, panel d shows estimates for the government budget spending for environmental and climate change management in percentage points. In all models, we control for age, gender, education, marital status, wealth, and household income. We use robust standard errors: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Full model outputs including the socio-economic controls are reported in Supplementary Table S4.

Figure 6. Panel a shows the WTP amounts. The amount is aggregated at the relational values index and plotted against the index. Panel d shows the same for the government budget outcome. The two separate lines in each panel are from a kernel frequency-weighted local polynomial regression (kernel = Epanechnikov, degree = 0, bandwidth = 0.3). The other four panels show the distribution and means (grey reference lines) of WTP amounts (Solomon Islands, panel b; Bangladesh, panel c) and budget allocations (Solomon Islands, panel e; Bangladesh, panel f) for three relational values categories: low (1-3), medium to high (3.25-4.75), or maximal (=5).

contested for various methodological reasons (Hausman 2012).[8] In our context, respondents with strong ties, and thus the highest interest in maintaining the socioecological system, only give very small absolute amounts (mean USD 10.5 ± 8.4). Individual respondents might have a higher valuation for the adaptation project at hand than their actual budget can afford at the point of the CVM survey. Thus, while trade-offs are important in economic thinking, they are biasing the overall importance of the project.

The potential appeal of WTP estimates is that they provide comparable valuation estimates on a monetary scale. The WTP can be extrapolated and included in a cost–benefit calculation. We estimate the WTP of all Solomon Islanders to be around USD 4.66 million, ranging between USD 4.12 to USD 5.21 million, suggesting that the Atoll Islands Protection Fund would receive enough funding to support between 5200 (lower bound) to 6600 (upper bound) vulnerable atoll islanders.[9] However, this aggregation can mask the underlying relational values and connections that are harder to quantify, further reinforcing the limitations of relying solely on monetary values. Respondents might inflate the absolute values of public budget allocations for environmental and climate change management, as they do not consider all tradeoffs and practical constraints. However, the treatment difference provides valuable insights into the relative importance of emphasizing human-nature relations. Based on our treatment estimate (+0.89%-points), highlighting relational values could lead to an estimated additional allocation of approximately USD 499 million (95%-CI

= −73 million, 1075 million) for disaster management in Bangladesh. Notably, this extra amount represents 55% of Bangladesh's entire 2021/2022 disaster management budget (USD 906 million).

The ability to pay argument can also be circumvented by employing agreement-based scale instruments or ranking tasks, however, naturally, neither of these two approaches provide comparable monetary valuations or involve tradeoffs, e.g. between ecological and economic objectives. Additionally, the individual expression of values is censored: Individual respondents might have an especially high relational valuation of nature but are still only able to state the highest degree of agreement allowed by the respective scale or ranking options available, and thus a lot of heterogeneity is not captured. This is exemplified by the fact that in our study the variation in WTP and government budget allocation among people scoring the highest on the Likert item was still substantial (see section 3.2). The quantification in the form of Likert items is of course valuable for analyzing relative differences in the context of adaptation policy (Olmsted et al. 2019; Uehara et al. 2020). As already outlined in the introduction, the quantification of relational values in monetary terms has the potential to trigger additional commodification processes of nature (Smessaert et al. 2020), thereby risking negative impacts on social justice, intrinsic motivation to conserve nature or social networks. This raises concerns about the potential for relational values to be oversimplified or misrepresented in decision-making processes, which could lead to flawed policy

recommendations. This danger is even greater given that the methodological problems revealed by our analysis are quite substantial. Although people report high relational values, an additional willingness to pay is not reflected in our study which, in isolation, could lead to flawed conclusions.

Our study suggests that relational values are important. However, there is, so far, no convincing shortcut in assessing their importance by trying to monetize them. As our findings indicate, policymakers should be cautious when attempting to quantify relational values solely through economic metrics. Policymakers will thus need to engage more deeply with qualitative accounts and deliberative methods (e.g. interviews, deliberative monetary valuation) for eliciting relational values (Kenter et al. 2016; Klain et al. 2017; Tadaki et al. 2017). Especially, elicitation methodology involving value deliberation is suitable, as the respondents' focus is put on shared value concepts, thereby potentially allowing for an acknowledgment of socioecological complexities inherent to the adaptation cause at hand (Jacobs et al. 2018; Ravenscroft 2019). In decision-making environments characterized by high social cohesion where a high degree of local legitimacy is required, it is particularly desirable that the incorporation of relational values in the decision-making process should happen in a bottom-up manner involving collective action (Huynh et al. 2022; van Noordwijk et al. 2023). A promising proposition fulfilling these criteria could be the implementation of value deliberation within the context of citizens' assemblies or juries (Robinson et al. 2008; Wakeford et al. 2015).

Besides using deliberative methods to better reflect non-monetary formulations of relational values, future research trying to disentangle relational from other value types may try to use more salient information than we did. This could be applied in the context of choice experiments or by using subject pools that already experienced relational value losses. For example, one may interrogate people who were compensated to resettle from their homes and ask them to rank the importance of different losses and weigh these losses against the potential monetary compensation they received. This could open new pathways for understanding the emotional and cultural dimensions of human-nature interactions in a more comprehensive manner. Thus, while we acknowledge the potential danger of oversimplifying the complexity of human-nature interactions with such an approach, we still believe future research aiming to monetize relational values is warranted. Importantly, such efforts should be seen as complementary to, rather than in competition with, existing approaches, helping to broaden our understanding by offering additional perspectives on how people relate to and value nature.

5. Conclusion

The outcomes of our quantitative study provide evidence that highlighting potential relational value losses within the context of a detailed contingent valuation scenario on the adaptation of atoll island and coastal communities against sea-level rise does not lead to a higher WTP among respondents. This suggests that in study contexts where relational values are already salient, alternative stated preference valuation techniques, like e.g. the discrete choice experiment incorporating tradeoffs between distinct types of nature values could be the preferred method to approximate relational values on a monetary scale. However, even these approaches remain limited, as the complexity and depth of relational values cannot be fully captured through traditional economic metrics alone. One drawback of this study, we deem noteworthy is the use of single-item scales for instrumental and intrinsic values potentially not capturing the complexity of these dimensions to the full extent and limiting the robustness of our results. Future research should consider the use of multiple-item scales to obtain a more nuanced understanding of these value categories.

Still, we observe that people with closer emotional and relational ties with the threatened socioecological system in question state higher relational values approximated by using Likert items, budget allocation, and WTP. Thus, the prevalence of relational values is most likely enculturated and dependent on individual and specific experiences. This further reinforces the argument that monetary valuations may provide only a partial understanding of these deeply rooted socio-cultural connections. Using the Likert or WTP approach does not help us to disentangle the importance of relational values in comparison to other value dimensions that could add to qualitative narratives about how important relational values are to people. In fact, the limitations of these quantitative measures highlight the risk of undervaluing relational values, especially when reducing them to economic figures. There is the danger that quantifying monetary values leads to an undervaluation of these values. This issue is critical because undervaluing these connections could have serious consequences, particularly if such measures were used in resettlement programs (Burger et al. 2023) or to estimate relational losses in unique human-nature relations.

The government budget allocation task has the potential to meaningfully incorporate relational values in climate disaster management decision-making, for example through participatory budgeting (Sintomer et al. 2008; Cabannes 2021), in the Global South. Further developing and validating this approach by including more detail and group deliberations can offer a more robust and nuanced understanding of the implications of shifting

Government budgets from one sector to the other. This approach, particularly in participatory budgeting, allows for collective decision-making that better reflects non-monetary, relational values, ensuring that such values are given due consideration. Such an approach, a simplified version of deliberative participatory budgeting, could address issues of low ability to pay and varying perceptions of responsibility. It would also provide a bottom-up approach to governance, ensuring that relational values are not overshadowed by the more easily quantifiable instrumental or economic values.

Notes

1. Based on their connection to atoll islands, respondents are likely to feature heterogeneity in their attachment to place (Adams 2016; Neef et al. 2018; Bora and Voiculescu 2021; Steimanis et al. 2021; Bell et al. 2021), social responsibility and stewardship toward nature (Nunn et al. 2016), social cohesion (Yeboah et al. 2022; Steimanis and Vollan 2022), as well as cultural (Adger et al. 2013; Witter and Satterfield 2014; Ford et al. 2020; Yeboah et al. 2022) and individual identities (Ford et al. 2020; Steimanis et al. 2021; Riethmuller et al. 2021; Xu et al. 2021).
2. Two weeks before the main data collection we conducted a pretest with 28 participants. Subsequently, we adjusted the contingent valuation scenario and other survey items in line with the feedback received.
3. We use the payment card approach with additional information on common household expenditures (see next subsection) to provide respondents context to their WTP (Bateman et al. 2002).
4. As discussed in the literature (Bateman et al. 2002), this method can be preferable over alternative options in research contexts where respondents are likely to have never answered a WTP question and are unsure about their preferences in face of a complex valuation scenario.
5. RV1: „There are landscapes that say something about who we are as a people".; RV2: 'I have strong feelings about nature, these views are part of who I am and how I live my life'.; RV3: „I often think of some wild places whose fate I care about and strive to protect, even though I may never see them myself".; RV4: „Humans have a responsibility to account for our own impacts to the environment because they can harm other people".
6. Indeed, the most common answer to why participants did not contribute to the Atoll Island Protection Fund was that they believed it was the government's responsibility to help people on atoll islands to adapt to climate change.
7. Apart from individual budget constraints, one could also argue that more economically wealthy individuals might be less dependent on public services financed by government spending. One could therefore argue that such people on average would be more willing to trade-off government spending on such causes for objectives like the protection of atolls.
8. Furthermore, CVM studies are prone to imprecision in individual WTP bids, e.g. due to issues relating to hypothetical bias (Murphy et al. 2005; Morrison and Brown 2009; Loomis 2014) and WTP estimates (at least those generated from CVM studies) do not allow for a clear separation of value dimensions – in our case, disentangling the extent of relational values in WTP bids against other value types.
9. Adjusted for an average inflation of 2.6% per anno from 2017 until 2023, yielding inflation adjusted average costs per beneficiary of $791 in 2023. More details on the extrapolation of WTP estimates are provided in Supplementary Section S1.3.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Consent

Informed consent to participate in the study was obtained at the start of each survey.

Data and materials availability

The surveys, data, and analysis files are available on GitHub.

Ethical clearance

The study design and field implementation were designed and conducted according to the ethical standards in the declaration of Helsinki ('World Medical Association Declaration of Helsinki', 2013). All respondents gave their informed consent in written form and were free to resign from the study at any time.

ORCID

Marco Nilgen 🔟 http://orcid.org/0000-0001-7358-4965
Maximilian Nicolaus Burger 🔟 http://orcid.org/0000-0003-2334-3885
Ivo Steimanis 🔟 http://orcid.org/0000-0002-8550-4675
Björn Vollan 🔟 http://orcid.org/0000-0002-5592-4185

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