Chapter

Nature and Happiness Levels: New SWB Domains for Rivers, a Lake, and Forests

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Abstract

By using a questionnaire survey, we measured nature-related happiness levels, which include specific domains that differ from the overall subjective well-being (SWB) in a Japanese watershed. We regarded nature-related happiness levels, specifically related to rivers, a lake, or forests, as meaningful indices because many people living separated from nature may be unaware of their relationship with nature. We found that nature-related happiness levels had convergent validity and distinct correlation patterns with the explanatory variables, and these patterns were different from those of the overall SWB. These findings support the case of measuring nature-related happiness levels and overall SWB. Nature-related happiness levels were positively correlated with leisure activities and contact with living things. The abundance of rivers in a district is negatively associated with river-related happiness. We speculated that this was due to unidentified disservices associated with the rivers. Lake-related happiness has stronger correlations with relaxation benefits than symbolism, local food culture, art/culture, or water sources. Considering these findings, policymakers should formulate policies based on nature-related happiness levels. Because nature-related happiness levels are not correlated with income level, such policies may contribute to residents' well-being in an egalitarian manner.

Keywords: happiness levels, subjective well-being (SWB), quality of life (QoL), nature, domains, river, lake, forest, ecosystem service

1. Introduction

There have been various discussions on the relationship between subjective well-being (SWB) and quality of life (QoL) in different domains [1–8]. Should the SWB and QoL of each life domain be regarded as part of a whole or independent of it? In the former case, it is unclear whether the parts equally comprise the whole or have differing weights. Although this study is not intended to solve this debate, we

propose "nature-related domains" to analyze the awareness of the benefits people receive from nature.

While domains associated with work and home life are familiar territories, not much consideration has been given to domains focused on nature. Ecosystem services, which are benefits derived from nature, have contributed to our overall well-being [9]. However, with global urbanization [10], it is possible that many people have been distanced from nature and will not be consciously aware of their relationship with it. Consequently, when people are asked about SWB and QoL, using nature-related domains rather than life as a whole should develop an awareness of such domains and improve the quality of responses. The relationship between overall SWB, QoL, and each domain may show a curved relationship instead of the simple sum of all domains [1], moderated by the weights assigned to each domain or by external factors [11, 12]. In such cases, it may be challenging to identify the relationship between SWB/QoL and relevant nature-related factors.

Nature-related SWB and QoL cross the boundaries of conventional domains. For example, people who enjoy nature with friends as part of recreational activities, people who engage with nature as part of their job, and people who enjoy nature in the form of their everyday scenery may value nature in a way that straddles the conventional domains of "interpersonal relationships," "work," and "overall life feeling." There would then be special significance in measuring and identifying the characteristics of nature-related SWB and QoL, which cuts across conventional domains and is more focused.

Meanwhile, Japanese people's happiness level is by no means high compared to the rest of the world, considering the country's income level. In the 2019 World Happiness Report, Japan ranked 58th, falling four places from its 2018 ranking [13]. The report measures the happiness levels of a country based on the citizens' responses to the question "How happy do you feel?" and explains the responses by explanatory variables such as GDP, life expectancy, tolerance, social support, level of freedom, and levels of corruption. Compared with other countries, Japan had smaller residuals (components unexplained by elements such as GDP).

Studies on the relationship between nature and SWB have demonstrated that green spaces and waterfront areas positively correlate with SWB and physical and mental health [14–17]. However, the relationship of Japanese people with nature may be related to the smaller unexplained residuals and, thus, lower levels of happiness. Therefore, improving Japan's level of happiness may be possible by enhancing its relationship with nature.

Considering the decreased level of happiness in Japan, we measured the happiness levels of Japanese people by evaluating their relationship with nature, particularly with bodies of water and forests. By doing so, we will measure the "nature-related happiness levels" using metrics devised and gain insights for leveraging nature to increase happiness levels. Consequently, we measured the levels of nature-related happiness and domains of SWB, and examined how they correlate with various factors.

2. Objectives

The first objective was to measure nature-related happiness levels and examine their validity. The second objective was determining and identifying the factors correlated with nature-related happiness levels.

3. Method

3.1 Questionnaire survey

In total, 34,691 questionnaires were distributed to all households in 83 randomly selected postcode districts out of 210 in the Yasu River watershed in Shiga Prefecture, Japan, between February and March 2016, and 3,220 responses from 81 postcode districts were received (response rate of 9.3%). In addition to overall life happiness, the questionnaire covered topics on nature-related happiness, the relationship with the local community and nature, and the respondents' background information. The average age of the respondents was 65, in comparison to residents' average age among the six cities in the watershed ranging from 40 to 46 as of 2015. Respondents were 35% female, whereas female residents in the six cities in the watershed ranged from 48–51% as of 2015 [18]. The most frequent occupations were pensioners (25% of respondents), housewives/husbands (18%), and private enterprises (17%) (multiple answers permitted; 3,888 reponses were obtained from 3,220 respondents). The cover letter of the survey asked one person, out of one household, who was older than or equal to 20 years old and most frequently interacted with local communities to fill in the questionnaire. The survey was conducted with the permission from the ethics committee of Kyoto University's Psychological Science Frontier Unit (permission number: 24-p-22).

The following three nature-related happiness levels were measured:

a. River happiness level: Responses to the statement "I feel happy when I see my local river" on a scale from 1 ("Totally disagree") to 5 ("Strongly agree").

b. Lake Biwa happiness level: Response to the statement "I feel happy when I see Lake Biwa" on the same scale as above.

c. Forest happiness level: Responses to the statement "I feel happy when I see my local forest" on the same scale as above.

d. Overall happiness level: Response to the question "On a scale from 0 to 10, with ten being 'Very happy' and 0 being 'Very unhappy,' how happy would you say you are at the moment?"

The survey was self-administered and the definition of happiness was left up to respondents. In this study, we define subjective well-being (SWB) according to Diener (p.34) as follows [19]. "SWB refers to people's evaluations of their lives–evaluations that are both affective and cognitive. People experience abundant SWB when they feel many pleasant and few unpleasant emotions, when they are engaged in interesting activities, when they experience many pleasures and few pains, and when they are satisfied with their lives. There are additional features of a valuable life and of mental health, but the field of SWB focuses on people's own evaluations of their lives." We further define "happiness" as follows. "Happiness represents domains of SWB interpreted by respondents in colloquial terms and the mixture of cognitive and affective evaluations."

After calculating the descriptive values based on the aggregate results, a multiple regression analysis was performed to determine the relationship between nature-related happiness and the various explanatory variables listed in **Table 1**.

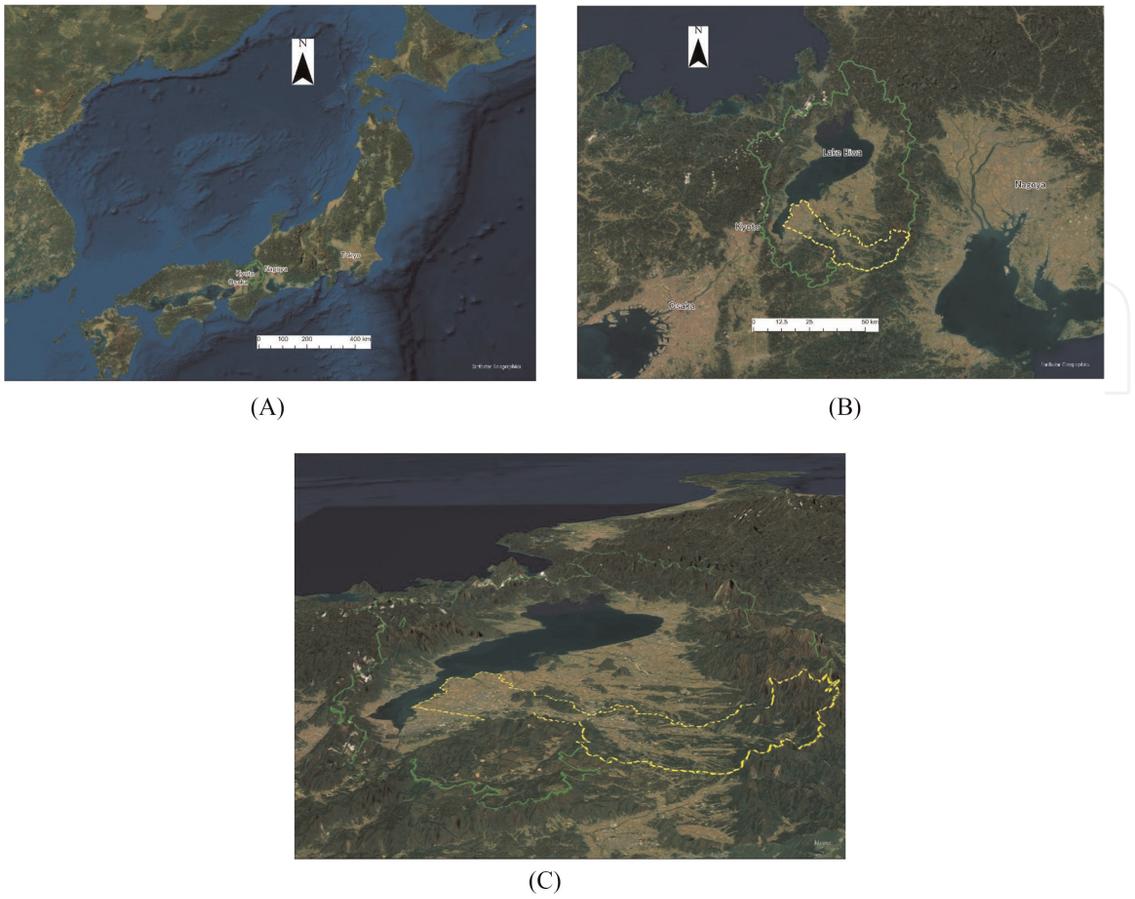
Groups of explanatory variables	Variables
Individual attributes	Health status self-evaluation, age, female (dummy), income (log value), married (dummy), number of family members, social interaction levels, and levels of educational background
Relationship with nature	Relationship with rivers, Lake Biwa, and forests; responses were coded as "Yes" =1, and "No" =0 for these variables. Work and leisure, I see it in passing, I see it from my home or workplace, I come into contact with living things, no relationship
Physical distance to nature	Coverage of rivers within the residence postcode (the proportion of the area occupied by a 100 m buffer zone around rivers), forest ratio (proportion of the area occupied by forested surface), and distance to Lake Biwa (shortest straight-line distance from the area to the shore of Lake Biwa)
Social infrastructure	Number of post offices, medical facilities, welfare facilities, conference halls, industrial waste treatment facilities, and general waste treatment facilities within the postcode district of residence, as well as commercial activity index and road density

Table 1.
List of explanatory variables.

GIS data on vegetation, rivers, and other forms of nature, as well as social infrastructure in different areas, were taken from a database and coded as variables.

3.2 Overview of the surveyed area

The Yasu River flows through Shiga Prefecture, located in central Japan, next to Kyoto (**Figure 1A–C**). Shiga Prefecture extends from a longitude of 135°45′50″E to 136°27′19″E and a latitude of 34°47′27″N to 35°42′13″ N. The Yasu River is 65.3 km long and flows into Lake Biwa, the largest lake in Japan (Figures **2A, B** and **3A, B**) [21]. The Yasu River watershed occupies an area of 387.0 km^2, including the administrative areas of Kusatsu City, Moriyama City, Rittō City, Kōka City, Yasu City, and Konan City, and had a total population of approximately 479,000 in 2015 [14]. The lower basin of the Yasu River (Kusatsu City, Moriyama City, Rittō City, and Yasu City) is served by the Tokaido Line, which connects Tokyo and Osaka, and the Meishin and Shin-Meishin Expressways, which connects Nagoya and Keihanshin (Kyoto, Osaka, and Kobe). This is a growing industrial base for the Kyoto–Osaka–Kobe economic zone, with the development of commuter towns. Agricultural lands in the lower basin mainly produce rice, while vegetable and fruit production is also actively pursued. Agriculture and forestry have historically been active industries in the upper river basin (almost the entirety of Kōka City), where the coverage of planted forests reaches 59% of all forested areas (**Figure 4A, B**). Japanese cypress (*Chamaecyparis obtusa*) planted in a part of Kōka city is renowned for producing high-quality timber. Nowadays, most residents in the area work for the manufacturing and service industries or public services. The entire watershed lies in a temperate forest region where many konara oaks (*Quercus serrata*) grow in natural forests, while Japanese cedar (*Cryptomeria japonica*) and Japanese cypress are cultivated in planted forests.



(A) (B)

(C)

Figure 1.
A. Location of Shiga prefecture [20]. The green line indicates the border of the prefecture. B. Location of the Yasu River watershed [20]. The green and yellow lines indicate the borders of the prefecture and watershed, respectively. C. Location of the Yasu River watershed (3D representation) [20]. The green and yellow lines indicate the borders of the prefecture and watershed, respectively.

4. Results

4.1 Nature-related happiness levels

Figure 5 shows the mean river, Lake Biwa, and forest happiness levels of 3.37, 3.76, and 3.51, respectively, which are higher than 3, the halfway point of the scale [= (1 + 5)/2]. Eighty to ninety percent of the respondents chose responses of 3, 4, or 5, with an overall positive perception.

Evaluating the correlation of the two water- and forest-related happiness levels with the overall happiness (**Table 2**), the correlations among the river, Lake Biwa, and forest happiness levels are strong, ranging from 0.59 to 0.84. In contrast, the correlations between nature-related happiness and overall happiness levels are weak, ranging from 0.19 to 0.20. Cronbach's alpha was high (0.87) between the water-related and forest happiness levels, including an overall happiness level of 0.68.

Therefore, the strong correlations among the indicators for nature-related happiness levels confirm convergent validity. In contrast, the weak correlation between the overall happiness level and indicators for nature-related happiness levels demonstrates the significance of measuring nature-related indicators separately from the overall happiness level.

(A)

(B)

Figure 2.
A. Yasu River(1) at downstream area. By Douggers at Wikipedia (CC BY 3.0). B. Yasu River(2) at upstream area. By Undoukai protein power at Wikimedia (CC BY-SA 4.0).

4.2 Relationship between nature-related happiness levels with various factors

Among explanatory variables for the nature-related happiness levels, we focused on the respondents' relationship with nature, such as work, leisure, and "I see it in passing." Accordingly, the aggregate values for "Relationship with nature" in **Table 1** were calculated (**Figure 6**).

As **Figure 6** shows, the most commonly-seen relationship is "I see it (river, Lake Biwa, or forest) in passing," accounting for approximately 40–70% of the responses, followed by "leisure" and "I see it from my home or workplace," accounting for approximately 10–40% of the responses. However, only 6% of the respondents said

(A)

(B)

Figure 3.
A. Lake Biwa (1). By baggio4ever at Wikimedia (CC BY 3.0). B. Lake Biwa (2). By Muscla3pin at Wikimedia (CC BY-SA 4.0).

that they could see Lake Biwa in their homes or workplaces. Furthermore, 9%, 4%, and 6% of the respondents said they only came into contact with living things "in rivers, Lake Biwa, and forests, respectively. Few said that they have a relationship with nature at" work"—2%, 1%, and 2% in rivers, Lake Biwa, and forests, respectively. Conversely, 9%, 30%, and 17% of respondents said they had "no relationship" with rivers, Lake Biwa, and forests, respectively.

This indicates a considerable number of relationships that entail lower-level involvement, such as "I see it in passing" and "I see it from my home or workplace," as well as "leisure," making these the principal ways that people relate to nature. Meanwhile, we recorded that a certain number of people did not regularly have contact with nature and thus responded that they had "no relationship" with it.

Next, we performed multiple regression analyses focusing on nature-related happiness levels (**Table 3**) using the seemingly unrelated regression (SUR) model to improve the estimation efficiency.

(A)

(B)

Figure 4.
A. Forests (1) (overview). B. Forests (2) (plantation).

The river and Lake Biwa happiness levels correlated positively with health, age, female gender (dummy), social interaction, and educational background indicators (i.e., positive and statistically significant coefficient). Only river happiness level

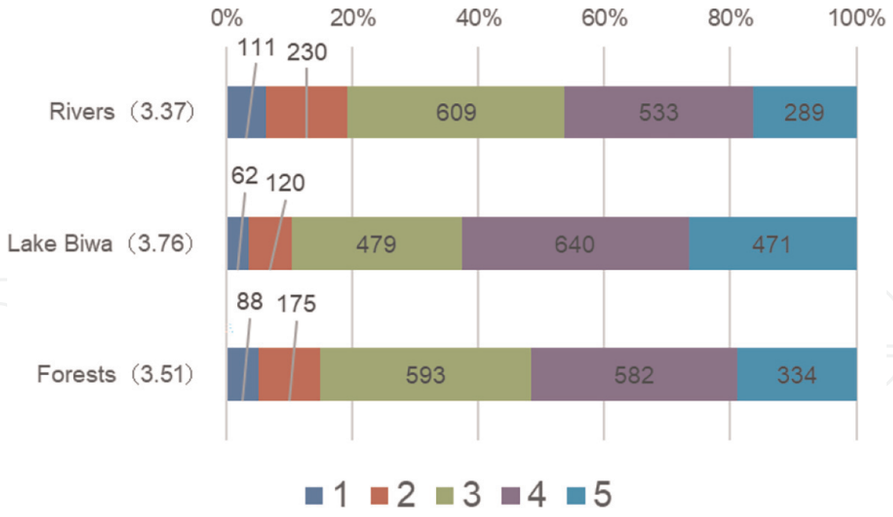


Figure 5.
Nature-related happiness levels (n = 1772). (values in parentheses are means).

	Rivers	Lake Biwa	Forests	Overall
Rivers	1.00			
Lake Biwa	0.59	1.00		
Forests	0.84	0.66	1.00	
Overall	0.20	0.19	0.20	1.00

Table 2.
Correlation among happiness levels.

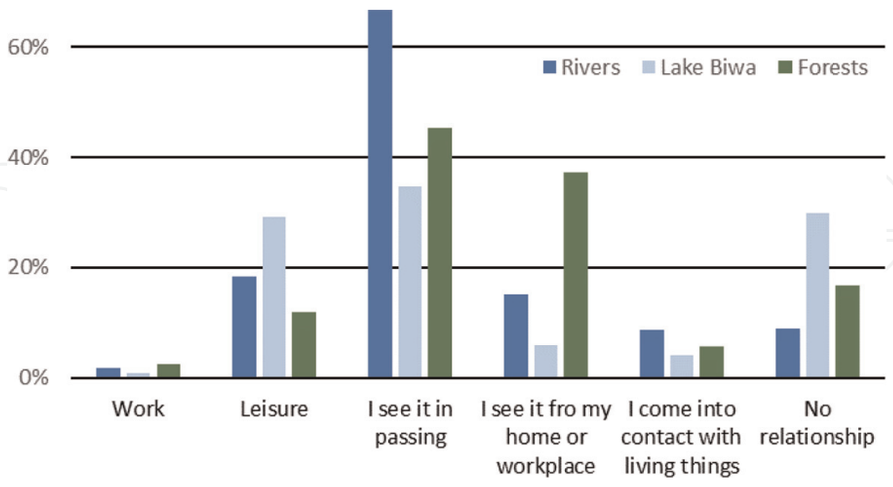


Figure 6.
Relationship with nature.

correlated positively with the "married" dummy variable. These results agree with previous studies of overall happiness levels [22, 23]. However, a correlation with income was not observed in nature-related happiness levels, arguably a unique aspect of nature-related happiness levels.

	River happiness			Lake Biwa happiness			Forest happiness			Overall happiness		
Explanatory variable	**Coeff.**	**SE**		**Coeff.**	**SE**		**Coeff.**	**SE**		**Coeff.**	**SE**	
Level of health	0.053	0.012	***	0.057	0.011	***	0.056	0.012	***	0.459	0.017	***
Age	0.120	0.024	***	0.143	0.023	***	0.114	0.023	***	−0.018	0.035	
Female(dummy)	0.111	0.066	*	0.173	0.063	***	0.062	0.064		0.220	0.097	**
Income (log value)	−0.061	0.043		−0.055	0.041		−0.020	0.041		0.222	0.062	***
Married (dummy)	0.123	0.074	*	0.014	0.070		0.047	0.071		0.479	0.107	***
Number of family members	−0.002	0.018		0.008	0.017		−0.012	0.018		0.013	0.027	
Social interaction index	0.065	0.013	***	0.048	0.012	***	0.071	0.012	***	0.093	0.018	***
Educational background index	0.126	0.026	***	0.047	0.025	*	0.115	0.025	***	0.102	0.038	***
Work	0.026	0.117		−0.152	0.203		0.099	0.090				
Leisure	0.105	0.043	**	0.171	0.056	***	0.112	0.043	***			
I see it in passing	−0.003	0.041		0.095	0.055	*	−0.034	0.034				
I see it from my home or workplace	0.059	0.044		0.172	0.082	**	0.114	0.033	***			
I come into contact with living things	0.155	0.053	***	0.220	0.093	**	0.084	0.059				
No relationship	−0.236	0.064	***	−0.187	0.062	***	−0.291	0.046	***			
River coverage	−0.283	0.139	**	−0.137	0.132		−0.245	0.133	*	−0.055	0.203	
Forest ratio	0.299	0.180	*	0.304	0.171	*	0.213	0.173		−0.262	0.263	
Distance to Lake Biwa	0.006	0.004	*	−0.011	0.004	***	0.000	0.004		−0.010	0.006	*
Constant	1.472	0.325	***	2.231	0.309	***	1.626	0.310	***	0.845	0.487	*
R^2	0.142			0.137			0.160			0.376		

****indicate statistical significance at 1% level.*
***indicate statistical significance at 5% level.*
**indicate statistical significance at 10% levels.*
"Work" through "No relationship" are variables that describe the relationship between the respondents and the river, Lake Biwa, or forest. When the explanatory variables describing relationships with nature were included in the model of overall happiness levels, none were statistically significant.
Results for the "occupation" dummy variable and social infrastructure variable are omitted for simplicity.

Table 3.
Multiple regression analysis of nature-related happiness levels as the objective variable (based on SUR estimation) (n = 1,772).

Among the kinds of relationships respondents had, both water-related happiness levels correlated positively with "leisure (related with rivers)" and "I come into contact with living things (in rivers)" while negatively with "no relationship (with rivers)." Meanwhile, "I see it in passing" and "I see it from my home or workplace"

correlated positively only with the Lake Biwa happiness level. These findings indicate the strength of the connections between ecosystem services and water-related happiness levels.

River coverage correlated negatively with river happiness levels, forest ratio correlated positively with water-related happiness levels, and distance to Lake Biwa correlated positively and negatively with river and Lake Biwa happiness levels, respectively. The negative correlation between river coverage and river happiness level is surprising considering that residents living near a river would enjoy its ecosystem services.

The pattern of significant coefficients of the forest happiness level is nearly similar to that of the water-related happiness levels. However, the "female" dummy variable is an exception and not significant. The log value of income and the "married" dummy variable are significant for the overall happiness level, which differs from the water-related and forest happiness levels. Lake Biwa and overall happiness levels were negatively correlated with distance from Lake Biwa. No correlation was found between the overall happiness level and the various relationships evaluated (e.g., work or leisure) with the river, Lake Biwa, and forest.

4.3 Why the river happiness level is low in areas with high river coverage

An unexpected negative correlation was observed between river coverage and river happiness level. One possible interpretation is that riverine disasters decrease the river's happiness. Therefore, we analyzed the responses to the following two questions about riverine disasters as explanatory variables appended to the group of explanatory variables. If riverine disasters are declining riverine happiness levels, adding these factors as explanatory variables should eliminate or diminish the negative correlation between river coverage and riverine happiness levels.

Experience with riverine disasters: Have you ever experienced water damage or flooding caused by a local river?

Hearsay about riverine disasters: Have you heard anyone talking about the water damage or flooding caused by your local river?

The responses to these two questions were coded as dummy variables, with "Yes" = 1 and "No" = 0.

Some of the results are shown in **Table 4**. Although the coefficient of river coverage decreased, it was statistically significant (p = 0.089). The coefficients for both experiences with riverine disasters and hearsay about riverine disasters were positive,

Explanatory variable	Coefficient (after adding)	Coefficient (before adding)
River coverage	−0.238*	−0.283**
Experience with riverine disasters	0.102	—
Hearsay about riverine disasters	0.140**	—
		—
R^2	0.148	0.142

****indicate a statistical significance of 1% level.**indicate a statistical significance of 5% level.*indicate a statistical significance of 10% level.*

Table 4.
Changes in the addition of the riverine disaster-related explanatory variables.

and the latter was statistically significant (p = 0.010). In other words, the awareness of riverine disasters or danger correlates positively with river happiness levels. Therefore, this analysis does not support the conjecture that awareness of the danger of natural disasters would negatively affect the river happiness level due to a negative correlation with river coverage.

Awareness of water-related disasters was positively correlated with riverine happiness levels. At present, we interpret this as follows. Awareness of water-related disasters engenders awe and reverence toward nature. Awe has physiological, psychological, and social effects. For example, awe helps one feel smaller or connected with others and induces kind and tolerant behavior, leading to a higher happiness level [24–27]. Such effects are likely to cause an awareness of water-related disasters to lead to a high, rather than low, happiness level. In this study, experience with and hearsay about riverine disasters correlated positively with awe, and awe correlated positively with the river happiness level (as well as the Lake Biwa and forest happiness levels).

4.4 Degree to which the benefits of Lake Biwa (ecosystem services) contribute to its happiness level

As part of the questionnaire, the respondents were asked to respond to the question, "Are there any benefits that you receive from Lake Biwa?" by circling all the choices applicable, including water source, source of local food culture, relaxation and pleasure (recreation), arts and culture, a symbol of the region, or nothing in particular. The responses were coded as dummy variables and appended as explanatory variables to a multiple regression analysis, with the objective variable being the Lake Biwa happiness level. Some of the results of this analysis are presented in **Table 5**.

If we look at the magnitude of the coefficients, or in other words, the size of the correlation with the Lake Biwa happiness level, the largest is "relaxation and pleasure (recreation)," followed by the symbol of the region," "source of local food culture", and "arts and culture", with "water source". Together with the results in **Table 3**, we can see that Lake Biwa is critical to the residents of the Yasu River watershed overall as a space for leisure, relaxation, and pleasure.

Variable	Coefficient
Relaxation and pleasure (recreation)	0.500***
Symbol of the region, other	0.277***
Source of local food culture	0.167***
Arts and culture	0.143*
Water source	0.013

****indicate a statistical significance of 1%.*
***indicate a statistical significance of 5%.*
**indicate a statistical significance of 10%.*
Explanatory variables were ordered according to the ranks of the magnitudes of coefficients.

Table 5.
Variables related to the benefits of Lake Biwa in a multiple regression analysis with the Lake Biwa happiness level as its objective variables.

5. Discussion and conclusion

We measured nature-related happiness levels, established a certain degree of validity, and related them to the relationship between people and nature (i.e., behavioral aspects and physical distance). Nature-related happiness levels comprise a domain with unique characteristics, such as not correlating with income. These results confirm the unique significance of examining the nature-related domains of SWB.

Abundant nature decreases nature-related happiness levels (as river happiness levels are low in areas with high river coverage). However, the responses in this study could not clarify it, even after conjecturing that it is likely due to an awareness of water-related disasters. The results suggest that riverine happiness levels may be influenced by disservices from rivers, which were not identified in this study. We can speculate that disservices connected with rivers, such as garbage disposal or fear of accidents, especially those associated with children or the elderly, are both prevalent issues in Japanese rivers.

We also examined the factors influencing the happiness level associated with Lake Biwa, a relatively large (approximately 600 km^2). The Lake Biwa happiness level was strongly correlated with high "relaxation and pleasure (recreation)" ratings but not with its benefit as a water source. This suggests that nonmaterial benefits were more strongly associated with the happiness than material benefits, such as water sources.

Distances to Lake Biwa were differently associated with happiness levels: positive with river happiness, negative with Lake Biwa happiness, and negative with overall happiness. Negative associations can be readily interpreted as indicating a decrease in the opportunities to enjoy benefits. The positive association with river happiness may indicate the upstream characteristics of rivers in locations distant from Lake Biwa. Generally, upstream rivers are small, flow rapidly, and have more natural characteristics, such as fewer artificial banks. Therefore, people may prefer these characteristics.

These findings may suggest ways to improve nature-related happiness levels by implementing policies, such as promoting activities that are supposed to enhance nature-related happiness, such as observing or catching plants and animals in rivers or water recreation in Lake Biwa. As nature-related happiness levels are not associated with income levels, these policies might have an egalitarian nature in terms of income. The unrelatedness of nature-related happiness with income levels might give policymakers unique opportunities to formulate "income-neutral" or "universal" policies.

Furthermore, varying patterns of nature-related happiness in different locations suggest that policymakers formulate policies that consider localities. For example, policies related to rivers affect different residents in river-rich and river-poor areas, and policies related to Lake Biwa affect differently depending on the distance from residential areas to the lake.

The abovementioned policy implications strengthen the case for investigating nature-related happiness or SWB for policy formulation. Forest-related SWB could contribute to forest policy formulation because 1) direct measurement of well-being is better than indirect measurement (e.g., GDP per capita); 2) SWB captures the quality of human interactions with forests; 3) SWB could identify inequalities between populations regarding access to or use of forest ecosystem services; and 4) SWB is a more holistic indicator that can capture the subjective perspectives of respondents [20]. Similarly, river or lake happiness indices may have several advantages over other policy indicators, such as water quality.

The limitations of this study are as follows. The sample analyzed in this study was relatively biased in the sense that the average age of respondents and the proportion of

males were higher than the ones of the population. In addition, the survey response rate was low (9.3%). Even though the correlations found in this study are robust for the sample, it is cautioned that generalization of the obtained results for the population might be misleading. The culture of Japan or this region might influence the obtained results.

Finally, SWB levels can be measured with satisfaction, level of fulfillment (*Eudaimonia*), and positive and negative emotions as separate dimensions [28]. It is necessary to examine whether this method is better or worse than the holistic and casual method used in this study. If we provide respondents with academic definitions of SWB, their answers might be different from what we obtained in this study. We need additional study on this issue. Furthermore, because the measurements in this study were one-time measurements, whatever can be said with certainty from the analysis is due to correlation and not causation. Time-series analysis is desirable to investigate such causality.

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