



Awareness and willingness to engage in climate change adaptation and mitigation: Results from a survey of Mediterranean islanders (Lesvos, Greece)

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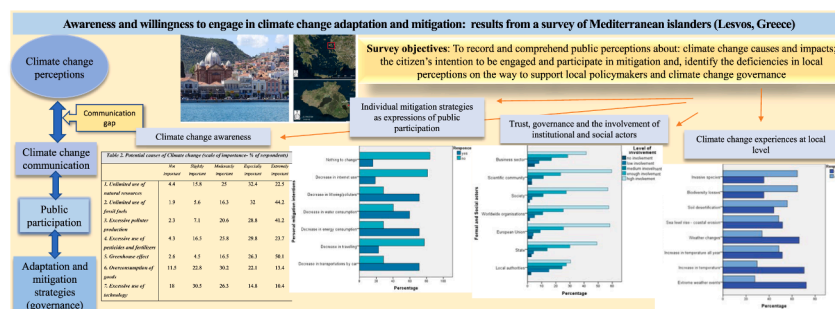
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HIGHLIGHTS

- Respondents acknowledge the existence of climate change and identify several anthropogenic causes as contributors.
- Respondents are inclined to trust formal institutions for climate change governance, but they are skeptical of their management outcomes.
- Most respondents are positive about making lifestyle changes and half of them intend to pay for mitigation/adaptation reasons, primarily for environmental protection and intragenerational justice.
- Audience-specific information campaigns, publicity, and educational initiatives can help authorities activate people to adopt new habits and make lifestyle changes by enhancing their understanding of the relationship between lifestyle and climate change.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Climate change perceptions
Awareness
Public participation
Engagement
Governance

ABSTRACT

Climate change has recently received a lot of media attention as a serious phenomenon; as a result of witnessing losses in lives and property, people are becoming increasingly aware of its effects. If climate change issues are misunderstood, people may be less likely to participate in adaptation and mitigation efforts and in the co-production of climate services. This paper contributes to the field of perception studies by providing a case study that could advise local policymaking. Residents of the Greek coastal city of Mytilene (Lesvos Island) were questioned about their opinions on climate change issues. According to the study's findings, respondents recognize the existence of climate change and are likely to take actions to address it. They also acknowledge that various anthropogenic causes, activities, and uses contribute to climate change (i.e., greenhouse gasses,

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pollution, and transportation). Most participants associate climate change with global warming and sea level rise/coastal erosion, whereas at a local level, they associate it primarily with weather-related phenomena. They are more likely to rely on formal institutions to address climate change challenges but are skeptical of management outcomes. The majority of respondents appear to be positive about making lifestyle changes, and half are willing to pay for mitigation/adaptation measures, primarily to ensure environmental protection and intragenerational justice. Because respondents appear to be unaware of their critical role, authorities must invest in a continuous effort of empowering and engaging them in both adaptation and mitigation practices and include them in the co-production of locally oriented climate services.

Practical implications

Climate change has received a lot of attention as a worldwide issue since humanity realized that something is changing. Despite the fact that international and European organizations have recognized the issues that humanity will confront in the (not-too-distant) future, the average person is unaware and unprepared. As stated in the European Commission's communication, people must recognize their unique role in adaptation and mitigation activities. (European Commission, 2021), in order to contribute to the co-production of climate services. The main objective of climate services is to assist society in adapting to and confronting climate change challenges by utilizing all available climate change information to aid decision-making (WMO, 2014). The underlying idea behind this case study is that if we want people to follow and support adaptation/mitigation strategies, we must first ensure that they have access to critical information and knowledge. Prior to disseminating information, it is vital to examine what individuals currently know, comprehend, and misunderstand. Climate change policy objectives must thus be met through the implementation of dissemination initiatives. The preceding mental process is considered a model in the current case study, which takes place in Mytilene, a Greek insular city. It has practical significance because the municipality of Mytilene recently agreed to join the European Union's mission for climate-neutral and smart cities by 2030 (European Commission, 2021). This initiative tries among other things, to change citizens' perspectives, through awareness-raising efforts and cooperation between several institutional and non-institutional partners (family, education, mass media, state, and local authorities). As a result, this work may provide early guidance to local authorities and policymakers on how to proceed in achieving the goals of such involvement.

As demonstrated by the study, residents of Mytilene recognize climate change as a worldwide concern and recognize its local manifestations. In particular, they acknowledge forest fires, sea level rise, coastal erosion, and weather-related events, as some of Greece's most pressing challenges, providing insight into specific climate services. They are able to distinguish between anthropogenic causes and consequences; yet, they are unaware of the causal link between energy needs and consumption patterns (including tourism), implying that accurate climate information must be provided. They are willing to make changes in their lives to support mitigation efforts. Policymakers should support this optimistic intention and help people enhance a sustainable way of life.

Funding for climate change adaptation and mitigation is a critical issue. Are respondents willing to provide funds to such priorities? They are divided but given the Greek economy's difficulties and the population's available income, this is reasonable. Environmental preservation and intergenerational justice were the two most often given rationales, both provided by half of those surveyed. Sustainability considerations are about expressing our concerns about the lives of future generations. The objective of mitigation strategies is to safeguard future generations' rights. As a result, disseminating mitigation strategies should be motivated by people's concerns about future generations. An ambitious finding is that nearly half of the respondents expect to fund adaptation and mitigation projects (as well as climate services).

(Mis)trust in authorities, institutions, and formal agents is a major barrier to the acceptance and implementation of adaptation and

mitigation policies. Respondents attribute the higher involvement to a number of formal actors including the scientific community, European, national, and local authorities. Furthermore, they support the outsourcing of Climate Change (CC) governance to formal institutions but are skeptical of the management they provide, which is contradictory to their perceptions about formal actors' involvement. Skepticism or uncertainty about adaptation or mitigation policies impedes their effective and prompt implementation. The issue of trust is critical because the public, as an end-user, must support and consent to climate information and solutions offered by the most relevant stakeholders (i.e., the scientific community, organizations, etc. which manage and diffuse climate change information). Public engagement in decision-making processes and hybrid methods that include multiple forms of participation, allow for the inclusion of a broader spectrum of people, rather than just "elite" stakeholders.

People acknowledge and perceive climate change as a worldwide problem, but by "localizing" the concerns, adaptive and mitigation measures may be successfully implemented before communities experience the adverse consequences of climate change. It has been demonstrated that people identify the impacts of climate change that they might experience or witness. Respondents in Mytilene appear to be puzzled about how climate change affects them. While they perceive the level of risk to be moderate, adaptation measures are likely to be ignored because they consider climate change as a distant threat. This is an important issue because adaptation, mitigation, and climate services are essentially dedicated to future living conditions. Furthermore, the majority of them do not believe that climate change will have an effect on their daily lives. Since the threat is no longer so distant, this perception needs to be changed. On the contrary, the majority, claimed that CC had threatened them, and they generally allude to weather-related incidents as a problem. Climate information must strive to broaden this narrow perspective.

Authorities and managers must invest in climate change communication and employ all available techniques to engage and organize society against climate change. Furthermore, because the general public is an end-user of climate services, the findings of this study may assist local planners and managers in meeting the needs of their community.

1. Introduction

Climate change (CC) has gained attention in public discourse in recent years, and people are becoming increasingly aware of its consequences, which include both human and direct asset losses. Public policy addresses various approaches to dealing with CC challenges globally (e.g., the Paris Agreement in 2015) or regionally (e.g., the European Union's CC strategy in 2021). In terms of the Mediterranean, researchers describe it as a CC hotspot (Ali et al., 2022). This highlights the multiple challenges and threats that people face, as well as the importance of participating in relevant decision-making processes. As a result, the requirement for public participation is present in many EU directives like Directive 2014/89/EU (European Union, 2014) in order for adaptation and mitigation strategies to be successful (Wolf & Moser, 2011; Catino and Reckien, 2021; European Commission, 2021).

The production of climate services (European Commission, 2015) necessitates this type of alliance (Hewitt and Stone, 2021). The main

objective of climate services is to assist society in adapting to and confronting climate change by utilizing all available climate change information to support decision-making (WMO, 2014). As climate services are being developed to meet the needs of end-users (<https://www.climateurope.eu/definitions-climate-services/>, 2023), methods to ensure end-user participation in identifying their own needs are needed for the success of national efforts (WMO, 2013). Because the general population is regarded as an end-user, we must endeavor to understand its climate change perceptions to provide more successful, practical, and locally oriented-climate services (Martinez et al., 2022).

Public perceptions of CC are required for addressing adaptation and mitigation programs, mobilizing people to confront threats and challenges, and working on mitigation solutions, such as reducing carbon dioxide emissions through a sustainable lifestyle model (Wolf & Moser, 2011; Pierrehumbert, 2019; Wang & Zhou, 2020). In this context, studies on people's perceptions can aid decision-making and ensure that public participation results in effective climate services (Williams and Jacob, 2021).

This study contributes to the growing body of CC perception studies, with a goal of incorporating useful information on public perceptions into decision-making and climate service co-production. More specifically, the purpose of the case study is to document and comprehend public perceptions of CC in Mytilene (the capital of Lesbos Island, Greece), its causes, impacts, and threats, as well as citizens' willingness to engage and participate in the mitigation process. Finally, it serves as a diagnostic tool for examining the perceptions, intentions, and deficiencies of the islander community to provide insights to local policymakers. This effort is essential because islands are likely to be subjected to more intense CC impacts (Mycoo et al. 2022), particularly in the Mediterranean Sea (Ali et al., 2022).

The first part of this paper addresses concepts related to CC perceptions. Its main themes help to improve understanding of CC communication, the role of public participation, the gap between public and scientific perspectives, and the value of a social learning process. The second section focuses on the case study and includes sections on results, discussion, and conclusion.

2. Theoretical framework: Simplifying climate change perception issues

2.1. Understanding climate change perceptions

Perceptions are shaped individually and subjectively based on personal views and interpretations of the phenomena related to or attributed to CC. The diversity of perceptions can be ascribed to the effects of CC and vary across societies, cultures, and natural environments (Papoulis et al., 2015; Becerra et al., 2020). Several studies have been conducted in recent years focused on how CC affects working life and recreation (Morzaria-Luna et al., 2014; Fatorić et al., 2017), health issues (Akerlof et al., 2015; Graham et al., 2019), and economics (Foguesatto et al., 2019; Torres-Bagur et al., 2019; Wang and Zhou, 2020).

Other studies give emphasis to risk perceptions about community resilience and adaptation to floods, erosion, water scarcity, droughts, and extreme natural events (Barr & Woodley, 2019; Antronico et al., 2020). Although risk perception and actual behavior do not always have a positive relationship, risk perception could be viewed as a determinant for participation in mitigation strategies (Becerra et al., 2020; Graham et al., 2019; Xie et al., 2019).

Many factors influence CC perceptions (Ruiz et al., 2020). Socio-demographic characteristics such as gender, age, income, and education have been identified as major drivers in some studies (Wolf & Moser, 2011; Voskaki and Tsermenidis, 2015; Antronico et al., 2020; Echavarren et al., 2019; Fatorić et al., 2017; Lorencová et al., 2019; Wang and Zhou, 2020). Other perceptions predictors (Sullivan & White, 2019) are attributed to political preferences (Akerlof et al., 2015; Sun & Han,

2018; Echavarren et al., 2019; Hornsey & Fielding, 2020) and world views (Weber, 2016). Environmental consciousness and social trust also serve as key predictors (Kuei Tien, 2013; St-Laurent et al., 2018). Furthermore, personal experience of an extreme weather event shapes perceptions (Weber, 2016; Zanocco et al., 2018; Lorencová et al., 2019; Sisco, 2021), since it works as proof for the existence of CC (Weber, 2016). As Wolf & Moser (2011) precisely note, "Climate change is perceived through the lenses of pre-existing cultural world views".

2.2. Climate change communication and public participation

Public participation is critical for the effectiveness of adaptation/mitigation strategies, and the delivery of climate services. and it must embrace a bidirectional flow of information (Hügel and Davies, 2020). Generally, understanding stakeholders' perceptions could advise policymakers and authorities to make efficient and viable decisions (Lorencová et al., 2019; Antronico et al., 2020; Portman and Zhulpa 2020).

CC awareness levels, as expressed through perceptions, interact directly with the acceptance of adaptation or mitigation measures (Lorencová et al., 2019) like the acceptance of higher prices for funding mitigation (Chang, 2018). The slow response of human societies (Howe, 2021) is justified, since CC is considered as a distant threat (Wolf & Moser, 2011; Weber, 2016). Public participation may expand as awareness grows (Reimann et al., 2021; Vollstedt et al., 2021).

A consensus in social acceptability among various groups of stakeholders (politicians, scientists, local societies, NGOs, etc.) and different levels of governance (European Commission, 2021) is a prerequisite for the success of measures. Trust in formal institutions is identified as a requirement for effective CC governance (Papoulis et al., 2015), and its absence unquestionably leads to ineffective governance and unsuccessful measures (Steenjtes et al., 2017; Sullivan & White, 2019).

Communication strategies are knowledge-raising tools that can help shape or change attitudes and behaviors (Otto-Banaszak et al., 2011; Voskaki and Tsermenidis, 2015; Hagen et al., 2016; Chang, 2018), and support the development of climate services while their absence poses difficulties in confronting CC challenges (Bonatti et al., 2019). Different scientific fields study CC under their scope and use complex technical and scientific terms (Steenjtes et al., 2017) that the general public is unable to understand. As a result of this situation, the public is excluded from the decision-making process, resulting in the so-called "communication gap" (Barr & Woodley, 2019). This gap could be filled by implementing a social learning process that leads to consensus among all participants in the CC dialogue, understanding each participant's mental models (Otto-Banaszak et al., 2011), and through the engagement and the empowerment of the public (Weber, 2016; Barr & Woodley, 2019). This might encourage the skeptical part of society to climate action (Hornsey and Fielding, 2020). As a result, there is a need to embrace social climate services in people's daily routines and social networks (Bremer et al., 2022) to assist those who need them to adapt more than people who have already the capacity to adapt (Williams and Jacob, 2021).

The social learning process is undoubtedly more efficient if it is locally oriented (Wolf and Moser, 2011; Jones et al., 2014; Wang and Zhou, 2020). After the many barriers are removed (Suhari et al., 2022), a locally oriented analysis of the numerous characteristics of the local environment is a prerequisite for establishing a co-production of climate services that fulfill the needs of actual people (Steynor et al., 2021; Martinez et al., 2022). A local orientation approach may motivate more people to participate since it personalizes and brings closer CC threats and impacts (Steenjtes et al., 2017; Barr and Woodley, 2019; Bonatti et al., 2019).

3. Materials and methods

3.1. The study site

Lesvos Island (Fig. 1) is located in the northeast Aegean Sea, and Mytilene (Fig. 2) is the capital and main port city (Northeast Mediterranean Sea). Mytilene has 29,656 inhabitants, while the island's total population is 86,436 (Hellenic Statistical Authority, 2014). Lesvos' coastline is 382 km long. The two semi-enclosed bays, Kalloni to the west, and Gera to the southeast, form the island's shape.

Several case studies quantify island's existing coastal erosion (Tourlioti et al., 2021), land degradation (Kosmas et al., 2000) and future water scarcity (Nabih et al., 2021), as well as the vulnerability of its fishing ports (Kontogianni et al., 2019), the resilience of the touristic beaches (Monioudi et al., 2017; Tzoraki et al., 2018) and the invasion by exotic plant species (Gritti et al., 2006). All these findings have some reference to CC. For instance, the study of Koutsovili et al. (2021) predicts significant variation of seasonal and annual scale forecasting of long-term average discharges and a general upward trend of actual evapotranspiration losses.

Recently, the municipality of Mytilene agreed to join the European Union's mission for climate-neutral and smart cities by 2030 (European Commission, 2021), aiming, among other objectives, to change citizens' mentalities through awareness raising and encouraging collaboration

among several institutional and non-institutional partners (family, education, mass media, state, and local authorities) (Lesvosnews.net, 2023). Therefore, this work could provide local authorities with an initial consultation on how to proceed to achieve the objectives of such engagement.

3.2. The survey sample and the research tool

Questionnaires are a popular tool in social surveys to gather information and access the perceptions, knowledge, and beliefs of the local population, also being used broadly for risk analysis purposes (Poljanšek et al., 2017). The objective of the present study was twofold. Primarily, to gather information about issues related to CC in the frame of both a global and local perspective; and secondly, to explore perceptions regarding CC issues (causes, impacts, policy, and strategies) and to identify the main factors that influence them among local population. This analysis stands in favor of successful adaptation and mitigation efforts. Additionally, it supports governance (authorities and policy-makers) to implement more tailor-made measures by setting the priorities to encourage local engagement.

According to the size of Mytilene's population, the sample size required for this study was 649 people with a 99% confidence level, and a 5% margin error (RAOSOFT sample size calculator webpage). Only permanent adult residents of Mytilene aged 18 to 65 years old, having a

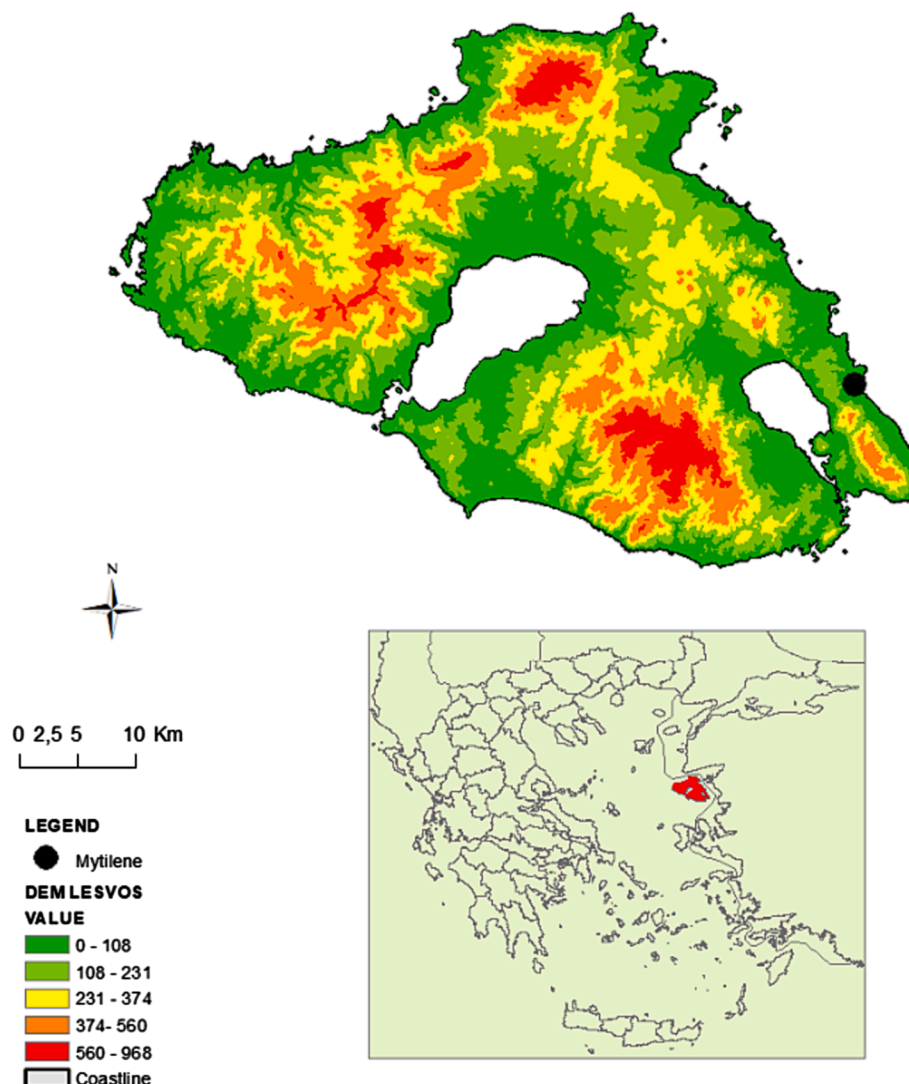


Fig. 1. Lesvos Island and the study site (map credited to the authors).



Fig. 2. View of the capital city Mytilene- port (photo credited to the authors).

job or being able to work, were allowed to participate. The survey, which was conducted in November 2019, was carried out through in-person interviews (using a questionnaire that was filled out anonymously), providing researchers the chance to explain the objectives of the study verbally and obtain participants' consent. Implementing a convenience sampling approach around places of significant activity in the city center (marketplace, port, and near the town hall) rendered 729 questionnaire responses. The researchers received eighty more than the requisite number of filled questionnaires while employing minimal time and human resources. The study represents a unique and novel approach for Lesbos island since there are only few studies concerning CC perceptions in Greece (Jones et al., 2014; Papoulis et al., 2015) and none regarding insular towns such as Mytilene which is located at the Easternmost periphery of the Greek islands. The voluntary character of the sample was the main constraint, along with the fact that specific age groups were left out (below 18 and above 65).

A structured questionnaire was designed to be as straightforward as possible; the use of complex phrases or overly scientific definitions was avoided. The questionnaire consisted of both open-ended and closed-ended scaled questions (in Likert scale) organized in six categories: a) sociodemographic characteristics (age, gender, educational level, occupation), b) CC perceptions and awareness, c) perceived CC causes, impacts, and threats, d) personal mitigation strategies (including willingness to pay for CC adaptation/mitigation measures), e) the role of global and local actors in CC governance, and f) local level experiences and valuation of the level of threat associated with CC impacts. Questionnaires were analyzed using IBM SPSS 23.

4. Results

A total of 729 responses were recorded with Table 1 summarizing the basic sociodemographic profile of the respondents.

Table 1

The sociodemographic characteristics of the sample.

Gender	Male: 50.8 % Female: 49.2 %
Age groups	18–25: 33.9 %, 26–35: 23.3 %, 36–45: 16.9 %, 46–55: 16 %
Educational level	Elementary school graduates: 1.6 %, High school graduates: 33.2 %, University degree/students: 45.1 %, MSc-PhD: 14.4 %, Other: 5.6 %
Occupation	Employees: 23.6 %, Civil servants: 18.2 %, Businesspeople: 15.4 %, Farmers: 8 %, Unemployed: 21 %, Other: 13 %

4.1. Awareness and perceptions of climate change and its causes

Most of the respondents are highly aware of CC (44.8 %), while only 20 % hold no or low degree of awareness, and the rest falling in the category of moderate awareness. This could be due to the sample's high proportion of young or middle-aged people. These respondents get their information from a variety of sources, including the internet (49.9 %), television shows (20.3 %), conferences (13.5 %), newspapers (8.3 %), and family and friends (7.9 %).

The highest importance (extremely and especially important) regarding the causes of CC (Table 2) is credited to the greenhouse effect and its triggers (pollution and the unlimited use of fuels). On the contrary, the lowest percentages (not important and slightly important) are attributed to overconsumption of goods and excessive use of technology, most likely due to respondents' inability to make a direct link between those causes and their energy needs.

In terms of CC generation mechanisms, transportation activities (72.9 %) and air conditioning (45.8 %) have the highest importance (especially and extremely important), while internet use (72 %) and travel/tourism (62.3 %) have the lowest or no importance at all. Because tourism is defined as a significant CC driver (World Tourism Organization UNWTO and International Transport Forum ITF, 2019), this finding reveals an inconsistency between people's perceptions and the reality.

4.2. Perceptions about climate change impacts

CC affects people in a variety of ways. When asked whether they agree or disagree that CC could impact their daily lives, and how they stated this, half of the respondents were found to be neutral (48.5 % neither agree/disagree). On the contrary, 30.7 % strongly agree (5-point scale of agreement) with the statement. Additionally, respondents can link CC with specific environmental phenomena and hazardous events (Table 3). Global warming and sea level rise/coastal erosion have, according to participants' views, the gravest impacts. The lowest percentages are ascribed to general economic consequences, most likely because people find it difficult to make a direct link between CC and economic impacts.

Regarding Greece's most significant problems, Respondents associate CC with its most visible impacts, such as forest fires (62.1 %), sea level rise, coastal erosion (58 %), and increased heating/cooling costs (58 %). Loss of income (41.4 %), health issues (45.6 %), and loss of arable land (45.7 %) receive the lowest scores (not and slightly

Table 2
Potential causes of CC (scale of importance- % of respondents).

	Not important	Slightly important	Moderately important	Especially important	Extremely important
1. Unlimited use of natural resources	4.4	15.8	25	32.4	22.5
2. Unlimited use of fossil fuels	1.9	5.6	16.3	32	44.2
3. Excessive pollutant production	2.3	7.1	20.6	28.8	41.2
4. Excessive use of pesticides and fertilizers	4.3	16.5	25.8	29.8	23.7
5. Greenhouse effect	2.6	4.5	16.5	26.3	50.1
6. Overconsumption of goods	11.5	22.8	30.2	22.1	13.4
7. Excessive use of technology	18	30.5	26.3	14.8	10.4

Table 3
Climate Change relevance/relation with specific phenomena (Scale of relevance-% of respondents).

	Not relevant	Slightly relevant	Moderately relevant	Especially relevant	Extremely Relevant
1. Global warming	1.8	2.9	8.8	35.2	51.3
2. Sea level rise/ coastal erosion	2.6	8.1	15.8	37.0	36.5
3. Extreme weather events- Floods	1.5	9.1	24.9	33.9	30.6
4. Extreme weather events- Snowfalls	4.4	15.5	26.6	30.5	22.9
5. Extreme weather events- Droughts	3.7	10.2	22.4	31.7	32.0
6. Forest fires	5.5	8.9	28.0	31.0	26.5
7. Water pollution	6.5	11.5	26.8	30.6	24.6
8. Air pollution	4.0	8.0	27.2	32.1	28.7
9. Soil desertification	3.4	15.9	22.8	34.9	23.0
10. Loss of biodiversity	1.7	11.0	20.0	37.0	30.3
11. Burden of the State budget	18.4	23.1	26.4	18.5	13.6
12. Loss of revenues in economic sectors	11.4	18.7	24.6	25.3	20.1
13. Property losses	19.6	21.8	19.5	20.3	18.7

relevant). Given that 28.9 % of the respondents agree and 66.8 % disagree with the statement that CC could elicit some benefits, it is clear that CC is perceived as negative.

4.3. Perceptions about mitigation strategies and personal intentions

Respondents recognize the significant role people have in mitigation efforts. Most of the respondents agree that changing their way of life could help in halting CC (mean 3.36 on a 4- point scale from 1-totally

disagree to 4-totally agree).

In addition, respondents were asked whether they agreed or disagreed with statements expressing personal mitigation intentions (Fig. 3). The most frequently mentioned intentions as mitigation actions relate to energy consumption, waste production, and car use. Respondents, stated a minor intention to reduce travel and internet use (use of the internet is not linked severely to CC).

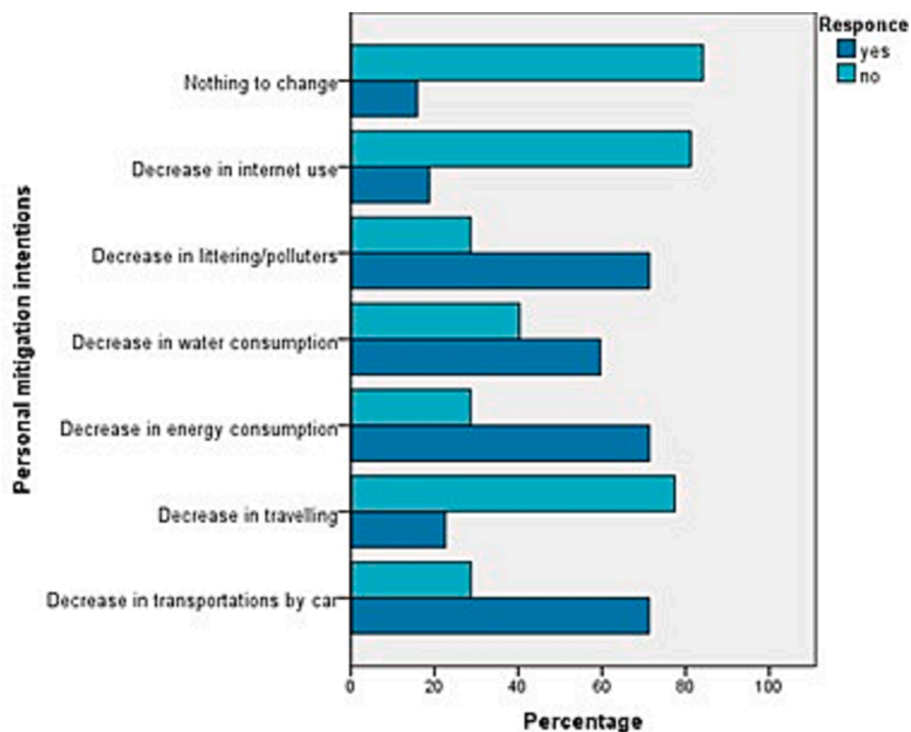


Fig. 3. Question 14 “ Which of the following habits will you adopt to help climate change mitigation?”

4.4. Climate change policy issues and governance

The majority of respondents (60 %) were unaware of the Paris Agreement, while 39.8 % were (the rest did not answer the question). The majority of participants (67.7 %) believe the Agreement’s measures are insufficient, while only 6 % believe they are adequate, and 23.9 % did not know; the remainder did not respond.

In terms of formal and social actors’ involvement in adaptation/mitigation strategies (Fig. 4), respondents attributed the highest level of involvement to the scientific community, followed by the European Union and other regional and global organizations. It is worth noting that all options have high scores, indicating that CC is viewed as a multifaceted and multi-institutional issue.

Formal institutions such as the European Union and governments have the highest involvement in adaptation and mitigation funding, while the business sector and citizens have the lowest scores (Fig. 5). As a result, people believe that the government should financially support efforts to adapt to or mitigate CC.

4.5. Intention of monetary participation in mitigation/adaptation strategies

Half of the respondents (56 %) are willing to pay for CC mitigation/adaptation measures, while 43.5 % are not. Environmental protection (43.7 %) and intra-generational justice (e.g., future generations’ rights) (39.7 %) are the most popular reasons for this willingness, followed by personal benefit (11 %). Consideration of future generations means that we have a moral obligation to pass on to future generations the right to enjoy what we have today, as defined in the Brundtland report’s definition of “sustainable development” (Brundtland, 1987).

The reasons given for the lack of willingness to pay are a lack of financial resources (52.6 %), respondents’ belief that they are not responsible for CC (10.6 %), and state authorities’ responsibility to administer funding (25.6 %). The remaining respondents (7.5 %) cite other reasons for their unwillingness to pay. A very small proportion of respondents (3.6 %) stated that they do not believe CC is actually

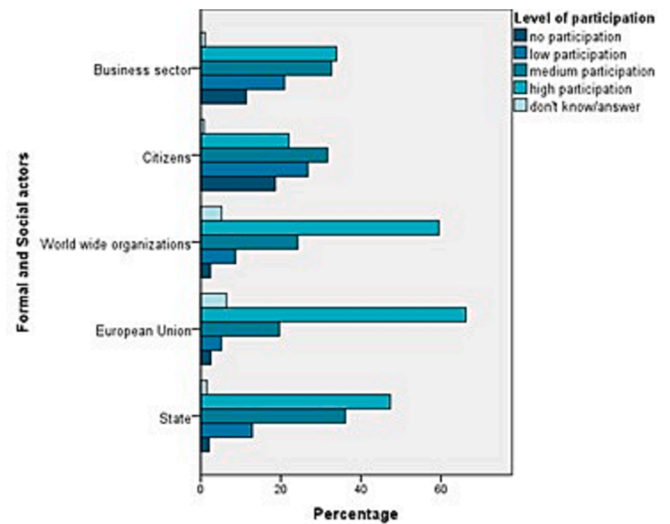


Fig. 5. Question 18 “Funding is required to deal with climate change (adaptation/mitigation). Please select each formal and social actor’s level of participation in funding.”

happening.

4.6. Climate change experiences at local level

Many respondents (60.7 %) stated that they had been threatened by CC and were asked to select the type of event they had witnessed from a list of options. Fig. 6 shows that climate hazards (72.29 %), heatwaves (70.42 %), and changes in weather patterns (66.11 %) are the most popular, most likely because they receive more attention, are more easily understood, and the majority of people have witnessed such phenomena.

Respondents perceive a moderate (42 %) to high (25.3 %) level of

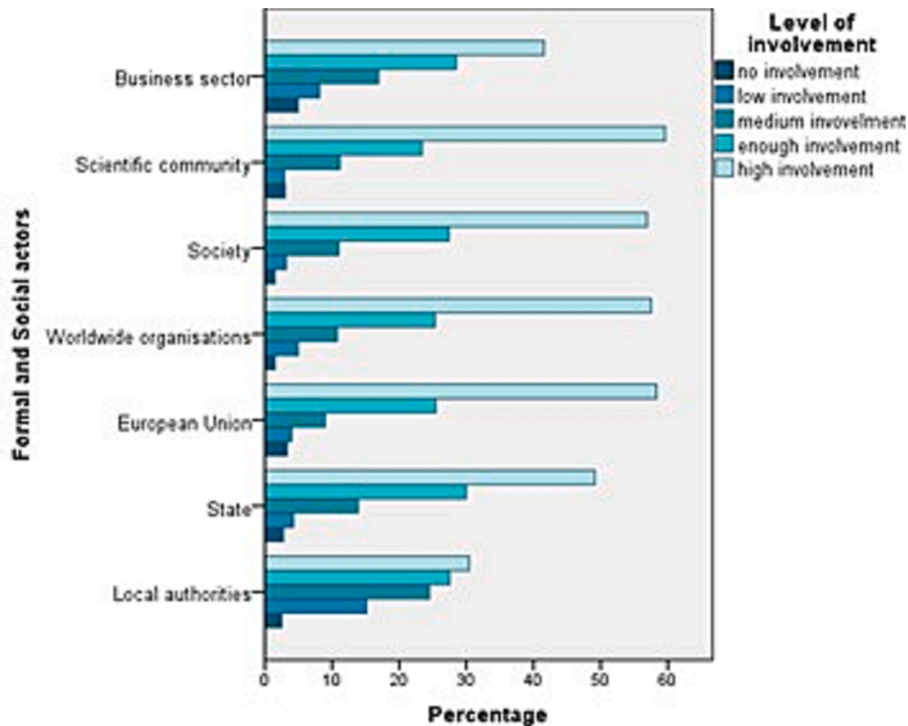


Fig. 4. Question 16 “ Climate change adaptation and mitigation require the involvement of specific formal and social actors. Please select the level of their involvement.”

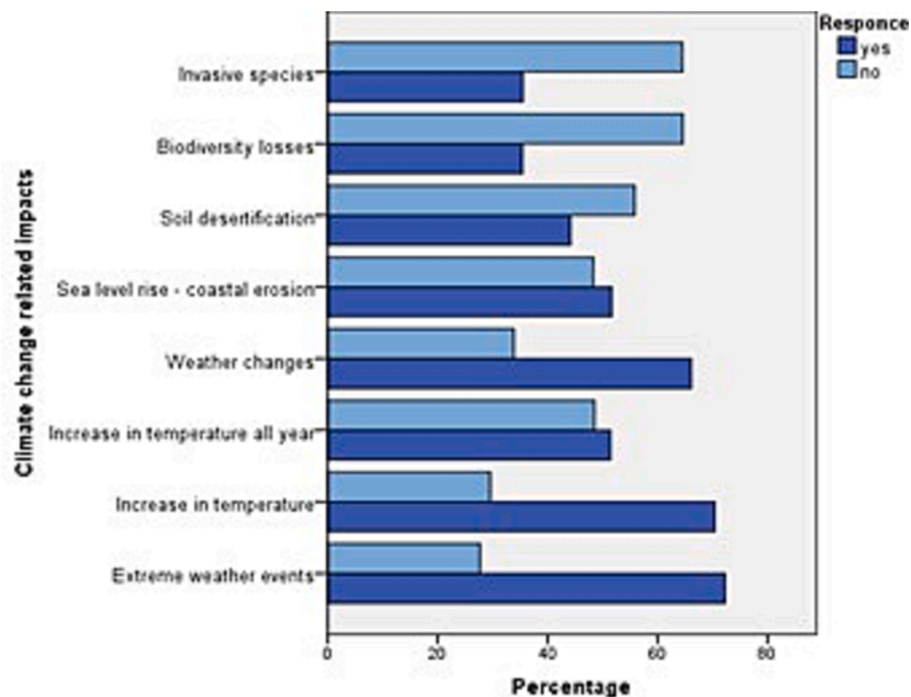


Fig. 6. Question 20.1 “ Please select one or more of the following impacts that you have experienced in Mytilene”.

threat, while 15.1 % perceive a low threat and 2.4 % no threat. The remaining 15.1 % choose to declare ignorance or no have no clear perception.

4.7. Investigating factors that determine perceptions and engagement

A statistical analysis was performed to correlate demographic characteristics with CC perceptions. Gender, educational level, and age were all thought to be variables that could affect specific responses. Statistical analysis (Pearson χ^2 tests of independence) revealed no statistical significance between gender and i) CC awareness ($p = 0.277$), ii) changing way of life ($p = 0.38$), and iii) adequacy of measures ($p = 0.835$). Willingness to pay for CC protection was found to be statistically significant ($p = 0.022$), with women being more likely to pay than men. An even clearer outcome was revealed in the case of reasons for paying ($p = 0.01$) where gender is considered as a factor that differentiates perceptions. More specifically, women are in favor of environmental protection and personal gains. This finding indicates that women are more climate risk aware confirming the results of other studies (e.g., [Lorenková et al., 2019](#); [Voskaki and Tsermenidis, 2015](#)).

Respectively, educational level was confirmed as a factor that determines i) the level of awareness about CC ($p = 0.0$), ii) perceptions about the adequacy of measures ($p = 0.005$), and iii) the intention to pay for CC adaptation/mitigation measures ($p = 0.02$). Expressed need for changing the way of life ($p = 0.513$) seems not to be associated positively with the level of education.

Age was confirmed as a factor determining CC awareness ($p = 0.0$), most likely due to the introduction of environmental education into formal Greek education and the fact that nearly half of the sample (45 %) are higher education graduates. It was also related to i) the perceptions about the adequacy of measures ($p = 0.0$) and ii) the willingness to pay for CC ($p = 0.012$). Age was also correlated with beliefs about Mytilene’s level of threat ($p = 0.005$).

3. Discussion

The current study emphasizes several critical issues and is consistent with the Protection Motivation Theory ([Rogers, 1975](#)), which is a two-

step approach: Is the public aware of the danger? Do they hold themselves accountable for lowering it? Respondents are aware of CC and its consequences. This is consistent with other studies such as [Jones et al. \(2014\)](#) and Eurobarometer 2020 for Greece ([European Commission, 2019](#)). Residents of Mytilene recognize the existence of CC and are more likely to participate in mitigation efforts. Similar findings were recorded by [Lorenková et al. \(2019\)](#). When referring to the local level, most participants associate CC with phenomena such as global warming, sea level rise, and coastal erosion, as well as the predominance of weather-related phenomena ([Steenjtes et al., 2017](#); [Wolf and Moser, 2011](#)). These issues are frequently discussed in the media and press, are widely acknowledged, and have been confirmed in other studies ([Osaka et al., 2020](#); [Pianta & Sisco, 2020](#); [Berglez & Al-Saqaf, 2021](#)). As a result, the most popular climate services are associated with weather forecasts and visually observable events (such as coastline erosion). This finding is strengthened by the fact that respondents live in a coastal city on an island which is characterized by its long coastline. Likewise, the communication of CC-related experiences by governance authorities and planners could have a positive impact on the awareness level by mobilizing and empowering local people ([Diakakis et al., 2021](#); [Ali et al., 2022](#)). Respondents acknowledge several anthropogenic causes as contributive to CC exactly as other European citizens do ([Jones et al., 2014](#); [Steenjtes et al., 2017](#)). The most well-known causes are the greenhouse effect, pollution, and the use of fossil fuels. Our findings share some similarities with the Eurobarometer survey ([European Commission, 2019](#)), lending credibility to this study. It is also shown that respondents are ignorant to the direct relationship between energy needs and consumption patterns (including tourism), emphasizing that accurate climatic information must be provided.

The most pressing climate change concerns in Greece, according to respondents, are sea level rise, coastal erosion, and forest fires, providing insight into the demand for climate services. However, this contradicts other studies conducted in Greece ([Papoulis et al., 2015](#); [Tourlioti et al., 2021](#)) where the destruction of ecosystems was mentioned as the most significant impact.

Regarding the participants’ intention to implement specific personal mitigation strategies (as expressions of public participation and engagement), the majority appear to be positive in making changes in

their lives. However, their intention does not guarantee a change in behavior in real life (Hornsey & Fielding, 2020). Participants' willingness should be capitalized on by local authorities. The importance of personal habits has been emphasized (Van der Linden and Weber, 2021; Verplanken and Whitmarsh, 2021) because they represent each person's contribution to CC mitigation and may act as barriers to more mitigative behaviors (Verplanken and Whitmarsh, 2021). As habits and intentions serve as the visible manifestations of involvement, it is important to examine more closely the factors (social, cultural, economic, and psychological) that develop and alter them.

Willingness to pay for adaptation and mitigation mostly represents an intention rather than reflecting actual behavior. Environmental protection and intergenerational justice are the two most often stated reasons for the financial support provided by half of those questioned. These options reflect socially desirable points of view. Concern for future generations was mentioned in other studies and is communicated as a social value that could accelerate CC action (Kuei Tien, 2013; Graham et al., 2019). Authorities should capitalize on people's concerns about future generations in order to increase positive feedback on supporting mitigation measures.

Shortage or lack of money, or, in general, financial circumstances (Graham et al., 2019; Papoulis et al., 2015), are the main reasons for abandoning monetary participation and are justified by the long economic crisis that has plagued the Greek economy for many years. When an economic crisis occurs, socioeconomic issues take precedence, while CC concerns fall to a lower priority position (Bonatti et al., 2019; Ruiz et al., 2020). Nevertheless, the aspiration of a significant percentage of respondents to finance adaptation and mitigation measures illustrates a promising finding. Because funding is a major barrier for implementing measures, policy actors must encourage and expand the positive responses and intentions of the public.

Trust in various institutional and social actors is a crucial issue in managing CC challenges. Respondents are inclined to delegate CC governance to formal institutions such as the European Union or state governments, but they are skeptical of the management they deliver. This finding is consistent with other survey findings for CC (Steenjtes et al., 2017; European Commission, 2019). Numerous studies (Kuei Tien, 2013; Jones et al., 2014; Papoulis et al., 2015; Zerva et al., 2021) have found that a lack of trust preoccupies people and prevents them from participating in mitigation and adaptation measures (Jones et al., 2014). As a result, reestablishing trust in formal institutions and authorities (whether local, regional, peripheral, or global) may have a positive impact on acceptance and participation in mitigation and adaptive strategies. In the case of monetary participation, the respondents credited the bare minimum to society, despite demonstrating a strong willingness to contribute individually to CC mitigation by changing some of their habits. This contradicts Papoulis et al. (2015) findings. Hence, people must be encouraged to recognize their empowered role in halting CC (European Commission, 2021), since slight changes in personal lifestyle lead to broader collective changes. This is consistent with the responses to the question about how people's actions can help in CC mitigation (mean 3.36 on a 4-point scale). As an outcome, respondents recognize their distinct role, and they should be empowered with the help of initiatives such as the European Climate Pact (European Climate Pact, 2022), which is an EU initiative for mobilizing people to participate individually by taking personal actions and making choices to reduce their carbon footprint. Furthermore, trust plays an important role in the co-production of climate services since end-users must believe the climate information and solutions supplied by the most relevant stakeholders (i.e., scientific community, organizations, etc. which manage and pass climate change information).

CC should be considered as a future challenge for Mytilene residents, but despite their high level of awareness, respondents appear to be a little confused about the personal actions they could take to deal with it. This finding is also mentioned by Schleyer-Lindenmann et al. (2022) as a "paradox" among two coastal cities. Hence, localizing the threat level

could end in enforcing adaptive and mitigative actions (Wolf & Moser, 2011; Steenjtes et al., 2017). In general, many studies (Rauken et al., 2015; Bonatti et al., 2019; Paterson & Charles, 2019) underline the significance of local-specific approaches for the success of CC governance. This study is a part of the effort. Furthermore, this case study is a first step in enhancing public participation, which allows everyday people to have indirect access to the decision-making process (Lin et al., 2021). This is extremely important, considering that the main contributors in the participation and governance process belong to power or expertise groups (Hügel and Davies, 2020). Furthermore, as Williams and Jacob (2021) point out, the development of climate services is directed toward users who have the capacity to adapt, rather than those who need them.

Because the general public is considered an end-user of climate services, the findings of this study could help local planners and managers fulfill the needs of their community. This is meaningful because Mytilene has recently joined the network of 100 climate-neutral and smart cities (European Commission, 2021), and the key findings of our study may be used by local government agencies to achieve the mission's objectives and to apply effective and inclusive climate services.

As previously demonstrated in other studies (Slovic, 1999; Lorencová et al., 2019; Chang, 2018; Wang & Zhou, 2020), socio-demographic characteristics (gender, age, educational level) were investigated as independent variables that influence perceptions and attitudes. The statistical analysis reveals a relationship between characteristics such as gender, age, and educational level and specific answers, particularly those connected to climate change awareness and funding for adaptation/mitigation measures.

4. Conclusion

CC is well-defined among scientists and politicians, but what about the public? Our research findings revealed that the participants are aware regarding CC issues, but all causal links between lifestyles and CC impacts must be elucidated. The connection between consumption patterns and CC does not appear to be understood by respondents. They concentrate on the link between CC and energy and transportation. They are supportive of changing some personal habits, such as reducing energy and water consumption and limiting car travel. As a result, local governments must invest in novel approaches to make this intention become a reality.

Respondents are unaware of how CC can affect various sectors of the economy and their daily lives, and they are capable of detecting weather changes or natural disasters. Although formal and social actors are perceived to be highly involved in dealing with CC, participants appear to be skeptical in trusting authorities. However, the ways of involvement along with the financial support need to be further investigated/clarified by future surveys. A number of participants appear to be in favor of participating monetarily, with intragenerational justice being the most important reason given. On the contrary, the main reason for abandoning monetary participation is a lack of financial resources. Women are more willing to pay for CC mitigation. Three out of four respondents (approximately 75 %) have witnessed CC-related phenomena, with weather changes or weather-related phenomena being the most common. Residents of Mytilene believe that CC poses an average threat to their lives, but as they live on an island, they will face more severe consequences in the future. Furthermore, this perception could discourage people from implementing adaptation measures. As a result, authorities need to invest in capacity building and enable people to cope with CC challenges in order to sustain their life on the island. They may also be able to provide favorable and more inclusive climate services if they are familiar with what people are aware of.

The bottom line is that, audience-specific information campaigns, publicity, and educational programs in schools or broader audiences are measures that could provide information and enhance knowledge about the systematic and multidimensional relations between lifestyle and CC.

Local-oriented approaches must be implemented since uniform solutions do not apply to all societies (Wolf & Moser, 2011; Jones et al., 2014; Wang & Zhou, 2020). The challenge for authorities is to find incentives to mobilize and activate each individual to adopt new habits and make lifestyle changes. The solution is obvious, and it takes the form of a continuous effort to inform, educate, and motivate people to act.

CRedit authorship contribution statement

Polina N. Tourlioti: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Michelle E. Portman:** Writing – review & editing. **Ioannis Pantelakis:** Visualization, Formal analysis. **Oourania Tzoraki:** Writing – review & editing, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgments

The authors are grateful to J. J. Portman (University of Miami Rosenstiel School of Marine, Atmospheric and Earth Sciences) for editing assistance and express their deepest gratitude to Dr Maria Sideri (University of the Aegean) and Dr Jeroen Warner (Wageningen University) for providing helpful recommendations.

Funding

Data analysis of the study (Polina N. Tourlioti and Ourania Tzoraki) funded by the Project “Coastal Environment Observatory and Risk Management in Island Regions AEGIS+” (MIS 5047038), implemented within the Operational Programme “Competitiveness, Entrepreneurship and Innovation” (NSRF 2014-2020), co-financed by the Hellenic Government (Ministry of Development and Investments) and the European Union (European Regional Development Fund).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cliser.2023.100427>.

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