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

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Abstract: Climate change is increasingly recognized as a significant issue facing humanity. The World Health Organization (WHO) designates climate change as the greatest threat to global health in the 21st century. 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. Climate change has recently become a significant concern in Bulgaria due to its impact on ecosystems, the economy, society, and infrastructure. This study provides a comprehensive analysis of the barriers to climate adaptation in Bulgaria, integrating sources from the literature with empirical data gathered from a survey. By employing cluster analysis, this research identifies five primary groups of barriers, offering a fresh perspective on the complexities involved in this process. The findings contribute to the existing body of knowledge on climate adaptation and hold the potential to guide policy development aimed at addressing these challenges.

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

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1. Introduction

Climate change is one of the most serious challenges facing today's generations, requiring a continuous rethinking of adaptation concepts and the adoption of effective strategies and policies [1]. Bulgaria is a country that does not remain isolated from these processes [2], which will lead to changes and challenges in all sectors of socio-economic development [3]

In some prior research [4], climate adaptation has been 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 is 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].

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

Since the 1980s, atmospheric CO_2 emissions have steadily increased, 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 levels have continued to rise throughout the decades, with peaks in the 2000s and, most recently, the 2010s [8].

For many years, the main approach to climate change has been reducing greenhouse gas emissions to minimize their 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 the melting of the Arctic and mountain glaciers, flooding, extreme heat waves, and storm damage.

In several studies, authors have considered barriers originating from different aspects. Some authors have regarded adaptation as being less critical in short-term policy goals than other issues [10,11]. In some studies [12], authors have highlighted barriers that stem from uncertainty among policymakers about future climate change. Multiple papers have drawn attention to the fact that many of the barriers to climate adaptation and adopting climate policies are due to weak institutional capacity [13–15]. Bajec [16] puts forward as a reason the weak integration of national climate policies into other sectoral and local-level documents. Koch et al. [17] see weak stakeholder engagement and poor communication between stakeholders as an obstruction to the effective implementation of climate policies. These are some of the most common barriers. Our study covers but is not limited to some of them.

This paper seeks to examine the primary barriers to climate change implementation policies in Bulgaria and assess their significance. To date, no research has been conducted on the challenges associated with the implementation of climate change policy in Bulgaria. Considering this, respondents from different sectors (politicians, municipal representatives, academics, NGOs) working directly on climate-related issues were asked what the main challenges they face in the process of developing and implementing policies and strategies for the successful implementation of climate change policies are.

The two main questions explored in this paper are as follows: (1) What barriers to implementation can be identified from the relevant documents and papers? (2) What do participants see as barriers to managing implementation and which ones do they identify as the most and least significant?

Thus, our study highlights the main challenges to adopting successful climate change policies by those directly involved in the process.

It is important to emphasize 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 [13].

This study aims to contribute to the scientific understanding of the climate change adaptation process and to identify opportunities to improve the process by focusing on the perspectives of participants. The results of the study will provide valuable information to potentially better develop more effective adaptation strategies without prejudice for aspects of political decision-making.

This paper is organized as follows: First, the Materials and Methods are presented. Second, we provide a thorough analysis of the legal framework and all relevant strategic documents concerning climate change adaptation. The findings of this review outline the key challenges, issues, and potential solutions. Third, we report the results of a survey

conducted in Bulgaria from March to May 2024 to better understand the barriers confronting those who bear direct responsibility for climate adaptation. Fourth, we examine and analyze the study's results in detail. Fifth, we highlight some recommendations derived from the study. Finally, we conclude with a summary of the findings.

For 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 labels for the concept of a barrier, such as obstacle, constraint, limit, and challenge. For our study, we use the word barrier.

2. Literature Review

Recently, there has been a significant shift in the focus of the employed strategies and perception of climate change adaptation. Previously, the EU's involvement in adopting policies towards climate change could have been considered inadequate, with its primary focus 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 [18] and White Paper "Adapting to climate change: towards a European framework for action" in April 2009 [19].

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 [20].

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 [21]. However, coal remains the country's primary energy source, resulting in Bulgaria having the most GHG-intensive economy in the European Union [22].

At this stage, there are three main international climate agreements: the UN Framework Convention on Climate Change (UNFCCC) [23]; the Kyoto Protocol, which governed international action up to and including 2020 [24]; and the Paris Agreement, which sets the framework for action to respond to climate change from 2021 onwards.

According to EU legislation, all member states are required to implement the 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 [25].

Each country that has ratified the Paris Agreement, such as Bulgaria, must 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 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 will efficiently utilize resources and minimize greenhouse gas emissions by 2050 [26]. The European Climate Act further reinforces this commitment by legally mandating the attainment of climate neutrality in the EU by 2050 [27].

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 fac-

tors. Implementing such policies requires the active participation and collaboration of numerous countries, each with unique interests and priorities, necessitating extensive coordination efforts.

Additionally, climate change impacts various sectors and areas, from energy and agriculture to health and tourism. As such, policy development must take into account the competing interests of various stakeholders, including governments, businesses, NGOs, and citizens, and find a balance that benefits all parties involved.

Due to the various contributing factors, implementing comprehensive climate-related policies can be a more complex 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, complex implemented actions can generally be categorized into two groups: those that mitigate its effects and those that adapt to changes already underway.

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.

Climate change policies require an understanding of the main challenges and barriers to implementation, in addition to a thorough analysis of the existing strategic frameworks.

Confronting the urgent challenge of climate change has emerged as a global priority, as nations around the world face the significant environmental, economic, and social repercussions of a rapidly warming planet. Within this context, the European Union (EU) has positioned itself as a key leader, championing ambitious climate policies and strategies aimed at fostering a sustainable, low-carbon future.

At the heart of the EU's climate initiatives is the European Green Deal, a comprehensive policy framework that lays out a roadmap for achieving climate neutrality in the EU by 2050 [28]. The European Green Deal encompasses a wide array of initiatives, including the EU Emissions Trading System, which targets the reduction in greenhouse gas emissions from the power sector, industry, and aviation within the EU [28]. Furthermore, it establishes national targets for sectors not included in emissions trading, such as transportation, buildings, and agriculture. To fulfill these ambitious objectives, the European Green Deal also underscores the vital contribution of Europe's forests and land in the battle against climate change, while aiming to reduce greenhouse gas emissions across various other sectors.

The European Green Deal outlines a comprehensive strategy for the EU, yet the responsibility for implementing and enforcing climate policies ultimately rests with individual member states. Several EU countries have distinguished themselves as leaders in developing and executing effective national climate strategies, illustrating the varied approaches taken across the continent.

European countries have different practices for implementing climate change policies. As the largest economy within the European Union, Germany has played a pivotal role in shaping the continent's climate policy. The country has established ambitious objectives aimed at reducing greenhouse gas emissions and enhancing the share of renewable energy in its overall energy portfolio. These efforts are supported by a diverse array of policy instruments, including feed-in tariffs and carbon pricing mechanisms [29].

France employs a distinctive approach to its climate strategy, relying heavily on nuclear power, which contributes a substantial portion of the country's electricity generation. Concurrently, France is making considerable investments in renewable energy sources, such as wind and solar, as it seeks to create a balanced energy mix and reduce its carbon footprint.

Poland faces challenges in transitioning from its reliance on coal-fired power generation. The country is exploring alternative energy sources, including nuclear power and renewable energy, but the transition is expected to be gradual. Poland's climate strategy also focuses on energy efficiency and sustainable forestry.

In Bulgaria, the National Adaptation Strategy and Action Plan is crucial for the country's efforts to address climate change. It is 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 [30].

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 nine 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.

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 that for the fulfillment of the requirement, as a horizontal criterion, 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, 30% of EU funds are 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, being mainly undertaken as 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 [31]. At this stage, Bulgaria is one of the few 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 specific national and local circumstances, which reflect global and regional processes.

The process of creating policies for implementing and adapting to climate change is complex, with many factors affecting it, some directly related to climate and others not so [32].

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 of 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 [33].

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

Addressing these barriers is essential for advancing climate adaptation in Bulgaria and establishing 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.

3. 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/ (accessed on 29 August 2024)) and the Ministry of Environment and Water's database (https://www.moew.government.bg/en/ (accessed on 21 August 2024)). It was crucial that all documents were current as of 1 April 2024 and therefore up-to-date.

We used a systematic approach to analyze the main themes underpinning the NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN and the overall policy framework.

Next, a survey was designed that included one open-ended question and two closed questions. These questions were crafted to identify the perceived barriers to climate change adaptation policies, drawing on the existing literature and tailored specifically to the Bulgarian context for maximum relevance. During the survey, respondents shared their views on what they considered the main obstacles to climate change adaptation in Bulgaria through an open-ended question. We received over 100 responses to this question, some of which were repetitive. By consolidating these responses, we identified the 33 most common barriers highlighted by respondents. In this process, we referenced prior research and theoretical frameworks [34] in the field of climate adaptation to ensure a comprehensive understanding of the challenges.

Thus, a list of 33 defined barriers was compiled, which the respondents in the second stage were asked to rate in order of importance (the seven most important to them and the seven least important). This approach allowed us to obtain first-stage responses for the most common challenges that impede climate adaptation in the country and to assess their relative importance by asking respondents to rate the defined barriers on a five-point Likert scale from 1 to 5 for the most and least significant barriers. The use of pre-defined barriers provided us with consistency and comparability in the data analysis, which in turn allowed us to explore the inter-relationships between different barriers and to identify the most significant factors influencing climate adaptation. The five-point Likert scale is widely used in social sciences and allows researchers to measure the degree of agreement

of respondents with different statements. This scale is reliable and valid for measuring subjective evaluations and perceptions.

Rigorous thematic analysis in the research process helped us generate insightful and reliable findings. The aim of using thematic analysis was to identify themes that were embedded in the data, rather than imposing pre-set interpretations. The thematic analysis was tailored to uncover recurring ideas, concepts, or patterns in the data.

This research involved on-site or telephone interviews with policymakers, academics, NGOs, and students. The respondents in our survey were well-informed and knowledgeable about climate change, some of whom were experts with previous experience with climate change who had been involved in climate projects. In the survey, 207 people were interviewed between March and May 2024 in the field and by telephone in different municipalities in Bulgaria, including students and researchers from Sofia University, "St. Kliment Ohridski", NGOs, etc.

The data analysis methods included qualitative content analysis for open-ended responses and statistical methods for closed questions to identify patterns, correlations, and significant barriers. The responses to questions were diverse and were analyzed and categorized using Excel and XLSTAT.

To address the substantial number of identified barriers (n = 33), we employed cluster analysis. This method aimed to uncover natural clusters of barriers that are closely interconnected. By performing so, we were able to streamline our analysis and gain a clearer understanding of the primary themes and dimensions associated with climate change adaptation. Furthermore, the cluster analysis facilitated the discovery of underlying relationships between barriers that may not have been evident in the initial assessment.

Data analysis for open-ended questions included the following steps. First, complete transcripts of the answers were made. In the next step, XLSTAT software 2024.3 was used to analyze 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, the seven most important and seven least important, on a scale of 1 to 5. As a result, the standard deviation revealed the range of views on the importance of each barrier. Our analysis indicates that a larger standard deviation corresponded to a wider variation in the opinions expressed by respondents. This suggests that as the standard deviation increased, the divergence in attitudes and perspectives among individuals also became more pronounced. Calculating an average value showed respondents' average rating on the importance of each barrier. Higher values meant that the barrier was perceived as more important. In the last step, cluster analysis was performed using the XLSTAT software tool. Cluster analysis was conducted using the k-means method, with the optimal number of clusters identified through the "elbow" method. The results indicated that respondents could be categorized into five main clusters, each defined by distinct combinations of barriers. The elbow method is widely recognized for determining the ideal number of clusters in cluster analysis. It operates on the premise that as the number of clusters increases, the intracluster distance (the distance between points within the same cluster) decreases while the intercluster distance (the distance between the centers of different clusters) increases. For each potential number of clusters, the sum of squared errors (SSE)—the sum of squared distances between each data point and the center of its nearest cluster—is calculated. These SSE values are then plotted on a graph, with the number of clusters on the x-axis and the SSE value on the y-axis. To pinpoint the optimal number of clusters, one should identify the point on the graph where the curve begins to flatten, forming an "elbow". This point signifies the optimal number of clusters, as any further increase in clusters leads to only a marginal reduction

in the SSE. Upon reviewing the survey data, the findings were inconclusive. There was a notable divergence in respondents' opinions regarding climate change in Bulgaria and the necessity for adaptation. This disparity can be attributed to several factors, including a lack of awareness regarding national climate change policies, insufficient coordination between national and local initiatives, and financial constraints.

4. Data Analysis

This research was conducted in Bulgaria among representatives of municipalities, academia, and NGOs. In pursuit of this objective, 402 surveys were disseminated via email, telephone, and face-to-face interactions. We received a total of 207 responses.

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

Fifty-two of the respondents (25%)—scientists, academics, and students—in the survey in the open-ended question expressed the belief that climate change is a natural process but 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 those from the NGO sector, students, and climate policy and project experts, indicated that the lack of coordination, responsibilities, and control at the national level makes 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 a summary of the results.

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 and were 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.

The respondents were asked to rank the seven most essential barriers out of the 33 predefined ones based on the existing climate policy challenges in Bulgaria 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 determined the perceived significance of each barrier. The standard deviation within the rating of each barrier of the seven most reoccurring ones indicated a diversity of opinions on the importance of each barrier, with a higher standard deviation reflecting more significant variability in the ratings. The average value, commonly called the average, was calculated by adding up all the scores given to a barrier and dividing by the total number of scores.

It is 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 1. Number of respondents to 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 the analysis.

5. 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 unemployment rates, out-migration, and social issues to contend with.

Despite Bulgaria ratifying all international climate agreements, most of its politicians and citizens, as EU members, lack a thorough understanding of climate change's impact 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 [35].

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 these crucial issues.

Table 2 displays the top seven barriers that emerged as the most common responses among the respondents, including the means and the standard deviations.

From the results in the table, it appears that the main barriers hindering the implementation of effective climate policies in Bulgaria, as perceived by respondents, included political instability and a lack of a clear regulatory framework. These factors were viewed as significant obstacles that impede the effective implementation of climate policies. Additionally, a notable proportion of respondents identified conflicts 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 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.	Conflicts 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

For the data from this table, it is accepted that all scores above 3.5 are classified as "very important"; all that are <3.5 are defined as "important".

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

Table 3. Seven 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
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 "know" everything about climate change	166	1.71	0.76

For the data from this table, it is accepted that all scores between 3 and 3.5 are classified as "important," all that are between 3 and 2.5 are defined as "slightly important", and those below 2.5 are described as "unimportant".

Respondents in this study ranked barriers related to a lack of appropriate technology and difficulties in technology transfer, a lack of international cooperation, uncertainty about and the rejection of climate issues, and the presence of too many experts as relatively less important. This could be attributed to several reasons:

1. Growing availability of technology: the majority of the respondents believed that there are sufficient technological solutions available to address climate change.
2. Optimism about technological development: the respondents, particularly students and academics, were optimistic about the future development of technology and its potential to address climate change.
3. Low assessment of international cooperation: A lack of international cooperation was rated as a less significant barrier. This may have been due to Bulgaria's membership

in the EU and its participation in various international climate initiatives. Many respondents believed 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 have been 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, had confidence in climate models and believed that they provide reasonably accurate information about future climate change.
6. Rejection of scientific evidence: a relatively small number of participants identified the 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 viewed technological barriers, a 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 was on other factors, including a 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.
- 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 barrier of "too many experts competent in the field of climate change", everyone agreed that this could not be a barrier, provided there was political stability and an adequate regulatory framework in the country. It is noteworthy that in other studies, the barrier of too many experts in the field is hardly mentioned.

There were 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 political instability barrier.

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

In regard to the low-interest barrier, it can be said that respondents working in institutions related to climate policies paid much more attention to this problem.

To better understand the results, we applied the cluster analysis method. For this purpose, we pre-specified the number of clusters (in our case, it was five) and used k-means cluster analysis. With the help of cluster analysis, we grouped the barriers into five different clusters, and according to the results, we draw several conclusions, which are mentioned below in the text in Table A1. We present all five clusters with barriers to the implementation of effective climate policies in Bulgaria from a cluster analysis conducted in XLSTAT of all 33 pre-defined barriers to effective climate policies.

The results obtained from the k-means analysis, according to five 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 determined which barrier (unit) belonged to which cluster.

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, a lack of citizen participation, and the 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.

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 five distinct clusters also leads to the following necessities:

- The provision of climate change and adaptation training to government officials.
- The establishment of dedicated units within the administration tasked with climate policy.
- The establishment of integrated information systems.
- The review and enhancement of legislation and regulations.
- The expansion of national public awareness campaigns regarding climate change.
- The integration of climate change in educational curricula.
- The design of financial mechanisms, such as green bonds and subsidies.
- The adjustment of the tax system to incentivize investment in low-carbon technologies.

- The formulation of sector-specific decarbonization strategies.
- Support for small and medium-sized enterprises engaged in the development of green technologies.

As a result of the five clusters, we can identify five key categories of barriers in Table 4: institutional; social and cultural; technological and natural; economic and political; and biological. Moreover, it is noteworthy that in many other studies on this topic, no biological barriers have been identified.

Table 4. Category of clusters.

Cluster	Primary Focus	Key Barriers
1	Institutional	Inefficient coordination, unclear responsibilities, capacity
2	Social and Cultural	Low awareness, lack of participation, denial of science
3	Technical and Environmental	Technology gaps, environmental degradation
4	Economic and Political	Economic interests, resource competition, carbon dependence
5	Biological	Invasive species

6. Discussion

Climate change is one of the most pressing challenges facing the world today, and the need for effective adaptation strategies has never been more urgent. Adaptation efforts are crucial to reducing the negative impacts of climate change on communities, particularly those that are most vulnerable. However, there are numerous barriers that hinder the implementation of climate adaptation measures, and understanding these barriers is essential for developing effective solutions.

One of the primary barriers to climate adaptation is the inherent uncertainty and complexity surrounding climate change. The magnitude and frequency of climate change-related events are often unpredictable, making it difficult for policymakers and local communities to plan and implement effective adaptation strategies [36]. Furthermore, the intricate interactions between human systems and the environment add to the complexity of the problem, making it challenging to develop comprehensive and coordinated responses.

An important barrier is the lack of robust institutional and policy frameworks to coordinate and execute adaptation strategies efficiently. Wellstead and Stedman [37] 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. Governments, businesses, and other institutions are often slow to adapt to the rapidly changing climate, as they are designed to handle more traditional problems and may resist necessary changes.

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 [38], respondents identified bureaucracy, conflicts 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. 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 [39].

From this point of view, it is no coincidence that Moser and Ekström [40] 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 [40], three sub-phases can be distinguished: (1) the detection of the problem or how institutions react to signals; (2) what information is collected about the climate; and (3) the redefinition of the problem. From this perspective, Sietz et al. [41] argue that institutional barriers in developing climate adaptation policies can be separated into three levels: (1) the individual level, determined by personal qualities, attitudes, and response capacity; (2) the organizational level, depending on each organization's characteristics; and (3) 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 at the enabling environment level 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 [41].

The lack of awareness serves as a significant obstacle to the better adaptation to the changing climate on a national level [42]. Oberlack and Eisenack [43] argue that the lack of awareness and engagement with climate change may lead to low public support.

According to Scoville-Simonds et al. [44], the primary challenges in political adaptation are closely related to three key issues: (1) differentiated responsibility across various levels; (2) varied vulnerability; and (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.

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 other studies. For example, Measham et al. [45] point out the difficulties in successful climate change adaptation in Sydney due to limited financial and human resources.

The lack of alignment between institutions and wavering political determination pose barriers to the robust implementation of policies necessary for adapting to climate change. This underscores the essential need for open dialog and deliberation among various stakeholders to address potential risks and consequences [46].

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

Mapfumo et al. [47] 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 and foster inclusive decision-making processes to enhance public engagement. Moreover, the government must improve its capacity to plan and execute effective climate policies to generate 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 the national and local levels, and demonstrate strong political will to participate in the process actively.

7. Conclusions

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 is worth noting that between 2021 and 2024, Bulgaria had six general elections, and this frequent political instability has eroded public trust in societal processes.

While previous studies have focused primarily on political instability and bureaucracy as major obstacles, our research reveals that a lack of public engagement also plays a significant role, while respondents tend to underestimate the importance of technological challenges. Our results highlight the need for investment in the development and diffusion of technologies to support climate change adaptation, which has not been identified as a barrier or need for action in other studies.

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 [48] 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.

While various national studies have identified weak regulation as a major problem, our regional study shows that a lack of planning capacity is a greater challenge for local authorities.

This survey aimed to gauge the varying levels of the importance of the barriers outlined in this study on Bulgaria. 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.

Our findings highlight the need for greater flexibility in the national adaptation strategy to allow rapid response to changing climate conditions.

It is important to note that the research analyzed in this article is subjective and limited due to several factors. Firstly, this study focuses 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 barriers 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 A1. Five 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 centroid	1.905	2.610	2.203	2.223	0.000
Maximum distance to 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
	Conflicts of interest	Low awareness	Difficulties in technology transfer	Rejecting 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 "know" everything about climate change	
	Climate change policies depend on land-use planning, urbanization, water management, and agriculture as vulnerable sector.	Lack of international cooperation	Tourism as obstacle	Agriculture as vulnerable sector	

Table A1. *Cont.*

Cluster	1	2	3	4	5
	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		

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