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# Climate change and pro-sustainable behaviors: Application of nudge theory

## Abstract

This empirical study uses nudge theory to develop conceptual models to predict the pro-sustainable behaviors of visitors. Two sets of antecedents, including the destination level (i.e., destination social responsibility [DSR]) and the individual level (climate change perception), were used as configurations to stimulate the pro-sustainable behavioral intentions of visitors in terms of willingness to sacrifice, eco-behaviors, and localism. The proposed models were tested using partial least squares-structural equation modeling (PLS-SEM) to investigate the net effect of the antecedents and fuzzy-set qualitative comparative analysis (fsQCA) to explore complex configurations leading to the pro-sustainable behavioral intentions of visitors. An interview study with experts was also conducted to develop a framework illustrating transformational drivers of actual pro-sustainable behaviors. Climate change concerns and environmentally responsible destinations appear to be significant predictors of visitors' willingness to sacrifice, localism, and eco-behaviors. Climate change awareness, beliefs, and concerns are necessary for pro-sustainable behavioral intentions. The results highlight the importance of nudge theory and creative practices to enact pro-sustainable behavioral change. The proposed framework offers guidelines at the tactical, strategic, and structural levels to stimulate visitors' actual behaviors toward climate change actions.

*Keywords:* Destination social responsibility; Climate change; Nudge theory; Pro-sustainable behavior; Mixed methods

## 1. Introduction

Tourism is often regarded as both the victim of and the contributor to climate change. On the one hand, tourism is a vulnerable sector due to its dependence on weather suitability and the natural environment as two main attributes in destination attractiveness (Scott et al., 2012a). Climate change influences tourism demand and destination choice (Hamilton et al., 2005; Gössling et al., 2012; Olya & Alipour, 2015). On the other hand, human activities, including tourism, affect the environment by creating greenhouse gases. Carbon emissions from transportation were estimated to be 5% of all man-made $CO_2$ emissions in 2016 (World Tourism Organization and International Transport Forum, 2019). The global tourism and travel industry accounted for approximately 8% of global greenhouse gas emissions between 2009

and 2013. Transport, food, and shopping are the main polluting subsectors of the tourism industry (Lenzen et al., 2018). $CO_2$ emissions from tourism are expected to rapidly grow because of the growth in tourism demand, trips frequency, and energy-intensive transport modes (Gössling et al., 2013).

Tourism is recognized as one of contributors of climate change; therefore, changes in the attitude and behavior of tourists toward sustainable travel are urgent. However, sustained behavioral changes at the public level is not straightforward. In addition to visitors' own climate change perceptions and the way that a destination is managed can affect their pro-sustainable behaviors (Olya & Altinay, 2016). In other words, apart from visitor's individual perception about ecological concerns, destinations must also be managed in a responsible way through the application of nudging strategies to enact pro-sustainable behaviors among visitors (Nelson et al., 2019).

The literature supports the linkages between the economic, sociocultural, and ecological impacts of tourism and the pro-sustainable attitudes and behaviors of tourists (Han et al., 2016; Han et al., 2017a). However, the relationships between visitors' climate change perceptions and 'pro-sustainable behavioral intentions' (van der Linden, 2016) along with the effect of destination social responsibility (DSR) on their pro-sustainable behaviors need to be unpacked (Lee et al., 2021). Furthermore, pro-sustainable behavior is a multifaceted factor. There is a paucity of empirical research that tests a model predicting this outcome as a three-dimensional construct which includes willingness to sacrifice, eco-behavior, and localism (e.g., Landon et al., 2018). There is also a need to use innovative research methods and theories to elucidate the associations between DSR and climate change with pro-sustainable behaviors (Slabbert & Du Preez, 2022; Wee et al., 2021) and guide policy makers to plan for potential strategies to drive actual behavioral changes. This study used nudge theory and a mixed-method approach to tackle the above research gaps. We crafted and tested a conceptual model that predicts visitors' 'pro-sustainable behavioral intentions' based on their perceptions on climate change and DSR. Based on experts' views from different sectors (i.e., government, industry, academia, and third sector organizations), we also developed a framework that illustrates how to apply tactical, strategic, and structural changes to promote 'pro-sustainable behaviors.'

## 2. Theoretical background

### *2.1. Nudge theory and pro-sustainable behaviors*

This study applies nudge theory to explain the mechanism for stimulating pro-sustainable behaviors. Nudge theory is a classical theory of behavioral science proposed by Thaler and Sunstein (2008) that explains how environmental factors and subjective selves can shape people's behaviors. In other words, people's behaviors can be alerted by manipulating the choice environment because they decide to use an expressive rationale to justify their behavioral decisions (Mills, 2023). Nudge theory has become a popular philosophical and pragmatic approach among scholars and practitioners in various disciplines, such as politics, health, business, and economics (Cai, 2020). Tett (2021) and Wee et al. (2021) discussed experiments that confirmed the functionality of nudge theory in driving pro-sustainable behaviors. For example, improving the accessibility of recycling bins and their visibility of signs significantly changed individuals' recycling behaviors. A study in the US showed that providing residents with protected bike lanes nudged them to choose cycling instead of driving (Mazar et al., 2021). In the travel context, Riggs (2017) tested economic and social stimuli as nudging techniques to promote pro-sustainable travel behavior.

Under the climate emergency, the communication of climate change concerns might seem irresponsible as it could potentially cause other problems, such as eco-anxiety and serious mental health issues (Verplanken & Whitmarsh, 2021), particularly among vulnerable groups (e.g., children). Therefore, based on nudge theory, a creative approach needs to be used to gently communicate climate change concerns leading to pro-sustainable behaviors. A recent study by Olya (2023) discussed how nudge theory can play an instrumental role in nudging local communities to support sustainable tourism development. Lee et al. (2021) applied nudge theory to explain how DSR can nudge park visitors to behave more responsibly. This means that visitors are less likely to misbehave when they observe that a destination is managed responsibly because they want to align their actions with contextual conditions and subjective norms. With this realization, this study contends that nudge theory can explain how a combination of destination social reasonability and climate change awareness, beliefs, and concerns can stimulate the pro-sustainable behavioral intentions of visitors.

Sustainable behaviors of visitors or residents have mainly focused on environmental aspects with a single dimension (Landon et al., 2018) rather than incorporating all three aspects of sustainability: economic, social, and environmental. Few studies have investigated all three dimensions or multiple dimensions (e.g., Han et al., 2017a; Landon et al., 2018). For example, Han et al. (2017a) investigated the antecedents of cruise traveler's pro-sustainable behaviors

as a three-dimensional construct. Landon et al. (2018) investigated tourists' pro-sustainable behavioral intentions using multiple dimensions, including willingness to sacrifice for sustainable tourism, intention to purchase and use local-based products, and eco-behavior during a trip. Hence, to broaden the discussion of pro-sustainable behavior, this study explores multiple dimensions of tourists' behavioral intentions. Supplementary A provides the definitions of the model factors that predict visitors' pro-sustainable behavioral intentions.

### *2.2. Destination social responsibility and pro-sustainable behavioral intentions*

Recent tourism studies have expanded the corporate social responsibility (CSR) literature by introducing DSR as a critical condition to achieve sustainable development at the destination level (Su et al., 2017). The concept of DSR represents the collaborative efforts of key stakeholders in a tourism destination to diminish the negative impacts caused by tourism and enhance the social and ecological aspects over the individual entities' economic interests (Su, Huang, and Huang, 2016). DSR studies were conducted from two streams, one from tourists' perspective and the other from the perspective of residents. Since research on DSR is in its early stages, little is known about the impact of DSR on sustainable behavior (Lee et al., 2021).

DSR conceptually captures destination management from different environmental, economic, and socio-cultural aspects. In other words, DSR measures the perceptions of visitors regarding how a destination is managed responsibly. Recent studies have investigated the associations between DSR and pro-sustainable behaviors or tourist satisfaction using a multidimensional approach (e.g., Lee, Olya et al., 2021). Lee et al. (2021) used three dimensions of DSR, namely, economic, environmental, and social responsibility, to develop a sustainable strategy at the destination level, which is important for determining which specific DSR activities are effective in encouraging visitors' sustainable behavior.

DSR is regarded as an important antecedent of visitors' attitudes, satisfaction, and behavioral intention. Recent studies revealed that DSR perception directly or indirectly influences tourists' satisfaction and intention to visit (Hassan & Soliman, 2021; Su et al., 2020a, 2020b). Previous studies attempted to explain the psychological mechanisms underlying the relationship between DSR activities, tourists' attitudes and behaviors by applying attribution theory (Su et al., 2020a; Su et al., 2020b), social exchange theory (Su et al., 2020b), signaling theory (Su et al., 2023), reciprocity theory (He et al., 2022), and nudge theory (Lee et al., 2021).

However, to the best of our knowledge, there is no empirical research that unpacks psychological mechanisms that show how DSR activities influence visitors' behaviors (Su et al., 2020b). In line with Lee et al. (2021), this study hypothesizes that the perception of DSR could nudge visitors to behave more responsibly.

When ecological issues matter to visitors, it is highly likely that they behave more responsibly during their trip, especially responding to environmental issues (Lee et al., 2017). As public awareness of climate change emergencies increases, more research were conducted to assess the associations of sustainable management of tourism with the pro-sustainable behaviors of tourists and residents (Su & Swanson, 2017; Lee et al., 2021). It is argued that tourists' perception of DSR positively influences environmentally responsible behavior (Su & Swanson, 2017; Lee et al., 2021). This study expands the impacts of the DSR on visitors' pro-sustainable behavioral intentions by considering all three dimensions of their willingness to sacrifice, eco-behaviors, and localism. The following hypotheses are then proposed:

*H1: Economically responsible destination management stimulates visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

*H2: Environmentally responsible destination management stimulates visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

*H3: Socio-culturally responsible destination management stimulates visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

### *2.3. Climate change and pro-sustainable behavioral intentions*

Early studies on the link between climate change and tourism focused on the role of tourism on climate change and the impact of climate change on the industry (Becken, 2004). Climate change have adverse impacts on a destination which include the destruction of tourism infrastructure and deterioration of coastal ecosystems (Phillips & Jones, 2006), changes in visitor demand flow and patterns (Hamilton et al., 2005; Gössling & Hall, 2006; Gössling et al., 2012; Scott et al., 2012b), structural changes in the tourism industry (Elsasser & Bürki, 2002), and long-term economic impacts on the destination (Dalir et al., 2021). These changes can influence visitors' perception, and eco-conscious visitors may wonder whether the destination is responsibly managed. Furthermore, understanding visitors' feedback is vital for

sustainable destination management to apply adaptive and mitigative strategies against the climate change crisis (Atzori et al., 2018).

In terms of visitor's view, the climate change and tourism literature has mainly investigated predictors that affect climate change perceptions and beliefs (Horne et al., 2021; Landon et al., 2019). Few studies have shown how awareness of climate change influences tourist flows and demands in a destination (Atzori et al., 2018) or have examined pro-sustainable behavioral intentions related to climate change or environmental consciousness (Han et al., 2017ab; Landon et al., 2018). In addition, pertinent studies showed that people do not agree with the argument that they should change their behavior to mitigate the effect of climate change at destinations (Becken, 2004; Dillimono & Dickinson, 2015; Huebner, 2012). It remains unclear whether climate change beliefs have changed, which affects pro-sustainable behavioral intentions. It is imperative to address this research gap by investigating individuals' perceptions of climate change and their intention to alter behaviors for sustainable tourism management because the situation of global warming has changed rapidly and concerns about climate change has recently increased among the public (Venghaus et al., 2022).

Climate change perception is defined as individuals' perception of the occurrence, timing, human causes, worries, seriousness, and threats of climate change (Perera et al., 2022). Climate change has been measured in various ways, such as a single question about the reality of climate change, anthropogenic climate change (Milfont et al., 2015), and climate change concerns (Jakučionytė-Skodienė & Liobikienė, 2022) or multiple questions about climate change awareness, beliefs, or concerns (Kim & Hall, 2019; Landon et al., 2019; Yilmaz & Can, 2020). This study distinguishes climate change perception into three constructs of awareness, beliefs, and concerns (Yilmaz & Can, 2020).

Climate change awareness, beliefs, and concerns in the public appeared to be predictors of intentions to make behavioral changes and support environmental policies (O'Connor et al., 1999; Spence et al., 2011; van der Linden, 2016). People who perceive the risks of climate change are more likely to act to combat the climate change crisis (Olya et al., 2019). Climate change beliefs, including awareness and concerns, affect pro-sustainable behavioral intention (Perera et al., 2022). Environmentally related cognitions and affective factors are associated with pro-sustainable behaviors (Landon et al., 2018). In this vein, Han et al. (2016) revealed that climate change awareness and moral responsibility positively affect visitors' sustainable behaviors in destinations with fragile ecosystems. With this realization, it is expected that

climate change awareness, beliefs, and concerns affect visitors' pro-sustainable behavioral intentions. The following hypotheses are then proposed:

*H4: Climate change awareness contributes to visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

*H5: Climate change beliefs contributes to visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

*H6: Climate change concerns contribute to visitors' pro-sustainable behavioral intentions (willingness to sacrifice (a), localism (b), and eco-behavior (c)).*

### *2.4. Model development*

The proposed conceptual model predicts visitors' pro-sustainable behavioral intentions in terms of their willingness to sacrifice, localism, and eco-behaviors (Figure 1). Drawing on nudge theory, destination social responsibility (economic, environmental, and socio-cultural responsibilities) and climate change (awareness, belief, and concern) are used as predictors of visitors' pro-sustainable behavioral intentions. It consists of structural and configurational models. The structural model aims to test six hypotheses (H1-H6) that investigate the net effect (sufficiency) of antecedents on pro-sustainable behavioral intentions. The hypotheses are tested using PLS-SEM. The necessity of six predictors in attaining pro-sustainable behavioral intentions is examined using ANC. fsQCA is used to test the configurational model and to explore recipes from DSR and climate change to stimulate willingness to sacrifice (A), localism (B), and eco-behaviors (C) (Figure 1). To develop a theoretical framework that guides stimuli of actual pro-sustainable behaviors, interviews were conducted to explore experts' views on tactical, strategic, and structural activities to help visitors to behave more responsibly.

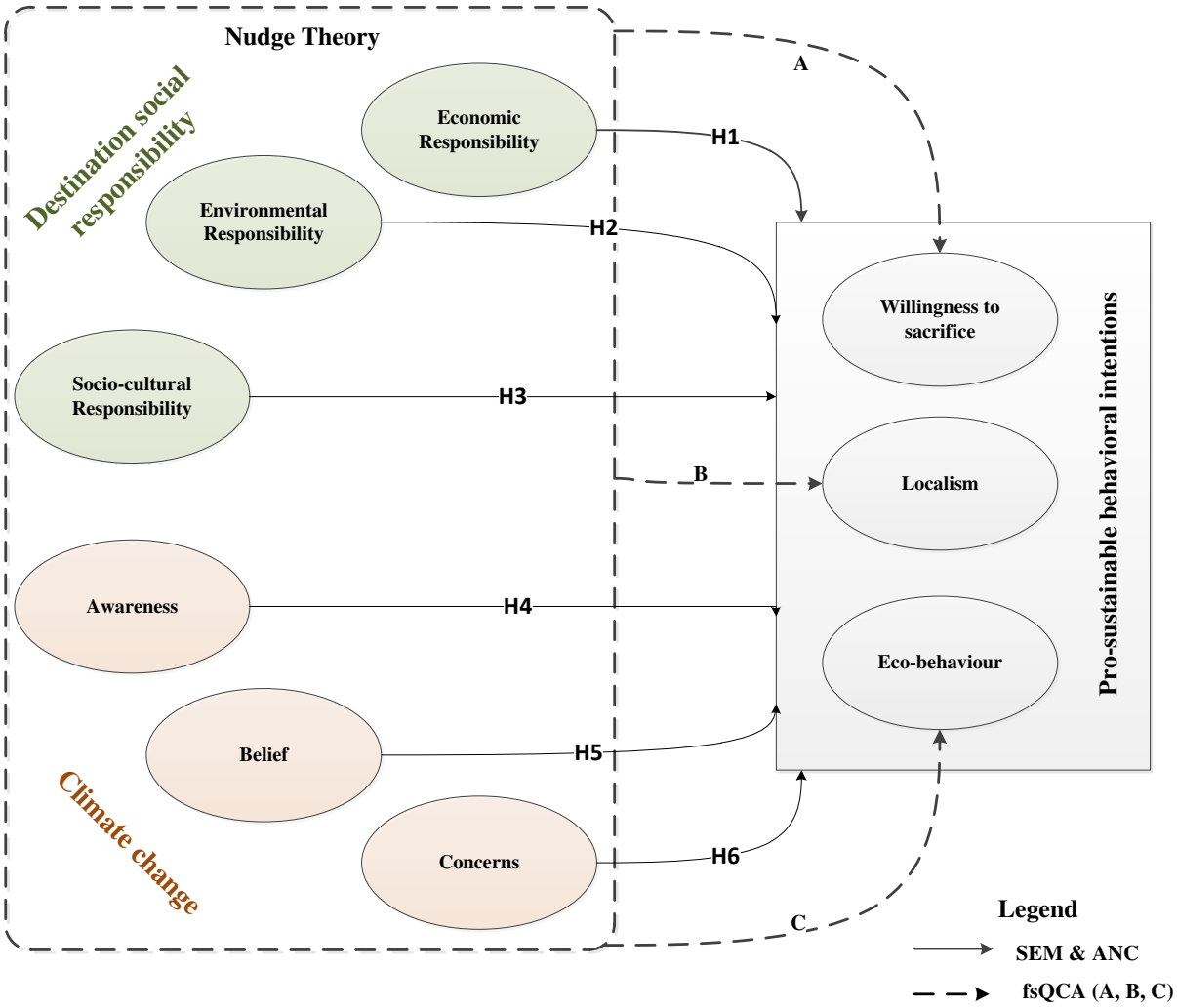


**Figure 1.** The proposed structural and conceptual models.

## 3. Methods

This work applies an exploratory mixed methods approach. In the first study, we administered a survey to test the proposed structural and configurational models that predict pro-sustainable behavioral intentions from the perspective of visitors. In the second study, we conducted interviews with experts to explore potential structural, strategic, and tactical changes to enhance actual behaviors toward climate change actions. From a theoretical perspective, findings from both quantitative and qualitative studies support the suitability of nudge theory in stimulating pro-sustainable behaviors.

### *3.1. Study 1: Visitor survey*

The survey questionnaire included 39 items and nine constructs: three DSRs (economic, socio-cultural, and environmental), three climate change perceptions (awareness, belief, and concern), and three environmentally-friendly behavioral intentions include a readiness to make sacrifices, supporting localism, and adopting eco-conscious practices. To measure the economic aspect of the DSR, five elements were taken from earlier research (Fatma et al., 2016; Lee, Olya, et al., 2021). Similarly, six components were used to evaluate the socio-cultural facet of the DSR, based on prior studies (Fatma et al., 2016; Lee, Olya, et al., 2021). The environmental aspect of the DSR was gauged using six elements from earlier research (Fatma et al., 2016; Su & Swanson, 2017). Finally, climate change awareness, beliefs, and concerns were each evaluated using three items drawn from previous literature (Kim & Hall, 2019; Marshall et al., 2013). There are different types of beliefs. Climate change beliefs refer to 'perception' and 'prediction' types of beliefs about climate change and its impacts on individual lives and society. Three environmentally conscious behavioral intentions, namely readiness to make sacrifices (five elements), promoting localism (four elements), and adopting eco-friendly practices (four elements), were assessed using previous research (Buerke et al., 2017; Kim & Hall, 2021; Landon et al., 2018) (refer to Supplementary B).

All items were measured using a 7-point Likert-type scale (1: strong disagreement - 7: strong agreement). A 7-point Likert-type scale was chosen due to its widespread acknowledgement for providing excellent reliability and discriminant validity (Olya & Al-Ansi, 2018). Moreover, general information questions associated with domestic destinations visited, attractions, and destination types, comparing domestic travel frequency before COVID-19, and concerns around climate change after the pandemic outbreak were included. Furthermore, participants were requested to provide their sociodemographic information, such as age, gender, marital status, occupation, education and income levels.

Initially, the measurement was prepared in English and subsequently translated into Korean by experts proficient in both languages. Then the Korean version was back-translated into English to address any inconsistencies in expression and intended meaning, leading to revisions in both language versions of the survey (Olya, 2023). Three specialists in DSR and sustainable tourism evaluated the measurements, and based on their feedback, an additional eco-behavior item was included to better communicate the desired meaning (i.e., "utilize tourist facilities promoting eco-friendly tourism"). At this stage, several items related to economic, socio-cultural, and environmental DSR; climate change awareness, belief, and concern; and pro-sustainable behavioral intentions such as willingness to sacrifice, co-behaviors, and localism, were slightly modified to further elucidate the questions' meanings.

A digital survey expert from the survey company evaluated the accessibility of the questionnaire items. Subsequently, the instructions, screen questions, general questions, concept constructs, and sociodemographic variables were adjusted to align with the online survey systems' requirements. The questionnaire was also tested online with a group of Korean graduate students who had recently traveled to domestic destinations, and based on their feedback, minor rewording was done. Finally, a pretest was carried out with 60 Korean residents who had visited local attractions within the past 2-3 years.

As web-based survey services enable cost-effective data collection, particularly when large panels are accessible, their use in consumer research has grown significantly. Online surveys are deemed especially suitable for this study, which examines the behavior of specific Korean consumers during the COVID-19 pandemic. The participants in this research were Korean residents aged 20 or older who had visited domestic locations within the previous 2-3 years. Utilizing data from the Ministry of the Interior and Safety (2021) on resident registration

demographics, a quota sampling technique was employed based on participants' age, gender, and residential area within the population.

For sample collection, Embrain (https://www.embrain.com/eng), an online survey company with the largest panel in the study area (comprising around 1.5 million members) as of November 18, 2021, was utilized. The survey company stringently follows suitable consumer sample selection procedures to guarantee data quality. These measures include verifying participant identities, discarding surveys completed too rapidly, excluding respondents who do not meet the screening question criteria, presenting a different question order for each respondent to minimize response bias, and requesting respondents to provide the name of the domestic destination they most recently visited.

Data collection took place between August 3 and 18, 2021, using the digital survey platform. An invitation containing information about the research purpose and assurance of personal data security was emailed to 37,251 individuals out of the 1,489,289 consumers in the survey company's databases. Among the 9,676 respondents who opened the email invitation, 6,101 proceeded to click on the provided link. In the screening questions specifically designed for this survey, all participants were asked to confirm that they had visited domestic destinations and attractions within the past 2-3 years. Since COVID-19 was still predominant in Korea, we gave it a longer time span. Only 2,532 panelists who answered the screening questions were eligible to answer the survey. Out of these, 1,053 respondents submitted completed questionnaires as valid samples. After removing outliers and unsuitable responses (e.g., finishing the survey in under 2.5 minutes) (Hair et al., 2020), 1,031 cases remained for analysis, accounting for 40.7% (1,031/2,532) of the total.

The respondents were fairly evenly distributed between males and females. Slightly under a quarter of the participants (23.8%) fell within the 50- to 59-year age range. A large

portion of the tourism group had completed university or higher education (71.2%). Most respondents were married (63.3%) and held full-time jobs (74.8%). Over half of the participants resided in the Seoul metropolitan area (53.0%). Samples in this study were chosen from those who took at least 2.5 minutes to answer all questions and confirmed visiting domestic destinations within the past 2-3 years. The majority of samples recently visited Jeju (52.3%) and natural tourist attractions (57.8%). More than one-third of the subjects visited domestic destinations more or the same in comparison to before the pandemic (39.9%). A significant portion of respondents (71.2%) expressed increased concern about climate change following the pandemic. Over a third of the participants reported a monthly personal income of 4 million Korean won (KRW) or higher (38.0%) (US$ 1 = KRW 1,158 as of August 15, 2021). The demographics of the respondents can be found in Supplementary C.

In order to evaluate the proposed conceptual model, partial least squares-structural equation modeling (PLS-SEM) was employed (Hair et al., 2017). PLS-SEM is acknowledged as an effective method for examining a structural model with non-normal data, small samples, second-order factors involving first-order factors, and/or complex models with multi-group analysis (Hair et al., 2020). Consequently, this study made use of SmartPLS 3.3.3 (Ringle et al., 2015) to validate both the measurement and structural models.

Analysis of necessary conditions (ANC) is conducted to identify which DSR and climate change factors are necessary for visitors to express pro-sustainable behavioral intentions. fsQCA was applied to explore recipes from a combination of DSR and climate change to predict visitors' pro-sustainable behavioral intentions (Ragin, 2017). fsQCA 3.0 software was used to run ANC and fsQCA (Olya & Al-Ansi, 2018). The results from analysis of the marker variable approach (Lindell & Whitney, 2001) and Harmon's single-factor method (Podsakoff

et al., 2003) indicated that common method variance was not an issue in this study (Supplementary D).

### *3.2. Study 2: Experts' interviews*

This study is designed to develop a framework by exploring the views of different actor groups on changes that can enhance pro-sustainable behaviors. To this end, we selected experts from different sectors, namely, businesses, government, academia, and NGOs, who had relevant experience on the topic of sustainable tourism management. Data saturation was achieved after the preliminary analysis of data from 19 semi-structured interviews (Guest et al., 2006).

The interviews took place in Korean and were subsequently back-translated into English, and the research team was fluent in both languages. The interview duration varied between 40 and 55 minutes. The interview questions mainly focused on the development and implementation of policies, practices, and actions that could improve pro-sustainable behaviors from the expert perspective. Supplementary E presents details of the interview information. Experts with a variety of relevant expertise (climate change, sustainable tourism, marketing, hospitality, and academia) and roles (CEOs and directors of public and private companies, agents, tour operators, hotel employees, and researchers) participated in this research. The interview questions offer a more holistic perspective of the triggers of pro-sustainable behaviors (Supplementary F).

We conducted thematic analysis to explore key themes to improve pro-sustainable behaviors (Braun & Clarke, 2006). Utilizing Braun and Clarke's (2006) method, we carried out a thematic analysis consisting of six stages: 1. becoming acquainted with the data, 2. creating initial codes, 3. looking for themes, 4. examining themes, 5. defining and labeling the themes,

and 6. generating the report. Following the transcription of the interviews, the research team individually assessed the responses to pinpoint the primary themes. To improve the consistency and validity of the data analysis procedure, the findings from the coded transcript along with the coding process were shared between the researchers, who then cross-checked the links between responses and the conceptual outline (Braun & Clarke, 2006). From the thematic analysis of qualitative data, eight factors emerged that were categorized under three key themes explaining the drivers and key actor groups involved in improving pro-sustainable behaviors.

## 4. Findings

### *4.1. Results of study 1: hypotheses testing*

Regarding measurements, a confirmatory factor analysis was conducted (Supplementary B), resulting in 35 indicators with factor loadings above 0.7, while 5 indicators with factor loadings below 0.7 were removed (Hair et al., 2020). Cronbach's α, Rho_A (reliability coefficient), and the composite reliability (CR) for constructs exceeded 0.7, confirming reliability and internal consistency validity (Stevens, 2009). The average variance extracted (AVE) for the variables was higher than 0.5, and the factor loadings of the items surpassed 0.7, establishing convergent validity (Hair et al., 2017).

The discriminant validity is evaluated by comparing the square root of each factor's AVE to the correlations between that factor and the others. If the square root of the AVE surpasses the correlations with other factors, discriminant validity is confirmed (Fornell & Larcker, 1981). As illustrated in Supplementary G, the AVE's square root for all factors is larger than the correlations with other factors, establishing discriminant validity. Moreover, a satisfactory level of predictive relevance was attained, as $Q^2$ values above zero were found for all endogenous factors, with a range of 0.186 to 0.220 (Stone, 1974). The variance inflation factor

(VIF) was utilized to examine the multicollinearity of variables. Multicollinearity was not an issue, as the external VIF values were within the range of 1.287 and 3.647 (Hair et al., 2020).

The current investigation employed PLS-SEM to evaluate six hypotheses, utilizing data that adhered to normal distribution (Supplementary B). The variance explained ($R^2$) indicates that three behavioral intentions favorable to sustainability, namely willingness to sacrifice (24.5%), localism (24.8%), and eco-behavior (27.9%), were identified (Figure 2). There is a no certain cutoff to accept $R^2$, but between 0.33 and 0.26 considered as moderate and substantial, respectively, measures for $R^2$ value, although the higher the $R^2$ value is, the better the prediction (Hair et al., 2020). Therefore, the $R^2$ values in this study were considered satisfactory. In addition, $Q^2$ was above 0 which means the model has a good predictive relevance. PLS-SEM with bootstraps of 5,000 resampling was used to evaluate the path coefficients and t-statistics for the hypotheses (Hair et al., 2017). As illustrated in Figure 2, economic DSR positively influences the localism of pro-sustainable behavioral intention ($H_{1b}$: $\gamma = 0.172$, t-value = 3.169, $p < 0.01$) and eco-behavior ($H_{1c}$: $\gamma = 0.129$, t-value = 2.498, $p < 0.05$), while economic DSR has not a significant effect on the willingness to sacrifice ($H_{1a}$: $\gamma = 0.096$, t-value = 1.910, $p > 0.05$). Therefore, $H_1$ is partially supported. Socio-cultural DSR has no influence on the willingness to sacrifice pro-sustainable behavioral intention ($H_{2a}$: $\gamma = -0.035$, t-value = 0.543, $p > 0.05$), localism ($H_{2b}$: $\gamma = -0.056$, t-value = 0.912, $p > 0.05$), or eco-behavior ($H_{2c}$: $\gamma = 0.036$, t-value = 0.539, $p > 0.05$). Hence, $H_2$ is not supported. The environmental DSR significantly influences the willingness to sacrifice pro-sustainable behavioral intention ($H_{3a}$: $\gamma = 0.300$, t-value = 5.220, $p < 0.001$), localism ($H_{3b}$: $\gamma = 0.347$, t-value = 6.326, $p < 0.001$), and eco-behavior ($H_{3c}$: $\gamma = 0.322$, t-value = 5.414, $p < 0.001$). Hence, $H_3$ is fully supported.

Climate change awareness significantly and negatively influences the willingness to sacrifice ($H_{4a}$: $\gamma = -0.124$, t-value = 2.776, $p < 0.01$) and eco-behavior ($H_{4c}$: $\gamma = -0.103$, t-value

= 2.166, p > 0.05) but has no influence on localism ($H_{4b}$: γ = -0.064, t-value = 1.419, p > 0.05). Thus, $H_4$ is not supported. Climate change beliefs significantly influences the willingness to sacrifice ($H_{5a}$: γ = 0.092, t-value = 2.020, p < 0.05) and eco-behavior ($H_{5c}$: γ = 0.130, t-value = 2.805, p < 0.01) but has no influence on localism ($H_{5b}$: γ = 0.023, t-value = 0.506, p > 0.05). Thus, $H_5$ is partially supported. Climate change concerns significantly influences the willingness to sacrifice ($H_{6a}$: γ = 0.343, t-value = 6.522, p < 0.001), localism ($H_{6b}$: γ = 0.237, t-value = 4.344, p < 0.001), and eco-behavior ($H_{6c}$: γ = 0.293, t-value = 4.842, p < 0.001). Hence, $H_6$ is fully supported.

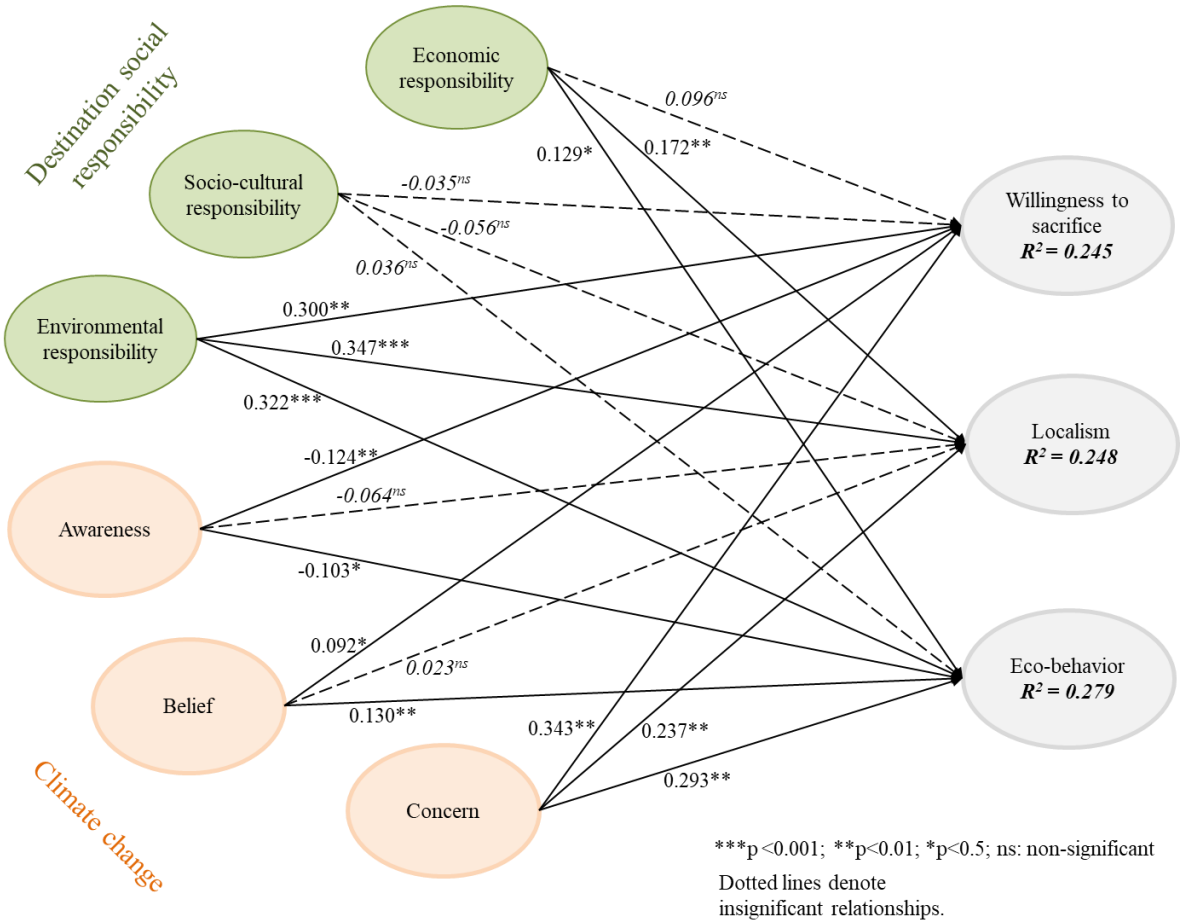


**Figure 2.** The results of hypotheses testing.

### *4.2. Results of study 1: ANC and fsQCA*

Supplementary H provides the ANC results. According to the ANC results, climate change awareness, beliefs, and concerns are necessary to stimulate the pro-sustainable behavioral intentions of visitors. However, three dimensions of socially responsible destinations were deemed unnecessary to achieve visitors' pro-sustainable behavioral intentions (Supplementary H).

Supplementary I presents the results of fsQCA. fsQCA is an asymmetric technique that detects essential requirements and adequate predictor combinations that can lead to a high outcome level. Notably, the outcomes reveal numerous causal combinations (referred to as configurations or recipes) for three dimensions of pro-sustainable behavioral intentions, along with ANC. Specifically, the first three solutions for the three outcomes are similar. Next, solution one suggests that climate change awareness, along with beliefs and concerns, could stimulate pro-sustainable behavioral intentions. Solution two suggests that awareness of climate change along with economic, socio-cultural, and environmental DSR increases stimulate pro-sustainable behavioral intentions. Solution three suggests that if destinations do not want to make visitors concerned about climate change, the destinations should be responsible across all aspects of socio-cultural, economic, and environmental factors. Solutions two and three highlight the importance of nudge theory, where responsible destinations can influence the pro-sustainable behavioral intentions of visitors. Solution four (for willingness to sacrifice) suggests that if destinations fail to be responsible, climate change awareness can still be effective in enhancing their willingness to sacrifice, although visitors do not have any concerns about climate change. Interestingly, the outcomes of ANC and fsQCA suggested that climate change awareness is a necessary factor (even though it was not sufficient based on SEM results) for encouraging pro-sustainable behavioral intentions. Solution five (for willingness to sacrifice) suggests that visitors who are unaware and unconcerned about climate

will sacrifice if the destinations promote socio-cultural responsibility, although economic and environmental DSR are not great. Solution six (for localism and eco-behavior) suggests that if destinations fail to be responsible, a combination of climate change awareness and beliefs could contribute to localism and eco-behavior.

### *4.3. Findings from study 2: Interviews with experts*

Figure 3 is developed from interview data that demonstrates a framework for promoting pro-sustainable behaviors. It consists of actions in three key themes, namely, structural, strategic and tactical. Three *structural changes* that enhance pro-sustainable behaviors include technology innovations, changes in visitors' demands and preferences, and policy development. Policymakers need to invest in new technology across all tourism and hospitality sectors that can make a real difference in boosting pro-sustainable behaviors. For example, extended reality (XR) and the metaverse could offer a virtual visit experience that could potentially satisfy expectations of the many visitors who may not feel they need to travel to visit the site.

One of the experts suggested an interesting idea regarding the use of innovative technology to encourage visitors to continue pro-sustainable behaviors: "*We need to develop user-friendly mobile applications that measure pro-sustainable behaviors of visitors and grant credit/voucher to appreciate their efforts"* (E2). Additionally, an expert from the smart tourism field suggested applying big data analytics to avoid overtourism and heavy traffic based on real-time data: "*Recently, UNWTO used mobile communication data to analyze the congestion level and this real-time data can be used to reduce the density of tourists based"* (E11). Drawing on nudge theory, one of the experts from government asserted that *"If a meter indicating the level of carbon emission is installed for each destination facility, users and*

*visitors can recognize how much their activities affect carbon emission, so they can convert their activities to eco-behaviors"* (E13).

As most businesses have transformed to a customer-centric approach, the demands and preferences of visitors need to be revisited. In particular, luxury tourism and hospitality services should be replaced with responsible services. This does not necessarily mean that luxury services should be banned; it is, however, important to strike a balance between these services or potentially change the view of the public regarding the best practices to appreciate. Based on nudge theory, services can be designed in a way that causes potential visitors to choose sustainable offerings due to the costs of those services or the attractiveness of other offerings. This was reflected in the comments of one of the experts:

*"There are great opportunities in changing people's attitude toward eco-friendlier tourism activities such as birdwatching, cycling, mountain biking, hiking, joggling, green campaigning. If hoteliers and tourism businesses are insisting in offering luxury services to make less eco- conscious visitors happy, they should pay carbon tax fees, like airlines, and also contribute to the investment and development of blue-green infrastructures"* (E7).

The third strategy focuses on policy development that may need to be implemented at the international scale, as climate change is a global crisis. For example, with the fast pace regarding the adoption of crypto currency, a number of businesses and services, including tourism and hospitality firms, accept crypto to pay the service fee. There is a need for policy to minimize the use of crypto due to virtual currencies' reliance on consuming significant amounts of energy, which creates a carbon footprint that is unnecessary. Other potential practices are exemplified by one of the interviewees:

*"I believe we as local authorities, particularly in environmentally fragile destinations, should try harder to manage tourism more responsibly. For example, using plastic bags and*

*disposable plastic bottles can be banned and alternatively jet bags and glass bottles can be used by both residents and visitors"* (E5).

As depicted in the framework, three strategic movements can increase pro-sustainable behaviors. First, strategic plans that consider the values of all key actor groups should be developed. For example, price, quality, and convenience are among the key criteria of the majority of visitors; therefore, tourism products and services should offer values that matter to visitors. In other words, it is less likely that visitors will show interest in pricy or poor-quality green products or services. Inclusivity is the second strategy that destination managers need to prioritize. As sustainability is complex and requires long-term efforts, all communities, namely, residents, local authorities, businesses, services, and visitors, should be involved in the planning through the implementation stages of climate change plans. One of the experts criticized the existent mechanism of decision-making and indicated that "*In most of the projects a top-down approach is used to develop and implement sustainable tourism plans, however, progress has been improved by involving end-user' views to design the plan. Nonetheless, intermediaries who play a key role in implementation and delivery of the objectives of plans are not included in the co-design and co-development of the project*" (E15).

The third strategy is sharing knowledge and offering training opportunities to both local and international stakeholders. Particularly, developing countries that are recognized as climate change contributors can be targeted to provide planned knowledge exchanges and run educational programs. One of the experts believed that the youth should be involved in educational events because "*they are more receptive to climate change concerns and also they could influence family decisions due to use of pester power*" (E10).

Two tactical actions that could be coordinated to improve pro-sustainable behaviors are green practices incentivization and creative communications. For example, tourism and

hospitality services can be awarded for their successful CSR practices. This nudges other companies to invest in CSR strategies. However, this is not straightforward, and one of the experts indicated that "*incentivisation and prizes of CSR may have unpredictable implications. Developing and implementation of economic innovations should be based on well-thought plans because the impacts can be huge for business and the economy of destinations*" (E10).

Second, tactics use creative tools to improve the communication of messages to stimulate behavioral and habitual changes. For example, green games can be designed in a way that involves visitors and nudges them on how to act as eco-conscious players. One of the experts highlighted the importance of nudge theory in the marketing communication plan of the business: "*If global warming is advertised very strongly, people may tend to not want to think about it after all they want to refresh and enjoy the short time that they have away from the normal stresses. One thing that I might add is that continuing to make people more aware (I know it has been too long) is one of the best methods to change people's habits. I also think now people are more likely to listen than in the past*" (E9). Another expert recommended to *"create incentives and/or mandates for transition to clean-energy land transport, then promote the scheme and the accomplishments -- and incorporate sustainability into promotional videos --- without using the word sustainable, just talk about the practices such as we have mostly clean energy vehicles, and charging stations are easily found for your rental cars, etc."* (E1).

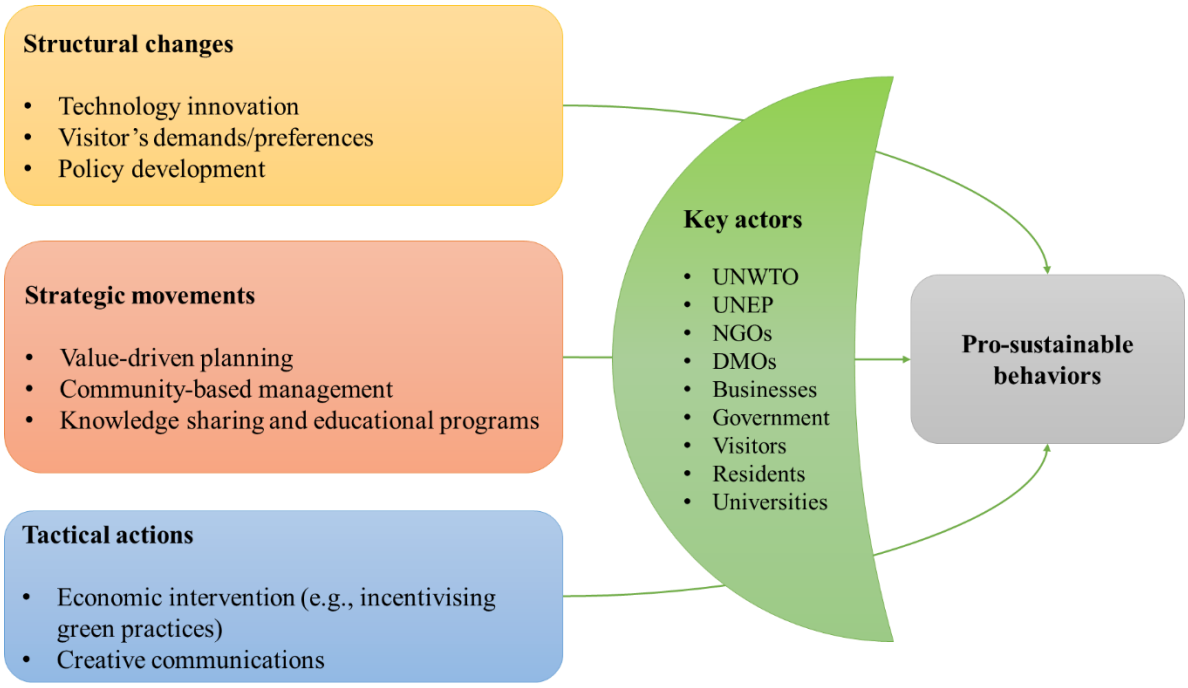


**Figure 3.** Framework for structural, strategic, and tactical transformation.

## 5. Discussions and implications

This study extends the existent knowledge of pro-sustainable behaviors by using a mixed method approach that first empirically tested conceptual models from visitors' perspectives and then interviewed key actors to explore the main structural, strategic, and tactical changes to improve pro-sustainable behaviors. In the first study, we used a quantitative approach to unpack visitors' views on the impacts of climate change and DSR on their pro-sustainable behavioral intentions. As concerns around climate change appear to be a significant trigger, we explored how we can nudge visitors to behave more sustainably. This was the motivation to conduct the second study and to interview experts who could provide practical examples of policies and solutions to improve pro-sustainable behaviors. Findings from the interviews deepened our understanding of what (structural, strategical, and tactical stimuli) and who (key actor groups) should be included in the plans for promoting pro-sustainable behaviors.

The results from the model testing confirmed the significance of the application of nudge theory to stimulate behavioral changes. This is in line with the recent article in Financial Times (Tett, 2021) and the study by Wee et al. (2021) that discussed a number of successful applications of nudge theory in driving pro-sustainable behaviors. Based on the quantitative results that investigated the impacts of DSR and climate change (awareness, belief, and concerns) on visitors' pro-sustainable behaviors, visitors concerned about climate change were highly likely to engage in pro-sustainable actions. However, the approach is effective when visitors are nudged about climate change. This is because visitors are more receptive to engaging with climate change actions if the message is communicated in a creative way. Furthermore, responsible management of destinations can nudge visitors to express more pro-sustainable behaviors. Findings from the qualitative study also confirmed the effectiveness of using nudge theory to enhance pro-sustainable behaviors. Some of the experts were specific about examples of nudge theory and recommended the use of technological tools and innovative policies to drive behavioral changes.

According to the results of the quantitative study, awareness, beliefs, and concerns toward climate change appeared as necessary conditions to drive visitors' pro-sustainable behaviors. However, unlike climate change concerns, awareness and beliefs may not be sufficient to increase pro-sustainable behavioral intentions. In other words, according to the SEM results, climate change awareness is insufficient, but concern is sufficient to increase the pro-sustainable behavioral intentions of visitors in terms of their willingness to sacrifice, localism, and eco-behaviors. This is in line with previous studies that show that people who are most aware of global warming and climate change are less willing to alter their travel behaviors (McKercher et al., 2010), and these linkages were not significant among Chinese tourists (Han et al., 2016). Although people have recently become more aware of the risks of

climate change, there are still hinders to making climate change issues a priority (Lorenzoni & Pidgeon, 2006). Therefore, climate change awareness is insufficient to alter people's behaviors (Howarth et al., 2008), which means that stimuli should move beyond awareness by stimulating their concerns. In accordance with previous studies, climate change concerns drive behavioral changes to combat climate change, such as reducing energy use (Spence et al., 2011).

Interestingly, beliefs partially influence visitors' pro-sustainable behavioral intentions and increases their willingness to sacrifice and eco-behaviors but has no net effect on localism. Climate change perception is complicated, and the relationship between risk perception on climate change and behavior is still controversial (van der Linden, 2016). Previous studies have confirmed that beliefs positively influence pro-sustainable behavioral intentions through personal norms (Han et al., 2017ab; Landon et al., 2018). None of the three DSR dimensions were necessary for pro-sustainable behavioral intentions. According to the SEM results, socio-cultural factors are insufficient to predict visitors' pro-sustainable behavioral intentions. Economic responsibility partially influences visitors' pro-sustainable behavioral intentions, affecting localism and eco-behaviors. However, environmental responsibility has a positive impact on visitors' pro-sustainable behavioral intentions. These results mean that visitors expected destination managers to prioritize environmental and economic dimensions over socio-cultural aspects. The findings of this study support previous studies that showed the direct impact of DSR on pro-sustainable behavioral intentions (Lee, Olya, et al., 2021).

To the best of authors' knowledge, this is the first empirical study that tests a configurational model using fsQCA to predict three dimensions of pro-sustainable behavioral intentions, namely, willingness to sacrifice, eco-behaviors, and localism. According to the fsQCA results, both visitors and destinations should work hand in hand to be able to promote pro-sustainable behavioral intentions. However, there is a group of visitors who engage in pro-

sustainable behavioral intentions (Solution 4 for three outcomes) if destination managers fail to make the destination responsible. Drawing on nudge theory, visitors will engage in pro-sustainable behavioral intentions if they understand that the destination is responsibly managed. Destination responsibility is important, as it could convince visitors who do not feel any concerns about the climate to participate in pro-sustainable behavioral intentions (Solution 3 for all three outcomes). Although climate change awareness is not sufficient, it is a necessary factor, as it stimulates pro-sustainable behavioral intentions in a responsible destination (Solution 2 for all three outcomes). Awareness, in combination with beliefs and concerns, could enhance pro-sustainable behavioral intentions (Solution 1 for all three outcomes).

Concerns about climate change appear to be a sufficient and necessary factor to predict visitors' pro-sustainable behavioral intentions. However, stimulating concerns may have negative implications, specifically among vulnerable groups. Therefore, visitors should be nudged gently about climate change concerns. For example, digital innovations can be used to develop creative solutions to nudge visitors about climate change implications. For example, a virtual influencer like Vida Kit could be an influential digital solution to nudge individuals, particularly young people, to behave responsibly. Destination managers need to be aware of the importance of the economic and environmental dimensions of DSR, as it could stimulate the pro-sustainable behavioral intentions of visitors. Destination managers can use annual reports, social networking platforms, and other channels as means of communication for the responsible management of destinations. However, visitors can observe environmental DSR during the destination visit.

This study deepens our understanding of what changes at different levels of structural, strategic, and tactical actions are required to improve pro-sustainable behaviors. We developed a framework based on the views of different key actor groups who stressed the roles of

technological innovations, revising the market demand and effective policies as three structural changes leading to behavioral changes. This is in line with Fang and Sun's (2016) empirical study that exemplified the application of technology (eco-visualization interface) in improving pro-sustainable behaviors by saving water consumption. Wood (2019) believed that market taste and preferences could be changed through social marketing and building resilience against eco-societal emergencies. In terms of policy development, Dubois et al. (2019) contend that climate-related policies can change individuals' consumption patterns and behavioral decisions.

The experts suggested three strategies of value-driven planning (customer-centric approach), inclusive and participative decision-making (community-based management), and knowledge-sharing systems that can drive change toward pro-sustainable behaviors. Roles of perceived value and participatory decision-making in promoting pro-sustainable behaviors were highlighted by Font et al. (2021), who suggested how customers and tourism businesses can co-create values to sustainable behaviors. Similar to our findings, Oghazi (2022) indicated that knowledge can navigate transformational changes in process and behavior through innovations. Experts emphasized the role of nudge theory in designing economic interventions and creative communications as two important tactics to trigger behavioral changes. Particularly, due to the impact of economic intervention on businesses, residents, and visitors, it is recommended that the idea be co-designed and pilot tested before implementation at national or international scales. This is in accordance with Kollmuss and Agyeman (2002, p. 249), who argued that "…people can be influenced by economic incentives to behave pro-sustainably (e.g., the Massachusetts Bottle Bill is responsible for the very high recycling rate of bottles at over 80% compared to an overall recycling rate of less than 10% in Boston, Massachusetts). The opposite is also true. [Because] economic factors are intertwined with social, infrastructural, and psychological factors." In this vein, Riggs (2017) found that social

norms are more impactful than economic incentives to change travel behaviors to a more sustainable mode.

This study attempts to test a model that involves DSR (destination level) and climate change (individual level) perception to predict visitors' pro-sustainable behavioral intentions. It also explores the views of different experts to understand what structural, strategic, and tactical changes need to promote pro-sustainable tourism. Future research should go beyond perception by studying habitual behavioral changes as effective solutions that consistently promote pro-sustainable behaviors. Further research could be conducted to measure the actual behaviors of visitors using experimental research to identify the effectiveness of various nudges in boosting visitors' pro-sustainable behaviors. We also recommend conducting longitudinal research and tracking studies to measure actual behavioral changes toward climate change over time for visitors with different levels of climate change awareness, beliefs and concerns while they are visiting destinations that are responsibly managed. Some of the experts exemplified some successful green practices and policies; however, future research could use nudge theory to develop case studies and specifically discuss how these ideas were generated, implemented and evaluated. Further research on using big data to study the pro-sustainable behaviors of visitors from different countries could provide a global insight on the behavioral patterns of visitors toward climate change action in the tourism context, and the results could help in developing strategies for tourism flow, taxation, pricing, and offerings to minimize the environmental impacts of tourism. This study benefits from the advantages of mixed methods to address the limitations of quantitative (limited outcomes and lack of control in the research setting and in-depth understanding of complex eco-societal phenomena) and qualitative (relatively small sample size and lack of generalizability of findings) methods. Further research

can use more innovative mixed methods (e.g., experiment and data mining) to address the aforementioned methodological limitations of this study.

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**Supplementary A**

Definition of constructs used to predict pro-sustainable behavioral intentions.

| Configuration | Construct | Definition | Source |
|---|---|---|---|
| Destination Social Responsibility | Economic | Refers to a destination's effort to provide direct and indirect economic impacts to the community and other stakeholders and pursue long-term economic development. | Su & Swanson (2017); Su et al. (2020c) |
| | Socio-cultural | Refers to a destination's effort to provide benefits to society and consider its impact on the community and to preserve cultural heritage and values. | Su et al. (2020c) |
| | Environmental | Refers to a destination's effort to pursue pro-sustainable practices and protect natural resources and biodiversity at a destination. | Su & Swanson (2017); Tran et al. (2018) |
| Climate Change Perception | Awareness | Indicates the extent to which individuals are aware of the severity and types of climate change impacts. | Kim & Hall (2019); Marshall et al. (2013) |
| | Beliefs | Refers to beliefs that individuals hold about the impact of climate change on their own and other people's lives as well as society. | |
| | Concerns | Defines as the extent of concern about threats to human society and the natural environment caused by climate change. | |
| Pro-sustainable Behavioral Intentions | Willingness to sacrifice | Indicates visitors' willingness to choose sustainable tourism options. | Landon et al. (2018) |
| | Localism | Refers to visitors' intention to respect and help the local community and the well-being of the local people. | Boley, Nickerson, & Bosak, (2011); Landon et al. (2018) |
| | Eco-behavior | Refers to visitors' intent to engage in individual behavior that minimizes environmental harm during a trip. | Landon et al. (2018) |

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**Supplementary B**

Results of confirmatory factor analysis and normality.

| Constructs | Factor loading | t-value | Mean | SD* | Kurto-sis | Skew-ness | VIF** |
|---|---|---|---|---|---|---|---|
| **Economic** DSR ("I thought that local authorities, service providers, and companies in Jeju, Gyeongju . . . ") | | | | | | | |
| 1. keep strict control over their cost. | 0.797 | 48.374 | 4.014 | 1.314 | -0.218 | -0.076 | 1.604 |
| 2. try to ensure their survival and long-term success. | 0.797 | 47.686 | 4.795 | 1.222 | 0.209 | -0.553 | 1.680 |
| 3. try to improve their economic performance. | 0.730 | 31.113 | 4.914 | 1.091 | 0.356 | -0.483 | 1.468 |
| 4. try to give back benefits from local tourism to the local community. | 0.839 | 63.760 | 4.340 | 1.206 | 0.108 | -0.175 | 1.783 |
| 5. encourage tourists to consume/use local products. | - | - | - | - | - | - | - |
| **Socio-cultural DSR** ("I thought that local authorities, service providers, and companies in Jeju, Gyeongju . . . ") | | | | | | | |
| 1. are concerned with improving the general well-being of society. | 0.854 | 82.644 | 4.533 | 1.211 | 0.115 | -0.324 | 2.546 |
| 2. provide experience for tourists through meaningful connections with local people and understanding of local culture. | 0.850 | 80.890 | 4.656 | 1.266 | -0.025 | -0.430 | 2.581 |
| 3. give full consideration to its impact on the community. | 0.837 | 66.333 | 4.897 | 1.137 | 0.564 | -0.582 | 2.544 |
| 4. protect the traditional culture of the community. | 0.779 | 49.409 | 5.091 | 1.232 | 0.481 | -0.688 | 2.081 |
| 5. play a role in society that goes beyond mere profit generation. | 0.871 | 93.786 | 4.406 | 1.268 | -0.124 | -0.193 | 2.870 |
| 6. act ethically and obey all legal obligations to fulfill their social responsibilities. | 0.870 | 101.893 | 4.415 | 1.179 | 0.199 | -0.150 | 2.753 |
| **Environmental DSR** ("I thought that local authorities, service providers, and companies in Jeju, Gyeongju . . . ") | | | | | | | |
| 1. are environmentally responsible in conducting their operations. | 0.876 | 105.132 | 4.345 | 1.245 | 0.049 | -0.264 | 3.007 |
| 2. use energy efficiently to protect the environment and recycle waste. | 0.873 | 87.503 | 4.328 | 1.279 | 0.021 | -0.232 | 2.909 |
| 3. communicate to tourists about their environmental practices. | 0.872 | 91.059 | 4.274 | 1.319 | -0.266 | -0.207 | 2.906 |
| 4. are concerned with respecting and protecting the natural environment. | 0.836 | 68.564 | 4.678 | 1.262 | 0.158 | -0.471 | 2.519 |
| 5. encourage tourists to be environmentally friendly. | 0.879 | 88.446 | 4.358 | 1.262 | -0.082 | -0.166 | 3.068 |
| 6. offer environmentally friendly products and travel programs. | 0.876 | 102.182 | 4.332 | 1.256 | -0.032 | -0.262 | 3.022 |
| **Climate change awareness** | | | | | | | |
| 1. I think that the climate crisis is occurring. | 0.879 | 55.102 | 6.122 | 0.934 | 3.402 | *-1.434* | 2.069 |
| 2. I think climate change is recently accelerating. | 0.887 | 61.764 | 6.201 | 0.892 | 2.405 | *-1.317* | 2.122 |
| 3. I think climate change is occurring in various forms. | 0.852 | 48.430 | 6.097 | 0.882 | 2.606 | *-1.217* | 1.891 |
| **Climate change belief** | | | | | | | |
| 1. I believe that the impact of climate change on our society is serious. | 0.866 | 61.469 | 6.016 | 1.025 | *2.739* | *-1.367* | 2.019 |
| 2. I believe that climate change will have a negative impact on people. | 0.877 | 69.126 | 5.916 | 0.997 | *2.589* | *-1.246* | 2.143 |
| 3. I believe that climate change will have a negative impact on my life. | 0.887 | 82.303 | 5.597 | 1.079 | *1.470* | -0.932 | 2.051 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Climate change concern** | | | | | | | |
| 1. I am concerned about climate change. | 0.892 | 74.244 | 5.958 | 1.030 | 3.489 | *-1.448* | 2.436 |
| 2. I am alarmed about the reasons for climate change. | 0.899 | 102.704 | 5.634 | 1.082 | *1.887* | *-1.057* | 2.095 |
| 3. I am worried about the consequences of climate change. | 0.873 | 62.269 | 5.941 | 1.040 | 3.545 | *-1.466* | 2.310 |
| **Willingness to sacrifice** | | | | | | | |
| 1. I am willing to pay more for travel if it helps the environment | 0.862 | 71.846 | 4.765 | 1.259 | 0.420 | -0.549 | 2.593 |
| 2. I am willing to purchase environmentally friendly tourism products even if they may be more expensive | 0.880 | 83.520 | 4.697 | 1.236 | 0.162 | -0.404 | 2.927 |
| 3. I am willing to use environmentally friendly means of transportation although this might take more time | 0.857 | 56.924 | 4.643 | 1.318 | -0.036 | -0.374 | 2.828 |
| 4. I am willing to use environmentally friendly means of transportation although this may be more expensive | 0.904 | 135.374 | 4.570 | 1.313 | -0.094 | -0.306 | 3.647 |
| 5. I am willing to pay more to stay at environmentally friendly accommodations | 0.889 | 113.503 | 4.525 | 1.298 | 0.007 | -0.364 | 3.124 |
| **Localism** | | | | | | | |
| 1. Stay at locally owned accommodations | 0.831 | 65.062 | 4.746 | 1.295 | -0.080 | -0.448 | 1.479 |
| 2. Eat locally sourced food | - | - | - | - | - | - | - |
| 3. Hire local guide services/tour operators | 0.764 | 38.487 | 3.871 | 1.507 | -0.635 | -0.112 | 1.287 |
| 4. Purchase locally produced crafts and goods | 0.781 | 38.556 | 4.822 | 1.303 | 0.534 | -0.715 | 1.412 |
| **Eco-behavior** | | | | | | | |
| 1. Separate recycling from waste | - | - | - | - | - | - | - |
| 2. Reuse bath linens during consecutive days stayed at accommodations | - | - | - | - | - | - | - |
| 3. Use eco-friendly tour operators | 0.907 | 103.529 | 4.580 | 1.320 | 0.184 | -0.450 | 1.701 |
| 4. Use reusable shopping bags | - | - | - | - | - | - | - |
| 5. Use tourist facilities that aim for eco-friendly tourism | 0.905 | 88.212 | 4.952 | 1.196 | 0.468 | -0.531 | 1.701 |

*Note*: The items in italics have a non-normal distribution. *Standard deviation. **Variance inflation factor of multicollinearity. DSR: Destination social responsibility. -: Items are deleted after confirmatory factor analysis.

## Supplementary C

Demographics of the respondents.

| Characteristics | 1031 (n) | 100 (%) | Characteristics | 1031 (%) | 100 (%) |
|---|---|---|---|---|---|
| **Gender** | | | **Domestic destinations traveled to in the last 2-3 ys**** | | |
| Male | 526 | 51.0 | Gangneung | 531 | 51.5 |
| Female | 505 | 49.0 | Geoje island | 321 | 31.1 |
| Other | 0 | 0.0 | Gyeongju | 629 | 61.0 |
| **Age** | | | Suncheon | 279 | 27.1 |
| Between 20 and 29 years old | 186 | 18.0 | Jeonju | 331 | 32.1 |
| Between 30 and 39 years old | 216 | 21.0 | Jeju island | 697 | 67.6 |
| Between 40 and 49 years old | 212 | 20.6 | Buyeo | 155 | 15.0 |
| Between 50 and 59 years old | 246 | 23.8 | Danyang | 233 | 22.6 |
| 60 years old and over | 171 | 16.6 | **Places most recently traveled to** | | |
| **Education level** | | | Gyeongju | 492 | 47.7 |
| Less than or high school diploma | 131 | 12.7 | Jeju island | 539 | 52.3 |
| 2-year college | 166 | 16.1 | **Types of destinations recently traveled to** | | |
| University | 598 | 58.0 | Natural tourist attractions | 596 | 57.8 |
| Graduate school or higher | 136 | 13.2 | Historical tourist attractions | 435 | 42.2 |
| **Marital status** | | | **More domestic travel compared to before COVID-19** | | |
| Single | 347 | 33.7 | Yes | 293 | 28.4 |
| Married | 653 | 63.3 | No | 619 | 60.1 |
| Other | 31 | 3.0 | Same | 119 | 11.5 |
| **Occupation** | | | **More concern for climate change after COVID-19** | | |
| Office workers (sales workers) | 348 | 33.8 | Strongly disagree | 11 | 1.1 |
| Professional/technical | 210 | 20.4 | Disagree | 21 | 2.0 |
| Entrepreneur/self-employed | 94 | 9.1 | Somewhat disagree | 85 | 8.2 |
| Service industry | 56 | 5.4 | Neither agree nor disagree | 180 | 17.5 |
| Public officials (public institutions) | 63 | 6.1 | Somewhat agree | 255 | 24.7 |
| Homemaker | 127 | 12.3 | Agree | 343 | 33.3 |
| Student | 50 | 4.8 | Strongly agree | 136 | 13.2 |
| Retirees | 41 | 4.0 | **Monthly personal income** | | |
| Other | 42 | 4.1 | Less than KRW*** 1.0 million | 81 | 7.9 |
| **Residential area** | | | KRW 1.0 – less than 2.0 million | 116 | 11.3 |
| Seoul metropolitan area | 547 | 53.0 | KRW 2.0 – less than 3.0 million | 282 | 27.4 |
| Non-metropolitan area | 484 | 47.0 | KRW 3.0 – less than 4.0 million | 160 | 15.5 |
| | | | KRW 4.0 – less than 5.0 million | 151 | 14.6 |
| | | | KRW 5.0 million and more | 241 | 23.4 |

Note: *The average mean time taken for answering the survey is 10.1 minutes. **Multi-choice item. ***KRW: Korean won. US$ 1 = KRW 1,158 as of August 15, 2021.

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**Supplementary D**

Common method bias tests.

| Test method | Test | Result |
|---|---|---|
| Harmon single-factor test | Four factors appeared<br>(the total 64.2% variance explained)<br>First factor: 33.9%<br>Second factor: 17.7%<br>Third factor: 9.5%<br>Fourth factor: 3.1% | Since more than one factor appears, and the first factor has less than 50% variance, common method bias is not an issue (Podsakoff et al., 2003). |
| Marker variable approach: Correlations between the marker variable (personal level perception of COVID-19 threat) and all the constructs in the research model | 1. Economic DSR: 0.057<br>2. Socio-cultural DSR: 0.094<br>3. Environmental DSR: 0.052<br>4. Climate change awareness: 0.337<br>5. Climate change belief: 0.428<br>6. Climate change concern: 0.415<br>7. Willingness to sacrifice: 0.121<br>8. Localism: 0.091<br>9. Eco-behavior: 0.120<br>The average of squared multiple:<br>correlations with marker variable: 0.143: | Since the correlations are low and the average of squared multiple correlations with the marker variable was insignificant, common method bias is not an issue (Lindell & Whitney, 2001). |

*Note:* All tests show that common method bias is not a problem in this study.

**Supplementary E**
Interview details.

| **Expert no.** | **Sector** | **Role** | **Area of expertise** |
|---|---|---|---|
| E1 | 3rd sector organization-International NGO | CEO | Sustainable tourism |
| E2 | Government-Tourism Organization | Director | Marketing |
| E3 | Industry- Travel agency | CEO | Tourism |
| E4 | 3rd sector organization-National NGO | Director | Sustainable tourism |
| E5 | Government- travel and transport department | Officer | Visitor economy |
| E6 | Industry | Tour operator | Tourism |
| E7 | Industry- Travel agency | Agent | Marketing |
| E8 | Academia | Research center head | Climate change |
| E9 | Industry-hotel | Front line employee | Hospitality |
| E10 | Industry- destination marketing company | Manager | Tourism economics |
| E11 | Academia | Dean | Smart city development |
| E12 | Academia | Journal editor | Smart tourism |
| E13 | Government-Tourism organization | President | Tourism policy |
| E14 | Academia | Director of research center | Big data analytics and artificial intelligence |
| E15 | Industry- company | CEO | Sustainable consumption |
| E16 | 3rd sector organization-National NGO | President | Sustainable Management |
| E17 | Industry-restaurant | CEO | Sustainable destination |
| E18 | Academia | Senior Researcher | Sustainable tourism |
| E19 | Government-Tourism | President | Tourism policy |

**Supplementary F**
Interview Questions

1. Can you please briefly talk about your background and your role?
2. Overall, how do you feel about the engagement of visitors in pro-sustainable actions?
3. In your opinion, what new policy should be developed to enhance the pro-sustainable behaviors of visitors?
4. Is there any policy that needs to be changed to nudge pro-sustainable behaviors?
5. In your opinion, how can the expectations, demands, and preferences of visitors be changed to manage the destination sustainably?
6. Based on your experience, what educational program or knowledge exchange plan can contribute to the sustainable management of destinations?
7. In your opinion, how can pro-sustainable behaviors be incentivized?
8. How should climate change concerns be communicated?
9. What technology helps tackle climate change and improve pro-sustainable behaviors?
10. What key actor groups should be involved in the sustainable management of destinations?
11. Do you have any other recommendations/solutions on combating climate change to manage the destination more responsibly?

## Supplementary G

Reliability and discriminant validity.

| Construct | Heterotrait-Monotrait Ratio (< 0.9) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. Economic DSR | **0.792** | | | | | | | | |
| 2. Socio-cultural DSR | 0.791 | **0.844** | | | | | | | |
| 3. Environmental DSR | 0.712 | 0.821 | **0.869** | | | | | | |
| 4. Climate change awareness | 0.058 | 0.050 | -0.009 | **0.873** | | | | | |
| 5. Climate change belief | 0.061 | 0.078 | 0.020 | 0.669 | **0.877** | | | | |
| 6. Climate change concern | 0.083 | 0.091 | 0.046 | 0.724 | 0.757 | **0.888** | | | |
| 7. Willingness to sacrifice | 0.309 | 0.319 | 0.359 | 0.186 | 0.277 | 0.341 | **0.879** | | |
| 8. Localism | 0.392 | 0.385 | 0.435 | 0.127 | 0.172 | 0.233 | 0.553 | **0.792** | |
| 9. Eco-behavior | 0.356 | 0.362 | 0.401 | 0.200 | 0.295 | 0.340 | 0.717 | 0.613 | **0.906** |
| Cronbach's alpha $\geq$ 0.7 | 0.935 | 0.919 | 0.935 | 0.844 | 0.85 | 0.867 | 0.926 | 0.703 | 0.782 |
| Rho_A $\geq$ 0.7 | 0.938 | 0.929 | 0.938 | 0.846 | 0.854 | 0.886 | 0.928 | 0.707 | 0.782 |
| Composite reliability$\geq$ 0.7 | 0.949 | 0.937 | 0.949 | 0.906 | 0.909 | 0.918 | 0.944 | 0.835 | 0.902 |
| AVE $\geq$ 0.5 | 0.755 | 0.712 | 0.755 | 0.762 | 0.768 | 0.788 | 0.772 | 0.628 | 0.821 |
| Effect size ($Q^2$) > 0 | - | - | - | - | - | - | 0.186 | 0.150 | 0.220 |
| Standardized root mean squared residual (SRMR) of model fit: 0.076 < 0.09 | | | | | | | | | |

*Note:* -: Exogenous variables influence endogenous variables, so only endogenous variables have an effect size in causal modeling.

**Supplementary H**

Results of the analysis of necessary condition (ANC) to predict pro-sustainable behavioral intentions

| **Antecedent condition** | **Outcome: Willingness to sacrifice** | | **Results** |
|---|---|---|---|
| | Coverage | Consistency | |
| Economic DSR | 0.863 | 0.835 | Unnecessary |
| Socio-cultural DSR | 0.848 | 0.860 | Unnecessary |
| Environmental DSR | 0.882 | 0.813 | Unnecessary |
| Climate change awareness | 0.714 | 0.988 | Necessary |
| Climate change beliefs | 0.741 | 0.981 | Necessary |
| Climate change concerns | 0.739 | 0.977 | Necessary |
| **Antecedent condition** | **Outcome: localism** | | |
| | Coverage | Consistency | |
| Economic DSR | 0.847 | 0.861 | Unnecessary |
| Socio-cultural DSR | 0.829 | 0.882 | Unnecessary |
| Environmental DSR | 0.864 | 0.837 | Unnecessary |
| Climate change awareness | 0.680 | 0.987 | Necessary |
| Climate change beliefs | 0.705 | 0.980 | Necessary |
| Climate change concerns | 0.702 | 0.974 | Necessary |
| **Antecedent condition** | **Outcome: Eco-behavior** | | |
| | Coverage | Consistency | |
| Economic DSR | 0.886 | 0.829 | Unnecessary |
| Socio-cultural DSR | 0.873 | 0.854 | Unnecessary |
| Environmental DSR | 0.902 | 0.803 | Unnecessary |
| Climate change awareness | 0.737 | 0.985 | Necessary |
| Climate change beliefs | 0.765 | 0.978 | Necessary |
| Climate change concerns | 0.763 | 0.974 | Necessary |

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## Supplementary I

Sufficient causal configurations for three pro-sustainable behavioral intentions.

| **A: Solutions for willingness to sacrifice** (Coverage: 0.980; Consistency: 0.758) | Raw coverage | Unique coverage | Consistency |
|---|---|---|---|
| AWCC*BECC*COCC | 0.967 | 0.215 | 0.762 |
| AWCC *ECDSR*SCDSR*ENDSR | 0.755 | 0.004 | 0.908 |
| ~COCC*ECDSR*SCDSR*ENDSR | 0.235 | 0.002 | 0.959 |
| AWCC*~COCC* ~ECDSR*~SCDSR*~ENDSR | 0.215 | 0.001 | 0.958 |
| ~AWCC*~BECC*~COCC*~ECDSR*SCDSR*~ENDSR | 0.160 | 0.003 | 0.978 |
| **B: Solutions for localism** (Coverage: 0.978; Consistency: 0.722) | | | |
| AWCC*BECC*COCC | 0.965 | 0.120 | 0.724 |
| AWCC *ECDSR*SCDSR*ENDSR | 0.784 | 0.004 | 0.897 |
| ~COCC*ECDSR*SCDSR*ENDSR | 0.249 | 0.002 | 0.966 |
| AWCC*BECC*~ECDSR*~SCDSR*~ENDSR | 0.450 | 0.002 | 0.883 |
| **C: Solutions for eco-behavior** (Coverage: 0.973; Consistency: 0.781) | | | |
| AWCC*BECC*COCC | 0.962 | 0.150 | 0.785 |
| AWCC *ECDSR*SCDSR*ENDSR | 0.745 | 0.004 | 0.928 |
| ~COCC*ECDSR*SCDSR*ENDSR | 0.228 | 0.001 | 0.965 |
| AWCC*BECC*~ECDSR*~SCDSR*~ENDSR | 0.428 | 0.002 | 0.912 |

*Note:* * denotes interaction between conditions. ~ denotes negation. AWCC: Climate change awareness; BECC: Climate change belief; COCC: Climate change concern; ECDSR: Economic DSR; SCDSR: Socio-cultural DSR; ENDSR: Environmental DSR.