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The importance of relational values in gaining people's support and promoting their involvement in social-ecological system management: A comparative analysis

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People's support and involvement are critical to the sustainable use and conservation of social-ecological systems (SESs). Integrating people's values into management decisions is pivotal. Without proper integration, the resulting SES may not align with their desires and may not be supported by people. Furthermore, values can be a deep leverage point within a system that is difficult to change, as people may be more willing to be involved in activities that support what they value. Recent studies have illustrated the importance of relational values as the third value class (in addition to instrumental and intrinsic). Relational values are preferences, principles, and virtues associated with human-nature relationships. Although studies on relational values are available, empirical studies, particularly studies about the usefulness of relational values in promoting pro-SES behavior, are rare. Consequently, our study administered questionnaires to residents in three SESs in Japan (N = 864, 1136, and 1000, respectively) to understand how relational values impact people's support and involvement in SES management as measured by pro-SES behavior scales. In addition, due to the lack of pro-SES behavior measurements, we developed measurement items and a development guideline. Our findings support previous theoretical discussions positing that relational values are critical as a single value class or as part of the plural values and need to be integrated into SES management decisions to gain people's support. Furthermore, our study demonstrated that cultivating relational values could promote pro-SES behavior to realize a desirable state of SES. Although from the viewpoint of residents, relational values overlapped with instrumental and intrinsic values; however, as per theoretical discussions, the results indicated that relational values were important in their own right as they were well associated with pro-SES behavior scales. The findings were similar across the three SESs, with different social-ecological characteristics. In summary, managers must integrate relational values into management

decisions to gain people's support and should cultivate relational values to promote pro-SES behavior, in order to realize a desirable state of SES.

KEYWORDS

instrumental value, plural value, Pro-SES behavior, relational value, social-ecological system, *satoumi*

Introduction

People's support and involvement are critical to the sustainable use and conservation of social-ecological systems (SESs). An SES is a type of complex adaptive system that embraces the dynamics of people and nature (Folke et al., 2005; Fischer et al., 2015). In general, the system embraces three characteristics: elements, interconnections, and a function or purpose (Meadows, 2008). The management of SESs requires that the two major, and often conflicting objectives, i.e., the advancement of human well-being and the conservation of ecosystem integrity, are balanced (Fischer et al., 2015). Considering the significant impact of people's behavior and interaction on the state of SES, people need to have a shared understanding of management goals for successful SES management. Moreover, people are involved in SES management, both directly (e.g., conservation activities) and indirectly (e.g., lifestyle elements, such as the use of nature), aimed at realizing the sustainable use and conservation of SES, when they understand and agree with the purpose of SES. Thus, SES management is people management (Berkes and Folke, 1998).

To gain people's support and promote their involvement in SES management, its management and purpose should be aligned with people's values (Jones et al., 2016), indicating the potential need for reflecting people's plural values. Relevant values must be articulated. In particular, it is critical to integrate the plurality of values into SES management (Jones et al., 2016; Arias-Arévalo et al., 2017; Pascual et al., 2017). When SES management does not reflect people's values or fails to shape them, either the management outcome (i.e., the state of SES and corresponding benefits) lacks public support, or the result is biased as people with neglected values are ignored or negatively impacted (Himes and Muraca, 2018). A previous empirical study showed that different value domains are connected to different ecosystem services (Martín-López et al., 2014). Using the Schwartz human-values theory, certain studies have revealed that different marine ecosystem services are closely related to different value domains (Hicks et al., 2015; Uehara et al., 2019b). Therefore, the negative impact on people with neglected values may be aggravated by trade-offs between ecosystem services (Cord et al., 2017; Ellis et al., 2019).

Accordingly, attention to plural values associated with nature, to overcome this intrinsic/instrumental dichotomy, has been increasing as relational values can be a promising bridge for the dichotomy toward a plural value approach (Gu and Subramanian, 2014; Jones et al., 2016; Arias-Arévalo et al., 2017; Pascual et al., 2017; Himes and Muraca, 2018). Relational values are the third value class of nature, in addition to instrumental and intrinsic values (Chan et al., 2016). Relational values are "preferences, principles, and virtues about human-nature relationships (Chan et al., 2018, A1)." We gain from nature (instrumental), live for nature (intrinsic), and live in nature (relational) (Himes and Muraca, 2018). Contrary to instrumental values, a relationship with nature matters more than a means to an end for relational values (Chan et al., 2018). There have been theoretical discussions regarding delineating relational values from various perspectives [e.g., a special issue on relational values in Current Opinion in Environmental Sustainability, edited by Pascual, Gould and Chan, (2018)]. Himes and Muraca (2018) have argued that while instrumental values are substitutable (e.g., the place where people swim does not matter as long as people can swim), relational values are non-substitutable (e.g., the place to swim matters, insofar as people value their connection to the place). While relational values refer to human-nature relationships, intrinsic values are ends in themselves, regardless of people's relationship with nature. Chan et al. (2018) conceptualized relational values with assigned values, moral values, and held values, indicating that they fill a gap between instrumental and intrinsic values. Muradian and Pascual (2018) proposed human-nature relational models to discuss the role of relational values in environmental decision-making. Jax et al. (2018) and West et al. (2018) discussed attention to nature as a relational value. Knippenberg et al. (2018) claimed that relational values are central to religious thoughts and include constitutive and intrinsic values.

Furthermore, relational values overlap with other, well-studied, concepts. For example, Riechers et al. (2021b) have argued that relational values are closely related to human-nature connectedness, indicating its usefulness as a solution to the disconnect with nature. The sense of a place, for instance, is a part of relational values (Chan et al., 2016; Arias-Arévalo et al.,

2017; Allen et al., 2018; Himes and Muraca, 2018). It describes the importance of a place to one's sense of self (Allen et al., 2018) and provides a theoretical perspective to articulate the motivation for stewardship (West et al., 2018). In addition, it is a part of relational values as individuals identify and administer the principle/virtue, respectively (Chan et al., 2016).

Although empirical studies on relational values are required as an input to SES management in practice (Jones et al., 2016; Arias-Arévalo et al., 2017; Uehara et al., 2020), the number of empirical studies remains limited (Kleespies and Dierkes, 2020a; See et al., 2020; Riechers et al., 2021b). In particular, quantitative research lacks, though it benefits the advancement of relational value studies (Schulz and Martin-Ortega, 2018). Further, empirical studies can corroborate the theoretical discussion of relational values and contribute to SES management in practice. For example, empirical findings on the relationship between intrinsic, instrumental, and relational values have been mixed (See et al., 2020; Riechers et al., 2021a).

In addition to understanding the characteristics of relational values, it is important to explore how they are related to people's involvement in SES management. While the significance of values as a foundation of attitudes and behavior is not new (Stern, 2000; Schwartz, 2012; Jones et al., 2016), there is growing discussion about the sustainability transformation of SES that sheds light on values as a deep leverage point (Abson et al., 2017; Fischer and Riechers, 2019; West et al., 2020; Davelaar, 2021). A leverage point is an effective intervention point in a system (Meadows, 2008). As opposed to a shallow leverage point, a deep leverage point is difficult to change; however, it is likely to enable a fundamental change to the system (Fischer and Riechers, 2019).

Although certain studies assert that relational values are a promising deep leverage point (Chan et al., 2020; Uehara et al., 2020; Riechers et al., 2021b) as they are connected to pro-environmental behavior and attitudes and promote sustainable SES use (Jones et al., 2016; Van den Born et al., 2017; Kleespies and Dierkes, 2020a), empirical studies are, once again, limited (Uehara et al., 2019a; Shin et al., 2022). Klain et al. (2017) suggested the potential contribution of relational values to the value-belief-norm theory to better understand pro-environmental behavior; however, most empirical studies of relational values focus on understanding its compositions, latent traits (Klain et al., 2017; Kleespies and Dierkes, 2020a; See et al., 2020; Uehara et al., 2020; Riechers et al., 2021a; Saito et al., 2021), and predictors (Arias-Arévalo et al., 2017; Kleespies and Dierkes, 2020b; See et al., 2020; Shishany et al., 2020; Riechers et al., 2021a).

Another point worth noting is the lack of studies on pro-SES behavior scales that could assist in empirically investigating the contribution of relational values to SES management. Empirical and theoretical literature on pro-environmental behavior is available (Steg and Vlek, 2009; Lange and Dewitte, 2019; Grilli and Curtis, 2021) and can be a good foundation for explaining pro-SES behavior. However, pro-environmental behavior scales may not be perfectly suitable for SES management as their purposes may not be the same. While pro-environmental behavior scales focus on behaviors for avoiding and mitigating the negative impact of human activities on the environment (Markle, 2013; Lange and Dewitte, 2019), its sustainable use is a critical purpose of pro-SES behavior, contributing to human well-being. However, in the SES literature, this point is not always explicit.

To fill these research gaps, this study aimed to empirically investigate how relational values contribute to people's support for and willingness to become involved in SES management (i.e., pro-SES behavior) in comparison with the other value classes. Five research questions (RQs) were formulated.

RQ1. How are relational values different from other value classes?

RQ2. What factors explain relational values?

RQ3. What are the characteristics of pro-SES behavior scales?

RQ4. How are relational values related to pro-SES behavior?

RQ5. How do answers to RQ1 to RQ4 differ in a social-ecological context?

RQ1 asks whether relational values are important as a single value class or as an addition to plural values. RQ2 provides insights into the cultivation of relational values. RQ3 reveals the characteristics of pro-SES behavior, which contribute to the realization of the desired SES. RQ4 asks whether higher relational values lead to pro-SES behavior. RQ5 investigates if the varied roles of relational values in pro-SES behavior in the management of the three SES are different or the same.

Materials and methods

Cases

This study investigates three SESs surrounding the Seto Inland Sea, the largest inland sea in Japan (Figure 1 and Table 1). We labeled these SESs as Kobe-Hanshin, Harima, and Kagawa. Each SES needs an appropriate system boundary to elicit management implications and comparison. However, defining a system boundary for SESs is not simple (Klauer, 1999; Uehara et al., 2016; Uehara and Mineo, 2017). An SES needs to embrace appropriate ecological systems whose management can maintain the key biophysical structures or processes, and thereby provide ecosystem services (Potschin-Young et al., 2017) and social systems, such as people and administrative entities. While landscapes and seascapes are conceptually relevant spatial boundaries (Gu and Subramanian, 2014; Matzdorf and Meyer, 2014), choosing their actual boundary is not easy in practice due to a variety of mismatches (e.g., between supply and demand of ecosystem services and between ecological systems and administrative jurisdictions) (Cumming et al., 2013; Geijzendorffer et al., 2015; Loft et al., 2015). In addition, we often face data availability issues.

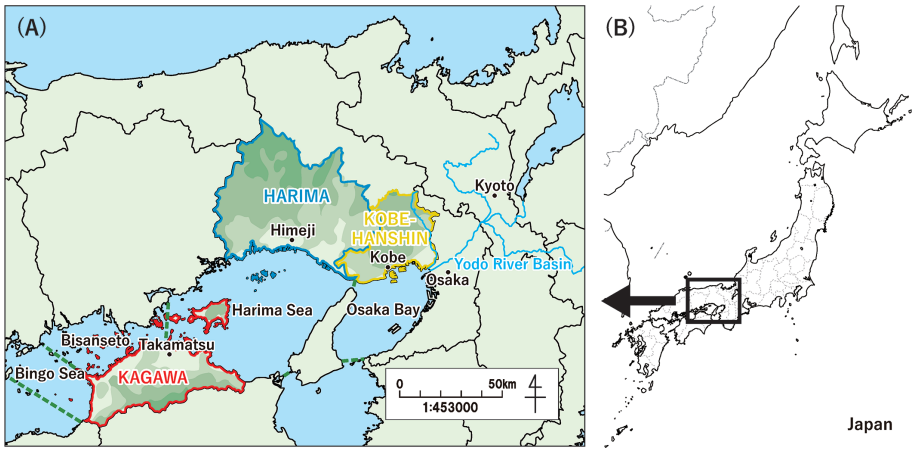

FIGURE 1
(A) Locations of the SESs and **(B)** their positions in Japan. **(A)** shows Geographical boundaries of the SESs. A darker green area in the SES indicates a higher altitude. Blue lines are major rivers, comprising the Yodo river basin.

For example, official statistics, collected by administrative jurisdiction, may not be consistent with the SES boundary.

The system boundaries in the three cases were delineated primarily based on the units of sea and administrative jurisdiction, in consultation with public officials in Hyogo and Kagawa prefectures. Municipalities can be used to delineate social system boundaries of the SESs, as in Martín-López et al. (2017), which proposed a method for delineating the system boundaries of the SES. Although administrative boundaries may not perfectly capture the SES boundaries, it may be a practical approach for SES management to capture the important elements of the SES. Social systems of SES may include people dealing with governance (Berkes et al., 2002). Municipalities and prefectures may be the main governing entities, though communities and non-profit organizations play important roles in SES management as well. Kobe-Hanshin and Harima face the Osaka Bay and Harima Sea, respectively (Figure 1). This study covers four out of twelve areas comprising the Seto Inland Sea (Ministry of the Environment). While corresponding landscapes are in Hyogo Prefecture, the region's north boundary is approximately along the drainage divide of the Seto Inland Sea. The landscapes are further split into Kobe-Hanshin and Harima regions, following the administrative boundaries of Hyogo Prefecture. However, as expected, some

TABLE 1 The primary characteristics of the three SESs.

		SES		
		Kobe-Hanshin	**Harima**	**Kagawa**
Municipal Government		Hyogo Prefecture	Hyogo Prefecture	Kagawa Prefecture
Sea		Osaka Bay	Harima Sea	Harima Sea, Bisan Seto, Bingo Sea
Sea area (km^2)		1,447	3,426	5,262
Land area (km^2)		1,207	3,594	1,877
Population (person)		3,280,063	1,798,528	950,244
Population Density (persons/km^2)		2,717	500	506
Water quality*	T-N (mg/L)	0.226 [0.12, 0.62]	0.169 [0.11, 0.26]	0.189 [0.11, 0.28]
	T-P (mg/L)	0.026 [0.015, 0.072]	0.023 [0.014, 0.048]	0.024 [0.014, 0.048]
	COD (mg/L)	2.230 [1.4, 4.8]	1.972 [1.3, 3.6]	1.988 [1.2, 3.6]

Sources: Geospatial Information Authority of Japan, Ministry of Internal Affairs and Communications, and Ministry of Land, Infrastructure, Transport and Tourism.
*Water quality data are the mean values of multiple monitoring points in each sea with the minimum and maximum values in "[]" for 2020. The data were collected by the Ministry of Land, Infrastructure, Transport and Tourism, (n.a.). Bingo Sea is not included in the estimates of water quality owing to lack of data. T-N (total nitrogen); T-P (total phosphorus); COD (chemical oxygen demanded).

survey respondents answered that they felt they were living closer to another sea (i.e., living in Kobe-Hanshin; however, Harima Sea is closer or living in Harima; however, Osaka Bay is closer); hence, they were treated as respondents in the SES related to the sea they considered closer to them. All regions in Kagawa Prefecture were included in Kagawa, as they were inside the drainage divide facing the Seto Inland Sea. Hence, the land area of Kagawa is at a prefectural level, whereas Kobe-Hanshin and Harima are collections of towns and cities.

Social and ecological systems are connected reciprocally (Binder et al., 2013). Coastal zones are important for socio-economic activities (e.g., fishery, manufacturing industries, and leisure). A study revealed that people in Hyogo Prefecture demanded a variety of ecosystem services (Uehara et al., 2021). An opinion poll showed that people in Kagawa desired a beautiful and clean sea with abundant fish and places for leisure and arts (Kagawa Prefecture, 2021b). Mismanaged plastic waste from rivers entering seas has a negative impact (Kagawa Prefecture, 2021c). Nutrients entering the seas from land (e.g., sewage) influence the water quality, which further influences fisheries (Hyogo Prefecture, 2016).

There are certain similarities and differences between the three SESs. First, those managing them must abide by the "Act on Special Measures concerning Conservation of the Environment of the Seto Inland Sea," which pursues sustainable use and conservation of the Seto Inland Sea. Specifically, the Act intends to realize *satoumi*, the Japanese concept of socio-ecological production landscapes and seascapes (SEPLS) in which human interaction with nature enhances diverse natural benefits (e.g., ecosystem services) while conserving nature (Duraiappah et al., 2012; Yanagi, 2012; Berque and Matsuda, 2013; Gu and Subramanian, 2014; Uehara and Mineo, 2017; Ministry of the Environment Japan, 2019a). In other words, *satoumi* and SEPLS are the desirable states of SES. In Japanese, *satoumi* means the sea area ("*umi*") where people live ("*sato*") (Ministry of the Environment Japan, 2019a). The *satoumi* concept is unique because active human involvement and enhancing the benefits from nature for human well-being, rather than leaving nature to be pristine and purely pursuing the conservation of nature, are key. Therefore, the pro-environmental behavior concept may be insufficient to address the behaviors that promote *satoumi*. Furthermore, because a state of *satoumi*, or a desirable state of SES, may vary from place to place (Uehara and Mineo, 2017), it makes it critical to compare several SESs to elicit management implications.

Second, since the Act stipulates that the prefectures draw management plans by reflecting the characteristics of each sea or bay, Hyogo Prefecture and Kagawa Prefecture, which target different seas, have separate management plans. Third, the water quality of Osaka Bay differs from the other two, which is one of the major reasons for splitting Hyogo Prefecture into two SESs for this study. Osaka Bay is surrounded by big metropolitan areas (Kobe City and Osaka Prefecture). The population density of Kobe-Hanshin is more than five times that of either Harima or Kagawa. Furthermore, the Yodo River, flowing into Osaka Bay, is connected to Kyoto City, another big metropolitan area (Figure 1). Coupled with limited management capacity, Osaka Bay's water quality is characterized by higher chemical oxygen demand (COD), less transparency, and higher total nitrogen (T-N) (Table 1). However, lower T-N and total phosphorus (T-P) are not always preferable because these poor nutrients may have negative impacts on the fisheries (e.g., Japanese sand lance (*Ammodytes personatus*), bivalves (asari clam, *Ruditapes philippinarum*), and aquaculture (e.g., seaweed farming) (Diaz, 2001; Miyoshi et al., 2012; Hyogo Prefecture Environmental Council, 2019; Fujiwara et al., 2020). The poor nutrients may decrease the primary production of phytoplankton and algae in marine ecosystems, which may be a limiting factor for the economic performance of fisheries (Tanda, 2011; Marshak and Link, 2021). Hence, Hyogo Prefecture set the lower bounds of T-N (0.2 mg/L) and T-P (0.02 mg/L) to maintain the sea's productivity (Hyogo Prefecture, 2019). To the best of our knowledge, this is the first attempt in Japan, and in the world, to increase nutrients through nutrient management, as opposed to the standard practice of using nutrient management to reduce nutrients (Sherwood et al., 2016).

Data collection

Two online questionnaires were administered to the SES residents. One for the residents in Kobe-Hanshin and Harima in November 2021 and the other in Kagawa in January 2022. The respondents were selected through a survey company where potential respondents registered (Cross Marketing Inc.), and sex ratios and age distributions were considered. Shopping points were given as tokens of participation. All the data are available in the Supplementary Material (SM).

While all the respondents of Kagawa (N = 1000) lived in the Kagawa Prefecture (Figure 1), the respondents of Kobe-Hanshin and Harima did not live in the corresponding areas, thereby demonstrating the difficulty of drawing an SES system boundary. Considering the relative population size, we obtained 1300 respondents living in Kobe-Hanshin and 700 respondents in Harima (Figure 1). However, 122 out of 1300 respondents living in Kobe-Hanshin answered that the Harima Sea was closer than Osaka Bay. This was true of respondents residing in Harima as well. As the connection to the sea is more important than the administrative and geographical area shown in Figure 1, we included 1136 respondents in Kobe-Hanshin and 864 respondents in Harima based on the sea closer to them. Before the surveys, pretests were conducted with 100 respondents who were not included in the main surveys. Informed consent was obtained from all the respondents.

Questionnaires

The two questionnaires had the same basic structure (see S1 in SM for the full set of questions for both surveys). They included socio-demographic information (e.g., gender and age), relationship with the sea (e.g., years lived in the area, frequency of visiting the sea, frequency of eating local seafood), opinions about environmental issues, the value statements of instrumental, relational, and intrinsic values of the sea, and pro-SES behaviors. We prepared two sets of questionnaires (one for Kobe-Hanshin and Harima, the other for Kagawa) because questions regarding pro-SES behaviors for Kagawa needed to be different from the ones for Kobe-Hanshin and Harima. To maintain data quality, we included a trap question (Liu and Wronski, 2018). Respondents who failed to answer the trap question correctly were excluded. The nine items for opinions about environmental issues were adopted from a survey conducted by the Ministry of Environment Japan (2016).

Value statements

Table 2 shows the value statements of instrumental, relational, and intrinsic values. The order of value statements was randomized to avoid bias. Respondents chose the extent to which each statement applied to them using a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree).

The value statements for instrumental values can be derived from ecosystem services (Klain et al., 2017; See et al., 2020). In our study, the instrumental value statements were obtained from a survey by Uehara et al. (2021) who studied marine ecosystem services in the Harima Sea, which is part of the current study. They identified 19 marine ecosystem services based on the generic marine ecosystem services developed by Hattam et al. (2015) and Böhnke-Henrichs et al. (2013) and analyzed their relative importance. To make the value statement items concise, we chose the four most important ecosystem services (Uehara et al., 2021). To date, there seems to be no established quantitative scale of relational values agreed upon among scholars (Kleespies and Dierkes, 2020a; Riechers et al., 2021a). Hence, we adopted the value statements developed by Uehara et al. (2020) for an area that surrounded the Seto Inland Sea but was outside the current study areas, whose items were drawn from Chan et al. (2016). As relational values are highly context-dependent (Himes and Muraca, 2018; West et al., 2020), it was desirable to adapt a scale tested in a similar context. The intrinsic value statements were drawn from See et al. (2020) and Riechers et al. (2021a). An unbalanced, small number of items for intrinsic values is not desirable (See et al., 2020). However, we chose previously tested items from similar studies rather than proposing untested items, because the development of new items to capture the intrinsic value concept was not the purpose of this study.

Pro-SES behavior

To the best of our knowledge, there is neither a standard nor widely utilized scale for pro-SES behavior or a guideline for its development. We developed the guidelines drawn on Markle (2013) who developed the Pro-Environmental Behavior Scale (PEBS). Although the PEBS is not a scale for pro-SES behavior because their purposes are not the same, the development of scales for pro-SES behavior can share this basic notion, as they overlap.

We propose five criteria to develop a scale for pro-SES behavior: empirically derived, comprehensive, concise, relevant to policy targets, and theoretically or conceptually founded. Since these criteria are related, we need to consider their suitability. For example, empirical data may not necessarily be consistent with a theoretical or conceptual base. A set of desirable behaviors

TABLE 2 Value statements of instrumental, relational, and intrinsic values.

Value class	Statement
Instrumental	The marine ecosystem of the sea is important to me because it provides me with food such as fish and shellfish
	The marine ecosystem of the sea is important to me as a means for preventing and mitigating disasters, such as floods, tsunamis, and typhoons
	The marine ecosystem of the sea is important to me because it purifies the seawater
	The marine ecosystem of the sea is important to me because it maintains the food chain of plants and animals
Relational	The sea is an important location for me
	The sea is an important location for local residents
	I am able to connect with others through my relationship to the sea
	Caring for the sea leads to caring for the people of the present and future
	We have a moral responsibility to protect the sea and its creatures
	Protecting the sea fills me with a sense of contentment and enables me to lead a good life
	Keeping the sea healthy is the right thing to do
Intrinsic	All creatures in the sea have the right to live
	The sea should be protected for the sake of nature itself

contributing to policy targets may not necessarily make sense statistically. The scale needs to be comprehensive yet concise. Comprehensiveness means that items sufficiently cover policy targets and their theoretical or conceptual base. Items should cover behaviors with significant impacts (Stern, 2000; Markle, 2013; Lange and Dewitte, 2019). Therefore, it is possible to retain items that do not contribute to the internal consistency of a scale based on Cronbach's alpha. Markle (2013) asserted that previous studies on pro-environmental behavior scales used behaviors whose contributions to environmental problems are dubious. In this study, the purpose of developing pro-SES behavior measures is to identify items to capture behaviors that contribute to the management of specific SESs; hence, policy relevancy is particularly important.

We developed two scales for three study areas: one for Kobe-Hanshin and Harima and the other for Kagawa (Table 3). We used the same scale for Kobe-Hanshin and Harima, as Hyogo Prefecture manages both. As shown in Table 3, the main difference between pro-environmental behavior and pro-SES behavior is that the latter explicitly includes items about sustainable use (such as the consumption of seafood and use of beaches) and active human interaction with nature. Such economic activities can be increasingly seen as part of sustainability solutions (Blewitt, 2018). Furthermore, Hyogo Prefecture intends to maximize the benefits derived from seas for human well-being, while conserving their biological diversity and productivity (Hyogo Prefecture, 2015). In developing these scales, we used policy documents (e.g., ordinances and plans) and the *satoumi* concept (Duraiappah et al., 2012; Yanagi, 2012; Uehara et al., 2016; Uehara and Mineo, 2017) and consulted the public officials involved in the coastal zone management of both prefectures to confirm the appropriateness and comprehensiveness of the scales.

Hyogo Prefecture stipulates what citizens should do by ordinance, stating, "Responsibilities of the citizens of the prefecture. The citizens of the prefecture must deepen their understanding of the basic principles and strive to revitalize the richness and beautifulness of the Seto Inland Sea through their own lives and community activities" (Hyogo Prefecture, 2015). The basic principles are related to *satoumi*, a desirable state of SES. There are three types of scale items: 1) basic principles, 2) lifestyles, and 3) community activities. These are in line with the following three of the four types of environmentally significant behavior acknowledged by Stern (2000): "Nonactivist public-sphere behaviors," "Private-sphere behaviors," and "Activism." For comprehensiveness, the items cover the four key measures to recover the Seto Inland Sea (Hyogo Prefecture), as stipulated by the ordinance (Hyogo Prefecture, 2015).

We adopted the same three categories for Kagawa to make their scales comparable. However, while Hyogo Prefecture focuses on the sea, Kagawa Prefecture includes mountains, rivers, and towns as part of the SES management, as they are a unified system (Kagawa Prefecture, 2013). In selecting question items, we reflected on their different approaches to the realization of *satoumi* and maintained the policy relevancy of the selected items for each SES. We considered the items regarding expected behaviors for *satoumi* creation, used in the public opinion poll by Kagawa Prefecture, as a base (Kagawa Prefecture, 2021b). We made several changes to the items based on the following four criteria. First, we added the basic principles. Citizens need to share the basic principles and support the desirable state of SES (Kagawa Prefecture, 2016). Second, we considered the interaction of people with the ocean and seaside as it expresses a key desirable state of the relationship between the Seto Inland Sea (Kagawa) and the citizens, which is missing from the items in Kagawa Prefecture's public opinion poll (Kagawa Prefecture, 2013; Kagawa Prefecture, 2016). Third, we added an item for the consumption of local seafood (Kagawa Prefecture, 2021a). Lastly, as the public opinion poll includes 22 items, we made them concise by excluding and merging some of the items.

Data analysis

Following See et al. (2020), we employed three methods—Cronbach's alpha, exploratory factor analysis, and correlation analysis—to assess how relational values differ from other value classes for the SES (RQs 1 and 5). Alpha examines the internal consistency of a scale, and exploratory factor analysis investigates its latent traits and dimensionality; alpha and exploratory factor analysis demonstrate the reliability of a scale to measure a concept or construct (Tavakol and Dennick, 2011). For dimensionality, based on the most commonly used criteria, we adopted an eigenvalue > 1 (Henson and Roberts, 2006). We applied them to the whole set of value classes (instrumental, relational, and intrinsic) as well as to each value class, as a separate concept. As the inclusion of a large number of items inflates the value of alpha and alpha is intended to test the reliability of a concept, it should be calculated for each concept (Tavakol and Dennick, 2011; Field et al., 2012). However, we computed alpha for the whole set of the three value classes to explore the importance of the relational value class from a practical perspective; this was in relation to the other two value classes and the whole set of values. There could be a concept that covers these value classes as a single construct [e.g., Nature's Contributions to People (Pascual et al., 2017)]. Therefore, the exploratory factor analysis was conducted to the whole set as well as the three value classes. Prior studies have used the exploratory factor analysis has been used to investigate if relational values relate to different latent traits than ones for instrumental and intrinsic values (See et al., 2020; Riechers et al., 2021a). The correlation coefficients among the three value classes demonstrated how respondents' valuation of each class related (or differed) (See et al., 2020). The confidence intervals of the correlation coefficient were estimated using bootstrap sampling and estimation methods along with their point estimates.

We applied the beta regression to investigate factors addressing relational values (RQs 2 and 5) by following Riechers et al. (2021a). The beta regression can address issues concerning skewness and heteroskedasticity (Smithson and Verkuilen, 2006). Since it uses a

TABLE 3 Pro-SES behavior scales for the three SESs.

Kobe-Hanshin and Harima			Kagawa			
Category	Item	Relevancy to policy targets	Category	Item	Relevancy to policy targets	
		Four key measures to recover the SIS ((a)-(d)) (Hyogo Prefecture)			Place	Five important issues of the Seto Inland Sea (1-5) (Kagawa Prefecture)
1) The basic principle	Satoumi_1: Osaka Bay (Harima Sea) should be an "abundant sea (*satoumi*)" with an appropriate balance between water quality (transparency) and fishing		1) The basic principle	Satoumi_k_1: Both the sea and land of the SIS (Kagawa Prefecture) should be considered as one whole integrated area. Through appropriate human involvement, we should aim to maintain a healthy sea inhabited by diverse organisms and realize an "abundant sea" that offers not only fishery resources but also many other benefits, such as scenery, recreational areas, food culture, and tourism	General	
2) Lifestyles	Satoumi_2: I try to participate in events related to the sea in the coastal areas of Osaka Bay (Harima Sea) and visit aquariums and swimming beaches		2) Lifestyles	Satoumi_k_2: I try to participate in environmental education activities	General	
	Satoumi_3: When I buy seafood, I try to choose seafood from Osaka Bay (Harima Sea)	d) Ensuring sustainable use of fishery resources		Satoumi_k_3: I try to take time to enjoy the mountains and the trees	Mountains	
	Satoumi_4: I try to dispose plastic waste properly (e.g., follow the designated separation method, and avoid littering)	c) Conservation of natural and cultural landscapes		Satoumi_k_4: I try to use chopsticks and other items made from timber removed in forest thinning	Mountains	
3) Community activities	Satoumi_5: I contribute to the conservation of seaweed beds and tidal flats (either as an individual or as a group)	a) Conservation, restoration, and creation of the coastal environment, b) conservation and management of water quality, d) ensuring sustainable use of fishery resources		Satoumi_k_5: When I buy seafood, I try to choose seafood from the SIS (Kagawa Prefecture)	Sea	
	Satoumi_6: I contribute to beach debris cleanup efforts (either as an individual or as a group)	c) Conservation of natural and cultural landscapes		Satoumi_k_6: I try to ensure that I have opportunities for interaction and leisure at the ocean and seaside	Sea	5. Diluting the relationship between people and the sea
				Satoumi_k_7: I grow flowers, trees, and other greenery in my home and community	Town	
				Satoumi_k_8: I conserve water by using the correct amounts of detergent and soap, saving water, and not pouring oil or solids down the drain	Town	1. No tendency to improve organic contamination, 2. Imbalance of nutrient circulation

(Continued)

TABLE 3 Continued

Kobe-Hanshin and Harima		Kagawa		
		Satoumi_k_9: I make efforts to dispose waste properly, such as avoiding littering and implementing the 3Rs (reduce, reuse, recycle)	Town	4. Marine debris problem that needs to be dealt with urgently
	3) Community activities	Satoumi_k_10: I contribute to research and conservation activities pertaining to the flora and fauna that live in the mountains, as well as tree planting and thinning	Mountains	2. Imbalance of nutrient circulation
		Satoumi_k_11: I contribute to cleanup efforts in the mountains	Mountains	
		Satoumi_k_12: I try to participate in cleanup activities of rivers and waterways	River	
		Satoumi_k_13: I try to participate in river water quality surveys	River	
		Satoumi_k_14: I try to participate in research and conservation activities for creatures that live in the river	River	
		Satoumi_k_15: I try to participate in research and conservation activities for creatures that live in the SIS (Kagawa Prefecture)	Sea	
		Satoumi_k_16: I contribute to the cleanup of foreign debris in the SIS (Kagawa Prefecture) (either as an individual or as a group)	Sea	4. Marine debris problem that needs to be dealt with urgently
		Satoumi_k_17: I contribute to the conservation of seaweed beds and tidal flats in the SIS (Kagawa Prefecture) (either as an individual or as a group)	Sea	3. Increasing but still few seagrass beds
		Satoumi_k_18: I try to participate in water quality surveys about the SIS (Kagawa Prefecture)	Sea	

dependent variable with an open unit interval (0, 1), we carried out a linear transformation of scales for relational values by following the formula proposed by Smithson and Verkuilen (2006). Each score y is transformed by y'= [((y – a)/(b – a))*(N – 1) + 1/2]/N in which a and b are the smallest and highest possible scores with a sample size N: a = 1, and b = 5 in our study. The models cover the three categories set by Riechers et al. (2021a) who explored the variables explaining relational values in Germany and Romania: personal characteristics of the respondent (gender and education), nature-based variables (years to having lived in the current place, distance to the sea, conservation volunteer experience, local fish-eating habit, and environmental attitudes), and landscape types (SES). The model was evaluated as per the Bayesian information criterion (BIC), as suggested by Smithson and Verkuilen (2006).

In exploring the characteristics of the pro-SES behavior items (RQs 3 and 5), we computed Cronbach's alpha by type and SES to see if some items could be used as a construct representing multiple items. As discussed before, we did not drop the items that did not contribute to internal consistency; a low contribution to the alpha of an item does not imply low policy importance in this context. These items were treated as individual items instead of being integrated into a composite scale.

To investigate the association between relational values and pro-SES behavior in comparison with other value categories (RQs 4 and 5), we ran the beta regression for the reason mentioned above. The dependent variables were pro-SES items, derived in the previous section. The explanatory variables were relational, instrumental, intrinsic, instrumental + intrinsic, and pooled (which included all three value categories). We did not add other variables to focus on how each value category explained the pro-SES items. The models were compared according to the BIC for model selection (Smithson and Verkuilen, 2006). A model that minimizes the BIC is considered the best model (Smithson and Verkuilen, 2006).

For data analysis, we used STATA 17.0 (https://www.stata.com). All the data required to replicate this paper's results are available as Supplementary Materials.

Results and discussion

This section addresses RQs 1 to 4. The results and discussion for each RQ are followed by its comparison by SES (i.e., RQ5).

Characteristics of respondents by SES

Table 4 shows the characteristics of the respondents (see S1 for the full set of questions). The gender ratios and distributions were similar to those of the represented populations. Respondents in Kagawa believed that they were closest to the sea, either in a subjective (their personal belief) or objective (how long it actually takes to reach the sea) sense, followed by Harima and Kobe-Hanshin. The recognition of the water quality partially matched the water quality data in Table 1; the current water quality of the seas in Kagawa is superior to that of Kobe-Hanshin, which corresponds with the respondents' answers. However, there was a stark difference in the knowledge of *satoumi* between the SES in Hyogo Prefecture (10.4% for Kobe-Hanshin and 10.8% for Harima) and Kagawa Prefecture (21.0%). Interaction with the sea in Kagawa was frequently expressed through eating local fish and opportunities to go to the sea for leisure or participate in conservation activities. Interestingly, contrary to the differences regarding instrumental, relational, and intrinsic values among the SESs, environmental attitude does not show significant differences. As the environmental attitude items were not specific to each SES but rather to general environmental issues, the results indicate that respondents' opinions about environmental issues, in general, did not differ by the SES.

Difference between relational values and other value classes (RQ1)

Table 5 illustrates the difference between relational values and other value classes measured by Cronbach's alpha, mean, and standard deviation for each value class and the SES. All scales indicated the reliability of the items (the lowest alpha was 0.804). The means of the instrumental, relational, and intrinsic values were highest in Kagawa, followed by Harima and Kobe-Hanshin (see Table 5).

TABLE 4 Characteristics of the respondents by SES.

		Kobe-Hanshin	Harima	Population* (Kobe-Hanshin & Harima)	Kagawa	Population* (Kagawa)
N		1,136	864	4,490,953	1,000	789,372
Gender	Male	48.9%	46.5%	47.5%	47.0%	47.4%
	Female	51.1%	53.5%	52.5%	53.0%	52.6%
Age	20s	10.8%	11.5%	11.0%	10.0%	10.1%
	30s	13.6%	16.0%	14.0%	14.0%	14.0%
	40s	19.4%	17.9%	18.0%	17.6%	16.4%
	50s	15.8%	14.9%	15.0%	15.8%	14.6%
	60s and above	40.4%	39.7%	41.0%	42.6%	44.9%
Distance from the sea	Close	44.8%	55.3%		70.6%	
Distance from the sea	Mean (min)	35.7	28.8		19.9	
	SD(min)	30.7	24.3		15.7	
Recognition of the sea water quality	Clean (1. Strongly disagree, … 5. Strongly agree)	2.61	3.08		3.19	
Knowledge of *satoumi*	Yes	10.4%	10.8%		21.0%	
Eat local fish	1. less than once a month, … 5. More than three times a week	2.32	2.59		3.00	
	% of don't know	83.2%	60.3%		33.8%	
Opportunity to go to the sea on leisure	1. no opportunity, …, 5. once a week	1.36	1.46		1.63	
Participation in conservation activities	1. Never 2. Have participated 3. Participate periodically	1.05	1.05		1.17	
Environmental attitude**	Composite scale comprising nine statements (1. Strongly disagree, … 5. Strongly agree)	3.92	3.90		3.96	

*Population data were obtained from the Statistics Bureau of Japan.
**Cronbach's alpha is 0.938 (Kobe-Hanshin), 0.948 (Harima), and 0.931 (Kagawa).

The exploratory factor analysis, which was conducted for the pooled items to explore the dimensionality and latent traits, showed mixed results (see S2 in SM for detail). While there seems to be a single factor (unidimensional) for Harima and Kagawa, there were two factors for Kobe-Hanshin.

Figure 2 demonstrates the correlations between the value classes by SES. Overall, they were positively correlated (from 0.604 for Instrumental vs. Intrinsic in Kobe-Hanshin to 0.868 for Instrumental vs. Relational in Kagawa). All three SESs showed the same patterns: the instrumental and relational values were the most strongly correlated, while the instrumental and intrinsic values were the least correlated. In comparing the SESs, all combinations in Kagawa were most correlated. Specifically, the lower bounds of confidence intervals of the three correlations for Kagawa did not overlap the upper bounds of the confidence intervals of the three correlations for Kobe-Hanshin. Two of the lower bounds for Harima did not overlap with the ones for Kobe-Hanshin; however, the confidence

TABLE 5 Cronbach's alpha, mean, and SD by value class and SES.

		Kobe-Hanshin	Harima	Kagawa
Pooled (13 items)	Alpha	0.942	0.956	0.951
	Mean	3.69	3.78	3.99
	SD	0.624	0.662	0.612
Instrumental values (4 items)	Alpha	0.903	0.914	0.867
	Mean	3.69	3.81	3.95
	SD	0.698	0.712	0.649
Relational values (7 items)	Alpha	0.902	0.922	0.912
	Mean	3.62	3.70	3.98
	SD	0.660	0.690	0.629
Intrinsic values (2 items)	Alpha	0.866	0.879	0.804
	Mean	3.96	3.96	4.14
	SD	0.737	0.742	0.686

SD, Standard Deviation.

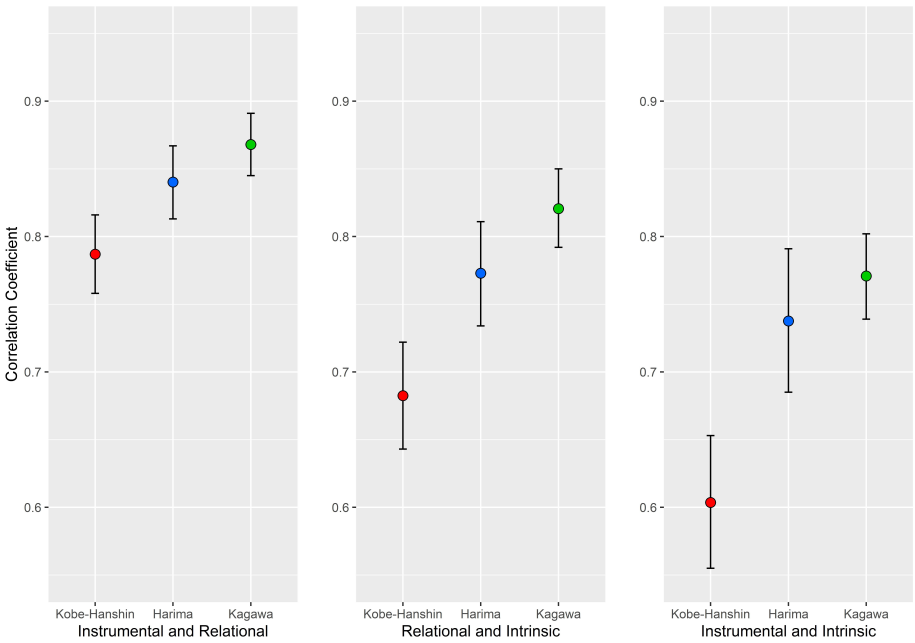

FIGURE 2
Correlation coefficients by value class and SES.

intervals of the coefficient between instrumental and relational values slightly overlap (0.816 vs. 0.813) (see S3 in SM for the values).

Two points are worth discussing to answer RQ1 (how relational values are different from other value classes). First, Cronbach's alpha (Table 5) and the exploratory factor analysis showed mixed results regarding whether the three value classes can be treated as distinguishable classes and then be compared. This means that, overall, the three value classes may not be distinguishable according to these two analyses. Previous studies reported mixed results as well, indicating the need for further study. Using the exploratory factor analysis, See et al. (2020) found only one factor, that is, one common factor can explain all three value classes. However, Riechers et al. (2021a) found that relational values and instrumental values were explained by different factors. See et al. (2020) argued that relational and instrumental values essentially measure similar things; they are nearly indistinguishable for the respondents in the survey. One possible explanation was that the participants could not clearly distinguish the values because of the wording of the items. Our results demonstrated that relational values and intrinsic values were nearly indistinguishable, except for Kobe-Hanshin whose distinction was not as clear as that by Riechers et al. (2021a). There may be two explanations for these findings. First, it is context-dependent (Uehara and Mineo, 2017; Preiser et al., 2018). As a complex adaptive system, an SES varies with place and time (Preiser et al., 2018); for example, human-nature relationships vary with place and time. Accordingly, what and how things are valued may differ according to the context. Second, although it is "exploratory," there are steps in the analysis where researchers make a series of choices that influence the finding, characterizing the indeterminacy of the analysis (e.g., choosing hypotheses and questionnaire items) (Henson and Roberts, 2006). While the main difference is ascribed to the context, it may be due to the framing of the value statements. Statements for instrumental values used by Riechers et al. (2021a) connoted nature's sacrifice (e.g., We humans have the right to use nature as we like), in contrast to the statements used by See et al. (2020) (e.g., "This green space can mitigate climate change"). Although trade-offs can happen due to the instrumental use of the environment, it may not be a key component of instrumental values in the discussion regarding the distinction between relational and instrumental values (Chan et al., 2018; Himes and Muraca, 2018).

Second, all three value classes were correlated but not perfectly, indicating that relational values were different from other value classes though they overlapped to some degree. Furthermore, relational values were more similar to instrumental values than to intrinsic values. These findings are in line with See et al. (2020); however, all correlation coefficients except for the correlation between instrumental and intrinsic for Kobe-Hanshin, were mostly higher than their study (0.75 between relational and instrumental, 0.66 between instrumental and intrinsic, and 0.55 between relational and intrinsic). The order of correlation (i.e., how much value classes overlap) was different from See et al. (2020). Our study found the strongest differentiation between instrumental and intrinsic values, while their study found the strongest differentiation between relational and intrinsic values. Our findings are in line with the recent theoretical arguments. Instrumental, relational, and intrinsic values overlap to some degree (Chan et al., 2018; Himes and Muraca, 2018). For example, while instrumental and relational values refer to human-nature relationships, intrinsic values do not, and relational and intrinsic values are not substitutable, as opposed to instrumental values (Himes and Muraca, 2018; Hoelle et al., 2022). Chan et al. (2018) argued that instrumental and intrinsic values are conceptually less overlapping, while referring to assigned values (mostly related to instrumental values) and moral values (mostly related to intrinsic values). These theoretical discussions by Himes and Muraca (2018) and Chan et al. (2018) (i.e., human-nature relationships vs. substitutability or assigned values vs. moral values) could explain our empirical findings, but our study lacks enough data to verify this point.

Comparison of differences between relational and other value classes by SES (RQ5)

Although the degrees of correlations among the three value classes differ by the SES, the order of their combinations (e.g., relational and instrumental values vs. relational and intrinsic values) was the same across the SESs (Figure 2); thus, the overlap of relational and intrinsic values was lower than the overlap of relational and instrumental values. At a respondent level, stronger correlations could indicate that the more a respondent values one type of value class (e.g., relational values), the more they value another value class (e.g., instrumental values). Since the overlap of relational values with the other two value classes was the highest for Kagawa, respondents in Kagawa were more appreciative of plural values those in the other two SESs. However, we do not have enough data to explore why the respondents in Kagawa appreciate plural values more than the respondents in the other two SESs. Furthermore, we are not aware of empirical studies conducting similar comparative research, which could provide insights to deepen the discussion of this study's results, including the reason for the difference. Although there are studies claiming that relational values and SESs differ by context (Himes and Muraca, 2018; Preiser et al., 2018; West et al., 2020), studies on why they differ, which can help interpret empirical results, are lacking. The understanding of how people appreciate plural values under the potential trade-offs between ecosystem

services may be associated with different values (Martín-López et al., 2014); why they differ by the SES is critical for SES management, and further studies are awaited in this field.

Comparison of factors explaining relational values by SES (RQ2 and RQ5)

The factors associated with relational values differ in all the SESs (Table 6), wherein the estimates of the beta regression explain relational values by the SES. The frequency of leisure on the beach and environmental attitude were statistically significant for all the three SESs. Gender was statistically significant, except for Harima, where males appreciated relational values more than the males in Kobe-Hanshin and Kagawa. Eating local fish was statistically significant, except for Harima. Water quality perception was statistically significant, except for Kagawa.

Mixed results about gender (i.e., the difference was found in Kobe-Hanshin and Kagawa) were in line with previous studies. Kleespies and Dierkes (2020b) found that females appreciated relational values more as they had a stronger environmental attitude than males. However, studies by Riechers et al. (2021a) in Germany and Romania and Duong and Van den Born (2019) in Vietnam did not show any significant gender-based differences. Education level (the final degree earned) was not associated with relational values in this study. However, since this study considered the general educational level, the finding does not disprove the effectiveness of environmental education to nurture relational values (dos Santos and Gould, 2018; Ives et al., 2018; Uehara et al., 2020). "Years to live" and "Distance" were not associated with relational values, indicating that living close to the sea for much longer did not automatically nurture relational values. The finding regarding "Distance" was in line with Riechers et al. (2021a). It was a surprise that a degree of participation in volunteer activities related to the conservation of the sea ("Volunteer") was not associated with relational values. One of the reasons could be that there were only a small number of people who volunteered regularly (0.4% in Hanshin-Kobe and Harima, and 1.4% in Kagawa). In line with the frequent use of natural goods by Riechers et al. (2021a), visiting frequency ("Leisure") and eating local fish were positively associated with relational values in some SESs. This is reasonable as visiting the place and eating local fish could improve human–nature relationships with a particular sea that is not substitutable with other seas (Himes and Muraca, 2018). In addition, it could be a medium to reconnect people with nature (Ives et al., 2018). Water quality perception was positively associated with relational values, except for Kagawa. Interestingly, this did not correspond with the measurements of water quality. Riechers et al. (2021b) argued that landscape simplification could negatively influence relational values. In our study, this was the case for Kobe-Hanshin and Harima, but not for Kagawa. This indicates that it is important to investigate the role of perceptions in forming relational values in addition to the state of SES. This needs further investigation to reveal how the state of SES is associated with relational values. The environmental attitude was positively related to relational values, which was in line with Riechers et al. (2021a). The attitude toward the environment constitutes relational values; for example, "Moral responsibility to non-humans" and "Stewardship principle/virtue" are two of the seven aspects of relational values (Chan et al., 2016, Figure 1).

TABLE 6 Estimates of beta regression to explain relational values by SES.

	Kobe-Hanshin		Harima		Kagawa	
	Coef.	**SE**	**Coef.**	**SE**	**Coef.**	**SE**
Gender	-0.138***	0.049	-0.089	0.056	-0.102*	0.051
Education	-0.007	0.023	-0.025	0.024	-0.020	0.023
Years lived	0.001	0.001	0.001	0.001	0.000	0.001
Distance	-0.004	0.049	-0.046	0.057	-0.083	0.056
Volunteer	0.068	0.100	0.058	0.119	-0.007	0.066
Leisure	0.064*	0.035	0.095***	0.035	0.101***	0.030
Local fish	0.101***	0.024	0.024	0.019	0.047***	0.016
Water quality perception	0.057**	0.025	0.062**	0.028	0.034	0.025
Environmental Attitude	0.993***	0.039	1.214***	0.043	1.240***	0.044
Constant	-3.287***	0.226	-4.018***	0.240	-3.689***	0.224
N	1,003	733	970			
BIC	-1031	-1006	-1612			

SE, Standard Error.
*p < 0.10, **p < 0.05, ***p < 0.01.

Characteristics of pro-SES behavior scales (RQ3)

Table 7 shows the characteristics of pro-SES items by SES, while the development of pro-SES behavior items, in Table 3, conceptually characterizes pro-SES behavior items based on the *satoumi* concept, policy documents, and consultation with policymakers. All the items, except for Satoumi_4 ("I try to dispose of plastic waste properly"), were integrated into a composite scale by category, based on the acceptable lower bound of Alpha (0.70) (Tavakol and Dennick, 2011). This means that overall, the items developed in this study measure their belonging categories (i.e., principle, lifestyle, and community activity). As discussed in the Materials and Methods section, we did not exclude Satoumi_4 for its low contribution to alpha. The purpose of calculating alpha was to reduce items by category to answer RQ4 (How are relational values related to pro-SES behavior)? and RQ5 (how answers to the RQs differ by SES) in a manageable manner (i.e., the relationship between pro-SES behavior and relational values). Satoumi_4 is an important pro-SES behavior for Kobe-Hanshin and Harima. In summary, while pro-SES behaviors for Kagawa can be characterized by three categories (i.e., principle, lifestyle, and community activity), those for Kobe-Hanshin and Harima can be characterized by four categories (i.e., principle, lifestyle, Satoumi_4, and community activity).

Comparison of characteristics of pro-SES behavior scales by SES (RQ5)

The mean values in Table 7 indicate how much the respondents in each SES support each category of pro-SES behavior. Overall, the basic principles were well supported (3.73 (Satoumi_k_1) to 3.96 (Satoumi_1) for Kobe-Hanshin); however, the involvement in community activities was limited in all the SESs (2.47 for Kagawa to 2.67 for Harima). Satoumi_4 for Kobe-Hanshin and Harima were exceptionally high (4.21 for Kobe-Hanshin and 4.16 for Harima). There may be two reasons for it. First, Satoumi_4 is not a sea-specific issue, but a general concern about environmental issues. The environmental attitude was strong, irrespective of the SES (from 3.90 for Kobe-Hanshin to 3.96 for Kagawa in Table 4). Second, the proper disposal of plastic waste has been a critical policy target in Japan and various policy measures have been implemented to change people's behavior at multiple levels (Ministry of the Environment Japan, 2019b, Ministry of the Environment Japan, 2021). It should be noted that, as described in Table 3, since the items used for Kagawa were different from those for Kobe-Hanshin and Harima, we compared the same categories; however, they comprised different items to reflect their corresponding contexts.

Association of relational values with pro-SES behavior by SES (RQ4)

Table 8 shows how relational values related to pro-SES behavior, measured by the BIC of beta regression models of value classes, regressed on pro-SES behavior scales. A shaded BIC was the best fit model (i.e., the smallest BIC) for each pro-SES behavior scale. It showed that four out of eleven pro-SES behavior scales were best explained by relational values and four were best explained by pooled values, including relational values; however, three were best explained by a value or a pooled value that did not include relational values.

TABLE 7 Characteristics of pro-SES items by SES.

		Kobe-Hanshin			Harima		
Category	**Item**	**Mean**	**SD**	**Alpha**	**Mean**	**SD**	**Alpha**
Principle	Satoumi_1	3.96	0.754	–	3.98	0.756	–
Lifestyle	Satoumi_2 and _3	2.82	0.932	0.812	3.07	0.894	0.755
	Satoumi_4	4.21	0.819	–	4.16	0.866	–
Community activity	Satoumi_5 and _6	2.52	1.050	0.955	2.67	1.036	0.950
	N	1,136			864		
		Kagawa					
Category	**Item**	**Mean**	**SD**	**Alpha**			
Principle	Satoumi_k_1	3.73	0.912	–			
Lifestyle	Satoumi_k_2 to Satoumi_k_9	3.17	0.730	0.858			
Community activity	Satoumi_k_10 to Satoumi_k_18	2.47	0.943	0.969			
	N	1,000					

TABLE 8 BIC for beta regression models by SES.

	Kobe-Hanshin (N = 1136)			
	Principle	**Lifestyle**		**Community activity**
	Satoumi_1	Satoumi_2 and _3	Satoumi_4	Satoumi_5 and_6
Relational	-2043.0	-364.3	-3694.2	-1033.4
Instrumental	-1919.5	-310.9	-3673.5	-991.5
Intrinsic	-2111.6	-102.9	-3796.6	-920.9
Instrumental + intrinsic	-2107.8	-244.3	-3755.0	-965.7
Pooled	-2138.8	-327.7	-3739.3	-1007.4
	Harima (N = 864)			
	Principle	**Lifestyle**		**Community activity**
	Satoumi_1	Satoumi_2 and _3	Satoumi_4	Satoumi_5 and_6
Relational	-1782.3	-361.1	-2611.9	-510.3
Instrumental	-1785.8	-260.0	-2658.2	-468.3
Intrinsic	-1739.9	-113.2	-2725.9	-424.1
Instrumental + intrinsic	-1876.9	-232.3	-2737.1	-455.9
Pooled	-1888.3	-321.2	-2688.3	-488.3
	Kagawa (N = 1000)			
	Principle	**Lifestyle**		**Community activity**
	Satoumi_k_1	Satoumi_k_2-9		Satoumi_k_10-18
Relational	-1286.3	-520.2		-396.2
Instrumental	-1201.1	-508.8		-402.4
Intrinsic	-1234.2	-410.0		-374.5
Instrumental + intrinsic	-1251.8	-498.5		-386.9
Pooled	-1292.0	-524.4		-392.7

All values are statistically significant at a 1% level (see S4 in Supplementary Material for the model details). A shaded BIC was the best fit model (i.e., the smallest BIC) for each pro-SES behavior scale.

Comparison of association of relational values with pro-SES behavior by SES (RQ5)

Comparing the three SESs, overall relational values were related to pro-SES behavior because eight out of eleven pro-SES behavior scales were best explained by relational values or pooled values, including relational values. Lifestyle (Satoumi_4) was not best associated with relational values or pooled values, including relational values in Kobe-Hanshin and Harima; pro-SES community activity behavior was not best associated with relational values or pooled values, including relational values.

These empirical findings support the importance of relational values as a single scale and as an addition to instrumental and intrinsic values in capturing the plural values toward the sea, particularly in their relation to pro-SES behaviors. As discussions on plural values assert (Jones et al., 2016), a failure to integrate relational values into management decisions may lead to shaping SESs that are not aligned with people's values because people may not cooperate with a management whose target is not aligned with their values. Furthermore, the resulting SES may ignore people who hold relational values and negatively impact some of them because of the trade-offs between ecosystem services (Martín-López et al., 2014; Cord et al., 2017; Himes and Muraca, 2018; Ellis et al., 2019).

A possible explanation for why a model including relational values is the best fit model overall, though our study did not have sufficient data to validate this point, is that relational values can be place-based values (Himes and Muraca, 2018). Therefore, in practice, relational values can contribute uniquely and meaningfully to understanding pro-SES behavior, thereby eliciting management implications. Understandably, a pooled scale best explained the basic principles of *satoumi*, irrespective of the SES, because the desirable state of SES realizes plural values. Satoumi_4 was best explained by scales including intrinsic values because it is about respect for the sea.

Given the overall importance of relational values for models explaining pro-SES behavior, including understanding the basic

principle of the desired state of SES, lifestyles, and community activities, relational values have the potential of being deep leverage points toward the realization of desirable SESs through people's understanding and involvement in SES management. Although it may not be easy to cultivate relational values, it is possible, for example, through environmental education (dos Santos and Gould, 2018; Uehara et al., 2019a; Uehara et al., 2020). Furthermore, there is room to improve relational values as their mean values are 3.62, 3.70, and 3.98 out of 5 (Table 5). Cultivating relational values may take time; however, it could have a significant impact on SES management through people's understanding and involvement.

Conclusion

This study aimed to investigate empirically how relational values could contribute to the promotion of people's support for and involvement in SES management. This study was conducted in three SESs in Japan in which a realization of *satoumi*, a desired state of SES in which human interaction with nature enhances diverse benefits from nature (e.g., ecosystem services) was being targeted as part of management strategy while conserving nature. They abided by the Act on Special Measures concerning Conservation of the Environment of the Seto Inland Sea. This empirical study corroborates previous theoretical and conceptual arguments that relational values are important, from a practical perspective, as a single value class and as part of plural values integrated into management decisions to gain people's support for SES management, which answered RQ1 (How are relational values different from other value classes)?. Furthermore, this study demonstrates that relational values or pooled values, including relational values, best address pro-SES behaviors, indicating that the cultivation of relational values could promote pro-SES behaviors to realize a desirable state of SES, which answered RQ4 (How are relational values related to pro-SES behavior)?. The results are similar across SESs, which answered RQ5 (similarities and differences by SES). Therefore, our study provides justifications for incorporating relational values in SES management that aims to realize an SES reflecting plural values.

In addition to the main contributions of this study about the importance of relational values in their connection to pro-SES behavior that indicates the people's support for and potential for involvement in SES management, there are two findings related to RQs 1, 2, and 3 and their similarities and differences by SES (RQ5). First, in answering RQ2 (What factors explain relational values)?, this study revealed the factors explaining relational values. Beta regression models for relational values provided some clues about cultivating relational values. For example, increasing the frequency of leisure on the beach could be a good candidate. It could tighten human–nature connectedness and enhance relational values (Riechers et al., 2021b). Although the general education level was not statistically significant, environmental education is a promising factor to cultivate relational values as environmental attitude was statistically significant. These findings were robust across the three SESs compared in this study. Second, in answering RQ3 (What are the characteristics of pro-SES behavior scales)?, we developed pro-SES behavior scales and a development guideline. While pro-SES behaviors for Kagawa can be characterized by three categories (i.e., principle, lifestyle, and community activity), those for Kobe-Hanshin and Harima can be characterized by four categories (i.e., principle, lifestyle, Satoumi_4, and community activity). This shows the need for developing pro-SES behavior scales tailored to each SES.

There are three limitations to this study. First, this study applied a simple beta regression analysis using each value class or their composition as a single explanatory variable to explore their relationship with pro-SES behaviors. The relationship needs to be further investigated by employing theoretical models. Theoretical models advanced in pro-environmental behavior literature (e.g., value-belief-norm theory (VBN) and theory of planned behavior) may be a good starting point. Second, there is an absolute lack of research on pro-SES behavior measurements. Although studies on pro-environmental behavior and their measurement items are instructive, they are not necessarily aligned with pro-SES behavior. We produced the development guideline; however, it needs to be tested in other studies. This study did not intend to develop new measurement items that could be widely applied to other SESs. Given the context-dependency of SES, the development of generic pro-SES behavior items may not be meaningful in the first place. However, general guidelines to develop a context-specific scale for pro-SES behavior could be useful. Furthermore, studies on the characteristics (e.g., behavioral types and latent traits) must be advanced for the theoretical development and practical use of pro-SES behavior items. Third, although our findings of the relationship between relational values and pro-SES behavior indicate that relational values could be a deep leverage for transforming SES into a desirable state through pro-SES behavior, our study did not verify this point. However, it is critical to empirically investigate whether cultivating relational values transforms SES into a desirable state by promoting people's support for and potential for involvement in SES management through pro-SES behavior.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

TU: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, roles/writing - original draft, writing - review & editing. RS: Conceptualization, methodology, validation, writing - review & editing. TH: Conceptualization, funding acquisition, validation, writing - review & editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2022.1001180/full#supplementary-material

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