Multiple criteria analysis of citizens' information and trust in climate change actions

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Abstract

In the past decades, the stakeholders, due to the evident impacts of climate change, were more involved in strategic actions and informing the public opinion on climate change. However, in order to achieve ongoing and substantial public participation in climate change actions undertaken by the stakeholders, the public will need to be fully informed about the causes and effects of climate change so that a mutual relationship of trust may be established. The present study aims to investigate public perceptions of the information citizens obtain from information sources, stakeholders' share of responsibility for climate change and citizens' degree of trust in the stakeholders which affects public participation in climate change actions. The study was conducted in Greece, where 1536 questionnaires were collected from January 2014 to June 2015. The collected data were analyzed using descriptive and nonparametric statistics, as well as the MUSA method (MUltic-riteria Satisfaction Analysis). The study findings indicated that the citizens do not trust adequately information sources regarding climate change and, at the same time, they perceive that the dissemination of information on climate change is limited and consider that the media which use scientific knowledge provide more objective information. Moreover, Greek citizens consider that industries, oil companies and governments contribute mostly to climate change and they were willing to participate in climate change actions carried out mainly by scientists, environmental groups, citizen groups and non-governmental organizations.

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1 Introduction

Climate change consists a global phenomenon with social implications which citizens do not comprehend, do not take seriously and do not regard as an important public threat (Dimendo and Doughman 2007). Consequently, there is great difficulty in creating communication models impacting the shaping of citizens' beliefs (Eveland and Cooper 2013). The development of a research body on carbon emissions as well as the knowledge and information level of the average European citizens—which has been indicated as considerably low—possibly contributes to the creation of these models (Toma et al. 2014). Hence, the publication of research findings could address journalists' lack of knowledge and provide reliable and objective information (Shanahan 2007; Zerva and Tsantopoulos 2013). Environmental communication can be characterized as a realistic solution since it can contribute to the solution of environmental issues and therefore of climate change too. In specific, environmental communication can become the link between relevant stakeholders and citizens because it has the ability to affect citizens' views and attitudes while providing useful information on climate actions. Additionally, it plays an important role in sustainable development because it can connect knowledge, action (Lindenfeld et al. 2012) and society's ethics and, at the same time, it can rationally correspond to environmental and social issues (Cox 2007). Moreover, environmental communication relies on the better understanding and translating of the man–nature relationship (Jurin et al. 2010), as well as on the importance of public perceptions of environmental topics (Peeples and Depoe 2014).

Therefore, the development of environmental communication strategies is one of the most crucial sociopolitical issues of our time (Brevini 2016), since their use is closely related to products, such as media. As with environmental policy, there are two major issues in environmental communication in terms of strategy implementation. These involve the ensuring of rational information without misusing or altering the content and the knowledge dissemination within a familiar context of interests, perceptions and commitments (Boehmer-Christiansen 1994). As a result, perceptions of environmental issues are more important than persuading the public about the importance of environmental issues (Senecah 2004). Communicators are responsible for establishing a link between environmental communication and the disclosure of public perceptions. They are also called upon to facilitate or participate in discussions on environmental policy in which public opinion plays a major role (Waddell 2001). In this process, public communication and commitment should not be considered as a simple way of knowledge dissemination to convince the public to view the discussions in a scientific manner or to perceive them as a scientist (Nisbet and Scheufele 2009). Conversely, the significance of the public's responsibility and values should be considered so that proper, simple and objective public information is achieved.

Yet, information objectivity and the understanding of environmental topics do not depend only on the values characterizing scientists, communicators and the media, but also on the level of the target public in terms of its upbringing, place of residence and culture (Corbett 2006). For this reason, the application of an interactive procedure including messages stemming from the sender to the public opinion and vice versa is required (Valenti 1999). To bridge gaps in this relationship and to derive information on the addressed by scientists or communicators public, it is necessary to establish a dialogue and interview with the public given that many communicators present solely the facts without considering the public's values (Dietz 2013). Additionally, this effort could be assisted by the improvement of communication with the stakeholders involved in policymaking who are

able to provide precise indications regarding citizens' concerns so that the role of science in addressing these concerns is enhanced (Fischhoff and Scheufele 2014).

The aim of the present study is, thus, to investigate Greek citizens' views on the sources they use to obtain information on climate change and to identify their views on which stakeholders contribute more to climate change. The conclusions of this study could be used by the stakeholders to improve their actions and make them more effective.

2 Literature review

Media professionals, such as editors and journalists, produce a new form of media within a political, economic, institutional, social and cultural landscape (Boykoff and Roberts 2007) which is, in many cases, affected by political beliefs. Apart from providing support and projection, the media project to the public targeted messages and influence citizens' views on environmental topics. In other words, the media are able to frame environmental events and affect the way in which society perceives them (Marin and Berkes 2012). However, in cases that the public is unable to decode the messages of the media, it is easily affected and led to false conclusions. The false conclusions often result from the language and vocabulary the media use to address the public in reporting environmental topics (Hansen 2011), but also from the limited coverage of news concerning global meetings on the climate (Karlsson-Vinkhuyzen et al. 2017). At the same time, media representations with their ability to combine sound and image consist a powerful and important connection between daily reality and social experiences (O'Neill et al. 2013). The problem is that these representations can easily alter the content of a topic and affect the public opinion with false messages which do not correspond to reality. These messages are often reproduced by third parties and increase the percentage of false understanding, while an atmosphere of misinformation is created. Another issue is that the media themselves can cover news in two different ways, either by focusing on politics or by stressing science (Freudenburg and Muselli 2013). Therefore, it may be stated that they are able to falsify, misinterpret, misrepresent and misinform in various degrees the public opinion on climate science (Boykoff 2008).

Another source of information, which will possibly affect public opinion and is used by a lower percentage of citizens compared to other media, is the Internet. Through the Internet, blogs, Wikipedia and social media, a new operator concerning the environment, science, social conversations has been created (Berkhout 2010). Many environmental and non-governmental organizations use websites as an interactive tool which allows an open dialogue about specific topics between organizations and communities (Jun 2011). However, the danger arising from the use of the Internet is based mainly on the lack of specific knowledge of environmental researchers and on the rapid dissemination of false messages through websites. As a result, websites and predominantly the unstructured environmental organizations, which lack policy and communication strategy, alter messages about climate change and broadcast them falsely. Moreover, information on the Internet is often not subjected to external control and evaluation like scientific journals (Ladle et al. 2005).

The differences among sectors, science, mass media and politicians are not random but rather systematic and create risks for each sector (Weingart et al. 2000). For this reason, it is by no means easy to connect the information provided by the media and citizens' attitudes to prospects, intentions and behavioral change (Boykoff 2013).

According to Smith (2005), the mass media have failed in public information and hold the main responsibility for the percentage of public ignorance regarding the causes and

effects of climate change, because climate change was chosen by the media as a topic for further dramatization and intensification (Von Storch 2009). The first increase in media's attention to climate change started in 1997 and coincided with the media's coverage of the Kyoto Protocol and the Conference of the Parties to the UN Framework Convention on Climate Change, which was held in December 1997. During that month, many articles on climate change were published, whereas the average number of articles regarding the same issue was considerably lower in the previous months (Liu et al. 2008). This implies a possible confusion about the role of the media. That is, although the media consist an important communication channel as they are the main information source about stakeholders' policymaking (Soroka 2003) with this information consisting an important policy tool if implemented correctly and combined with other measures (Tsitsonia and Toma 2013), certain communication dangers are observed in events which become more evident (Weingart et al. 2000). Most importantly, the dangers involve the selective presentation of topics by the media which focus more on the effects rather than the prevention of climate change (Pasquaré and Oppizzi 2012). This happens because the media try to prevent the public's possible indifference to climate change, but also because politicians are afraid of losing voters due to the lack of climate change actions (Aykut et al. 2012). The latter results from the fact that climate change is mainly covered by the public media and consequently it is felt that the mass media present climate change as a social problem (Wilson 1995; Antilla 2005).

To conclude, having acknowledged that the media constitute important information sources for policymakers and can raise public environmental awareness which, in turn, will affect public support for this issue (Doulton and Brown 2009; Karasmanaki and Tsantopoulos 2019), scientists have conducted numerous studies on the coverage of climate change by the media during the last 2 decades (Liu et al. 2008). These studies have indicated that the presentation and description of climate change mainly by the mass media is equally important for the global governance regarding the long-term success or failure of the efforts to tackle climate change (Boykoff and Yulsman 2013). A prerequisite for objective public information is the balance and correlation between the mass media and scientific knowledge (Sivakumar 2011).

3 Methodology

The study was conducted in Greece from January 2014 to June 2015 and a total of 1536 questionnaires was collected from the overall population of Greece. According to the last census in 2011, the total population in Greece was estimated at 10,815,197 people (Hellenic Statistical Authority 2011), of which 49.2% were male and 50.8% were female. A rather special feature of the present study is that it was carried out during the Greek economic crisis; that is, a time when the stakeholders and the majority of citizens have neglected the environmental issues in favor of the financial ones. Hence, the research gaps the study fills involve citizens' view on the influence and contribution to climate change of governmental and business bodies, environmental groups, non-governmental groups and mass media. In addition, it examines citizens' satisfaction and trust level in climate change actions undertaken by the aforementioned stakeholders. With regard to climate change, Greece is a special case since as a Mediterranean country is one of the most vulnerable areas of Europe both now and in the future. Every part of Greece is equally important for research on climate change since due to its

geographic features (mountainous and coastal areas), Greece is predicted to suffer different climate impacts on every geographic section and, therefore, people living in these areas have different perceptions of dangers due to climate change. These different perceptions of dangers influence the views and attitudes toward climate change, as well as citizens' participation in activities. As a result of such notable differences, the selected sample represented all geographic regions in the country.

3.1 The questionnaire

The findings of the present study are part of a larger research which was conducted in Greece and aimed at investigating the views, attitudes and knowledge of the Greek citizens on climate change. To perform the pilot and basic study, a specialized questionnaire was used. All personal data were anonymous and to obtain objective results, the questions were closed-ended and based on findings of the recent literature (Bord et al. 2000; Norton and Leaman 2004; Anable et al. 2006; Lorenzoni et al. 2006; Nisbet and Myers 2007; European Commission 2009; Leiserowitz et al. 2010; Manolas et al. 2010; Clements 2012; Markowitz 2012; Vignola et al. 2013). Moreover, the questions were formulated in a simple and easy-to-understand manner because they were addressing citizens of different educational levels, religious beliefs, political ideologies and places of residence.

3.2 Sampling method

Due to the sample's special nature, a simple random sampling approach was adopted (Matis 2001). Additionally, this sampling method requires the least possible information on the sample.

The sample size was estimated based on the following formula, while the sampling frame was created based on the demographic lists of municipalities.

$$n = \frac{t^2 \cdot \bar{p} \cdot (1 - \bar{p})}{e^2} = \frac{1.96^2 \cdot 0.50 \cdot (1 - 0.50)}{0.025^2} \cong 1536,$$

where t = the value of the Student distribution for probability $(1 - \alpha) = 95\%$ and $n - 1$ degrees of freedom, p = the proportion estimate, and e = the maximum allowed difference between the sample mean and the unknown population mean.

According to this framework, each citizen corresponds to a symbolic number which includes the region, prefecture and municipality in which the citizen resides. As with every sampling process, the main problem was to create the sampling framework. In order to establish this framework, we used the results of the most recent census of the Hellenic Statistical Authority (2011). However, the population number is constantly changing due to deaths and births or the population migration number.

The survey was conducted using an extensive closed-type questionnaire, which consisted of two parts. The first part refers to the trust of citizens in the actions undertaken by stakeholders to address climate change, while the second part refers to citizens' demographic data. Prior to the conduct of the survey, a pilot study was carried out in order to determine the citizen trust criteria that should be included in the questionnaire (Zerva et al. 2018).

3.3 Data analysis

For the analysis of the data, the statistical program SPSS (v16.0) was used. Descriptive statistics and the Friedman's nonparametric criterion were calculated. Friedman's nonparametric test is used for comparing the values of three or more correlated groups of variables. The distribution of Friedman's test is the χ^2 with degrees of freedom (*df*) $df = k - 1$, where *k* is the number of groups or samples. This test classifies differently the values of variables for each criterion and calculates the average class of classification values for each variable (Freund and Wilson 2003; Ho 2006).

In our analysis, the MUSA (MUlticriteria Satisfaction Analysis) method was used to investigate stakeholders' contribution to climate change as well as citizens' levels of trust in the media and the climate actions carried out by the stakeholders. The MUSA method was chosen because it is an innovative methodology which is based on the multicriteria decision analysis and also because it provides a direct and objective feedback of citizens' preferences and expectations. In addition, it involves an analytical and composite approach for addressing the issue of estimating and analyzing satisfaction.

The MUSA method follows the general principles of ordinal regression analysis under constraints (Grigoroudis and Siskos 2002, 2010), using linear programming techniques (Jacquet-Lagreze and Siskos 1982; Siskos and Yannacopoulos 1985). The method is a collective approach that estimates the preference systems of a set of respondents. Thus, one primary result is the criteria weights, as well as a set of normalized indices that can help to analyze the problem of evaluating citizen trust (Grigoroudis and Siskos 2002).

- Criteria weights: the weights show the relative importance according to a set of criteria or sub-criteria that a group of citizens assigns to the defined values of the trust dimensions (Grigoroudis and Siskos 2010).
- Average trust indices: these indices are the main performance indicators, since they present in a simple manner the citizens' degree of trust, combining the outputs of the MUSA method with the results of descriptive statistical analysis.

That is, the MUSA method estimated the additive value function and a set of partial value (trust) functions based on citizens' views with the aim of finding the maximum possible consistency between the estimated value function and the citizens' views. The estimated value functions consist the major results of the MUSA method given that these show the real value expressed by the total of customers for each qualitative trust level (Grigoroudis and Siskos 2010), normalized in an interval [0,100]. These functions indicate the citizens' level of demanding and are divided into three basic categories according to the level of demanding (Grigoroudis and Siskos 2010):

- Neutral citizens: in this category, the value (trust) function has a linear form meaning that the more satisfied citizens report to be, the higher the percentage of their expectation is fulfilled.
- Demanding citizens: The value (trust) function is convex, and the citizens are particularly satisfied only when they are provided with the highest level of services.
- Non-demanding citizens: The value (trust) function is concave, and the citizens state they are satisfied even though a small proportion of their expectations has not been fulfilled.

Next, through the action and improvement diagrams, the stakeholders who contribute mostly to the creation of climate change were found. Moreover, the diagrams revealed the media and the stakeholders who will need to improve their information methods and actions to increase citizens' trust in them and encourage them to participate in future climate change actions.

The action diagram contains the actions requiring immediate action. This diagram specifies the media and the stakeholders that must act immediately by combining the results of the criteria weights and the average indices. It is divided into four quadrants depending on the performance and importance of the criteria (Grigoroudis and Siskos 2002, 2010). Of these four quadrants, the first represents the "action opportunity" action area and it includes the most critical trust criteria for stakeholders requiring immediate action. The second quadrant depicts the "leverage opportunity" area which contains actions which can be improved. The third quadrant illustrates the "status quo" area which usually refers to possible threats but requires no immediate action and the fourth quadrant presents the "transfer resources" area including criteria which are not particularly important but significant resources are spent to keep their performance high (Grigoroudis and Siskos 2002, 2010) (Fig. 1).

However, the action diagrams are not effective on their own since they can indicate factors requiring improvement but cannot prioritize improvement actions. This issue can be addressed by the construction of improvement diagrams. As with the action diagram, the improvement diagram is constructed according to the average demanding and effectiveness indices in order to define the improvement priorities. It is also divided into the 1st (High effectiveness/Small effort), the 2nd (High effectiveness/Large effort and Low Effectiveness/Small effort) and the 3rd (Low effectiveness/Large effort) priority quadrants (Grigoroudis and Siskos 2002) (Fig. 2).

Fig. 1 Action diagram (Customers Satisfaction Council 1995; Grigoroudis and Siskos 2002, 2010)
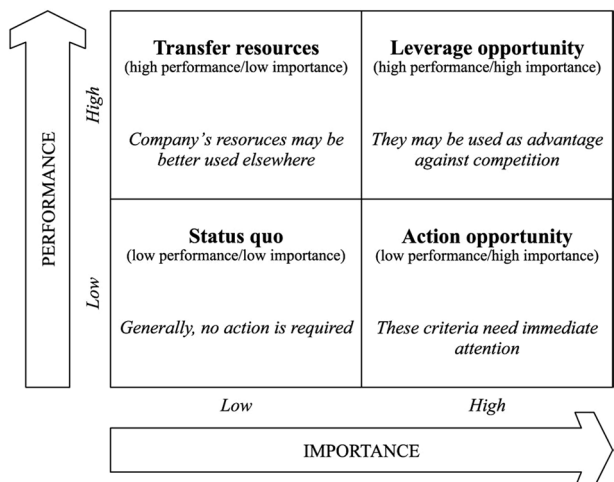
Fig. 2 Improvement diagram (Grigoroudis and Siskos 2002, 2010)
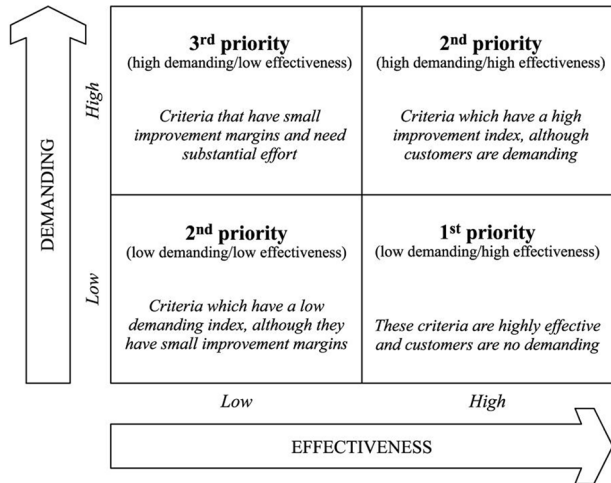
4 Results

4.1 Socioeconomic characteristics of the respondent sample

It can be observed from the characteristics of the sample that female respondents are more than the male ones. In terms of age, in their majority the participants are aged between 18 and 30 and between 41 and 50, while those older than 51 years are fewer. Regarding the educational level, most respondents are graduates of tertiary education (45.9%), while the number of holders of graduate degrees and graduates of technical and elementary education is significantly lower. In terms of occupation, the majority of respondents are public servants (28.3%), employees of the private sector (16.4%), freelance professionals (13.2%), whereas those involved in the primary sector (farming and livestock farming) or those engaged only in household work are fewer. At the same time, a particularly high percentage of citizens, about 15.5% of the respondents, are unemployed. Regarding the place of residence, most citizens of the sample (29.2%) live in large cities with more than 100,000 inhabitants. There is also a high share of citizens who live in provincial towns with less than 15,000 inhabitants.

4.2 Descriptive statistics

First, the frequency with which the respondents read or watch environment news was examined. It was indicated that the majority of them read or watch environment news sometimes (37.1%) and a considerable percentage do so often (29.2%). Conversely, only few citizens read and watch environment news very often (8.3%), while the remaining participants rarely (14.9%) or never (10.5%) (Fig. 3).

The participants who stated they read or watch environment news were then asked to report how much they trust the media from which they obtain information on climate change. Results show that most citizens trust moderately (32.2%) or slightly (33.3%) the information sources for their information on climate change. At the same time, a very low percentage of respondents expresses no trust in them (11.6%), whereas only few citizens trust information sources very much (3.1%) or much (9.3%) (Fig. 4).

Fig. 3 Percentages relating to the frequency by which the citizens watch or read environment views (%)
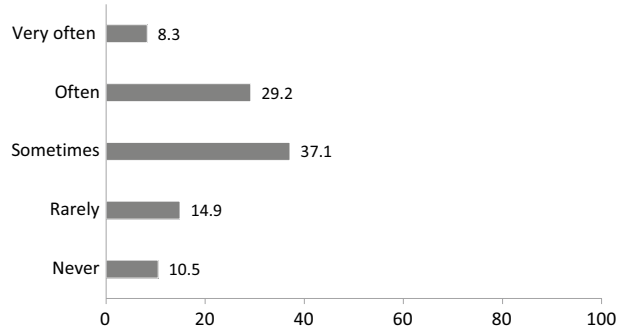
Fig. 4 Percentages regarding citizens' trust in information sources for their information on climate change (%)
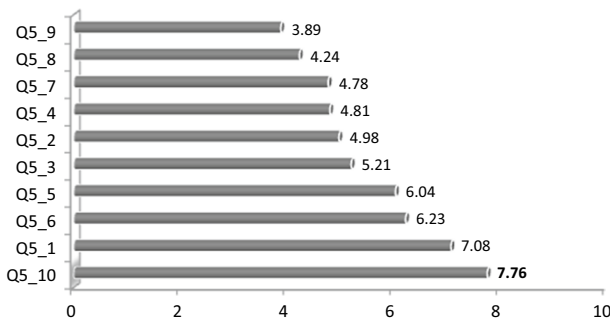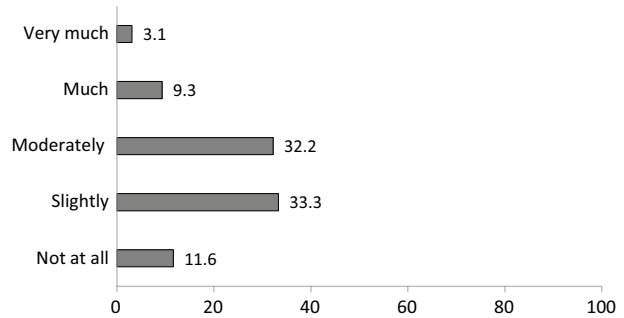
Fig. 5 Application of the Friedman test for ranking information sources related to citizens' trust. Q5_1 = Specialized websites, Q5_2 = General websites, Q5_3 = News websites, Q5_4 = Television, Q5_5 = Books or magazines, Q5_6 = Environmental organizations, Q5_7 = Family members or friends, Q5_8 = Radio, Q5_9 = Movies, Q5_10 = Documentaries. $N = 1375$ Chi-Square = 2610.13 $df = 9$ Asymp. Sig. < 0.001

According to the rankings of the Friedman test, it appears that for their information on climate change the surveyed citizens trust mostly documentaries (mean rank 7.76), specialized websites (mean rank 7.08) and environmental organizations (mean rank 6.23) followed by the remaining sources (Fig. 5). More analytically, as it can be seen in Table 1, for obtaining information on climate change, respondents trust extremely

**Table 1** Percentages concerning citizens' trust in information sources (%)

	Extremely	Very	Moderately	Slightly	Not at all
Specialized websites	15.6	23.7	27.7	13.5	9.0
General websites	1.9	9.8	30.1	37.0	10.8
News websites	2.3	11.5	31.8	31.8	12.0
Television	3.4	10.1	25.3	34.8	16.0
Books or magazines	4.6	18.4	34.8	23.4	8.3
Environmental organizations	8.5	20.1	29.9	18.9	12.0
Family members or friends	2.5	8.3	28.4	38.0	12.3
Radio	1.4	6.3	23.6	39.6	18.6
Movies	2.0	6.6	18.3	36.2	26.4
Documentaries	18.2	28.9	27.3	11.6	3.5

(18.2%) and very (28.9%) the documentaries, whereas they trust the radio slightly (39.6%) and not at all the movies (26.4%).

Participants who stated they read or watch environment news were then asked to evaluate the coverage of climate change by the media. Results show that most of them assessed it as moderate (35.5%) and small (37.2%). At the same time, considerably fewer citizens evaluated it as excessive (5.2%), nonexistent (10.5%), whereas only 1.0% of respondents reported they knew nothing on this issue or were not willing to answer (Fig. 6).

Fig. 6 Percentages concerning the coverage of climate change by the media (%). Next, the respondents were asked which stakeholders they trusted mostly to participate in climate change actions that these stakeholders carry out (Fig. 7)
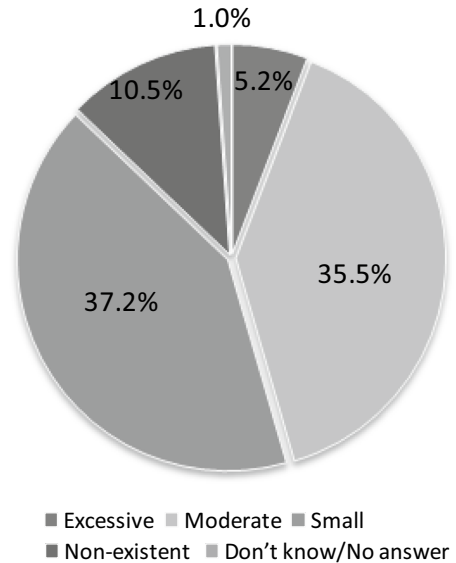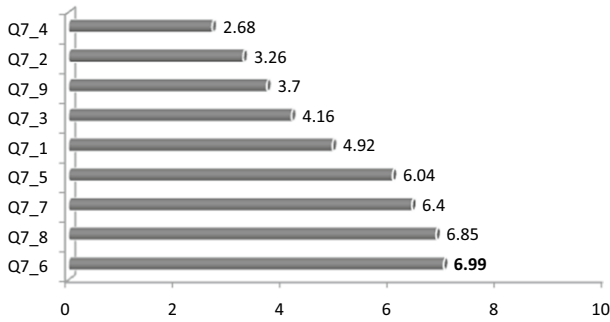
Fig. 7 Application of the Friedman test for ranking the stakeholders regarding citizens' trust in them to participate in actions addressing climate change Q7_1 = European Union, Q7_2 = Government, Q7_3 = Local authorities, Q7_4 = Political parties, Q7_5 = Environmental non-governmental organizations, Q7_6 = Environmental groups, Q7_7 = Citizen groups, Q7_8 = Scientists, Q7_9 = Mass media. N = 1535 Chi-Square = 5508.89 df = 8 Asymp. Sig. < 0.001

Table 2 Percentages relating to citizens' trust in the stakeholders to take part in climate change actions (%)

Stakeholders	Extremely	Very much	Moderately	Slightly	Not at all
European Union	3.4	11.2	28.2	36.8	20.4
Government	1.2	2.5	10.3	43.0	43.0
Local authorities	1.8	5.3	22.5	42.4	27.9
Political parties	0.8	2.3	4.9	30.6	61.4
Non-governmental organizations	7.1	20.8	36.6	24.5	10.9
Environmental groups	11.4	30.9	37.5	15.7	4.5
Citizen groups	8.9	23.5	37.0	24.9	5.7
Scientists	13.0	26.6	37.8	17.1	5.7
Media	1.1	4.1	15.5	44.5	34.8

According to the analysis of the Friedman test, it was indicated that to participate in climate change actions, the citizens trust mainly the environmental groups (mean rank 6.99), scientists (mean rank 6.85) and citizen groups (mean rank 6.4), while they expressed considerably less trust in the remaining stakeholders (Fig. 7).

As Table 2 shows, 42.3% of the citizens trust the environmental groups very much and extremely, even though these do not present a particularly increased degree of trust. Moreover, a considerable share of participants (37.5%) trust the environmental groups moderately, whereas only 15.7% trust them slightly and 4.5% express no trust at all. This suggests that even the environmental groups which have presented the highest trust percentages need to make efforts to improve their actions. Regarding the remaining stakeholders, the respondents trust the scientists very much (26.6%) and citizen groups (23.5%), moderately the non-governmental organizations (36.6%) and slightly the local authorities (42.4%) and the European Union (36.8%). At the same time, the citizens reported no trust in the political parties (61.4%) and the government (43.0%).

Fig. 8 Application of the Friedman test for ranking the stakeholders' contribution to climate change. Q8_1 = Industries, Q8_2 = Oil companies, Q8_3 = People driving big-engined cars, Q8_4 = Governments, Q8_5 = Political parties, Q8_6 = Scientists and universities, Q8_7 = Media. N = 1536 Chi-Square = 3599.42 df = 6 Asymp. Sig. < 0.001
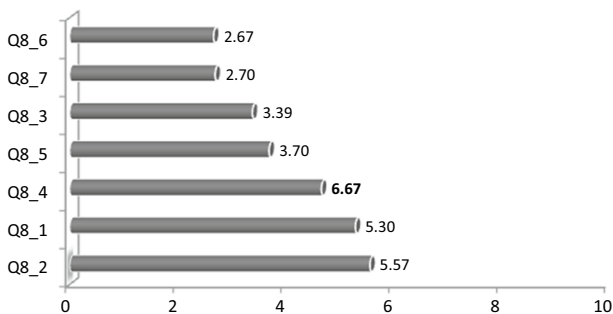
**Table 3** Percentages of the stakeholders' contribution to climate change (%)

Stakeholders	Very high	High	Moderate	Low	Very low
Industries	37.7	48.0	8.7	3.0	2.6
Oil companies	48.8	39.0	7.4	2.5	2.2
People driving big-engined cars	7.6	26.8	39.1	19.0	7.4
Governments	29.9	35.4	20.2	10.2	4.2
Political parties	17.7	27.0	25.9	20.2	9.2
Scientists and universities	6.4	16.2	28.6	29.2	19.5
Media	8.2	15.4	27.9	28.6	19.9

According to the rankings of the Friedman test, it appears that the respondents consider that oil companies (mean rank 5.57), industries (mean rank 5.3) and governments (4.67) carry most of the responsibility for the problem of climate change (Fig. 8).

The majority of participants perceive that the oil companies and industries make the greatest contribution to climate change. Hence, as it appears in Table 3, most citizens regard oil companies' contribution to climate change as very high (48.8%) and high (39.0%), probably due to the water pollution that is caused during oil extraction. Conversely, only a very small proportion of respondents perceives the climate change contribution of these companies as moderate (7.4%) and very low (2.2%). Likewise, industries are considered responsible for climate change by most citizens (85.7%). This is possibly due to the dangerous gases emitted by industries which do not comply with the existing legislation and which contribute to climate change. Simultaneously, the remaining citizens consider that industries' contribution is moderate (8.7%), low (3.0%) or very low (2.6%). Additionally, they perceive that people driving big-engined cars contribute to climate change moderately (39.1%), whereas scientists and universities make a moderate (29.2%) and the media a very low contribution (19.9%).

4.3 Analysis of the stakeholders' contribution to climate change and the citizens' trust in media

Of the overall trust, it appears that the citizens do not trust particularly information sources to inform them about climate change topics. On a general note, the results account for the specific identifications, since according to Fig. 9, the average trust indexes of most criteria
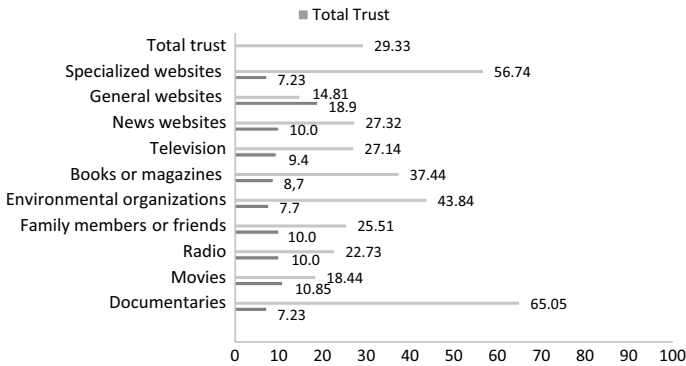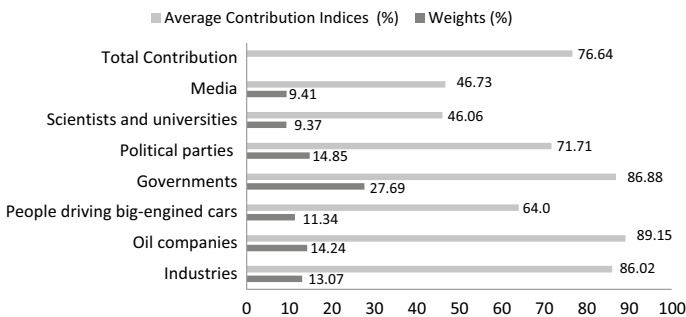
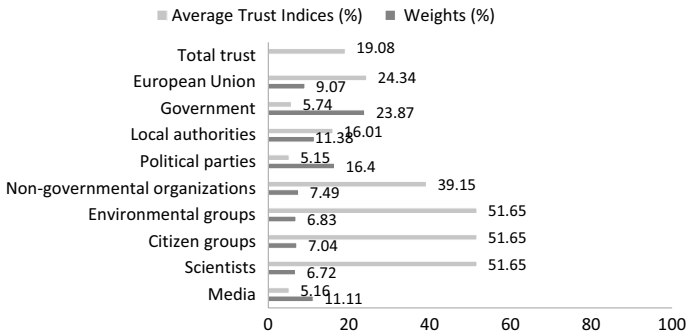**Fig. 9** Weights of criteria and average indices concerning citizens' overall trust in information sources

are at a considerably low level ranging approximately between 15.0 and 65.0%. This confirms the lack of particularities of information sources to approach citizens and develop trust regarding the information on environmental topics and topics on climate change.

The overall trust index of information sources on climate change is scarcely satisfactory due to the low levels of the trust indexes in the biggest range of the criteria. The citizens seem to trust for their information mostly specialized websites, documentaries, environmental organizations and books or magazines. Conversely, the remaining criteria such as news websites (27.32), television (27.14%), family members or friends (25.51%), radio (22.73%), movies (18.44%) and general websites present lower percentages of trust indexes. That is, citizens appear not to trust at all the general websites, while they trust slightly the remaining media (television, radio, movies) and family members or friends, even though respondents attach great importance to them. This is identified by the criteria weights of general websites (18.9%), movies (10.85%), radio (10.0%) and television (9.4%) which are higher compared to the other weights and influence the overall trust index directly. The remaining criteria have an even lower importance level since their weight percentages are below 10.0%.

Moreover, statistics and data in Fig. 10 show that respondents perceive that the stakeholders have a considerably high contribution to climate change. That is, most stakeholders have particularly high contribution indexes.

Fig. 10 Weights of criteria and average indices of the overall contribution of stakeholders to climate change

■ Average Trust Indices (%)   ■ Weights (%)

Total trust — 19.08
European Union — 9.07 — 24.34
Government — 5.74 — 23.87
Local authorities — 11.38 16.01
Political parties — 5.15 16.4
Non-governmental organizations — 7.49 39.15
Environmental groups — 6.83 51.65
Citizen groups — 7.04 51.65
Scientists — 6.72 51.65
Media — 5.16 11.11

0   20   40   60   80   100

Fig. 11 Weights of criteria and average indexes of the overall trust in the stakeholders to participate in actions

More specifically, the respondents consider that the governments contribute greatly to climate change (86.88%) because of their decisions and participation in the issue. In addition, significant contribution to climate change is made by the oil companies (89.15%), industries (86.02%) and political parties (71.71%) in view of their strategies and views on the issue. On the contrary, according to the majority of respondents, the remaining stakeholders contribute less to climate change since their contribution indexes are lower than the overall contribution index and range between 65 and 45.0%.

In terms of citizen trust (Fig. 11), the citizens do not trust particularly the stakeholders and consequently express minimum trust in participating in the stakeholders' climate change actions. This is indicated by the low percentage of the overall trust index which corresponds to 19.08%. However, the citizens under study trust adequately the non-governmental organizations (NGOs) that undertake climate change actions (39.15%) and less the European Union (24.34%). The other stakeholders present even lower percentages of citizen trust and thus require great improvement. That is, the percentages range below 16.0% and are lower than the overall trust index. Generally, these results account for the specific identifications given that the average trust indexes of most criteria are low, ranging between 5 and 50.0%. This confirms the lack of trust, objective argumentation and information provision by stakeholders which could prompt citizens to participate in or undertake climate change actions.

Regarding stakeholders' contribution to climate change, they will have to put a great deal of effort into reducing their contribution to climate change since the majority of the public opinion consider that almost all stakeholders contribute significantly to climate change. To be specific, the following diagrams indicate that a group of stakeholders will possibly need to carry out more actions and improve their abilities in order to reduce their contribution because this group increases directly the overall degree of contribution to the issue. Conversely, another group of stakeholders will need to undertake less actions and make relatively less effort to improve their abilities as it does not affect the overall degree of contribution.

In general, all action diagrams indicate that there is a gap between the quadrants. This points to the fact that there is a gap between the actions the citizen's request from the stakeholders and the media, and the actions offered by the latter.

According to Fig. 12, the action and improvement diagrams indicate that the information sources will probably have to make little action effort to enhance criteria such as
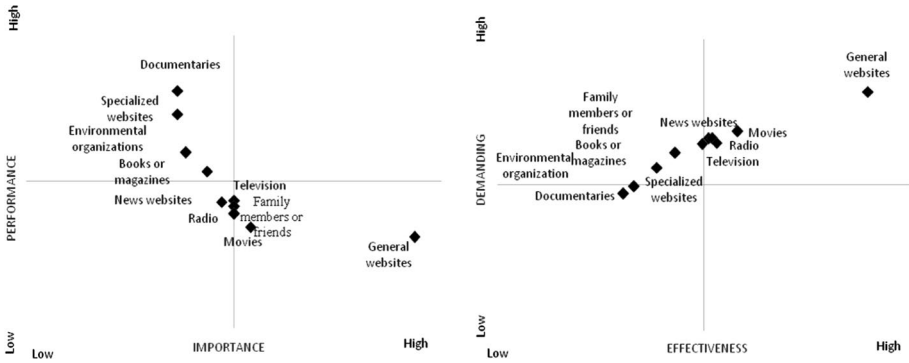
Fig. 12 Action/improvement diagram of citizens' trust in information sources regarding climate change

documentaries, specialized websites, environmental organizations and books or magazines. These present high trust and consequently high trust percentages which provide high efficiency. Moreover, they belong to the upper-left quadrant of the action diagram and present low significance in terms of information sources. In other words, they consist the last priority of the information sources regarding action for improving citizen trust since despite being important for citizens they present high efficiency. Nevertheless, the same criteria belonging to the upper-left quadrant of the improvement diagram (3rd Priority) require great improvement effort since they present low efficiency but high effort and thus high demanding. To raise their trust percentages, information sources will have to improve the characteristics concerning the general websites, movies and radio as these are located in the lower-right action quadrant meaning they consist the first priority and citizens do not trust them particularly. Simultaneously, these information sources need to try more to improve the specific criteria because in the improvement diagram they belong to the lower-left quadrant (2nd Priority) and the criteria in this quadrant provide high effectiveness but require greater effort. Moreover, it is indicated that the citizens are demanding and express low trust percentages regarding the information provided by the information source. In addition, there is high demanding regarding the improvement of the criteria which are located in the two quadrants of the diagram (2nd Priority and 3rd Priority).

To create the action and improvement diagrams for the stakeholders' contribution to climate change, a different interpretation was used because the question about their
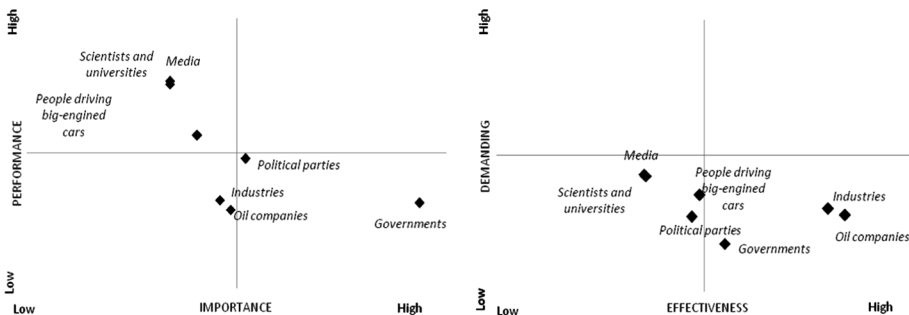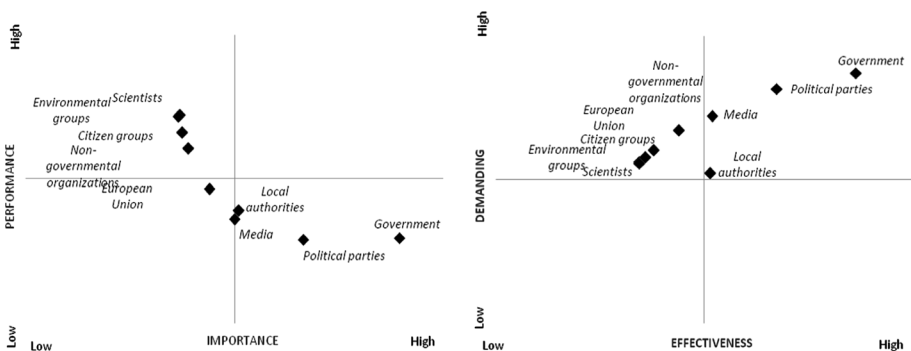

Fig. 13 Action/improvement diagram of stakeholders' contribution to climate change

contribution was set out differently (Fig. 13). For this, has been taken into account the direction of the questions. Of the stakeholders mentioned in the question and who contribute more to climate change, mainly governments and political parties will have to make greater efforts to improve their overall degree of contribution to the problem. Namely, they consist the main priority for citizens as their contribution to climate change is causing dissatisfaction. Other significant stakeholders contributing substantially to the problem involve oil companies and industries. As such, they will have to carry out similar improvement actions to enhance their activities and decrease their contribution to the issue but also to reduce the overall contribution index. Furthermore, these stakeholders present more room for improvement since they are located close to the vertical axis of the action diagram. Conversely, the remaining stakeholders like people driving big-engined cars, scientists and universities and the media belong to the upper-left quadrant. This means that these stakeholders are not particularly important for citizens and their activities have high efficiency. At the same time, oil companies and industries will have to focus more on improving their contribution to climate change as they belong to the lower-right quadrant where they present high effectiveness while citizens do not appear to be especially demanding toward them. Likewise, since they are in the lower-right quadrant, governments will need to focus more on efforts aiming at improving their contribution to climate change. Unlike oil companies and industries, governments present greater room for improvement because they are located along the vertical axis of the improvement diagram. Then, political parties and people driving big-engined cars are the stakeholders consisting the second priority and belonging to the upper-left quadrant. Additionally, these stakeholders present low effectiveness while citizens do not appear to be particularly demanding toward them. On the contrary, mass media, scientists and universities consist the last priority since they belong to the upper-left quadrant. Yet, these stakeholders have greater scope for improvement since they are on the horizontal axis of the improvement diagram.

Regarding citizens' trust level in the stakeholders, political parties, government, local authorities and mass media present low trust indexes and belong to the lower-right action quadrant which contains stakeholders that citizens do not trust to carry out climate actions and consequently these will have to make greater effort to enhance their actions (Fig. 14). In addition, they present considerably low efficiency despite being regarded as important stakeholders by citizens. For this reason, they also present the lowest trust percentages regarding citizen participation in climate change actions. The same stakeholders will have

Fig. 14 Action/improvement diagram of citizens' trust in the stakeholders to participate in climate change actions

to exert substantial effort to improve their arguments and services in order to increase citizens' trust in them since they belong to the lower-left quadrant. Although the efficiency of these stakeholders is high, citizens do not express increased trust in them possibly because they perceive that these stakeholders undertake inadequate climate actions. Conversely, scientists, environmental groups and citizens groups will perhaps have to make little action effort due to the fact that they present the highest citizen trust. The same applies to non-governmental organizations (NGOs) and the European Union even though both present relatively lower trust indexes. What is more, for citizens these stakeholders have low significance because they do not affect directly the overall trust degree and belong to the upper-left quadrant of the action diagram and thus will not have to act immediately. In other words, these stakeholders consist the last priority of criteria in terms of actions to improve citizen trust because even though they are not regarded as significant stakeholders by citizens they present high efficiency. Finally, it is indicated that citizens are particularly demanding and present low percentages in terms of their trust in the stakeholders. This can be accounted for by the fact that citizens express high demand for the improvement of the criteria located in the upper-left and right quadrants of the diagram (2nd Priority and 3nd Priority) which are those requiring greater effort.

5 Discussion and conclusions

Stakeholders' actions on global environmental problems should be well designed and integrated into programs of Environmental Communication (Piperopoulos and Tsantopoulos 2006; Zerva et al. 2018). To ensure maximum results, public attitudes must be taken into account in the construction of Environmental Communication programs. Conversely, fragmented actions have nothing to offer citizens and can even have negative results. Hence, we can achieve rational information which contributes not only to the enhancement of citizen trust in actions conducted by stakeholders, but also to citizen participation in climate change actions. The aim of this study has been to investigate the characteristics of information sources and ways to improve stakeholders' climate change contribution, while the research findings could be used by stakeholders to enhance citizen participation in climate change actions. The study objective has been fulfilled to a satisfactory extent since the research has identified the information sources which citizens trust mostly for their information on climate change, stakeholders with the highest contribution to the problem and the stakeholders that citizens trust for their participation in environmental actions. For their information on climate change, the majority of citizens trust mostly documentaries, specialized websites, environmental organizations and books or magazines. Namely, they trust those media that provide specialized information and knowledge about climate change. Possibly, these media will not have to immediately exert efforts to improve the information they provide on climate change. Therefore, these media could be used by the stakeholders who presented low trust levels such as government, political parties, local authorities and mass media.

However, in order to apply this and to implement a rational communication strategy, it is necessary to first establish the unhampered conduct of environmental communication programs and then to ensure that the coverage of events follows a framework of interests and perceptions (Boehmer-Christiansen 1994). That is because mere action is not sufficient, but it is essential that the broadcasting language of the data is rational, simple and objective (Nisbet and Scheufele 2009). Hence, the important values of these data are

society's knowledge and action which are activated through sustainable development (Lindenfeld et al. 2012), as well as through society's moral obligation toward environmental issues (Cox 2007). It is also linked to the perceptions of the majority of Greek citizens, who trust more the specialized media to inform them about climate change. Simultaneously, they trust the environmental groups to participate in climate change actions and they believe that the oil industry has made a great contribution to the creation of climate change and is mainly responsible for environmental degradation (Papoulis et al. 2015).

It is also important to note that the findings of the present study, which was conducted in 2014–2015, are quite similar to those of recent studies. To be more exact, similar findings were recorded in a recent study which was conducted in Europe (European Commission 2019). This study examined citizens' views, attitudes and knowledge about climate change and indicated that in Sweden at least 50% of citizens perceived climate change as a serious threat to the world. In Greece, however, citizens who were concerned about climate change accounted only for a low percentage (11%) even though they also viewed it as an important environmental issue. As for relevant stakeholders, European citizens considered that national governments are mainly responsible for addressing climate change and the other responsible stakeholders that followed were businesses, industries, the European Union, personal responsibility, regional and local authorities as well as environmental groups. Similar findings were indicated in relevant studies which were carried out in Greece and it was shown that citizens perceived that national governments bear the greatest responsibility for climate change (Voskaki and Tsermenidis 2016). At the same time, they did not trust public authorities and big enterprises but instead trusted scientists and environmental organizations for tackling climate change (Papoulis et al. 2015). It is also interesting to note that Greek citizens were found to have low levels of knowledge about the effects of climate change (Diakakis et al. 2018) whereas citizens in the Greek island of Crete ascribed climate change to anthropogenic causes and reported that they are already experiencing its effects (Petraki 2016). In terms of citizen information, it has been shown that citizens are informed about climate change mainly through the local media while they acquire little information from the state at educational and operational level (Angra and Sapountzaki 2019). In addition, individuals with low educational level tend to feel insecure due to the effects of climate change and this insecurity could be stemming from the information provided by social media (Voskaki and Tsermenidis 2016).

Consequently, mass media are particularly important and can contribute substantially to strategies addressing climate action. That is because the media have the ability to present the same data in different ways (Freudenburg and Muselli 2013). In this regard, it can be easily understood that some media are responsible for the public's lack of information on climate change (Smith 2005) or even the dramatization of the events (Von Storch 2009). Possibly, this is also due the selective broadcasting of topics by the media which have focused more on presenting the effects rather than the timely prevention of climate change (Pasquaré and Oppizzi 2012).

However, it cannot be disputed that for citizens mass media consist important information sources, which in combination with the consent of science could evolve into effective means and information tools for the application of communication strategies carried out by stakeholders and prompt citizens to participate in climate change actions. Apart from the media which contribute directly to public information, the stakeholders who carry out climate change actions have also an important role to play; however, Greek citizens were found to be significantly dissatisfied with their actions (Zerva et al. 2018).

This reported discontent stems possibly from stakeholders' actions in which the appropriate means are not used effectively in the planning of communication strategies. To conclude, since Greek citizens trust mostly information sources like documentaries, specialized websites and environmental organizations, the significant stakeholders with the lowest citizen trust should take more action. To this end, they could use these information sources in their communication strategies and, at the same time, cooperate with scientists, environmental groups and citizen groups.

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