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CLIMATE CHANGE AND GREEK PORTS: INVESTIGATING THE PERCEPTION OF STAKEHOLDERS

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Abstract

Ports are vital infrastructure for insular countries like Greece, playing a crucial role in international trade, economic growth, and social cohesion. However, their coastal locations—often in low-lying or deltaic areas—make them highly vulnerable to the impacts of climate change. With 227 inhabited islands, most of which rely solely on coastal transport for connectivity, climate change poses significant challenges for both passenger and cargo transportation. This study aims to explore the perceptions and attitudes of key stakeholders in the Greek port industry regarding climate change and its potential impact on port operations. A total of 65 structured questionnaires were anonymously completed via Google Forms by port employees, board members, and specialized environmental staff between September 2023 and May 2024. The findings reveal a strong consensus on the increasing visibility of climate change in recent years, while also highlighting significant challenges in addressing its effects on ports.

Keywords

climate change recognition, port vulnerability, environmental concerns, information gaps

1. Introduction

Ports are vital to global supply chains, facilitating trade, transport, and economic development. As central hubs of the "Blue Economy" (EU, 2021), they support maritime transport, fisheries, offshore energy, and coastal industries. With over 80% of global trade moving by sea (Asariotis, 2021), ports are essential for economic growth and societal well-being.

However, their coastal locations make them highly vulnerable to climate change, leading to delays, disruptions, and infrastructure risks. Most ports were designed for past climate conditions (USCCSP, 2008), necessitating urgent adaptation. While research highlights these challenges (Ng et al., 2015; Monioudi et al., 2018; Asariotis et al., 2024), few port authorities have taken action.

Given climate change projections, stakeholders must integrate climate resilience into port planning and operations. This study examines the perceptions of key individuals in the Greek port industry regarding climate change and its potential impact on port activity.

2. Greek Ports

Ports are vital infrastructures for insular countries like Greece. They are not only facilitating the country’s international trade, contributing in the economic development but they play a key role in social cohesion. Greece has 227 inhabited islands with the majority of them having sea coastal transport as the only transport mean to be connected with other nearby islands and with the mainland. As a result ports are playing a vital role for these islands acting as the gates for passengers and cargo transports.

The Greek port system includes more than 1.000 port infrastructures with many of them not belonging to a port authority or operator. The backbone of the Greek port system is the 13 Port Authorities operating as Societe Anonymes with two of them (Piraeus Port Authority S.A. and Thessaloniki Port Authority S.A.) being listed in the Athens Stock Exchange since 2003 and 2001 respectively (Pallis and Vaggelas, 2017). The Greek port reform that started in 1999 with the transformation of Piraeus Port Authority and Thessaloniki Port Authority to Societe Anonymes, resulted in the concession of Piraeus Container Terminal to COSCO Pacific (second round of port reform) and eventually to the de facto privatization of several port authorities (Piraeus, Thessaloniki, Heraklion, Igoumenitsa, so far) through the sale of the majority of the Port Authority shares (third round of port reform).

The 13 major Greek ports facilitated 5,7 million TEUs, 5,6 million tons of dry bulk cargoes, 31,7 million passengers and 2,7 million cruise passengers in 2023, while the secondary port system of the country (ports operating as state or municipal port funds) handled 39,5 million passengers, and 21,2 million tons of cargoes for the same year (Vaggelas and Pallis, 2024).

3. Methodology and materials

The analysis is based on a broader survey examining key port community stakeholders' perceptions of climate change and its impact on port activity. The survey involved distributing questionnaires to various port associations, differing in type, size, and governance, targeting stakeholders actively involved in environmental decision-making. The goal was to explore the perspectives of different social groups on major climate change-related challenges affecting port operations. The questionnaire included 37 questions divided into 7 subsections: (i) socio-demographic characteristics identifying respondents' profile eg. age, education, work experience in the field (ii) port track record eg. type of port association, description of services, type of Legal entity (iii) cognitive and personal aspects related to climate change (iv) social and political aspects (v) description of factors influencing decision making (vi) historical events in the port related to weather or climate impacts (vii) level of port resilience, preparedness and adaptation planning. A total of 65 structured questionnaires were anonymously completed via Google Forms by stakeholders with expertise in environmental issues and decision-making in Greek ports. Respondents included port employees, board members, and specialized environmental staff. The survey took place from September 2023 to May 2024.

4. Results

A significant portion of respondents (63.1%) work for municipal port funds, 35.4% are employed by port authorities, and 1.5% work in marinas. Additionally, 76.9% are part of public legal entities, with 23.1% working for private entities. Among these, 57.1% are members of the European Sea Ports Organisation (ESPO), 21.4% belong to the Hellenic Ports Association (ELIME), 14.3% are part of both, and 7.1% are members of ESPO & MEDCRUISE.

When asked to rank environmental concerns, energy consumption was identified as the top priority, receiving 33.6% of the votes, whilst port Waste/ Garbage and water quality were tied with 12.5% and 12.4% each. In turn, climate change concern came in the fourth place scoring 12.3%, followed air quality (7.5%), ship waste (6.1%), port development (4.8), dredging operations (4.8%), land degradation (4.8%) and noise (1.9).

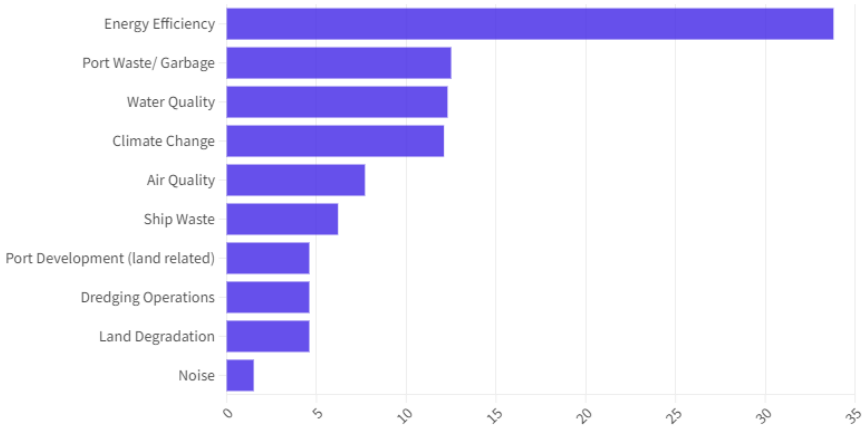

Figure 1. *Ranking of port environmental concerns*

Based on participants' responses regarding changes in weather conditions and climate, the survey revealed that the majority (78.5%) acknowledged significant shifts in the climate. A smaller portion (12.3%) stated that they had not observed any changes, while 9.2% were unsure or preferred not to answer. Participants who observed changes were then asked if they believed these changes were linked to climate change. 69.8% agreed that the changes in weather conditions were indeed connected to climate change. A minority (3.2%) disagreed with this assessment, and 27% were uncertain or could not provide an answer. Lastly, 96.9% affirmed climate change is reality, demonstrating an overwhelming consensus that climate change is a significant and ongoing issue. Only 3.1% questioned its existence, highlighting the broad recognition of its importance.

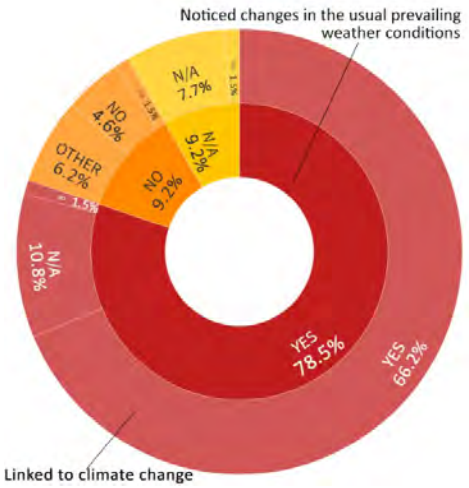

Figure 2. *Observation of changes in prevailing weather conditions over the last 5 years*

Regarding the existence of specialized environmental departments at ports, 63.1% reported that no such department exist, suggesting a potential gap in organized environmental management, while 33.8% indicated the presence of such departments, reflecting growing recognition of their importance.

Participants identified the increase in strong winds (27.7%) as the most concerning climate change hazard on ports, followed by rising sea levels (20.6%), heatwaves (17.7%), and storms (18.4%). Fewer respondents highlighted flooding from inland sources (8.5%) or the sea (5.7%). Key concerns of the participants regarding the impact of climate change on ports included damage to infrastructure (31.8%) and coastal erosion (21.7%). Other issues included disruptions to port operations (19.7%), damage to superstructures (11.5%), and mechanical equipment failures (6.4%). It is stated that none of the respondents argued that there would be no impact *(Figure 3)*.

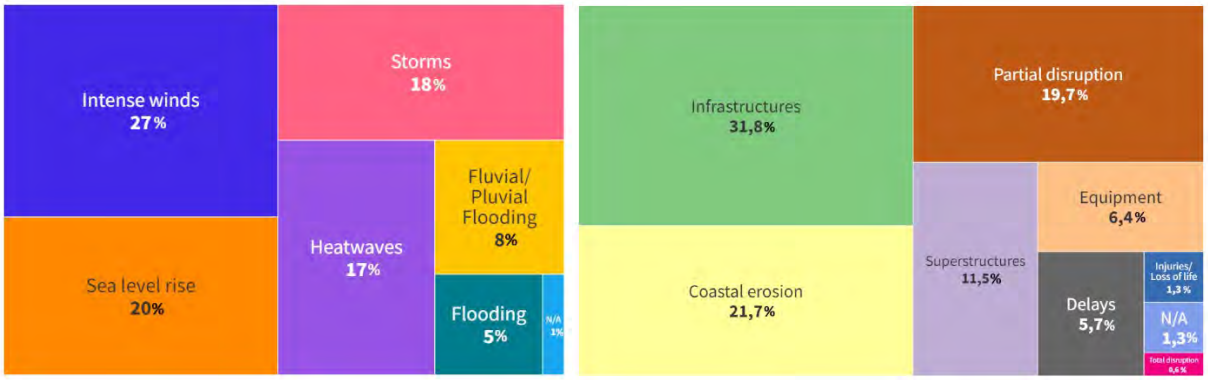

Figure 3. *Perceived most significant (a) hazard of climate change and (b) potential impact on ports*

When asked to rate the potential impact of climate change on their ports, 26.2% assigned a score of 8 out of 10, while 21.5% gave a rating of 7. Regarding the ability to address climate change impacts, 36.9% believed the issues could be moderately addressed, with 24 respondents assigning a score of 7 *(Figure 4)*.

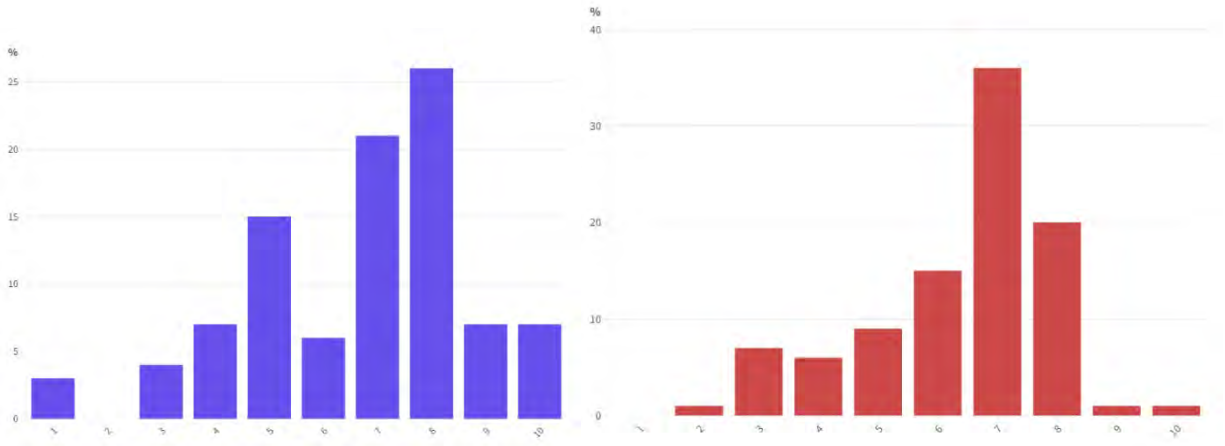

Figure 4. *Rating of the (a) potential impact of climate change on their ports and (b) ability to address climate change impacts*

The majority (56.9%) assigned responsibility for addressing climate change at ports to the state, while 20% believed port administrations should take the lead. Smaller percentages attributed responsibility to international bodies (15.4%) and local communities (4.6%). When asked who should lead

efforts to combat climate change, 44.6% pointed out international organizations, such as the United Nations, emphasizing the need for a global approach. National governments were cited by 20%, with smaller percentages attributing responsibility to industry (6.2%), local governments (10.8%), and civil society (6.2%). Some (7.7%) believed responsibility should be shared among all groups. However, 12.3% felt climate change could not be addressed, and 15.4% were unsure (*Figure 5)*.

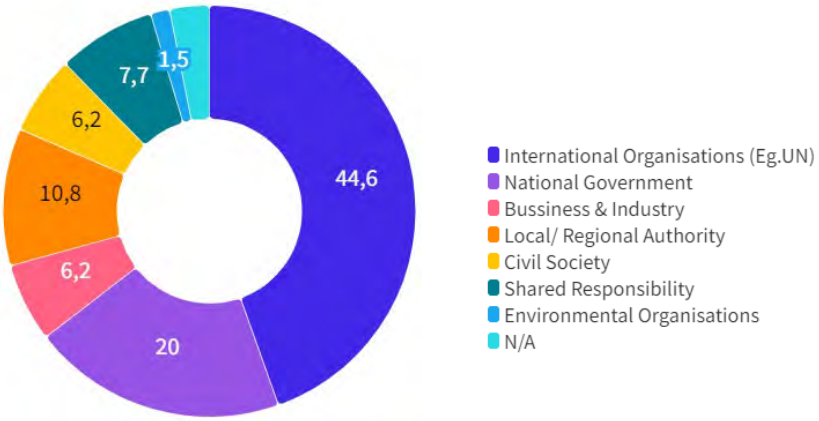

Figure 5. *Bodies that should have the main responsibility for tackling climate change*

Regarding solutions, 58.5% favored mitigation efforts focused on reducing the causes of climate change, such as greenhouse gas emissions *(Figure 6)*. Another 26.2% supported adaptation measures to help societies adjust, while 15.4% were undecided. Regarding fit-for-purpose investments 78.5% of the respondents didn't know whether forthcoming port infrastructure plans take into account the possible expected impacts of weather or climatic factors, 16.9% declared that adaptation measured are included whilst 4.6% responded that there has not yet carried out any relevant work.

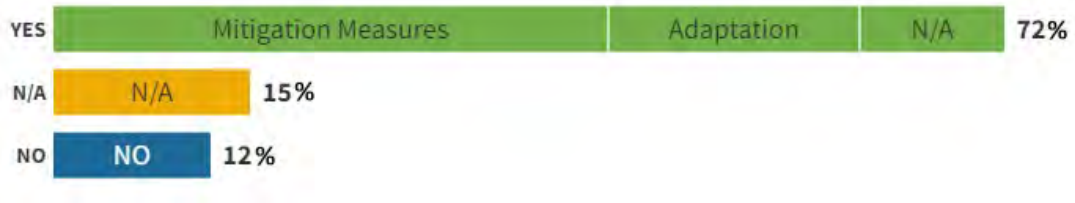

Figure 6. *Perceived approach to tackle climate change*

Concerning the influence of local governments on port environmental policies, 33.8% felt they played a role through specific climate change proposals. Another 22.5% cited government or political pressure, and 21.3% pointed to social mobilization. However, 11.3% believed local governments had no influence. Regarding the role of international organizations in shaping port environmental policy, 49.3% believed they provided guidance in an advisory capacity, while 24.7% viewed them as enforcers of sanctions. Another 21.9% felt their involvement added unnecessary bureaucracy, and 4.1% were undecided. The European Union was seen as the most influential body in port regulations (31.4%), followed by the International Maritime Organization (24.8%) and the European Sea Ports Organisation (13.3%). Other organizations, such as the UN and Hellenic Ports Association, were seen as less influential (*Figure 7)*.

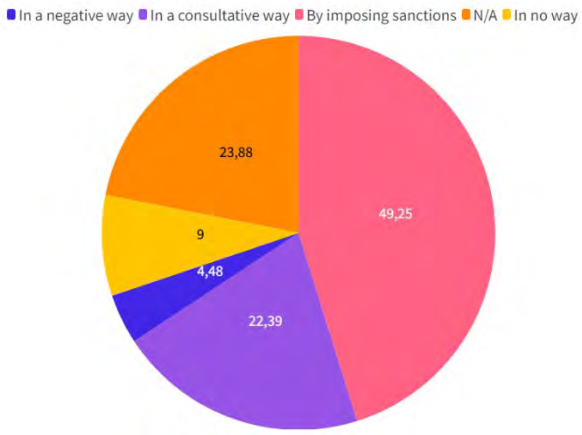

Figure 7. *Perceived role of international organizations in shaping port environmental policy*

Stakeholders were seen as influential in shaping port environmental policies by 75.4% of respondents, while 18.5% believed they had no impact, and 6.2% were uncertain. Conflicts of interest influencing port environmental policies were attributed primarily to domestic private capital (43.1%), followed by international state interests (18.5%) and national state interests (15.4%). Foreign private capital was noted by 12.3%, while 7.7% were unsure. On decision-making authority for environmental policies, 81.5% identified the Board of Directors as responsible, 13.8% mentioned the President or CEO, and 1.5% pointed to the Head of the Environmental Department.

A large majority (96.9%) agreed that improved stakeholder education about climate change at ports is necessary, with only 3.1% uncertain and none opposed. Seminars and conferences were seen as the most effective way to raise environmental awareness (51%), followed by electronic media (34%). Smaller percentages mentioned written materials (12%) and rule enforcement with fines (1%).

5. Conclusion

This survey is based on a sample of respondents consisted primarily of individuals with significant work experience and a high level of education. The age distribution reflects a mature workforce, with the majority being over 45 years old. Most respondents work for municipal port entities and primarily public legal bodies. The integration into broader organizations is not common, but when it happens, ESPO and ELIME are the most popular organizations.

Based on the results of the survey there is a clear tendency toward recognizing noticeable changes in the climate over the past few years, showing by common consent a strong belief in the link between weather changes and climate change. Additionally, there is near consensus that climate change is present and significant, highlighting increased awareness and concern about its capability to affect ports' infrastructure, operations and services in future.

Although most respondents reported being impacted by weather/climate events, prompting consideration of climatic factors in future investments, the study revealed key information gaps for Greek seaports. Most stakeholders surveyed had no opinion on whether weather/climate considerations are mainstreamed in planning adaptation measures. Notably, the minority addressing these issues in future designs is mainly from major Greek port authorities.

Most significantly, albeit the recognition of the hazard, ranking of top environmental concerns placed climate change in the fourth place, contrary to the status at a European level based on which climate change issues appear to be the top environmental concern of the sector (ESPO, 2023).

Participants largely believe international organizations should take primary responsibility for addressing climate change, and most think it is possible to tackle it. However, they also recognize the strong influence of local authorities and stakeholders on port environmental policies, emphasizing the need for more information and conflict resolution, especially regarding private capital. They prefer

preventive and educational approaches, focusing on personal interactions and knowledge exchange via conferences and online platforms. The results also highlight the complexities of working with international organizations, particularly bureaucracy and sanctions, while underscoring the significant impact of international and regional policies on port decision-making.

Acknowledgments

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