Tohoku University Research Center for Policy Design Discussion Paper

TUPD-2026-012

Psychological Distance and Willingness to Pay for a Climate Change Fund: The Role of Environmental Knowledge in Japan

Katsutoshi Nohara
College of Tourism, Rikkyo University
Graduate School of Economics and Management, Tohoku University

Sep 2026

Psychological Distance and Willingness to Pay for a Climate Change Fund: The Role of Environmental Knowledge in Japan

Katsuhito NOHARA†

Abstract

This study applies a partial proportional-odds model to examine whether people's psychological distance from climate change changed during a period encompassing the unprecedented heat experienced in Japan in 2023 and 2024. It also investigates how psychological distance and environmental knowledge are associated with willingness to pay for climate change mitigation measures. The study draws on two repeated cross-sectional surveys using identical questionnaires administered to different respondents in 2022 and 2025. Propensity scores and overlap weighting were used to improve the comparability of the two survey samples by balancing observed differences in age, gender, and prefecture of residence. After this adjustment, respondents in 2025 were more likely than comparable respondents in 2022 to perceive climate change as psychologically proximate. Specifically, the predicted probability of reporting a high level of psychological proximity was approximately 13 percentage points higher in 2025. Although this difference cannot be attributed exclusively to the record-breaking heat experienced in 2023 and 2024, the findings suggest that the unprecedented heat may have contributed to making climate change appear more immediate and personally relevant. Furthermore, the contingent valuation analysis shows that the positive association between environmental knowledge and willingness to pay depends on psychological distance: greater environmental knowledge is associated with higher willingness to pay, particularly among individuals who perceive climate change as psychologically close. These findings provide important insights into the design and communication of climate policies.

JEL classification: C21, C25, D91, Q51, Q54

Keywords: Psychological distance, Overlap Weights, Contingent Valuation, Partial proportional-odds, Heckman selection model

1. Introduction

By 2025, atmospheric greenhouse gas concentrations had reached record highs, and 2023–2025 were the three warmest years on record globally (WMO, 2026). Japan was no exception, experiencing exceptionally high temperatures, particularly in 2023 and 2024. According to the Japan Meteorological Agency (JMA), the mean temperature anomaly—computed by selecting 15 stations from northern to southern Japan in areas least affected by urbanization; calculating, for each station, deviations of

†E-mail: noharak@rikkyo.ac.jp

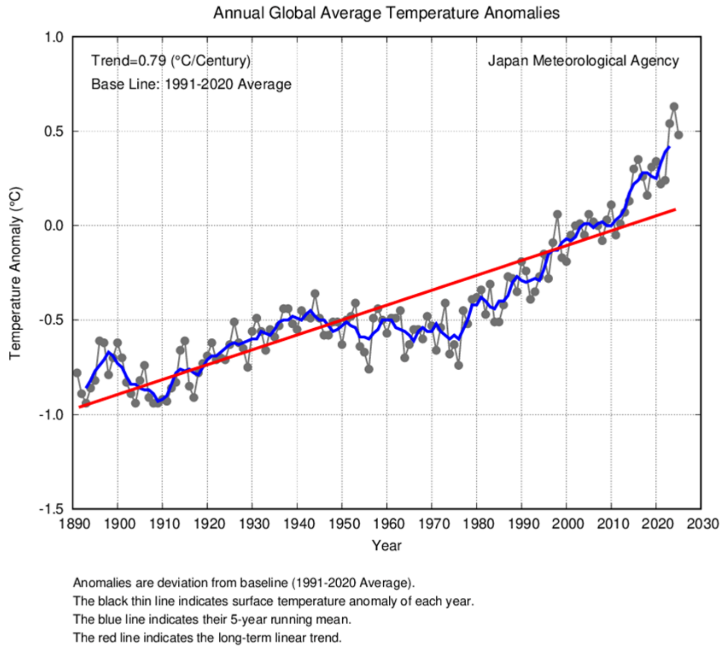

Figure 1. Temperature rise in Japan (mean temperature anomaly)

Source: JMA website (https://www.data.jma.go.jp/cpdinfo/temp/an_jpn.html), accessed June 16, 2025.

observed monthly mean temperatures from the 1991–2020 (30-year) average; averaging these deviations by year and season for each station; and then averaging across the 15 stations—remained around +0.6°C from 2019 to 2022, but rose sharply to +1.29°C in 2023 and +1.48°C in 2024 (Figure 1). This magnitude of warming is more than double the JMA's preliminary estimate of the 2024 global annual surface temperature anomaly (+0.62°C relative to the 1991–2020 average). Over these two years, anomalous heat and weather-related disasters linked to climate change shattered numerous records. For example, Japan recorded its warmest spring (March–May) in 2023 since national statistics began in 1898 (JMA; 2023a). In early June 2023, heavy rainfall affected the Pacific side of western and eastern Japan, with linear precipitation bands observed in Kochi, Wakayama, Nara, Mie, Aichi, and Shizuoka Prefectures; some locations recorded their highest one-hour rainfall totals on record (Cabinet Office; 2024). In August, according to JMA (2023b), Itoigawa City, Niigata Prefecture, registered the highest daily minimum temperature ever observed in Japan (31.4°C). JMA (2023c) also reported that parts of Osaka Prefecture recorded unusually high daytime temperatures in early November 2023, reaching 27.9°C in Osaka on November 5 and 28.6°C in Sakai on November 6. Japan recorded its hottest year on record in 2023, and 2024 surpassed that record. In July, Shinjo City, Yamagata Prefecture, recorded more than 380 mm of precipitation in 24 hours—the highest on record—and in August, Typhoon No. 10 led multiple stations along the Pacific coast from western to eastern Japan to set new records for 72-hour precipitation (JMA, 2024a). In October, Toyota City,

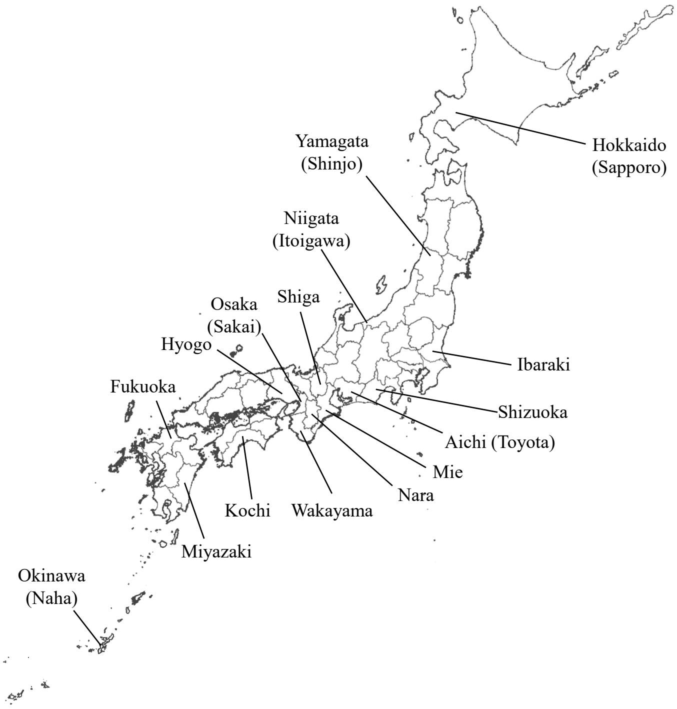

Figure 2. Location of each city in Japan

Source: Created by editing GSI Maps published by the Geospatial Information Authority of Japan. URL: https://maps.gsi.go.jp/

Aichi Prefecture, registered 34.1°C, and 80 stations nationwide set new records for the highest October temperature (JMA; 2024b). In addition, the 2024 summer and autumn mean temperature anomalies relative to the baseline were the highest since national statistics began in 1898 (JMA; 2024c).

In 2023–2024, a series of disasters noted above, rising heatstroke cases, and price spikes linked to damage to agricultural crops (e.g., vegetables) directly disrupted daily life (Fire and Disaster Management Agency, 2024; Ministry of Agriculture, Forestry, and Fisheries, 2024). Therefore, given Japan's rapid rise in temperatures over the past two years and the accompanying weather-related disasters, it is likely that many people have come to recognize climate change as an imminent and significant risk. Climate change, including global warming, is affecting many aspects of daily life, for example through declining crop quality, shifts in wildlife habitats, heightened flood risk due to more frequent heavy rainfall, and increases in heatstroke-related emergency transports. According to a public opinion survey on climate change conducted by Japan's Cabinet Office (2023), overall, 87.6% of respondents reported that they were aware that such a wide range of impacts could occur. The same survey also shows that, among climate-change impacts perceived in everyday life, "summer heat" was cited most frequently (94.8%), followed by "the intensity of rainfall" (79.6%), "changes in familiar plants such as the timing of cherry blossoms" (39.2%), and "winter cold and snowfall patterns" (30.1%). Taken together, these responses suggest that a large share of the public perceives abnormal summer heat and unusual weather conditions.

Accordingly, first, this study examines whether psychological distance to climate change changed between 2022 and 2025, a period encompassing exceptionally high temperatures in Japan, and identifies other factors associated with psychological distance. However, this study does not distinguish between direct perceptions of climate change, such as rising temperatures and more severe disasters, and indirect perceptions, such as soaring crop prices. To the best of our knowledge, this is the first study to examine the relationship between extreme weather events and psychological distance using a partial proportional-odds model. Second, this study applies the contingent valuation method (CVM) to elicit willingness to pay (WTP) for climate change measures—specifically, the establishment of a climate fund—thereby providing an economic valuation of perceived policy salience and identifying factors that may facilitate the advancement of climate policy in Japan.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and positions the study. Section 3 describes the data, Section 4 presents the empirical results, Section 5 discusses the findings, and Section 6 concludes.

2. Review

To advance climate policy effectively, it is essential to sustain high public awareness of climate change and to build broad social consensus in support of related measures. Individuals who have experienced climate-change-related weather disasters are more likely to develop stronger disaster-preparedness awareness, recognize the importance of countermeasures, and adjust their behavior accordingly (Gould et al., 2024; Hoffmann et al., 2022; Howe, 2021; Ogunbode et al., 2020; Weber, 2006; Weber and Stern, 2011). Moreover, the intensification of weather disasters may instill a sense of urgency in a wider segment of the public; coupled with scientific evidence, this can heighten perceived risk and potentially motivate action (Demski et al., 2017; Marx et al., 2007; Weber, 2006). Extreme events can function as “focusing events” that refocus attention on previously neglected risks and stimulate collective action (November et al., 2009; Renn, 2011). In the context of climate change, such events may make otherwise abstract future impacts more tangible (cf. Demski et al., 2017). Because disaster impacts are widely communicated through media coverage, the role of media is also important: prior research shows that media reporting can significantly influence public perceptions (Boykoff, 2008; Pandey, 2025; Speers, 2005). However, the literature has not reached a consensus on the relationship between past experiences of extreme weather and climate-related behavior (Cologna et al., 2025). In recent years, a growing body of research has suggested that individuals who link extreme weather to climate change are more likely to perceive climate change as a risk and to engage in mitigation behaviors (Ogunbode et al., 2019; Wong-Parodi & Rubin, 2022). While localized hazards such as intense rainfall and heatwaves may raise awareness among those directly affected, it remains unclear whether individuals who are not directly exposed—despite potential influence via news coverage—

will interpret such events as serious and personally relevant.

As noted above, experiences of weather-related disasters linked to climate change—and the associated shifts in how people perceive climate change—provide an important lens for understanding public responses. A large body of research in environmental psychology and risk perception has examined the psychological distance of climate change, including its perceived spatial, temporal, and social dimensions (Brügger et al., 2016; Chu and Yang, 2020; Jones et al., 2016; Keler et al., 2022; Loy and Spence, 2020; Maiella et al., 2020; McDonald et al., 2015; Spence et al., 2012, Van Lange and Huckelba, 2021). However, it is important to move beyond awareness and provide an economic valuation of public demand for climate-change measures. Specifically, understanding how these perceptions translate into WTP for climate policies is crucial for informing and advancing climate policy. For example, Tien et al. (2024) examine WTP for forest environmental services and show that key determinants include both socioeconomic characteristics and psychological/attitudinal factors. Kotchen et al. (2013), using an online survey in the United States, report that individuals with higher educational attainment and higher household income exhibit greater WTP for climate policy. They also find that respondents who more strongly believe that global warming is occurring report greater uncertainty about their WTP for greenhouse-gas reduction policies. This suggests that even when individuals are convinced that global warming is real, they may be uncertain about how effective emissions reductions will be in mitigating warming, and stronger beliefs do not necessarily translate directly into support for such policies. However, examining how WTP is shaped by scientific evidence—including evidence of anthropogenic influence—has become even more important, given the IPCC's Sixth Assessment Report (2021), which concluded that human influence on warming is "unequivocal." Gould et al. (2024), drawing on an online survey in the United States, find that individuals who have previously experienced wildfires or hurricanes exhibit higher WTP for climate-change mitigation measures. Notably, WTP increases even among respondents who do not accept anthropogenic climate change, which the authors suggest is consistent with the effect of direct experience of climate-related changes. According to Konisky et al. (2016), recent, rare experiences such as extreme weather have only a limited influence on decision-making; instead, climate-change beliefs are shaped more strongly by factors such as personal ideology and partisan affiliation. Sambrook et al. (2021) likewise argue that the existing literature provides insufficient evidence on the extent to which personal experience shapes climate-change beliefs, and they call for more experimental research.

Against this backdrop, Cologna et al. (2025) offer particularly important evidence. Using data from 68 countries, they examine whether experiences of weather-related disasters—such as heavy rainfall, typhoons, heatwaves, and wildfires—are associated with climate-policy support. They show that subjective attribution of these events to climate change is associated with greater support for climate policy. Several previous studies examine the relationship between climate change beliefs and

Table 1 The number of extremely hot days across Japanese cities

City	Location	Number of days with daily max temp ≥ 30°C		
		1990-2020 (Anomaly)	2023	2024
Sapporo	Located in northern Japan	8.5	30	19
Tokyo	The capital of Japan	51.2	88	80
Osaka	Central-western Honshu	73.2	91	91
Fukuoka	Northern Kyushu	59.3	86	89
Naha	Far southwest	94.5	101	100

political ideology or partisan affiliation (Kotchen et al., 2013; Winden et al., 2018; Milfont et al., 2025). However, in Japan, climate change has not been a major electoral issue, and its salience in party competition remains limited (Fukuoka, 2026; 350 Action, n.d.). As a result, concerns about the adequacy of the government's climate response have increasingly spilled over into the judicial arena, becoming visible as external pressure through developments such as climate-related litigation (The Japan Times, 2025). Accordingly, political ideology and partisan affiliation are not examined in this study.

As shown in Table 1, the anomalous heat experienced during 2023–2024 was a shared experience across the population, making it important to assess the extent to which it influenced psychological and attitudinal change. In light of Cologna et al. (2025), subjective attribution of climate change—operationalized here as psychological distance—is an important lens for advancing climate policy, and there is a need for economic policy evaluation that explicitly incorporates this dimension.

3. Research design and Data

The sample size was 2,000 for the 2022 wave (fielded in March; Rakuten Insight, Inc.) and 1,503 for the 2025 wave (fielded in July; iBridge Inc.). In both waves, respondents were Japanese residents aged 18–80, with quotas set to match the population distribution by gender and age group. Although the survey provider was changed to minimize the likelihood of overlapping samples, sample sizes differed between the two survey waves because of budget constraints. Therefore, propensity scores were estimated and overlap weights were applied (Section 4).

In both waves, perceived psychological distance to climate change (Distance) was measured on a Likert-type scale with endpoints labeled 1 ("very close"), 9 ("very far"), and 10 ("not related at all"), with 5 labeled "neutral." Descriptive statistics are reported in Table 2. The survey then asked, in sequence, whether respondents think global warming is occurring (GW); whether they know that the IPCC has concluded that climate change, including global warming, is anthropogenic (IPCC); and whether they know that the Paris Agreement's aspirational target is 1.5°C (Paris1.5). Next, four climate-change-related disasters and record-breaking events that occurred in Japan approximately five to six years before each survey wave were selected, and respondents were asked whether they

Table 2 Descriptive statistics

Variables	Description	Mean		Min		Max	
		2022	2025	2022	2025	2022	2025
Distance	Perceived proximity of climate change	3.948	3.717	1	1	10	10
GW	= 1 if the respondent believes global warming is occurring	0.932	0.856	0	0	1	1
IPCC	= 1 if the respondent knows the IPCC's statement that climate change is anthropogenic	0.426	0.370	0	0	1	1
Paris1.5	= 1 if the respondent knows the Paris Agreement's aspirational target	0.086	0.095	0	0	1	1
News	Number of past news in Japan related to climate change	1.319	1.016	0	0	4	4
Keywords	Number of keywords that respondents know	4.386	2.809	0	0	17	16
Power saving	= 1 if the respondent saves electricity with awareness of climate change	0.870	0.542	0	0	1	1
Water saving	= 1 if the respondent saves water with awareness of climate change	0.704	0.460	0	0	1	1
AC	= 1 if the respondent adjusts air conditioner temperature with awareness of climate change	0.657	0.411	0	0	1	1
Reusable bag	= 1 if the respondent possesses reusable bags with awareness of climate change	0.861	0.631	0	0	1	1
Food loss	= 1 if the respondent reduces food loss with awareness of climate change	0.619	0.477	0	0	1	1
Tax	= 1 if the respondent knows they are subject to an environmental tax	0.161	0.512	0	0	1	1
Child	= 1 if the respondent has children	-	47.04	-	0	-	1
Income	Annual household pretax income (Japanese ten thousand yen)	553.3	553.5	100	50	1500	2000
Age	Respondents' age	49.87	51.39	18	20	79	80
Gender	Respondents' gender	0.495	0.496	0	0	1	1

Note: Number of observations is 2,000(2022) and 1,503(2025)

Table 3 News on climate-change-related disasters and record-breaking events in Japan

Selection criteria	News stories used in the 2022 survey (2017 - 2021)	News stories used in the 2025 survey (2019 - 2024)
All of Japan	The annual average temperature reached its highest level since records began (2020).	The annual average sea surface temperature reached a record high (2024).
Local	Tokyo recorded its lowest amount of sunshine since records began (2017).	Hakone Town recorded its highest 24-hour precipitation on record (2019).
Heavy rain	Kyushu experienced torrential rain disasters for three consecutive years for the first time on record (2019).	Record-high rainfall was observed from western Japan to Tohoku (2020).
Season	For the first time since records began, cherry blossoms reached full bloom in March in Sendai and Niigata (2021).	The spring average temperature reached its highest level since records began in 1898 (2023).

were aware of them (News). As shown in Table3, regarding the criteria for selecting news stories,

Table 4 Keywords in 2022 and 2025 surveys

2022 survey	2025 survey
1992 Earth Summit (16.1)	1992 Earth Summit (8.3)
Severn Cullis-Suzuki (1.7)	Severn Cullis-Suzuki (2.5)
UNFCCC (12.6)	UNFCCC (10.3)
Common but Differentiated Responsibilities (1.9)	Common but Differentiated Responsibilities (3.1)
Kyoto Protocol (65.7)	Kyoto Protocol (52.2)
Kyoto Mechanisms (5.3)	Kyoto Mechanisms (5.8)
Emission (Allowance) Trading (31.6)	Emission (Allowance) Trading (27.0)
Greta Thunberg (36.8)	Greta Thunberg (29.5)
Greenhouse Gases (GHGs) (57.7)	Greenhouse Gases (GHGs) (56.2)
CCS or CCUS (2.4)	CCS or CCUS (3.3)
Carbon Footprint (6.2)	Carbon Footprint (10.5)
Carbon Neutrality (56.1)	Carbon Neutrality (55.9)
Global Warming Potential (13.4)	Global Warming Potential (9.6)
COP3 (23.9)	William Nordhaus (2.3)
COP21 (34.8)	Johan Rockström (2.2)
Paris Agreement (61.1)	Global Stocktake (2.3)
Clean Development Mechanisms (5.9)	

Numbers in parentheses indicate the percentage of respondents who recognized the term.

three dimensions were emphasized: region (news on climate across Japan and in specific regions), weather-related disasters (news on heavy rainfall, the most frequent type of weather-related disaster over the past 10 years), and season (particularly spring, when topics such as cherry blossom blooming and cedar pollen are often covered in relation to climate). In addition, all of these cases were reported by national newspapers and national television news programs on the basis of observational records and official announcements issued by the JMA. If interest in climate change is low, individuals are less likely to recognize or recall reported weather disasters and record-breaking events. Accordingly, News can be interpreted as a proxy for interest in climate change. Moreover, even among respondents with initially low interest in environmental issues, repeated exposure to media coverage of increasingly frequent weather-related disasters in recent years may heighten interest; thus, the number of news items recognized can reasonably be viewed as capturing climate-change interest. It should be noted that, while some respondents may have happened to recognize particular articles, this study did not take that possibility into account.

Respondents were then presented with the climate-related keywords listed in Table 4 and asked to select all terms they recognized (Keywords). Although the keyword set differs across waves, the first 13 items are identical in both years. Percentages in parentheses indicate the share of respondents who reported recognizing each term. In the 2022 survey, "COP3" was included; however, it was excluded from the keyword list in the 2025 survey because respondents were likely to associate it mainly with the Kyoto Protocol. In addition, the 2025 survey asked about COP21 and the Paris Agreement elsewhere in the questionnaire. Instead, the 2025 survey included the names of prominent climate-related figures, as well as major outcomes and other salient terms associated with recent COP meetings. In particular, the substantial decline in the mean value of the Keywords variable in 2025 relative to 2022 is unlikely to be driven by differences in the total number of keywords presented. Rather, it likely reflects the fact that few respondents recognized the newly added personal names and the more recent climate-policy terms included in the 2025 survey.

In the empirical analysis (Section 4), Keywords is constructed from six of the 13 terms common to both survey waves that have been included in Japanese compulsory-education textbooks and supplementary materials since 2010: the Earth Summit, Severn Cullis-Suzuki, the UN Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, emissions trading, and greenhouse gases. These terms are therefore likely to have been learned through formal schooling, particularly among younger respondents. At the same time, because these events, terms, and names had become widely known by the late 1990s, respondents aged 40 or older—although they may not have encountered them in school—were still likely to have learned about them through everyday exposure (e.g., news coverage and newspapers). Accordingly, Keywords can be interpreted as a proxy for learning effects (i.e., accumulated knowledge) related to environmental issues.

According to the Cabinet Office of Japan (2023), 12.7% of respondents reported being aware of the Paris Agreement and understanding its content. The 2025 survey used in this study yielded an even lower share (9.5%), underscoring the low level of public awareness of the Paris Agreement. The Cabinet Office (2023) also reports that, among actions undertaken in daily life to achieve a decarbonized society, "saving electricity" was the most common (70.1%), followed by "adjusting heating and cooling settings" (60.7%) and "purchasing energy-efficient appliances" (47.8%). In our 2025 survey, responses to the question on which actions respondents consciously practice to address climate change indicate relatively high rates for saving electricity (54.2%) and setting appropriate heating/cooling temperatures (41.1%). The highest response rate, however, was for using a reusable shopping bag (63.1%). Table 2 reports the five actions with the highest response rates among climate-conscious daily practices—saving electricity, saving water, adjusting air-conditioner settings, carrying a reusable bag, and reducing food waste—all of which ranked in the top five in both the 2022 and 2025 surveys. In the Cabinet Office (2023) survey, the three least common actions were purchasing products from companies working to address global warming (11.1%), switching to renewable energy (8.1%), and supporting organizations or individuals engaged in climate action (3.8%). Similarly, the Working Group on Life and Environment (2025) survey reports that more than 90% of respondents cited behaviors such as not littering and turning off lights as environmentally conscious actions, whereas fewer than 10% reported voting for pro-environment political parties, participating in environmental events, or donating to environmental activities. A similar pattern is observed in this study: the response rates for installing renewable energy (9.3%) and participating in environmental events (3.3%) are very low. Taken together, these results suggest that when Japanese people engage with environmental issues, they tend to start with relatively low-cost actions that entail low out-of-pocket and opportunity costs. By contrast, behaviors more likely to contribute to broader social transformation—such as incorporating environmental considerations into political choices, participating in environmental events, or making donations—appear to be rare. These findings are consistent with Emori (2020), who argues that Japanese people, compared with those in other countries, tend to perceive climate change measures as reducing their quality of life.

One of the variables showing the largest difference in mean values between the 2022 and 2025 surveys is awareness of the environmental tax (Tax).[1] In the 2022 survey, awareness was limited to about 16%, whereas in the 2025 survey it was more than three times higher. This increase may reflect heightened public attention to fuel-tax policy debates in the Diet during this period, including discussions in 2025 about abolishing the provisional (temporary) gasoline and diesel tax surcharge. Because Japan's carbon-tax component is levied on fossil fuels as part of the Petroleum and Coal Tax, such debates and related media coverage may have provided an opportunity for the public to become more aware of the environmental tax. Regarding Child, because iBridge provided the child indicator at no additional cost, this variable is reported only for the 2025 survey.

Finally, the survey asked whether respondents support the establishment of a climate-change fund and, if so, how much they would be willing to pay.[2] For the willingness-to-pay question, a payment card format was used. The payment amounts presented were based on the values reported by respondents in a preliminary survey conducted in 2021 using an open-ended format. Japan's environmental tax, the Tax for Climate Change Mitigation, is set at 289 yen per t-CO_2 (approximately USD 1.8 at current exchange rate), far below the level recommended by the IMF for G20 countries (Parry 2019). On the other hand, further increases in the environmental tax may be politically and economically difficult under current conditions, including prolonged weakness in real wages (Ministry of Health, Labour and Welfare 2026), high energy prices, and yen depreciation. Therefore, rather than assuming additional climate policy financing through carbon taxation, this study asked respondents about their WTP for a climate fund, which is more conducive to respecting individual preferences.

4. Estimation

4. 1 Reweighting analysis using overlap weights

[1] In Japan, the tax is officially referred to as the Tax for Climate Change Mitigation and is commonly described as an "environmental tax."

[2] For details of the survey questions, see Appendix 1.

Table 5 Estimation results for the propensity score model (standard errors in parentheses)

		Coefficient
Gender		0.0025 (0.0693)
Age		0.0062*** (0.0022)
Prefecture	Ibaraki	-1.0492** (0.4306)
	Shizuoka	-0.7890*** (0.2996)
	Shiga	-0.9248** (0.4356)
	Hyogo	-0.3707* (0.2137)
	Nara	-0.6349* (0.3368)
	Miyazaki	0.9780* (0.5182)
Log likelihood		-2359.104
Pseudo R-squared		0.014
Observation		3,503

***,**,and* denote significance at the 1%, 5%, and 10% levels, respectively.

To account for potential differences in the demographic and regional comparison of the 2022 and 2025 survey samples, propensity scores $\hat{p}_i = Pr(T_i = 1|X_i)$ were estimated for each individual i, and overlap weights were applied to emphasize regions of common support. The treatment indicator was coded as $T_i = 1$ for the 2025 survey and $T_i = 0$ for the 2022 survey. The propensity score was estimated using a logistic regression with gender, age, and prefecture of residence as covariates (X_i). Following Li et al., 2018, overlap weights were defined as $w_i = 1 - \hat{p}_i$ for treated units and $w_i = \hat{p}_i$ for control units. As shown in Table 5, no statistically significant gender differences were detected between the two survey waves, whereas small differences were observed for age and for several prefectures.

Note that Table 5 reports only those prefectures, among the 47 prefectures, with statistically significant estimated coefficients. The pseudo R^2 is small at 0.014, indicating that the observed covariates have limited power to distinguish between the two survey waves. Therefore, the estimated propensity-score distributions overlapped sufficiently across the two groups, and there was no evidence of extreme separation. Figure 3 presents kernel density estimates of the propensity score distributions for the 2022 survey and the 2025 survey. The two distributions overlap substantially across most of the support, suggesting no evidence of serious lack of common support.

Overlap weights based on the estimated propensity scores were then applied to adjust for differences in observed covariate distributions between the two survey waves, particularly in age and prefecture of residence. Using these weights, this study estimated weighted mean differences in key

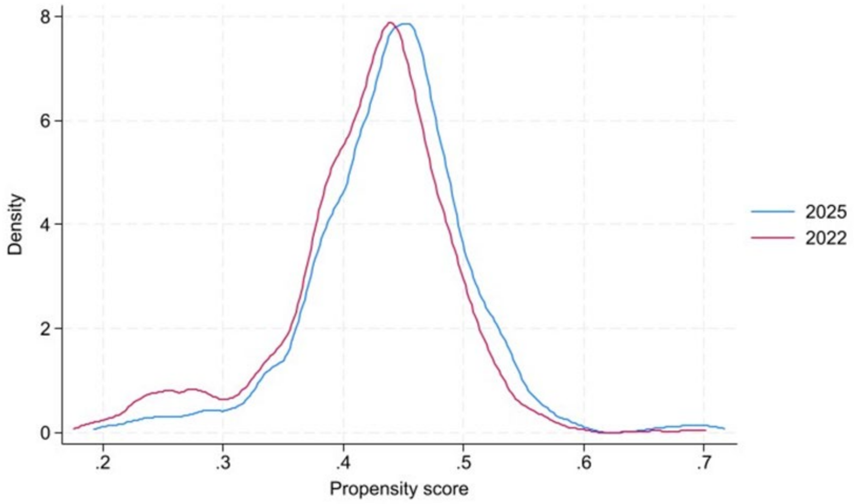

Figure 3 Kernel density estimates of the propensity scores (2022 vs 2025)

outcomes via weighted least squares:

$$y_i = \alpha + \delta T_i + \epsilon_i$$

where y_i is (i) perceived psychological distance (Distance), (ii) belief that global warming is occurring (GW), and (iii) trust in IPCC evidence (IPCC). Robust standard errors are reported. The coefficient δ is interpreted as the reweighted difference in means between the 2025 and 2022 surveys (percentage-point differences for binary outcomes). As reported in Table A1, the estimated δ is negative and statistically significant for all three outcomes, indicating that—after reweighting to align age and prefecture distributions—the 2025 survey reports lower average psychological distance by 0.19 points, lower belief in global warming by 8.1 percentage points, and lower trust in IPCC evidence by 6.0 percentage points, relative to the 2022 survey. These findings suggest that climate change was perceived as more psychologically proximate in 2025, among respondents with comparable observed characteristics across the two survey waves. However, the decline in belief in global warming and trust in IPCC evidence indicates that increased perceived proximity does not necessarily coincide with stronger acceptance of climate science or greater trust in scientific evidence.

4.2 Partial proportional-odds models for ordinal response

In this study, Distance—a measure of psychological distance (perceived proximity) to climate change—was first treated as the dependent variable and estimated using an ordered logit model. The results indicated that the parallel-lines (equal-slope) assumption was violated for multiple covariates.

Accordingly, this study employed a partial proportional-odds (PPO) model to identify determinants of perceiving climate change as psychologically close. In this specification, covariates satisfying the parallel-lines assumption (IPCC, Paris1.5, and News) were constrained to have common effects across cut-points, whereas the remaining covariates were allowed to have category-specific coefficients (Peterson & Harrell, 1990; Williams, 2006). However, because 1.6% or fewer respondents selected values of 8 or higher on the 1–10 scale, estimation became unstable. Therefore, this study collapsed response categories and re-estimated the model (Model 1) as follows: responses 1–2 were recoded as Category 1 ("close"); 3–4 as Category 2 ("somewhat close"); 5 as Category 3 ("neutral"); 6–7 as Category 4 ("somewhat far"); 8–9 as Category 5 ("far"); and 10 as Category 6 ("not related at all"). It should be noted that psychological distance, originally measured on a Likert scale, was redefined into Categories 1–6, whereas the estimation identifies thresholds (cut-points) between these categories. The estimation results are reported as follows: Table 6 presents the results for covariates that do not satisfy the parallel-lines assumption, whereas Table 7 reports the estimated coefficients for the three covariates that satisfy the parallel-lines assumption, along with the log pseudolikelihood, the pseudo chi-square test statistics, and the sample size used for estimation. Age and Keywords were standardized.

In this study, Model 1 was estimated separately for each survey year, while Model 2 was estimated using pooled data from the two survey waves to examine changes in psychological distance between 2022 and 2025. Turning to the 2022 estimates in Model 1, the coefficient on GW is negative and statistically significant across all categories (at each cut-point), indicating that believing global warming is occurring is associated with perceiving climate change as more psychologically proximate. Keywords is negative and statistically significant at the lower categories, suggesting greater perceived proximity; however, the association is not statistically significant among respondents in the neutral or more distant categories. Gender is not statistically significant only at the Category 5 threshold; otherwise, it is the only covariate that is consistently positive and significant, implying that men tend to perceive climate change as less personally relevant. For Age, the coefficient is not statistically significant only at the Category 1 threshold, but it is otherwise negative and significant, indicating that older respondents tend to perceive climate change as more proximate. Among the covariates constrained to satisfy the parallel-lines assumption (IPCC, Paris1.5, and News), only Paris1.5 is not statistically significant. The coefficients on IPCC and News are negative and significant, suggesting that greater awareness of the scientific basis for global warming and greater exposure to (or recognition of) disaster-related news are associated with perceiving climate change as more psychologically close. The 2025 estimates show that GW is negative and statistically significant across all categories (at each cut-point), exhibiting the same pattern as in 2022. Keywords is also statistically significant at the Category 3 threshold, indicating a broader association with perceived proximity than in 2022. By contrast, Gender is positive and statistically significant even at the Category 5 threshold, suggesting

Table 6 Estimation results for variables that do not satisfy the parallel-lines assumption (robust standard errors in parentheses)

	Category 1			Category 2			Category 3			Category 4			Category 5		
	Model 1		Model 2	Model 1		Model 2	Model 1		Model 2	Model 1		Model 2	Model 1		Model 2
Variable	2022	2025	Pooled	2022	2025	Pooled	2022	2025	Pooled	2022	2025	Pooled	2022	2025	Pooled
GW	-1.7906***	-1.2394***	-1.4088***	-2.5130***	-1.7695***	-2.0178***	-1.5669***	-1.4731***	-1.5612***	-2.0265***	-2.1106***	-2.0953***	-2.7629***	-2.3007***	-2.5164***
	(0.4789)	(0.2736)	(0.2338)	(0.3025)	(0.1896)	(0.1494)	(0.1974)	(0.1799)	(0.1307)	(0.2146)	(0.2430)	(0.1545)	(0.3632)	(0.3723)	(0.2716)
Keywords	-0.2189***	-0.1646**	-0.2049***	-0.2951***	-0.3817***	-0.3202***	0.0634	-0.1642*	-0.0138	-0.0966	-0.2506	-0.1645**	-0.3460	-0.3855	-0.4069**
	(0.0632)	(0.0719)	(0.0467)	(0.0570)	(0.0824)	(0.0457)	(0.0642)	(0.0953)	(0.0523)	(0.1016)	(0.1570)	(0.0838)	(0.2247)	(0.3399)	(0.1902)
Gender	0.5256***	0.4452***	0.4847***	0.5335***	0.3473***	0.4632***	0.5836***	0.3110*	0.4732***	0.4611**	0.5387**	0.4707***	0.1747	0.8214***	0.5239**
	(0.1163)	(0.1228)	(0.0839)	(0.1004)	(0.1269)	(0.0786)	(0.1373)	(0.1657)	(0.1037)	(0.1907)	(0.2299)	(0.1457)	(0.2771)	(0.3103)	(0.2138)
Age	-0.0494	-0.1605**	-0.0957**	-0.1834***	-0.2547***	-0.2126***	-0.2999***	-0.3609***	-0.3475***	-0.2041**	-0.3927***	-0.2905***	-0.2493*	-0.5101**	-0.3358***
	(0.0566)	(0.0643)	(0.0419)	(0.0513)	(0.0677)	(0.0401)	(0.0681)	(0.0992)	(0.0558)	(0.0822)	(0.1367)	(0.0695)	(0.1456)	(0.2039)	(0.1154)
Year			-0.5895***			-0.7486***			-0.2728***			-0.6493***			-0.5862***
			(0.0829)			(0.0801)			(0.1031)			(0.1455)			(0.2268)

Table 7 Estimation results for variables that satisfy the parallel-lines assumption + other results

	Model 1		Model 2
Variable	2022	2025	Pooled
IPCC	-0.3639***	-0.3197***	-0.3372***
	(0.0946)	(0.1159)	(0.0720)
Paris 1.5	-0.1307	-0.2728	-0.1836
	(0.1437)	(0.1881)	(0.1140)
News	-0.1726***	-0.3375***	-0.2357***
	(0.0415)	(0.0531)	(0.0321)
Log pseudolikelihood	-2692.339	-1902.44	-4613.032
Pseudo chi 2	0.00	0.00	0.00
Observation	2,000	1,503	3,503

***,**,and* denote significance at the 1%, 5%, and 10% levels, respectively.

Table 8 Average marginal effects

	AME of 2022-2025	Delta-method std. err.	95% CI	
(1) Very close	0.1029***	0.0145	0.0745	0.1313
(2) Somewhat close	0.0310*	0.0164	-0.0011	0.0631
(3) Neutral	-0.1051***	0.0121	-0.1289	-0.0813
(4) Somewhat far	0.0039	0.0009	-0.1301	0.0208
(5) Very far	-0.0180***	0.0059	-0.0297	-0.0064
(6) Unrelated	-0.0147***	0.0056	-0.0257	-0.0036

*** and * denote significance at the 1% and 10% levels respectively.

that the 2025 results more strongly indicate that men tend to view climate change as not personally relevant. Age is negative and statistically significant across all categories (at each cut-point), indicating that older respondents tend to perceive climate change as more psychologically close.

Then, the pooled estimates from Model 2 indicate that all covariates are statistically significant at the 5% level or below, except Keywords at the Category 3 threshold and Paris1.5, and that all variables except Gender had negative coefficients. Year is a dummy variable equal to 1 for 2025 and 0 for 2022. In Model 2, average marginal effects were calculated to quantify changes in psychological distance from 2022 to 2025 (Table 8). The estimated changes were +13.39 percentage points (pp) for “close,” −10.51 pp for “neutral,” −1.80 pp for “far,” and −1.47 pp for “not related at all.” All of these marginal effects were statistically significant, except for the “somewhat far” category. Taken together, the results suggest that, compared with 2022, a substantial proportion of respondents shifted away from a neutral position toward perceiving climate change as personally relevant in 2025. The proportion of respondents who regarded climate change as completely unrelated to themselves also declined slightly.

4.3 Two-stage econometric analysis

As the primary objective is to analyze how the anomalously high temperatures in 2023 and 2024 affected WTP, the analyses below use only the 2025 survey. In the 2025 survey, after excluding protest responses, the sample size decreased from 1,503 to 976, and 818 respondents (83.8%) support establishing the climate fund. This distribution suggests that the data do not exhibit substantial excess zeros. In this study, respondents were first asked whether they would be willing to pay to establish a fund to address climate-change-related impacts (e.g., increased weather-related disasters). Those who answered affirmatively were then asked how much they would be willing to pay. Accordingly, a two-step Heckman selection model is employed with robust standard errors. Following Heckman (1979), the selection and outcome equations are specified in Equations (1) – (3). In the second stage, an interval regression (Tobit-type) model consistent with the payment-card format is used (Botzen and van den Bergh 2012; Withey et al. 2019).

Selection equation;

$$s_i^* = x_i'\beta + u_i \tag{1}$$

$$s_i = \begin{cases} 1 & if\ s_i^* > 0 \\ 0 & otherwise \end{cases} \tag{2}$$

Outcome equation;

$$y_i^* = z_i'\gamma + \nu\lambda_i + \varepsilon_i \tag{3}$$

In Equation (1), s_i^* is a latent variable indicating individual i's propensity to be willing to pay; x_i' is a vector of explanatory variables; and u_i is an error term $(u_i \sim N(0,1))$. In Equation (2), $s_i$is an indicator variable that equals 1 if $s_i^* > 0$ and 0 otherwise. In the second stage, the inverse Mills ratio λ_i is obtained by first estimating β in the selection equation via a probit model and then computing $\lambda_i = \phi(x_i'\hat{\beta})/\Phi(x_i'\hat{\beta})$, where $\phi(\cdot)$ and $\Phi(\cdot)$ denote the standard normal density and cumulative distribution functions, respectively. Equation (3) is then estimated with λ_i included to correct for potential sample-selection bias. Here, ε_i is an error term $(\varepsilon_i \sim N(0,\sigma^2))$, and $\nu = \rho\sigma$, where ρ is an unknown correlation parameter and σ is the standard deviation of ε_i; hence, $\mathrm{Cov}(u_i, \varepsilon_i) = \rho\sigma$. The latent outcome $y_i^* \in (L_i, U_i]$ is observed only for individuals with $s_i = 1$. The terms L_i and U_i denote the lower and upper bounds of WTP implied by the payment-card interval selected by respondent i.

In this study, a Heckman selection model without the interaction term was estimated first (Model 3). In selection equation, in addition to Distance, Keywords, GW, and IPCC, the regression equation included a dummy variable indicating awareness of the environmental tax, as well as age, gender, the presence of children, and the logarithm of household income. All variables were statistically significant at the 1% or 5% level (see Table 9). Notably, contrary to expectations, respondents who were aware of the existing environmental tax were more likely to support the establishment of a climate fund. In addition, support for the fund increased with age, and women were more likely than men to support its establishment. Regarding the outcome equation, the findings showed that individuals who perceive climate change as more personally relevant, those with greater environmental knowledge, and those with higher household incomes are willing to contribute larger amounts to the fund. The inverse Mills ratio, λ_i was significant at the 5% level, indicating potential latent sample selection bias. Regarding the variable selection, a comparison between the full model and a reduced model excluding Age, Gender, and GW showed log-likelihood values of -2812.35 and -2813.13, respectively, indicating only a negligible difference between the two specifications. In other words, including these three variables resulted in only a negligible improvement in model fit, and none of them was statistically significant. By contrast, in the reduced model, the estimates for the main variables—Distance, Keywords, and Log income—became clearer. These results suggest that the three

Table 9 Estimation results of sample-selection model (robust standard errors in parentheses)

	Model 3 (Heckman selection)		Model 4 (Interaction)
	Selection eq.	Outcome eq.	Outcome eq.
Distance	-0.13615*** (0.03082)	-245.792** (114.250)	324.374 (250.760)
Keywords	0.13174*** (0.03486)	389.958*** (130.976)	670.446*** (246.898)
Dist × Key			-142.236** (68.0387)
GW	0.64070*** (0.20190)		
IPCC	0.46675*** (0.13954)	531.494 (331.949)	182.166 (340.015)
Environmental tax	0.34384*** (0.12232)	544.516 (400.283)	331.216 (344.113)
Age	0.01487*** (0.00372)		
Gender	-0.35683*** (0.11794)		
Child	0.28707** (0.13631)	198.777 (374.899)	-195.682 (302.934)
Log income	0.14263** (0.06720)	673.201*** (204.486)	518.883*** (172.593)
Inverse Mill's ratio		3070.24** (1547.00)	
Log likelihood	-306.969	-2813.13	-2809.27
Prob > chi squared	0.00	0.00	0.00
Number of obs	976	818	818

***,**,and* denote significance at the 1%, 5%, and 10% levels, respectively.

variables primarily affect the decision to participate in the payment for the climate fund, whereas their direct effect on the amount of WTP is limited. They were therefore included only in the selection equation. This specification also helps satisfy the exclusion restriction in the Heckman selection model. Furthermore, the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were5648.70 and 5705.18, respectively, for the full model, compared with 5644.26 and 5686.63 for the reduced model. On this basis, the reduced model was adopted in this study.

Second, this study introduced an interaction term between Distance and Keywords (Model 4) to test whether individuals are unlikely to engage actively in climate change mitigation unless they both possess substantial environmental knowledge and perceive climate change as a personally relevant issue that directly affects their lives. However, after the interaction term (Dist×Key) was introduced, λ_i became statistically insignificant (p=0.51), suggesting that the interaction captures systematic heterogeneity that may previously have been reflected as apparent selection bias. Because the results for the selection equation were the same as those for Model 3, Table 9 reports only the results for the outcome equation. The estimation results for Model 4 indicate a significant interaction between environmental knowledge and psychological distance, suggesting that environmental knowledge

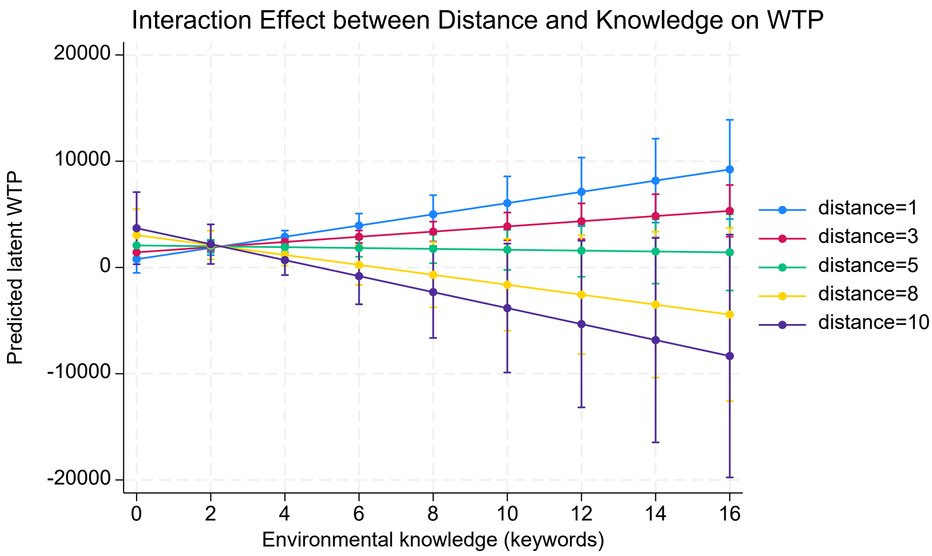

Figure 4 Interaction effect on WTP

increases WTP only when climate change is perceived as psychologically close (Figure 4).

When the issue is perceived as distant, additional knowledge does not lead to higher WTP. This pattern is consistent with construal level theory, which predicts that individuals are more likely to act on their knowledge when a risk is perceived as concrete and personally relevant. Then, full-information maximum likelihood (FIML) estimation was performed using the cmp command in Stata 18. The interaction term remained statistically significant ($p<0.01$), further supporting the robustness of the model.[3]

5. Discussion

The results of Model 1 showed that, in both 2022 and 2025, individuals who believed that global warming is occurring perceived climate change as more personally relevant. Gender was the next factor to have a significant effect across all categories, with men showing a lower sense of personal relevance than women. In addition, perceived personal relevance increased with age, indicating significant differences in climate change perceptions by gender and age. Average marginal effects were then estimated using the pooled data from both years in Model 2. The results suggested a shift between 2022 and 2025 toward perceiving climate change as a more personal issue. In other words, the record-breaking heat in Japan in 2023 and 2024 may have generated a "Lully effect" (November et al. 2009), acting as a focusing event that made climate change risk feel more psychologically proximate.

[3] Because the interaction term may capture the systematic heterogeneity underlying the apparent sample selection bias, Table A2 in Appendix presents the results of the simultaneous estimation of the selection equation and the outcome equation.

Table 10 Mean WTP of model 3 and 4

	Mean (WTP)	Delta-method std. err.	95% CI	
Model 3	2411.2	154.92	2107.52	2714.76
Model 4	2410.6	154.04	2108.74	2712.56

Unit: Japanese yen (the exchange rate at that time was roughly 148 yen to one dollar)

The results of the Heckman selection model revealed that individuals who perceive climate change as a personal issue are more likely to support the establishment of a climate change fund. Furthermore, GW and IPCC were both significant, suggesting that broader recognition that climate change is occurring, together with greater awareness of the scientific evidence, is important for building support for a climate fund. In addition, having children appears to increase awareness of the intergenerational inequity associated with climate change. However, having children did not affect WTP, suggesting that households facing the financial burden of raising children may have limited financial capacity to take environmental concerns into account. An interesting implication is that increasing awareness of environmental taxes—which are often embedded in pricing structures and may lack both visibility and a clear sense of purpose for many fossil fuel consumers—could itself be an effective strategy for building broad support for the climate change fund. On the other hand, awareness of environmental taxes was not significantly associated with willingness to pay. Regarding attitudes toward carbon taxes, Fairbrother (2022) argued that people in many countries are reluctant to pay a "price" for climate change mitigation. The findings of the present study are inconsistent with those of Cao et al. (2024), who found that knowledge of carbon taxes in Japan was strongly associated with willingness to pay. This discrepancy suggests that the effect of policy knowledge may depend on institutional design, including whether the policy is based on a pricing mechanism, such as a carbon tax, or a contribution-based mechanism, such as a climate fund, as well as the extent to which the use of the revenue is earmarked. Model 4, which incorporates an interaction term, was estimated to examine whether the effect of environmental knowledge on WTP for a climate change fund depends on the extent to which individuals perceive climate change as a personal concern.

Finally, Table 10 reports the estimated mean WTP. The mean WTP estimated from Model 3 (without the interaction term) and Model 4 (with the interaction term) was 2,411.2 yen and 2,410.6 yen, respectively (2,411 yen is approximately USD 16.3), and their 95% confidence intervals largely overlapped. This indicates that the estimated mean WTP is robust to the inclusion of the interaction term and remains largely unchanged across model specifications. Based on the estimated number of households in Japan in 2025 (57.273 million), reported by the National Institute of Population and Social Security Research (2024), the mean WTP was approximately 138.10 billion yen (120.70–155.58 billion yen) under Model 3 and 138.06 billion yen (120.77–155.36 billion yen) under Model 4. These estimates are of the same order of magnitude as the FY2025 initial budget for greenhouse gas reduction measures (196.7 billion yen) reported by the Ministry of the Environment (2025).

6. Conclusion

This study applied a partial proportional-odds model to examine whether people's psychological distance to climate change changed during a period encompassing the unprecedented heat experienced in Japan in 2023 and 2024. Propensity scores and overlap weighting were used to improve the comparability of the two survey samples by balancing observed differences in age, gender, and prefecture of residence. After this adjustment, respondents in 2025 were more likely than comparable respondents in 2022 to perceive climate change as psychologically proximate. Although this difference cannot be attributed exclusively to the record-breaking heat experienced in 2023 and 2024, the findings suggest that the unprecedented heat may have contributed to making climate change appear more immediate and personally relevant. Weber (2006) argues that personally experiencing global warming and witnessing its devastating consequences can serve as highly effective "teachers" and "motivators." Consistent with Weber (2006), the findings of this study suggest that the unprecedented heat experienced in 2023 and 2024 may have functioned as a teachable moment, making climate change feel more immediate and personally relevant.

It also investigated how psychological distance and environmental knowledge are associated with willingness to pay for climate change mitigation measures. The CVM results showed that the positive association between environmental knowledge and willingness to pay depends on psychological distance: greater environmental knowledge was associated with higher willingness to pay, particularly among individuals who perceive climate change as psychologically close. This finding suggests that enhancing the psychological proximity of climate change is as important as environmental education and that policy designs promoting both simultaneously may be particularly effective in fostering public support for climate change measures.

In the early 2000s, OECD (2002) noted that many Japanese people had relatively limited knowledge of environmental issues and that this has not translated into climate action. In 2002, the Period for Integrated Studies was introduced into the compulsory education curriculum to promote the study of real-world issues across subject boundaries, and environmental education was incorporated into the program (Fujioka 2007). Although environmental education gained momentum in the early 2000s and was expected to shift public awareness and promote climate action, in Ipsos's 2025 survey, Japan recorded the lowest level of agreement among 32 countries (40%) with the statement that, unless individuals take action on climate change, responsibility will be passed on to future generations (Ipsos 2025). This suggests that environmental education in schools alone may not be sufficient and should be complemented by lifelong learning and broader public engagement to foster an understanding of climate change as an issue of intergenerational inequality. Continuous environmental education is likely to be effective in fostering a long-term sense of responsibility toward future generations. While promoting such efforts at the national level is important, community-based initiatives may be especially effective in encouraging participation (Drews and van den Bergh 2016; Van Lange and Huckelba 2021). At the same time, Japan is experiencing rapid population aging and a declining birthrate, and changes in social structure—partly associated with the weakening of interpersonal ties due to the rise in single-person households—have contributed to the weakening of local communities (Ministry of Internal Affairs and Communications 2022). Addressing climate change therefore requires not only traditional top-down policy responses led by government but also proactive, autonomous bottom-up initiatives rooted in local communities. Since climate change impacts differ across regions, the role of local communities is likely to become increasingly important. Rebuilding inclusive local communities that bring together residents of all ages, and using them as spaces for environmental education where intergenerational understanding of region-specific risks can be fostered, will therefore be crucial.

As the OECD (2025) notes, stakeholder participation in policymaking in Japan remains relatively limited, partly because many citizens feel that the government does not adequately take public opinion into account. Promoting a more inclusive and participatory approach is therefore particularly important in the formulation of environmental policy. The OECD (2025) also highlights the limited opportunities available to women and young people in Japan to participate in and influence government decision-making. These observations are broadly consistent with the findings of this study. In Model 3, age had a significant positive effect on support for the establishment of a climate change fund, suggesting that younger individuals were less likely to support the policy. In addition, the significant negative coefficient on gender indicates that women were more likely than men to support the fund, given that men were coded as 1. These findings underscore the importance of establishing institutional arrangements through which the views of women and younger generations can be more effectively incorporated into environmental policymaking. Community-led, bottom-up environmental education programs should also be prioritized, as they may encourage these groups to participate more actively in environmental policy discussions and express their views.

Finally, the limitations of this study should be noted. First, the 2022 and 2025 surveys used in this study differ in sample size. In addition, because the surveys were conducted at different points in time, it cannot be strictly ruled out that differences between the two survey years may have affected the estimation results. Furthermore, it will be necessary to continue examining the effects of other variables—not included in the present study but potentially more closely related to climate change—through further refinement of the estimation model. In particular, variables related to political beliefs and attitudes toward climate change are likely to be especially important. These issues should be addressed in future research to help inform the development of effective climate change measures in Japan.

Acknowledgements

This study was funded by the Environment Research and Technology Development Fund (JPMEERF20S11821) of the Environmental Restoration and Conservation Agency of Japan, and JSPS KAKENHI Grant Number 24K00245.

References

1. Bergquist P, Warshaw C (2019) Does global warming increase public concern about climate change? J Polit, 81(2): 686-691
2. Botzen W W, van den Bergh J C (2012) Risk attitudes to low-probability climate change risks: WTP for flood insurance. J Econ Behav Organ, 82(1): 151-166
3. Boykoff M T (2008) Media and scientific communication: a case of climate change. In D Liverman, C Pereira, B Marker (eds) Communicating Environmental Geoscience (Geological Society, London, Special Publications, 305): 11–18
4. Cabinet Office, Government of Japan (2023) Public opinion survey on climate change. https://survey.gov-online.go.jp/r05/r05-kikohendo/gairyaku.pdf [in Japanese]
5. Cabinet Office, Government of Japan (2024) White Paper on Disaster Management 2024: Major disasters occurring in FY2023, Section 1: Disasters caused by heavy rain associated with the seasonal rain front in 2023 [in Japanese]
6. Cao L, Toyohara A, Li Y, Zhou W (2024) Willingness to pay for carbon tax in Japan. Sustainable Prod. Consumption 52: 427-444
7. Cologna V, Meiler S, Kropf C M, Lüthi S, Mede N G, Bresch D N, Lecuona O, Berger S, Besley J, Brick C, Joubert M, Maibach E W, Mihelj S, Oreskes N, Schäfer M S, Linden S V D (2025) Extreme weather event attribution predicts climate policy support across the world. Nat Clim Change 15(7): 725-735
8. Demski C, Capstick S, Sposato R G, Spence A (2017) Experience of extreme weather affects climate change mitigation and adaptation responses, Climatic Change 140: 149-164
9. Drews S, Van den Bergh J C (2016) What explains public support for climate policies? A review of empirical and experimental studies. Climate policy 16(7): 855-876
10. Emori S (2020) Reconsidering “concern and action” toward climate change: From the perspective of communication experience as an expert. Environ Inf Sci 49(2): 2–6 [in Japanese]
11. Fairbrother M (2022) Public opinion about climate policies: A review and call for more studies of what people want. PLoS Climate 1(5): e0000030
12. Fire and Disaster Management Agency (2024) Ministry of Internal Affairs and Communications, Japan. Annual report on heatstroke-related ambulance transports (May–Sep 2024) [in Japanese]
13. Fujioka T, (2007) 総合的な学習の時間における環境教育展開の意義と課題 [Significance and challenges of implementing environmental education in the Period for Integrated Studies].

Kankyo Kyoiku (Environmental Education) 17(2): 26–37 [in Japanese]
14. Fukuoka N, (2026) 気候変動対策、なぜ衆院選で語られない？ [Why is climate policy not discussed in Japan’s Lower House election?]. Tokyo Shimbun Digital, 31 January. Available at: https://www.tokyo-np.co.jp/article/465809, accessed March 5, 2026 [in Japanese]
15. Gould R K, Shrum T R, Harrington D R, Iglesias V (2024) Experience with extreme weather events increases willingness-to-pay for climate mitigation policy. Global Environ Chang 85: 102795
16. Heckman J J (1979) Sample selection bias as a specification error. Econometrica: Journal of the econometric society: 153-161
17. Hoffmann R, Muttarak R, Peisker J, Stanig P (2022) Climate change experiences raise environmental concerns and promote Green voting. Nat Clim Change 12(2): 148-155
18. Hornsey M J, Harris E A, Bain P G, Fielding K S (2016) Meta-analyses of the determinants and outcomes of belief in climate change. Nat Clim Change 6(6): 622-626
19. Howe P D (2021) Extreme weather experience and climate change opinion. Curr Opin Behav Sci 42: 127-131
20. Ipsos (2025) People and climate change: Public attitudes to the climate crisis and the transition to net zero. Ipsos
21. Japan Meteorological Agency (2023a) Seasonal highlights on the climate system (March-May 2023), Available at https://www.data.jma.go.jp/tcc/tcc/products/clisys/season_highlights_pdf/shcs202305.pdf?utm_source=chatgpt.com, accessed August 25, 2025 [in Japanese]
22. Japan Meteorological Agency (2023b) Seasonal highlights on the climate system (March-May 2023), Available at https://www.data.jma.go.jp/tcc/data/news/press_20230928.pdf?utm_source=chatgpt.com, accessed August 25, 2025 [in Japanese]
23. Japan Meteorological Agency (2023c) Search for past weather data (November 2023), Available at https://www.data.jma.go.jp/stats/etrn/view/daily_h1.php?block_no=00&day=&month=11&prec_no=62&view=p3&year=2023, accessed August 25, 2025 [in Japanese]
24. Japan Meteorological Agency (2024a) Heavy rain, strong winds and gusts caused by Typhoon No. 10 in 2024, 27 August–1 September 2024. Available at https://www.data.jma.go.jp/stats/data/bosai/report/2024/20241008/20241008.html?utm_source=chatgpt.com, accessed August 25, 2025 [in Japanese].
25. Japan Meteorological Agency (2024b) Daily weather charts, October 2024 [in Japanese]
26. Japan Meteorological Agency (2024c) Global temperature for 2024 to be the highest since 1891 (Preliminary) Available at https://ds.data.jma.go.jp/tcc/data/news/press_20241225.pdf.

27. Konisky D M, Hughes L, Kaylor C H (2016) Extreme weather events and climate change concern. Climatic Change 134(4): 533-547
28. Kotchen M J, Boyle K J, Leiserowitz A A (2013) Willingness-to-pay and policy-instrument choice for climate-change policy in the United States. Energ Policy 55: 617-625
29. Li, F., Morgan, K. L., Zaslavsky, A. M. (2018). Balancing Covariates via Propensity Score Weighting. J. Am. Stat. Assoc, 113(521), 390–400.
30. Maiella R, La Malva P, Marchetti D, Pomarico E, Di Crosta A, Palumbo R, Cetara L, Domenico A L, Verrocchio M C (2020) The psychological distance and climate change: A systematic review on the mitigation and adaptation behaviors. Front Psychol 11: 568899
31. Marx S M, Weber E U, Orlove B S, Leiserowitz A, Krantz D H, Roncoli C, Phillips J (2007) Communication and mental processes: Experiential and analytic processing of uncertain climate information. Global Environ Chang 17(1): 47-58
32. McDonald R I, Chai H Y, Newell B R (2015) Personal experience and the 'psychological distance' of climate change: An integrative review. J Environ Psychol 44: 109-118
33. Milfont T L, Sibley C G, Osborne D (2025) Ideological underpinnings of climate change beliefs: A 13-year longitudinal study. J Environ Psychol 102: 102554
34. Ministry of Agriculture, Forestry and Fisheries (2024) Annual Report on Food, Agriculture and Rural Areas in Japan (FY 2024)
35. Ministry of Education, Culture, Sports, Science and Technology, Ministry of Health, Labour and Welfare, and Ministry of Economy, Trade and Industry (2023) Ethical Guidelines for Medical and Biological Research Involving Human Subjects. [Partial revision dated March 27, 2023]. Available at https://www.mhlw.go.jp/content/001087960.pdf?utm_source=chatgpt.com [in Japanese]
36. Ministry of Health, Labour and Welfare (2026) Monthly Labour Survey: February 2026 (Preliminary Report)
37. Ministry of Internal Affairs and Communications (2022) Study Group Report on Local Communities. [in Japanese]
38. Ministry of the Environment (2025) Initial Budget for Fiscal Year 2025 (FY2025) Available at https://www.env.go.jp/earth/42024_00004.html [in Japanese]
39. National Institute of Population and Social Security Research (2025) Projections of Households for Japan (National Projection), Available at https://www.ipss.go.jp/pp-ajsetai/j/HPRJ2024/hprj2024_gaiyo_20240412.pdf. [in Japanese]
40. November V, Penelas M, Viot P (2009) When flood risk transforms a territory: the Lully effect. Geography, 94(3): 189-197

41. OECD (2002) OECD environmental performance reviews: Japan 2002. OECD Publishing Available at https://www.oecd.org/en/publications/oecd-environmental-performance-reviews-japan-2002_9789264175334-en.html.
42. OECD (2025) OECD Environmental Performance Reviews: Japan 2025. Paris: OECD Publishing. Available at https://doi.org/10.1787/583cab4c-en
43. Ogunbode C A, Demski C, Capstick S B, Sposato R G (2019) Attribution matters: Revisiting the link between extreme weather experience and climate change mitigation responses. Global Environ Chang 54: 31-39
44. Ogunbode C A, Doran R, Böhm G (2020) Individual and local flooding experiences are differentially associated with subjective attribution and climate change concern. Climatic Change 162(4): 2243-2255
45. Pandey C L (2025) Media coverage of climate change and public opinion, in Djillali Benouar (ed.) Oxford Research Encyclopedia of Natural Hazard Science. Oxford University Press
46. Parry I (2019) What is carbon taxation. Financ. Dev 8: 54-55
47. Peterson B, Harrell Jr F E (1990) Partial proportional odds models for ordinal response variables. J R Stat Soc C-App 39(2): 205-217
48. Renn O (2011) The social amplification/attenuation of risk framework: application to climate change. Wires Clim Change 2(2): 154-169
49. Sambrook K, Konstantinidis E, Russell S, Okan Y (2021) The role of personal experience and prior beliefs in shaping climate change perceptions: a narrative review. Front Psychol 12: 669911
50. Spence A, Poortinga W, Pidgeon N (2012) The psychological distance of climate change. Risk Anal 32(6): 957-972
51. Speers T (2005) A Picnic in March: Media Coverage of Climate Change and Public Opinion in the United Kingdom. in Humphrys G, Williams M (eds) Presenting and Representing Environments. The GeoJournal Library vol 81. Springer
52. The Japan Times (2026). Available at https://www.japantimes.co.jp/news/2025/12/18/japan/crime-legal/climate-change-lawsuit/?utm_source=chatgpt.com., accessed March 5, 2026
53. Tien N D, Duyen T N L, Huyen N T T, Thuy P T, Dat L Q, Oanh N T, Hanh T H, Lee K (2024) Willingness of payment for forest environmental services: a systematic literature review for determinants. J of For Res-JPN 29(5): 327-342
54. Van Lange P A, Huckelba A L (2021) Psychological distance: How to make climate change less abstract and closer to the self. Curr Opin Psychol 42: 49-53
55. Weber E U (2006) Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). Climatic change 77(1): 103-120

56. Weber E U, Stern P C (2011) Public understanding of climate change in the United States. Am Psychol 66(4): 315
57. Williams R (2006) Generalized ordered logit/partial proportional odds models for ordinal dependent variables. Stata J 6(1): 58-82
58. Withey P, Sullivan D, Lantz V (2019) Willingness to pay for protection from storm surge damages under climate change in Halifax Regional Municipality. J Environ Manage 241: 44-52
59. Wong-Parodi G, Rubin N B (2022) Exploring how climate change subjective attribution, personal experience with extremes, concern, and subjective knowledge relate to pro-environmental attitudes and behavioral intentions in the United States. J Environ Psychol 79: 101728
60. Working Group on Life and Environment (Seikatsu Kankyo Kenkyukai) (2025) Environmental Awareness and Behavior: 2025 National Survey, https://life-environment.jp/activity/, accessed August 7, 2025 [in Japanese]
61. World Meteorological Organization (2026) State of the Global Climate 2025.
62. 350 Action (n.d.) Available at https://350jp.org/climatemedia/?utm_source=chatgpt.com, accessed March 5, 2026

Appendix

Appendix A1. Willingness-to-Pay Question

If climate change becomes more severe in the future, it is highly likely to affect people’s daily lives both directly and indirectly by increasing disaster risks, such as flooding and stronger typhoons. For example, the socioeconomic impacts are expected to become even greater than they are today, including damage to aging infrastructure (such as roads and bridges), disruptions to logistics caused by factory flooding, losses in agricultural production, and substantial insurance payouts to affected individuals.

Suppose that, in order to protect the livelihoods of future generations, a fund is established to (i) prepare for such risks and (ii) respond when disasters occur. To finance this fund, a tax would be collected. However, the payment would be made only once a year, and no additional payment would be required in subsequent years. Would you support paying this amount to establish the fund? Please answer while keeping in mind that this payment would reduce the budget available for other purchases.

**According to projections by the National Institute of Population and Social Security Research, the working-age population, which forms the core of the tax-paying population, is expected to decline from approximately 75 million at present to around 45 million by 2070. If climate change worsens in the future, securing sufficient fiscal resources to address these risks may place a substantial burden on future generations.*

1. Less than 100 yen 2. 300 yen 3. 500 yen 4. 1,000 yen 5. 2,000 yen 6. 3,000yen
7. 7,000 yen 8. 10,000 yen 9. 15,000 yen 10. 20.000 yen 11. 30,000 yen 12. 50,000 yen
13. More than the above amount: ___ yen

Table A1 Estimation results of the reweighted difference in means (2025 vs 2022)

Distance					
	Coefficient	Std. err.	P-value	95% CI	
Treat	-0.1907***	0.0719	0.008	-0.3317	-0.0498
Constant	3.9304	0.0461	0.000	3.8400	4.0209
Global warming					
	Coefficient	Std. err.	P-value	95% CI	
Treat	-0.0813***	0.0109	0.000	-0.1027	-0.0598
Constant	0.9323	0.0056	0.000	0.9212	0.9434
IPCC					
	Coefficient	Std. err.	P-value	95% CI	
Treat	-0.0602***	0.0168	0.000	-0.9320	-0.0272
Constant	0.4303	0.1124	0.000	0.4083	0.4523

Observations: 3,503

Table A2 Estimation results for the CMP model

	CMP Mode	
	Probit	Interval
Distance	-0.13615*** (0.03008)	151.170 (97.5548)
Keywords	0.13174*** (0.03212)	618.089*** (94.4177)
Dist×Key		-112.952*** (27.644)
GW	0.64070*** (0.19827)	
IPCC	0.46675*** (0.13575)	296.318 (275.066)
Environmental tax	0.34384*** (0.12693)	401.023 (275.884)
Age	0.01487*** (0.00414)	
Gender	-0.35683*** (0.11976)	
Child	0.28707** (0.13577)	3.72283 (261.973)
Log income	0.14263** (0.07036)	486.102*** (157.836)
Log likelihood	-306.969	-4278.289
Prob > chi2	0.00	0.00
Observations	976	976