Perception of the Barriers to the Implementation of a Successful Climate Change Policy in Bulgaria

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Article

Perception of the Barriers to the Implementation of a Successful Climate Change Policy in Bulgaria

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Abstract: Climate change is an undeniable global phenomenon with severe and long-lasting impacts on the environment, economy, and society [1]. Like countless other nations, Bulgaria is already feeling the effects of climate change, with rising temperatures and heat waves [2], erratic precipitation patterns, and frequent occurrences of extreme weather events. Bulgaria is under imminent threat from climate change. The country is projected to experience a temperature increase of up to 4°C by 2100. This will lead to changes in precipitation patterns, resulting in numerous consequences. These include reduced water storage, impacts on public health, disruptions in agricultural production, stress on the country's biodiversity and forests, damage to infrastructure and private property, changes in tourism patterns, and many other potential issues [3]. Climate change has recently become a significant concern in Bulgaria due to its impact on ecosystems, the economy, society, and infrastructure. This study aims to examine the varying perspectives of different stakeholders regarding the barriers that impede the effective implementation of climate policies in Bulgaria. Key representatives from public administration, NGOs, businesses, and academia were interviewed in-depth. Additionally, an online and face-to-face survey was conducted among a diverse sample of the Bulgarian population. Results show that the most cited barriers include political instability, long-term vision, inadequate financial resources, limited public awareness, conflicting interests across sectors, and slow administrative processes. Moreover, the survey highlights notable disparities in perceptions among different stakeholder groups.

Keywords: climate change; policy; effectiveness; regulations; Bulgaria; perceptions; barriers; stakeholders

1. Introduction

This study will review some basic concepts concerning climate change and adaptation. In some studies – Smit et al. [4], climate adaptation is seen as „adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts". Brooks [5] defined adaption as: "adjustments in a system's behavior and characteristics that enhance its ability to cope with external stress".

The issue of climate change and its impact on various European regions has been discussed among experts. While many scientists have researched this issue, it's important to note that not all regions in Europe will be affected equally by climate change [6]. Sectors that are particularly vulnerable to climate change will be impacted the most, which will further add to the challenges and pressures on socio-economic development and functioning [7].

Being a part of the EU, Bulgaria cannot afford to remain indifferent to the ongoing climate change processes. Therefore, it becomes crucial to conduct a thorough analysis of the existing climate policies and strategies to ensure their effectiveness and sustainability.

Since the 1980s, there has been a steady increase in atmospheric CO2 emissions, reaching their highest levels in 2021. Tragically, human activities, such as burning fossil fuels, are the primary cause of these emissions, which in turn contribute to the ongoing climate change crisis. Specifically, the

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levels have continued to rise throughout the decades, with peaks in the 2000s and most recently, the 2019s [8].

For many years, the main approach to climate change has been reducing greenhouse gas emissions to minimize its effects. With a steadfast dedication to researching and implementing effective policy objectives, the European Union has been a leading contributor to global efforts to curb greenhouse gas emissions since the 1980s. Several EU countries have distinguished themselves as pioneers in this area [9]. However, the need to prioritize adaptation measures has become increasingly pressing as we witness the real-world effects of climate change, such as melting Arctic and mountain glaciers, flooding, extreme heat waves, and storm damage.

In recent times, there has been a significant shift in the focus and perception of climate change adaptation. Previously, the EU's involvement in adopting policies towards climate change could be considered inadequate, with the Community primarily focused on fulfilling the objectives outlined in the Kyoto Protocol. However, the European Union's awareness of the importance of implementing comprehensive climate change adaptation strategies at the national level has been greatly influenced by two crucial documents. These documents include the European Commission's Green Paper 'Adapting to climate change in Europe - Options for EU action' in June 2007 [10] and the White Paper 'Adapting to climate change: towards a European framework for action' in April 2009 [11].

The scientific community has played a crucial role in shaping the political discourse on climate change policies in recent years. Beginning in 2005, Member States within the European Union have taken steps to develop and implement comprehensive National Adaptation Strategies to effectively promote, facilitate, and coordinate adaptive efforts within their respective countries. These strategies serve as an important tool in addressing the challenges of climate change and ensuring the resilience of communities and economies [12].

According to a report from the European Parliament Research Service, Bulgaria has made significant strides in reducing its overall greenhouse gas emissions, achieving a 44% reduction from the levels recorded in 1990 [13]. It's worth noting, however, that coal remains the primary source of energy in the country, resulting in Bulgaria having the most GHG-intensive economy in the European Union [14].

At this stage, there are three main international climate agreements: The UN Framework Convention on Climate Change (UNFCCC) [15], The Kyoto Protocol, which governs international action up to and including 2020 [16], and the Paris Agreement, which sets the framework for action to respond to climate change from 2021 onwards.

According to EU legislation, all Community Member States are required to implement National Energy and Climate Plans (NECPs) for the 2021-2030 period. These plans are crucial in each EU country's efforts to meet the binding 2030 climate and energy targets [17].

Each country that has ratified the Paris Agreement, such as Bulgaria, is required to develop a climate action plan. These plans outline the measures that countries will take to decrease their greenhouse gas emissions and to adapt to a shifting climate. While European Union (EU) member states work together to accomplish the goals of the Paris Agreement, they are not individually bound to make nationally determined contributions, but must still enforce relevant legislation within the Union.

Alongside these records, the European Green Deal outlines climate change objectives that strive to establish the EU as a thriving community with an economy that efficiently utilizes resources and minimizes greenhouse gas emissions by 2050 [18]. The European Climate Act further reinforces this commitment by legally mandating the attainment of climate neutrality in the EU by 2050 [19].

Developing and executing policies to address climate change on a global and European scale is a complex and challenging task. This is primarily due to a few key factors. Firstly, the implementation of such policies requires the active participation and collaboration of numerous countries, each with its unique interests and priorities, necessitating extensive coordination efforts.

Additionally, climate change impacts a wide variety of sectors and areas, from energy and agriculture to health and tourism. As such, policy development must take into account the competing

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interests of various stakeholders, including governments, businesses, NGOs, and citizens, and find a balance that benefits all parties involved.

Due to various contributing factors, implementing comprehensive climate-related policies can be a more involved process. For example, the horizontal nature of such policies often necessitates the involvement of all relevant state institutions, businesses, and NGOs. Additionally, to effectively address climate change, implementing complex actions can generally be categorized into two groups: those that mitigate its effects and those that adapt to already underway changes.

The challenge is that strategies to address the negative impacts of climate change are decided based on global agreements and established climate policies in Europe. However, strategies related to adapting to climate change are determined on a national level, taking into account unique national characteristics and the associated risks.

As a result, this paper endeavors to assess and appraise the efficacy of the climate change policy in Bulgaria.

We will also delve into the barriers hindering the adaptation to climate change among individuals affiliated with climate change work institutions, NGOs, and academic circles, including scientists and students. Our study endeavors to offer insights into addressing the primary challenges facing national-level adaptation efforts.

It is important to highlight that for this study, the term "adaptation and climate policies" encompasses all relevant national documents, measures, and policies adopted at regional and local levels. This includes policies and measures aimed at adapting to climate change impacts and reducing vulnerability to climate-related risks [20].

The aim of soliciting feedback from actors engaged in the climate change implementation process is to assist decision-makers in enhancing the climate adaptation process through the policies and measures implemented. This feedback mechanism helps to refine the technical aspects of the process, thereby improving the overall efficacy and effectiveness of climate adaptation efforts [21].

As part of our study, we aim to uncover the institutional barriers hindering effective adaptation to climate change. Additionally, we seek to explore the perspectives of policymakers in the country to identify the most significant obstacles.

To address the first question, we thoroughly analyzed the country's legal framework and all strategic documents about climate adaptation.

A survey was conducted in Bulgaria from March to May 2024 to understand better the barriers confronting those who bear direct responsibility for climate adaptation. Respondents came from various institutions, NGOs, academic circles, and experts. The second part of this article provides a thorough analysis of the legal framework and all relevant strategic documents concerning climate change adaptation at both national and local levels. The findings of this review outline the key challenges, issues, and potential solutions.

The following section thoroughly discusses the study's methodology. Then, the fourth part examines and analyzes the study's results in detail. The fifth section highlights some recommendations derived from the study. Finally, the paper concludes with a summary of the findings.

For the purposes of this paper, it should be borne in mind that many of the studies already conducted on the topic of barriers to climate adaptation use different concepts, such as barrier, obstacle, constraint, limit, and challenge. For our study, we have used the word barrier.

In several studies, authors have considered barriers originating from different aspects. Some authors have focused on adaptation being less critical in short-term policy goals than other issues [22,23].

Nalau et al. [24], on the other hand, refer to barriers that stem more from uncertainty among policymakers about future climate change in their studies.

Some authors have drawn attention in their research to the fact that many of the barriers to climate adaptation and the adoption of climate policies are due to weak institutional capacity [24–26].

Bajec [27] draws attention to the weak integration of national climate policies into other sectoral and local-level documents, which appears to be a barrier to implementing effective climate policies.

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Koch et al. [28] see weak stakeholder engagement and poor communication between stakeholders as barriers to the effective implementation of climate policies.

These are some of the most common barriers, some of which overlap with our study but are not limited to them.

2. Materials and Methods

Our first step in this study was to locate, collect, and arrange all strategic and planning documents from Bulgaria. To accomplish this, we extensively searched the Ministry of Public Works and Regional Development's database (https://www.mrrb.bg/en/) and the Ministry of Environment and Water's database (https://www.moew.government.bg/en/). It was crucial that all documents were current as of April 1, 2024, and therefore up-to-date.

The methodology used in this study involves a systematic approach to the analysis of the main themes underpinning the NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN and the overall policy framework. The aim was to achieve a comprehensive and detailed understanding of key climate change adaptation issues in the context of national policy and planning framework. The results of the study are expected to provide valuable insights into the challenges and opportunities associated with climate change adaptation and to inform future policy and planning initiatives in this critical area.

The survey design in the second part of this study is based on:

Survey Development: A comprehensive survey was formulated, incorporating a mix of closed and open-ended questions. These questions were meticulously crafted to pinpoint perceived barriers to climate change adaptation policies, drawing from existing literature and tailored to the Bulgarian context for maximum relevance. The survey encompassed interviews with policymakers, scientists, NGOs, and students. Respondents in our survey are well-informed and knowledgeable about climate change. Respondents are people and experts with prior experience in climate change, who participated in climate projects. In the survey, a total of 402 people were interviewed in March and May 2024 through email, phone, and face-to-face. All the respondents who completed the study were 207 respondents (51,4%).

The survey was distributed through online platforms, email, or in-person meetings to maximize the response rate. The data analysis methods include qualitative content analysis for open-ended responses and statistical methods for closed-ended questions to identify patterns, correlations, and significant barriers. The responses to questions were diverse, analyzed, and categorized using Excel and XLSTAT. We applied the cluster analysis method described in the Results section to understand the survey results better.

Data analysis for open-ended questions includes the following steps. First, complete transcripts of the interviews were made, audio files were available, and the written surveys were recorded in Word. In the next step comes the role of XLSTAT software, with the help of which we analyzed the data, especially repetitive responses or those that overlapped in some sense and were grouped into one category (e.g., low interest and lack of commitment to participate from the public). In the next phase, respondents were asked to rank the importance of 33 pre-defined barriers to climate adaptation, seven most important and seven least significant, on a scale of 1 to 5. As a result, the standard deviation was calculated to show the range of views on the importance of each barrier, showing us how the more significant the standard deviation, the greater the variation in respondents' opinions. Calculating a mean shows respondents' average rating on the importance of each barrier. Higher values mean that the obstacle is perceived as more important. In the last step, cluster analysis was performed using the XLSTAT software tool.

The selection of study topics is closely tied to addressing the most pressing issues for sectors of the national economy vulnerable to climate change, including agriculture, water, tourism, etc. Upon analyzing the survey data, the findings were inconclusive. Many survey respondents held contrasting views on climate change in Bulgaria and the necessity of adapting to climate change in general. This disparity can be attributed to a variety of factors, such as inadequate awareness of

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national climate change policies, insufficient coordination between national and local policies, and financial limitations.

3. Results

Our research focuses on Bulgaria's response to climate change policies. The country's economy, influenced by the Communist era, has traditionally prioritized environmentally insensitive industries. This has made it difficult to transition to a more sustainable economy, as there are high rates of unemployment, out-migration, and social issues to contend with.

Despite Bulgaria's ratification of all international climate agreements, the majority of its politicians and citizens, as members of the EU, lack a thorough understanding of the impact that climate change has on their daily lives. The significant challenge lies in the vast scope and intricacy of the issue, as the effects of climate change reach beyond mere changes in temperature and precipitation patterns, impacting various aspects such as infrastructure, agriculture, and public health [29].

An important obstacle is the lack of robust institutional and policy frameworks to coordinate and execute adaptation strategies efficiently. Wellstead and Stedman [30] argue that the adaptation and adoption of climate change strategies are often tied precisely to the political capacity of government organizations, which aspire to follow the steps of a standard political cycle.

While some adaptation planning is underway, there remains a shortage of well-defined, assessed measures being implemented at the necessary magnitude. Challenges like limited funding, jurisdictional constraints, and inadequate public awareness and engagement persist in hindering progress [31].

From this point of view, it is no coincidence that Moser and Ekström [32] suggest that one initial phase in implementing climate policies relies on 'understanding' climate change, or how the government interprets climate change signals, what information is collected about them, and how it is used. In this initial phase of understanding [32], three sub-phases can be distinguished: 1. Detection of the problem or how institutions react to signals; 2. What information is collected about the climate; 3. Redefinition of the problem, in which sub-phase the problem is now reformulated in terms of the information collected in the second sub-phase. In this perspective, Sietz et al. [33] argue that institutional barriers in developing climate and climate adaptation policies can be distinguished into three levels: 1. Individual, determined by personal qualities, attitudes, and response capacity; 2. The organizational level depends on each organization's characteristics; 3. At the enabling environment level, where it depends on the interactions between the political and societal contexts and how their influence may positively or detrimentally affect the ability of the state or municipalities to plan climate change policies, bearing in mind here that barriers in the enabling environment are largely dependent on the laws and regulations that are adopted, and these, in turn, can be entirely incompatible with the climate policy planning process [34].

The lack of awareness serves as a significant obstacle to better adaptation to the changing climate on a national level [35]. Oberlack and Eisenack [34] argue that the lack of awareness and engagement about climate change may lead to low public support.

Despite available observational data and research results confirming the impacts of climate change in Bulgaria, there has yet to be a clear vision of national priorities or concrete actions taken to address this crucial issue.

The National Adaptation Strategy and Action Plan is crucial in the country's efforts to address climate change. It's worth noting that the strategy takes a sectoral approach, rather than a regional approach, which some may view as a drawback in the broader national policy [36].

Establishing a comprehensive guide in Bulgaria that outlines a plan for addressing climate change adaptation and identifies key areas of focus until 2030 is crucial. However, having this document alone is not sufficient to drive progress. Rather, the specific actions outlined within the guide - tailored to 9 distinct sectors, including agriculture, biodiversity, energy, forests, human health, tourism, transport, urban environment, and water - provide a solid foundation from which to develop and implement practical measures to adapt to the impacts of climate change successfully.

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Once the European Commission adopts the Partnership Agreement, Bulgaria's Recovery and Sustainability Plan, and other climate-related regulations, they are mandated for implementation. These documents must specify the fulfillment of the requirement, as a horizontal criterion, that a certain proportion of EU funds under all programs should be allocated to finance climate change-related measures.

During the 2014-2020 programming period, the requirement was 20%; for the 2021-2027 period, it is 30% of EU funds to be used for such measures. Furthermore, in Bulgaria, actions related to the implementation of climate change response policies are predominantly reactive rather than proactive, mainly being undertaken in the implementation/transposition of binding EU acts without considering country-specific circumstances, especially the increasing specific risks of adverse effects of climate change in the country.

As an EU Member State, Bulgaria was obliged in 2014 to adopt the Climate Change Mitigation Act [37]. At this stage, Bulgaria is one of the countries with such a law. Still, its main focus is the regulation of the legal relations that arise for EU countries, such as obligations under international and European greenhouse gas emissions trading schemes.

In Bulgaria, existing issues have not only gone unsolved for years but have also worsened. This is not solely due to the impacts of climate change but also due to a lack of understanding and neglect of the necessity to implement a coherent climate policy to mitigate these changes' adverse effects.

When developing and enacting a national climate change policy, it is crucial to consider more than just international commitments and external funding. It is essential also to consider the specific national and local circumstances, which reflect global and regional processes.

The process of creating policies for adapting to climate change is complex, with many factors affecting it, some related to the climate itself and others not [38].

Bulgaria encounters numerous substantial barriers in its efforts to adapt to climate change, impeding the advancement in addressing its impacts. Among the foremost challenges is the absence of comprehensive, tailored policies and strategies that account for Bulgaria's distinct climate conditions and vulnerabilities. The absence of a clear framework for adaptation leaves decision-makers and stakeholders grappling to prioritize and execute impactful measures to alleviate the effects of climate change.

Furthermore, Bulgaria's lack of sufficient financial resources presents a major barrier to climate adaptation endeavors. Inadequate funding constrains the capacity to make necessary investments in infrastructure improvements, disaster readiness, and other vital adaptation initiatives. Without adequate financial backing, Bulgaria may face challenges in fortifying itself against the growing threats brought on by climate change.

Another substantial challenge is the limited awareness and understanding of climate change impacts among the general population and key decision-makers. This lack of awareness could lead to a lack of urgency in addressing climate adaptation and may hinder the implementation of crucial policies and measures.

Insufficient engagement from policymakers and relevant organizations in addressing climate change presents significant risks associated with a lack of comprehensive understanding of the phenomenon. This, in turn, may lead to an inadequate assessment of the dangers posed by climate change [39].

Furthermore, addressing the complex and interconnected impacts of climate change requires a multi-sectoral approach to adaptation. However, in Bulgaria, coordinating and collaborating among different sectors and stakeholders can be challenging. This can lead to fragmented efforts and a lack of comprehensive and coordinated adaptation strategies.

Addressing these barriers is essential for the advancement of climate adaptation in Bulgaria and the establishment of resilience to climate change impacts. This necessitates a coordinated effort to formulate customized policies, secure sufficient funding, raise awareness, and encourage collaboration across multiple sectors and stakeholders.

The analysis reveals various barriers to successfully developing effective climate policies in the second part of the study. The research was conducted in Bulgaria among representatives of

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municipalities, academia, and NGOs. In pursuit of this objective, 402 surveys were disseminated via email, telephone, and face-to-face interactions. Ultimately, a fraction of 207 surveys were satisfactorily completed.

The survey participants can be classified into the following groups: 87 are decision-makers (municipal councilors, mayors, heads and directors of environmental and waste directorates, experts working on climate change), 64 are scientists, researchers, and students, 10 are from the tourism sector, 17 from the agricultural sector, 8 from NGOs, and 21 fall into the "other" category.

Fifty-two of the respondents (25%) - scientists, academics, and students - in the survey in open-ended questions expressed the belief that climate change is a natural process, but it has been worsened in recent decades by human activities and high industrialization. They also noted an opportunity to introduce measures at the national level to adapt to climate change. On the other hand, 103 respondents (49.7%), primarily from the NGO sector, students, and climate policy and project experts, indicated that the lack of coordination, responsibilities, and control at the national level would make it difficult to implement effective climate policies. Additionally, 15 respondents (7.2%) from the "other" category, mainly from the tourism sector, expressed the opinion that Bulgaria is not threatened by climate change. Meanwhile, 35 individuals (16.9%) recommended that Bulgaria should focus on long-term planning for the implementation of climate change adaptation measures.

Table 1 clearly shows the summary results.

Table 1. Number of respondents to a survey conducted in March and May 2024.

	Respondents (answers)
Invitations for participation in the survey (Total)	**402**
People who participated in the survey	**207**
Respondents by categories:	
1. Policymakers, experts, etc.	**87 (42%)**
Municipal mayors and Municipal Councilors	25
Politicians	9
Experts	53
2. Scientists, researchers, and students	**64 (30,9%)**
3. Experts from the tourism sector	**10 (4,8%)**
4. Agriculture sector	**17**
5. Other (Individuals with limited engagement in climate initiatives)	**21**
Levels	
National	**37**
Municipal	**34**
Individual	**136**

**All survey respondents who did not respond, and indicated "don't know" or "don't have an opinion on the matter" were excluded from this analysis.*

In the initial part of the survey, participants were prompted with open-ended inquiries. The first question asked them to identify the primary barriers to effectively implementing policies for achieving successful climate change initiatives and policies. The responses to this open-ended question were diverse, analyzed, and categorized using Excel and XLSTAT. Notably, the most prevalent sentiment expressed by respondents was the "complete lack of government interest in addressing climate change" with 68 out of 207 respondents (32.8%) sharing this viewpoint. Following closely, 45 respondents (21.7%) cited "political instability" as a significant barrier, while 32 respondents (15.4%) highlighted the "lack of institutional understanding and awareness of climate change" as another common barrier.

After the initial ranking of the three barriers to the effective implementation of climate change policies in Bulgaria, the respondents were asked to rank the seven most essential barriers out of the 33 pre-defined ones by the authors' team based on the existing climate policy challenges in Bulgaria

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and the literature review on the topic. They ranked these barriers in order of importance and rated them on a scale of 1 to 5. By calculating the average ratings, we were able to determine the perceived significance of each barrier. Additionally, the standard deviation expressed in Table 2. Top 7 highest-rated barriers to effective implementation of climate change policies in Bulgariaindicates the diversity of opinions on the importance of each barrier, with a higher standard deviation reflecting more significant variability in the ratings. The mean, commonly called the average, is calculated by adding up all the scores given to an obstacle and dividing by the total number of scores. It provides a broad indication of the collective respondents' perceived importance of the barrier.

It's worth noting that all 207 respondents in Bulgaria identified the same barriers to effective climate change adaptation policies in both the closed and open-ended questions. Table 2. Top 7 highest-rated barriers to effective implementation of climate change policies in Bulgaria displays the top 7 barriers that emerged as the most common responses among the respondents.

Table 2. Top 7 highest-rated barriers to effective implementation of climate change policies in Bulgaria.

Position	Barriers	N	Mean	Std. dev
1.	Political instability	205	3.72	1.15
2.	Weak regulatory framework, heavy bureaucracy	201	3.61	1.09
3.	Conflict of interest	200	3.55	1.15
4.	Insufficient capacity to plan and implement	198	3.49	1.16
5.	Lack of coordination between institutions	183	3.48	1.09
6.	Low awareness	183	3.44	1.25
7.	Lack of long-term planning	183	3.31	1.14

In the table, it is accepted that all scores above **3.5 are classified as "very important"; all that is <3.5 are defined as "important.".*

Key observations and potential conclusions from Table 2. Top 7 highest-rated barriers to effective implementation of climate change policies in Bulgaria:

The main barriers hindering the implementation of effective climate policies in Bulgaria, as perceived by respondents, include political instability and a lack of a clear regulatory framework. These factors are viewed as significant obstacles that impede the effective implementation of climate policies. Additionally, a notable proportion of respondents identified conflict of interest as another barrier, which may stem from opposition between different sectors of the economy, political interests, or other factors. Moreover, issues related to capacity and coordination were highlighted, including insufficient capacity for planning and implementation, as well as inadequate coordination between different institutions. Lastly, low awareness and a lack of long-term planning were also identified as barriers, indicating the necessity to invest in public awareness and develop long-term strategies to address climate change.

Table 3 shows the 7 lowest items in the responses indicated by respondents as the main barriers to the effective implementation of climate policies in Bulgaria.

Table 3. Top 7 lowest ranked barriers to effective implementation of climate change policies in Bulgaria.

Position	Barriers	N	Mean	Std. dev
27.	Climate change policies depend on land-use planning, urbanization, water management, and agriculture as a vulnerable sector	198	2.49	1.06
28.	Lack of appropriate technology	187	2.45	1.05
29.	Difficulties in technology transfer	185	2.11	0.94
30.	Lack of international cooperation	179	2.04	0.87

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31.	Uncertainty about future climate conditions	172	2.01	0.85
32.	Rejecting the scientific facts about climate change	169	1.81	0.79
33.	Too many people in institutions who "Knows" everything about climate change	166	1.71	0.76

**In the table, it is accepted that all scores between 3-3.5 are classified as "important," all that is between 3-2.5 are defined as "slightly important," and those below 2.5 are described as "unimportant.".*

Key observations and potential conclusions from Table 3. Top 7 lowest ranked barriers to effective implementation of climate change policies in Bulgaria.:

Respondents in the study ranked barriers related to lack of appropriate technology and difficulties in technology transfer as relatively less important. This could be attributed to several reasons:

1. Growing availability of technology: A majority of respondents believe that there are sufficient technological solutions available to address climate change.

2. Optimism about technological development: The respondents, particularly students and academics, are optimistic about the future development of technology and its potential to address climate change.

3. Low assessment of international cooperation: Lack of international cooperation was rated as a less significant barrier. This may be due to Bulgaria's membership in the EU and its participation in various international climate initiatives. Many respondents believe that the country has access to the necessary international support.

4. Uncertainty about future climate conditions: Participants rated uncertainty about future climate conditions as less important. This could be due to the focus on short-term measures for effective climate policies in the country, especially among policymakers and experts in municipalities and institutions.

5. Confidence in climate models: A proportion of participants, including scientists, students, and climate experts, have confidence in climate models and believe that they provide reasonably accurate information about future climate change.

6. Rejection of scientific evidence: A relatively small number of participants identified rejection of scientific evidence on climate change as a significant barrier, indicating broad agreement on the reality of climate change.

7. Presence of too many experts: The last position in the ranking is related to the presence of too many people in institutions who think they know everything about climate change. This could be interpreted as an indication of bureaucratic barriers and a lack of effective communication between different stakeholders.

According to the survey results, participants view technological barriers, lack of international cooperation, and uncertainty about future climate conditions as relatively less significant barriers to the effective implementation of climate policies in Bulgaria. Instead, the primary focus is on other factors, including lack of political will, funding, and public awareness.

In both on-site and telephone surveys, it was expected that respondents from different sectors such as politics, science, academia, and NGOs would provide divergent answers. Surprisingly, this was not the case. All respondents unanimously agreed on several points, including concerns about political instability, weak regulations, and excessive bureaucracy. However, some variations in responses were observed in the following areas:

- Respondents from the tourism and agriculture sectors emphasized the significance of climate change policies regarding land-use planning, urbanization, water management, and agriculture as a vulnerable sector.
- While students and academics downplayed the lack of appropriate technology as a barrier, politicians and municipal authorities viewed it as a more pressing concern.

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- All respondents, regardless of the sectors in which they work, highlighted the lack of international cooperation as a less important factor, pointing out that Bulgaria's EU membership and access to funding programs mitigate this problem.
- As for the obstacle of "too many experts competent in the field of climate change," everyone agrees that this could not be an obstacle, provided there was political stability and an adequate regulatory framework in the country.

There are also some differences in the responses at the local and national level.

Respondents at the local level (municipal experts, councilors, and mayors) noted the extremely high importance of the barrier to political instability.

Regarding the weak legislative and regulatory framework, respondents working at the local level attached much more importance to this barrier than politicians or persons working in ministries.

Experts and respondents working in municipalities assigned much greater importance to the problem of insufficient capacity to plan and implement climate policies. The same can be said for the lack of coordination between institutions.

With the barrier of low interest, it can be said that respondents working in institutions related to climate policies pay much more attention to this problem.

Table A4. 5 clusters with barriers to the implementation of effective climate policies in Bulgaria presents all 5 clusters from a cluster analysis conducted in XLSTAT of all 33 pre-defined barriers to effective climate policies. A total of 5 clusters were identified using the cluster analysis.

To better understand the results, we have applied the cluster analysis method. For this purpose, we have pre-specified the number of clusters (in our case, it is 5) and used K-Means Cluster Analysis. With the help of cluster analysis, we have grouped the barriers into five different clusters, and according to the results, we have drawn several conclusions, which are mentioned below in the text.

The results obtained from the K-means analysis according to 5 predefined clusters (classes) show the central objects obtained as a consequence of the method used. This method considered the distance of each barrier (unit) to the centers (centroids) of the individual clusters. The closest distance determines which barrier (unit) belongs to which cluster.

Table A4. 5 clusters with barriers to the implementation of effective climate policies in Bulgaria presents the results of a cluster analysis applied to a dataset describing different barriers to climate adaptation in Bulgaria. The K-means algorithm was used to group similar barriers into five distinct clusters. This analysis aims to identify the main themes and interconnections between the different barriers, which can help to better understand the challenges of climate adaptation in the country.

Analysis of Clusters

Cluster 1: Institutional Weaknesses and Lack of Capacity

This cluster highlights issues such as inefficient coordination between institutions, unclear responsibilities, and insufficient capacity to plan and implement adaptation measures. This indicates that Bulgaria's institutional frameworks and human resources may not be adequately prepared to tackle the challenges of climate change.

Cluster 2: Social and Cultural Barriers

This cluster encompasses barriers such as low awareness, lack of citizen participation, and denial of scientific facts about climate change. It underscores the significant role played by social and cultural factors in impeding the adaptation process.

Cluster 3: Technical and Environmental Issues

This cluster focuses on barriers related to the lack of appropriate technologies, challenges in technology transfer, and environmental issues such as biodiversity loss and water pollution. It implies that technological constraints and environmental problems present serious barriers to effective adaptation.

Cluster 4: Economic and Political Barriers

This cluster encompasses barriers related to economic interests, competition for limited resources, and dependence on carbon-intensive sectors. It suggests that economic and political factors strongly influence the adaptation process.

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Cluster 5: Invasive Species

This separate cluster encompasses only one barrier—invasive species. This may be due to the problem's specific characteristics and relatively independent impact on ecosystems.

The findings of the cluster analysis indicate that the barriers to climate adaptation in Bulgaria are complex and interconnected, spanning various domains such as institutional, social, economic, technological, and environmental aspects. The identification of these 5 distinct clusters also leads to the following insights:

- It is necessary to provide climate change and adaptation training for government officials.
- Establishment of dedicated units within the administration tasked with climate policy.
- Establishment of integrated information systems.
- Review and enhancement of legislation and regulations.
- Expansion of national public awareness campaigns regarding climate change.
- Integration of climate change into educational curricula.
- Design of financial mechanisms, such as green bonds and subsidies.
- Adjustment of the tax system to incentivize investment in low-carbon technologies.
- Formulation of sector-specific decarbonization strategies.
- Support for small and medium-sized enterprises engaged in the development of green technologies.

4. Discussion

This study aimed to contribute to the existing body of literature on barriers to effective climate policies in Bulgaria, an area that has been largely understudied. The identified barriers are mainly associated with our country's lack of sustained political commitment in recent years, resulting in political instability. This, in turn, exacerbates the inadequate public awareness of these issues. It's worth noting that between 2021 and 2024, Bulgaria has had six general elections, and this frequent political instability has eroded public trust in societal processes.

In our findings, we presented a concise summary of the current legislative landscape in Bulgaria concerning climate change and highlighted key obstacles hindering the implementation of impactful climate policies. These insights were obtained through a survey of 207 participants across various sectors. The most prominent barriers identified by respondents included political instability, a fragile regulatory framework, conflicts of interest, limited planning capacity, inadequate coordination between institutions, and a lack of solid commitment.

It is essential to recognize that addressing climate change and its associated challenges requires tailored policy approaches rather than a one-size-fits-all solution. In a study by Pressend [40], respondents identified bureaucracy, conflict of interest, and a lack of planning capacity as significant barriers to addressing climate change. Pressend also pointed out that government inefficiency in utilizing international funding for climate action often leads to difficulties accessing that funding due to excessive bureaucracy.

According to Scoville-Simonds et al. [41], the primary challenges in political adaptation are closely related to three key issues: 1. Differentiated responsibility across various levels; 2. Varied vulnerability; 3. Power imbalances in the decision-making process. While not directly climate-related, these barriers significantly impact the implementation of climate policies. Additionally, the survey indicated that individuals involved in climate-related projects and initiatives share a comprehensive understanding of the factors constraining the implementation of climate policies.

Furthermore, our research indicates differences in perceptions of barriers to effective climate policies between local and national levels. This disparity may be due to local authorities showing a greater tendency toward adaptive approaches [42] but facing barriers due to inadequate coordination with national institutions. Barriers to local adaptation often stem from higher-level government interventions, such as introducing new regulations or unclear policies. An additional challenge in implementing climate policies at the regional level is the lack of local capacity and the allocation of financial resources by the government to municipalities. Similar barriers have been highlighted in

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other studies. For example, Measham et al. [43] point out the difficulties in successful climate change adaptation in Sydney due to limited financial and human resources.

This survey aimed to gauge the varying levels of importance of the barriers outlined in the study. The findings reflect the collective views of all survey participants. To gain a deeper understanding of each scenario, it is crucial to meticulously evaluate the severity of the barriers to ascertain how climate policy implementation and adaptation are progressing and fully comprehend each barrier's impact.

The lack of alignment between institutions and wavering political determination poses barriers to the robust implementation of policies necessary for adapting to climate change. This underscores the essential need for thorough dialogue and deliberation among various stakeholders to address potential risks and consequences [44].

This makes it difficult to effectively plan, implement, and monitor adaptation measures and reduces the country's resilience to the negative effects of climate change."

Mapfumo et al. [45] point out that political will is one of the most important factors in shaping climate policies with long-term sustainable solutions.

The successful implementation of climate policies in Bulgaria hinges on achieving a common understanding among decision-makers at all levels. To accomplish this, the Bulgarian government must raise awareness and educate all citizens about climate change, fostering inclusive decision-making processes to enhance public engagement. Moreover, the government must improve its capacity to plan and execute effective climate policies, leading to generating innovative ideas and initiatives. Overcoming existing barriers requires proactive efforts from those in positions of power, including government officials and ministers, to drive regulatory changes, bolster coordination at both national and local levels, and demonstrate strong political will to participate in the process actively.

5. Conclusions

Based on the study, we can conclude that a complex set of factors hampered the implementation of effective climate policies in Bulgaria.

Political instability and the changing regulatory environment emerge as the most serious barriers. The lack of a long-term vision and stable politics will hamper the design and implementation of effective climate policies.

Conflicts of interest between different sectors of the economy and political forces are also a significant obstacle. This creates conditions for compromise and delays in decision-making.

Insufficient administrative capacity and lack of coordination between institutions further complicate the situation. Lack of resources, expertise, and clear responsibilities hampers effective planning and implementation of climate policies.

Low public awareness and a lack of long-term planning are also crucial factors. These points to the need to invest in public awareness and develop long-term strategies to tackle climate change.

To overcome these barriers and make progress in tackling climate change in Bulgaria, it is necessary to:

- Efforts to build political consensus on the need for climate action and create a robust regulatory framework.
- Better coordination between institutions and the creation of mechanisms for effective governance of climate policies.
- Investment in administrative capacity and increased expertise on climate change.
- Raising public awareness of climate change issues and the need for action.
- Develop long-term strategies for transition to a low-carbon and sustainable economy.

Only by addressing these challenges can Bulgaria make significant progress in combating climate change and contributing to achieving global climate goals. Survey respondents ranked barriers related to technology, international cooperation, and uncertainty about future climate conditions as less significant. The study participants expressed optimism about the availability of existing technologies and the potential for their development. This optimism may stem from the

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increasing awareness of climate change and the availability of innovative solutions. Interestingly, uncertainty about future climate conditions was deemed less significant. It's important to note that the research analyzed in this article is subjective and limited due to several factors. Firstly, the study focused on the perspectives of a small group of 207 individuals from various institutions directly involved in climate change-related projects and initiatives. The sample size is not representative due to the limited number of survey respondents, which suggests the need for further research. Secondly, the study is constrained by the limited participation of government representatives, which hampers a comprehensive understanding of the challenges faced by the government. Additionally, the study does not delve into regional challenges, highlighting the necessity for further research.

The outcomes of our study highlight the significance of research in addressing obstacles to effective climate policies. However, it is essential to note that the identified barriers are highly contextual, making comparisons difficult and generalization unfeasible without further research into climate change policies.

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Appendix A

Table A4. 5 clusters with barriers to the implementation of effective climate policies in Bulgaria.

Cluster	1	2	3	4	5
Number of objects by cluster	6	8	11	6	1
Sum of weights	6	8	11	6	1
Within-cluster variance	5,077	9,174	6,950	7,631	0,000
Minimum distance to centroid	0,882	0,431	0,363	0,785	0,000
Average distance to the centroid	1,905	2,610	2,203	2,223	0,000
Maximum distance to the centroid	3,251	3,851	4,296	4,521	0,000
	Weak regulatory framework	Lack of coordination between institutions	Lack of appropriate technology	Uncertainty about future weather conditions	Invasive species
	Conflict of interest	Low awareness	Difficulties in technology transfer	Rejecting the scientific facts about climate change	
	Insufficient capacity to plan and implement	Lack of long-term planning	Lack of civil society participation	Too many people in institutions who "Knows" everything about climate change	

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	Climate change policies depend on land-use planning, urbanization, water management, and agriculture as a vulnerable sector	Lack of international cooperation	Tourism as an obstacle	Agriculture as a vulnerable sector
	Dependence on carbon-intensive sectors	Loss of biodiversity	Soil degradation	Urbanization
	Lack of clear responsibilities	Water pollution	Lack of public support and resistance from local communities	Competition for limited financial resources
		Lack of public support and resistance from local communities	Insufficient research	
		Slow administrative procedures	High initial investments	
			social inequalities	
			Land use conflicts	
			Lack of regional climate models	

References

1. Cohen, S.J.; Waddell, M.W. Climate Change in the 21st Century; McGill-Queen's University Press - MQUP: Montreal, Canada, 2009.
2. Nojarov P (2019) Factors affecting air temperature in Bulgaria. Theoret Appl Climatol 137(1–2):571–586. https://doi.org/10.1007/s00704-018-2622-2
3. NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN, Available: https://www.moew.government.bg/bg/klimat/mejdunarodni-pregovori-i-adaptaciya/adaptaciya/, (Accessed 09 April. 2024)
4. B. Smit, I. Burton, R. Klein, J. Wande, An anatomy of adaptation to climate change and variability Climatic Change, 45 (2000), pp. 223-251
5. Brooks, N., 2003. Vulnerability, Risk and Adaptation: A Conceptual Framework. Working Paper 38, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, Available:https://www.researchgate.net/publication/200032746_Vulnerability_Risk_and_Adaptation_A_Conceptual_Framework, (Accessed 10 April 2024)
6. M.L.ParryAssessment of Potential Effects and Adaptations for Climate Change in Europe: The Europe ACACIA Project Jackson Environment Institute, University of East Anglia, Norwich, UK (2000)
7. C. Folke Resilience: the emergence of a perspective for social-ecological systems analyses Global Environmental Change, 16 (3) (2006), pp. 253-267
8. State of the Global Climate 2020 Provisional Report, https://library.wmo.int/viewer/56241?medianame=2020_wmo_provisional-report-state-climate_en_#page=4&viewer=picture&o=bookmark&n=0&q=
9. G.R. Biesbroek, R.J. Swart, W.G.M. van der Knaap The mitigation-adaptation dichotomy and the role of spatial planning Habitat International, 33 (3) (2009), pp. 230-237, Available: https://www.sciencedirect.com/science/article/pii/S019739750800060X, (Accessed 10 April 2024)
10. CEC, 2007. Green paper. From the Commission to the Council, the European Parliament, the European Economic and Social Committee, and the Committee of the Regions. Adapting to climate change in Europe–options for EU action (No. COM(2007) 354 final {SEC(2007) 849}). Commission of the European Communities, Brussels.

 doi:10.20944/preprints202409.1322.v

11. CEC, 2009. White paper – Adapting to climate change: Towards a European framework for action (COM(2009) 147 final). Commission of the European Communities, Brussels.
12. B. Smit, J. Wandel Adaptation, adaptive capacity and vulnerability Global Environmental Change, 16 (3) (2006), pp. 282-292, Available: https://www.sciencedirect.com/science/article/pii/S0959378006000410, (Accessed 10 April 2024)
13. https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689330/EPRS_BRI%282021%29689330_EN.pdf
14. IMF Country Report No. 22/191, file:///C:/Users/Lenovo/Downloads/1BGREA2022002.pdf
15. UN Framework Convention on Climate Change (UNFCCC), Available: https://unfccc.int/, (Accessed 06 April 2024)
16. Kyoto Protocol, Available: https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/kyoto-protocol-targets-for-the-first-commitment-period, (Accessed 06 April 2024)
17. Република България, Министерство на енергетиката, Министерство на околната среда и водите, Интегриран план в областта на енергетиката и климата на Република България 2021 – 2030 г. (НПЕК), февруари 2020 г.
18. European Green Deal, Available: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en, (Accessed 09 April 2024)
19. European Climate Law, Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119, (Accessed 10 April 2024)
20. Adapting to Climate Change — SOER 2010 Thematic Assessment, European Environment Agency (EEA), Copenhagen, (2010); Rob J. Swart et al., Europe Adapts to Climate Change: Comparing National Adaptation Strategies, Partnership for European Environmental Research (Peer), 01/2009, Helsinki: Finnish Environment Institute (SYKE) (2009).
21. Tom D. Lowe and Irene Lorenzoni, Danger Is All Around: Eliciting Expert Perceptions for Managing Climate Change through a Mental Models Approach, 17 Global Environmental Change 17, 131 (2007); Pallab Mozumder et al., Adaptation Behavior in the Face of Global Climate Change: Survey Responses from Experts and Decision Makers Serving the Florida Keys, 54 Ocean and Coastal Management 37 (2011)
22. Orru, K., Tillmann, M., Ebi, K., Orru, H., Making Administrative Systems Adaptive to Emerging Climate Change-Related Health Effects: Case of Estonia, Atmosphere, 9 (6) (2018), https://doi.org/10.3390/atmos9060221
23. Hickey, C., Weis, T., The challenge of climate change adaptation in Guyana Clim. Dev., 4 (1) (2012), pp. 66-74, https://doi.org/10.1080/17565529.2012.661036
24. Nalau, J., Handmer, J., Dalesa, M., Foster, H., Edwards, J., Kauhiona, H., The practice of integrating adaptation and disaster risk reduction in the south-west Pacific
25. Pardoe, J., Conway, D., Namaganda, E., Vincent, K., Dougill, A., Kashaigili, J., Climate change and the water–energy–food nexus: insights from policy and practice in Tanzania, CLIMATE POLICY2018, VOL. 18, NO. 7, 863–877https://doi.org/10.1080/14693062.2017.1386082
26. Azhoni, A., Holman, I., Jude, S., Adapting water management to climate change: Institutional involvement, inter-institutional networks and barriers in India, Global Environmental Change-Human and Policy Dimensions, 44 (2017), pp. 144-157
27. Bajec, N., Integrating climate change adaptation policies in spatial development planning in Serbia - A challenging task ahead, Spatium, 24 (2011), pp. 1-8
28. Koch, I.C., Vogel, C., Patel, Z., Institutional dynamics and climate change adaptation in South Africa Mitigation and Adaptation Strategies for Global Change, 12 (8) (2007), pp. 1323-1339
29. Bantilan, M C S and Mohan, G (2014) Adaptation to Climate Change in Agriculture in Selected Asian Countries: Insights from micro-level studies and implications for policy. Documentation. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Hyderabad, Andhra Pradesh. (Accessed 4 July 2024)
30. Wellstead A, Stedman R (2015) Mainstreaming and beyond: policy capacity and climate change decision making. Michigan Journal of Sustainability 3. https:// doi. Org/ 10. 3998/js. 12333 712. 0003. 003
31. Baker, I., Peterson, A., Brown, G., McAlpine, C., Local government response to the impacts of climate change: An evaluation of local climate adaptation plans, Landscape and urban planning Volume 107, Issue 2, August 2012, Pages 127-136, https://doi.org/10.1016/j.landurbplan.2012.05.009, (Accessed 4 July 2024)
32. Moser SC, Ekström JA (2010) A framework to diagnose barriers to climate change adaptation. Proc Nat Acad Sci 107:22026–22031. https:// doi. org/ 10. 1073/ pnas. 10078 87107
33. Sietz D, Boschütz M, Klein RJT (2011) Mainstreaming climate adaptation into development assistance: rationale institutional ba rriers and opportunities in Mozambique. Environ Sci Pol 14:493–502. https:// doi. org/ 10. 1016/j. envsci. 2011. 01. 001
34. Oberlack C, Eisenack K (2017) Archetypical barriers to adapting water governance in river basins to climate change. J Institutional Econ 14:527–555. https:// doi. org/ 10. 1017/ S1744 13741 70005 09

 doi:10.20944/preprints202409.1322.v

35. Biesbroek, R.; Klostermann, J.; Termeer, C.; Kabat, P. Barriers to climate change adaptation in the Netherlands. Clim. Law 2011, 2,181–199. [CrossRef]
36. National Climate Adaptation Strategy and Action Plan, Available: https://strategy.bg/StrategicDocuments/View.aspx?Id=1294, (Accessed 16 April 2024)
37. Закон за ограничаване на изменението на климата, Climate Change Mitigation Act https://www.moew.government.bg/bg/zakon-za-ogranichavane-izmenenieto-na-klimata/, (Accessed 11 April 2024)
38. Burch, S., In Pursuit of Resilient, Low Carbon Communities: An Examination of Barriers to Action in Three Canadian Cities, https://doi.org/10.1016/j.enpol.2009.06.070, Available: https://www.sciencedirect.com/science/article/pii/S0301421509004753, (Accessed 16 April 2024)
39. Füssel HM (2007) Vulnerability: a generally applicable conceptual framework for climate change research. Global Environ Change 17:155–167. https:// doi. org/ 10. 1016/j. gloen vcha. 2006. 05. 002
40. Pressend, M. Financial barriers to adaptation implementation: A South African case study on financing water adaptation. In Overcoming Barriers to Climate Change Adaptation Implementation in Southern Africa; Masters, L., Duff, L., Eds.; Africa Institute of South Africa: Pretoria, South Africa, 2011; pp. 163–179.
41. Scoville-Simonds, M.; Jamali, H.; Hufty, M. The Hazards of Mainstreaming: Climate change adaptation politics in three dimensions. World Dev. 2020, 125, 104683. [CrossRef]
42. Louise W. Bedsworth and Ellen Hanak, Adaptation to Climate Change: A Review of Challenges and Tradeoffs in Six Areas, 76 J. Am. Plann. Assoc., 477 (2010).
43. Measham, T.G.; Preston, B.L.; Smith, T.F.; Brooke, C.; Goddard, R.;Withycombe, G.; Morrison, C. Adapting to climate change
44. Ross, H.; Shaw, S.; Rissik, D.; Cliffe, N.; Chapman, S.; Hounsell, V.; Udy, J.; Trinh, N.T.; Schoeman, J. A participatory systems approach to understanding climate adaptation needs. Clim. Chang. 2015, 129, 27–42. [CrossRef]
45. Mapfumo, P.; Onyango, M.; Honkponou, S.K.; El Mzouri, E.H.; Githeko, A.; Rabeharisoa, L.; Obando, J.; Omolo, N.; Majule, A.; Denton, F.; et al. Pathways to transformational change in the face of climate impacts: An analytical framework. Clim. Dev. **2017**, 9,439–451. [CrossRef]