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Differences and Similarities in Climate Change Adaptation Policy Instrument Mixes in Selected European Countries

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Abstract: The increasingly severe effects of climate change have resulted in a shift in countries' approach to climate policy. From an initial focus on mitigation efforts, adaptation to climate change is now given equal importance. Adaptation policies in individual countries provide for different sets of instruments owing to different natural conditions and climate change impacts and their resulting problems as well as different approaches related to the sociopolitical characteristics of the country. In the paper, we identify and classify adaptation policy instruments and then look for the differences and similarities in the adaptation instrument mixes included in the national adaptation strategic documents of selected European countries. We focused on Western European (WE) and Central and Eastern European (CEE) countries, as the latter are underrepresented in studies on adaptation policies. Based on text-mining methods, i.e., categorisation of policy instruments using a set of criteria and clustering, we looked for similarities and differences between the adaptation instrument mixes in the chosen European countries. We found similarities between the two CEE countries studied—Poland and Lithuania. These countries are also different from WE countries in this regard. The results indicate that CEE countries have a sectoral rather than systemic approach to adaptation policy, and instruments from the management sphere are less prominent.

Keywords: climate change adaptation; adaptation policy; adaptation instruments

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1. Evolution of the Climate Change Adaptation Policy

Climate policy has been built on two pillars: mitigation, i.e., measures aimed at reducing greenhouse gas emissions that are responsible for global warming, and adaptation to climate change, i.e., measures enabling societies and economies to adapt to global warming impacts [1,2]. Both mitigation of and adaptation to climate change have the same purpose: reducing its undesirable consequences. Mitigation aims at reducing the climate change effect; adaptation aims at reducing vulnerability to these effects. Both pillars are linked in various ways [3].

As defined by IPPC, adaptation to climate change refers to the process of adjustment to actual or expected climate and its effects [4]. Adaptation to climate change is still a relatively new and underdeveloped field compared to actions in the mitigation area [5] and is characterised by high uncertainty concerning the projection of climate change and its effects [6,7]. Accordingly, creating strategies, policies, and actions in the field of adaptation are a particularly huge challenge for states and their policy-makers, especially since these actions imply serious economic and social impacts. Law seems to be a factor that makes the development of strategies, policies, and actions in the area of adaptation more dynamic, as the law imposes specific obligations on national authorities. It creates a legal architecture for developing adaptation strategies and policies, including measures to reduce exposure to climate change impacts as well as to increase resilience to the effects of these changes and to establish market and financing mechanisms to cover adaptation costs [8,9].

1.1. International Law as A Factor in Adaptation Policy Development

The legal dimension of adaptation to climate change has its roots in international law, which has a strong impact on legal regulations being adopted at the national or regional level (including European Union law). The United Nations Framework Convention on Climate Change of 1992 (UNFCCC) [10], the Kyoto Protocol of 1997 [11], and—in particular—the Paris Agreement [12] have contained various commitments concerning the formulation and implementation of adaptation policy. In these agreements, highly developed countries also committed to provide financial and practical support to developing countries in their adaptation efforts. At the beginning of forming climate policy foundations in international law, the attention of states focused on mitigation issues; therefore, the primary goal of the UNFCCC and the Kyoto Protocol was to stabilise and then to reduce the emission of greenhouse gases. Nevertheless, both the Convention and the Protocol addressed the problem of adaptation to climate change. Unfortunately the issues of adaptation did not play a significant role during the first two decades of negotiating and implementing the climate protection commitments [13]. As emphasised in the literature, adaptation to climate change remained in the shadow of efforts to reduce greenhouse gas emissions during this period [14].

The real breakthrough came with the adoption of the Paris Agreement in 2015. It places a much greater emphasis on adaptation issues than previous agreements do. In Art. 7(1), the treaty sets up a global adaptation target to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. By adopting the global goal of adaptation, the Agreement recognises adaptation as a global challenge and identifies the main tools for achieving this goal. These are planning and implementing adaptation at all levels, strengthening international cooperation, and periodic submission and update of adaptation communications.

Two of them are essential for the development of national adaptation strategies (NAS) and plans (NAP). Pursuant to Art. 7(9) of the Agreement, each party is to undertake adaptation planning processes and adequate implementation measures as appropriate, including the development of proper plans, policies, or contributions. The core of adaptation planning mechanism is not the development of the document itself (the National Adaptation Plan). This mechanism is related to the practical implementation of the adopted measures and strategies. It is therefore a recurring cycle of planning, implementation, monitoring, and evaluation of plans, policies, programmes, and adaptation activities. In this process, an important factor is the correction based on the evaluation results and the conclusions drawn. Each party to the Agreement should submit and periodically update a communication on adaptation that should inform about national priorities, plans, actions, and needs for implementation and support (Art. 7(10)) [15]. Communication can play a key role in identifying national needs and communicating to the international community what countries are doing now and in the future [16].

1.2. The Role of National Adaptation Strategies in Achieving the Adaptation Policy Objectives

The Paris Agreement recognises the formulation and implementation of national adaptation plans as one of the fundamental obligations of Parties, and these plans are a key measure for combining different adaptation actions into coherent and sustainable strategies [17]. The European Climate Law (hereinafter: ECL) also attributes significant importance to adaptation strategies and plans. Under EU law, the ECL establishes the legal framework for achieving progress towards the global adaptation target set out in Art. 7 of the Paris Agreement; therefore, it sets up a long-term goal of increasing adaptability and resilience to climate change.

The key to achieving this goal is to ensure the coherence of the adaptation strategies adopted by the European Union institutions and the Member States, commitment to measures that increase adaptation capacity, and resilience to climate change in all sectors of the economy and society as well as the implementation of consistent policies in law-making and in political strategies. A considerable role in this respect is played by the Member

States, which are committed to adopting and implementing national adaptation strategies (NAS) and plans. National strategies and plans should be based on sound analyses of climate change and vulnerability, should take into account the EU adaptation strategy [18] progress assessments and indicators, and should be based on the best available and the most up-to-date scientific evidence. The process of planning and implementing policies and actions concerning adaptation to climate change assumes an iteration between the Member States and the European Commission, which has been equipped with some corrective powers. Therefore, achieving the objectives of climate change adaptation policy depends on effective and coherent planning documents—strategies and plans for adaptation to climate change. These documents play a key role; they constitute a system of planning acts in the field of adaptation.

Strategies are acts of planning of a general and comprehensive nature and serve to set strategic goals and define ways of achieving them; they establish planning rules, actions, monitoring and evaluation measures, reporting rules [19,20]. They define the framework for planning the entire system of adaptation measures in the long-term. Formally, one can assume that the national adaptation strategy should be a superior act in relation to other planning acts, i.e., adaptation plans and action programmes, as well as an act with an integration dimension. An adaptation strategy should bring together the various elements of the planning process and use them to achieve goals, i.e., increasing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change.

National strategies and action plans in the field of adaptation to climate change should be based on systemic solutions applied in various spheres of public administration activity (e.g., legal and organisational solutions, financing models), and they should indicate the entities responsible for setting strategic and executive goals and for their effective implementation.

Achieving the goals of the climate change adaptation strategies and plans depend on properly selected policy instruments (for example, B. Poskrobko on the broader issue of programming and planning in the field of environmental protection [21]). Such strategies may include various types of adaptation measures and activities (information, education, technical, infrastructural, and others). They might be additionally supported by various types of legal instruments as well as economic, planning, organisational, and financial ones of a more universal nature. Appropriate instruments and tools for management, monitoring, evaluation, control, and reporting as well as cooperation and coordination of activities of competent authorities or institutions are part of the planning architecture in the sphere of adaptation to climate change. They form a certain bundle of instruments that should be mutually consistent and synergistic. Adaptation activities should also be tailored to specific organisational, social, environmental, and financial conditions [22] and therefore there might be significant differences between countries in this regard. This is the subject of study in our paper.

2. Current State of Research on Adaptation Policy Instruments in Central Eastern European Countries

Public policies can be broadly understood as the deliberate actions of public actors to address problems of public interest. Policies are implemented using a wide range of activities and specific measures that are generally called policy instruments. The early line of analysis of policy instruments was to categorise them [23,24]. Empirical studies of different policies on how policy instruments are used by governments resulted in various typologies of these instruments. These typologies usually focus on different features of policy instruments, such as steering style, design criteria, and how governments influence different members of society [25–28]. Apart from that, individual policies were analysed separately in terms of policy instrument mixes.

One of the most commonly used typologies is that proposed by Hood, which distinguishes four types of resources available to and applied by governments: information (nodality), regulation (authority), financial means (treasure), and institutional influence

(organisation) [25]. This typology was extended by Howlett and Rayner [29], who described policy instruments based on two characteristics: the governing resource according to Hood and the governing logic, i.e., the approach that governments take to achieve their goals. These two approaches to policy implementation are: direct provision of goods and services (substantive policy instruments) or indirect actions to modify beliefs and behaviours of actors (procedural policy instruments).

Other classifications of public policy instruments adopt a very similar approach, for example Niang-Diop and Bosch [30], who also distinguish four groups of instruments:

- Legislative, regulatory, and juridical;
- Economic (financial and market-based);
- Institutional;
- Education and information.

A similar classification was used by Biesbroek et al. [31] (regulatory, economic, voluntary, and communication-related). Such typologies are commonly used in the analysis of environmental policy [21,32] and studies of public policies in general [28], especially Vedung's *the stick, carrot, and sermon* [33].

Regardless of existing typological disputes and problems, the essence of using policy instruments is that their appropriate selection is a key factor of whether and how policy goals are achieved. Effective policy design requires that all phases of the policy cycle are logically linked and especially that policy goals and instruments are appropriate to the climate change impacts.

Nevertheless, an appropriate typology of policy instruments is important when comparative analysis of policy instruments used by various bodies is conducted. Such comparative analyses are carried out for various types of policies, including adaptation policies.

Adaptation policy analysis involves serious methodological challenges and difficulties, owing to the multidimensional, cross-boundary, and qualitative nature of the phenomenon. The first publications on climate change adaptation policies appeared at the time the UNFCCC was adopted and mainly concerned actions that may be taken to respond to climate change [34–36]. Within this broad object of research (for a recent meta-analysis see, e.g., [37,38]), adaptation policy instruments have already been covered quite extensively in the literature, although the first publications on this subject began to appear only after 2000 [39]. Initially, the subjects of research were climate change adaptation plans and strategies in general by both national and local governments [29,40–42], while detailed research on adaptation policy instrument mixes appeared a few years later. Most of these studies covered local adaptation policies, and a substantial contribution was made by Lesnikowski [42,43], especially in the methodological dimension.

There are numerous studies on the adaptation policies of individual countries [44,45]; groups of countries, [31,46–49]; regions, [50,51]; and continents [52–54]. Climate change adaptation policies in Central and Eastern European (CEE) countries have been the subject of several comparative studies [47,55]. Several analyses covering CEE countries, including Poland, concerned the initial phase of the adaptation policy, i.e., before 2010 [56,57]. These studies were mainly descriptive and paid little attention to comparing policy instruments.

To our knowledge, there are few analyses covering policy instruments mixes in CEE countries. In their meta-analysis Bisbroek and Delaney [58] covered 184 studies on adaptation policy instruments in European countries, but without special focus on adaptation policies or strategies. However, they concluded that there is a substantial gap related to studies on adaptation policies of countries other than large Western European countries. This conclusion also applies to Eastern European countries. These authors stress that this geographical bias contributes to serious problems, including building theory and formulating recommendations concerning future policy making based on biased evidence. The same underrepresentation can be seen in the study by Bauer et. al. [48] Our work seeks to fill this gap. In addition to this small number of studies covering CEE countries, we chose European Union countries because of the EU's emphasis on adaptation strategies and common guidelines in this field. Since EU countries are experiencing quite similar

adaptation problems and challenges, we could compare objects that are relatively comparable. We decided not to include countries from other continents as it could have resulted in differences that we would not have been able to interpret.

Among different approaches to studying adaptation policy instruments, Lesnikowski et al. [42] distinguished descriptive, evaluative, and measurement. These three approaches are used alone or in combination depending on the objectives of a particular study. Descriptive approaches aim at capturing and measuring the key characteristics of policy instrument mixes. Evaluative approaches focus on the efficiency of the policy instruments and seek to improve their results. Some recent studies apply measurement approaches, which means that the instrument mix is used to define different typologies of adaptation policies, e.g., [45]. In our study we generally follow the first approach, i.e., our goal is to define, compare, and find the differences between policy instrument mixes in selected countries. The advantage of our study is that we analysed the original policy documents in their original languages.

Although any quantitative methods are difficult to apply to policy instruments analysis, more and more attempts are being made to make analyses more structured and objective. As the scale of adaptation policy has expanded, and case studies and descriptive analyses provided knowledge about its essence, large(r)-n comparative adaptation policy studies emerged. Additionally, among them, a qualitative approach was used at first [31,46]. However, currently, quantitative or rather quasi-quantitative methods [42,59,60]—including statistical modelling [43,47]—are increasingly used. For the purposes of quantitative analyses, the contents of the documents where the adaptation policy and specific instruments are defined and encoded using the appropriate methodology. We have adopted a similar procedure in this study.

The aim of the paper is to find the similarities and differences between the adaptation instrument mixes included in the national adaptation strategies of selected European countries. We look for similarities and differences between the adaptation instrument mixes in Western European and Central and Eastern European countries. As the work is underway on a new adaptation strategy in Poland, we formulate conclusions regarding its improvement.

In the article, we analyse the adaptation strategies and plans regardless of whether they were written in English or in the national language. By doing so, we contribute to filling the gap representing the low presence of countries other than high-income Western countries in the research on the adaptation policy instruments.

3. Materials and Methods

3.1. Documents Covered in the Study

In this paper, we focus on formalised national adaptation strategies and plans that have been developed by central governments. We analyse adaptation policy instruments included in the national adaptation strategies and plans developed by selected European countries. After an initial review of strategic documents on adaptation to climate change, eight countries have been selected for detailed analysis, namely: Austria, France, Germany, Lithuania, Spain, Switzerland, Finland, and the Netherlands. This choice is supported primarily by the high level of advancement of works on the implementation of the strategy in these countries and the availability of strategic documents. In addition, the analysis also covers Poland, for which we develop recommendations regarding the evolution of instruments of adaptation to climate change.

The sources of information on strategic documents concerning adaptation to climate change are:

- The Climate-ADAPT database of the European Environment Agency on adaptation to climate change: https://climate-adapt.eea.europa.eu/ (accessed on 15 November 2022);
- The assessment of the adaptation progress to climate change made by the European Commission in 2018 [61];

- Internet resources of institutions responsible for the strategic planning of adaptation to climate change in individual countries.

The results presented in this article are based partially on the results of a research project "Analysis of solutions introduced in other European countries on their strategies, and the legal and economic tools that allow for preparing the economy and society for climate change and adapting to these changes" [62]. The study was carried out by the authors of this article under the project entitled "Knowledge base on climate change and adaptation to its effects and channels of its dissemination in the context of increasing the resilience of the economy, environment and society to climate change, and counteracting and minimising the effects of extraordinary threats" in the period of August–November 2020. This project was cofinanced from the Operational Programme Infrastructure and Environment 2014–2020 and commissioned by the Institute of Environmental Protection—National Research Institute.

We define the national adaptation strategy following Niang-Diop and Bosch [30] as "*a general plan of action for addressing the impacts of climate change, including climate variability and extremes. It will include a mix of policies and measures with the overarching objective of reducing the country's vulnerability. Depending on the circumstances, the strategy can be comprehensive at a national level, addressing adaptation across sectors, regions and vulnerable populations or it can be more limited, focusing on just one or two sectors or regions*". National adaptation strategies have not yet been strictly defined in the regulations of the European Union, although the EU has prepared appropriate guidelines for developing of national adaptation strategies [63] and requires the adoption of appropriate policies and reporting on adaptation actions, including adaptation strategies and plans [64]. In most of the countries analysed in these two documents, a strategy and action plan are used, but some countries have adopted other solutions, as shown in Table 1.

Table 1. Overview of the national adaptation strategic documents covered in the study.

Country	The Main Strategic Document in Force	The Implementation Document
Austria	Austrian strategy for adaptation to climate change. Part 1—Context [65]	Austrian strategy for adaptation to climate change. Part 2—Action Plan [66]
Finland	Finland's National Climate Change Adaptation Plan 2022 [67]	Action Plan for the Adaptation to Climate Change of the Environmental Administration 2022 [68]
France	National Strategy for Adaptation to Climate Change 2006 [69]	National Action Plan for the Adaptation to Climate Change (PNACC 2, 2017) [70]
Spain	National Action Plan for the Adaptation to Climate Change 2021–2030 (2020) [71]	The Action Plan 2021–2025 [71]
Netherlands	National Climate Adaptation Strategy 2016 [72]	Implementation Programme 2018–2019 [73]
Lithuania	National Strategy for Climate Change Management Policy [74]	National Energy and Climate Plan of the Republic of Lithuania for 2021–2030 [75]
Germany	German Strategy for Adaptation to Climate Change [76]	Adaptation Action Plan of the German Strategy [77]
Switzerland	Adaptation to Climate Change in Switzerland [78]	Adaptation to climate change in Switzerland: Action Plan 2020–2025 [79]
Poland	Strategic adaptation plan for the sectors andareas sensitive to climate change up to the year2020 with a perspective until 2030 [80]	No action plan in force

In some countries, the main strategic document is called a plan (Finland, Spain), and implementing documents are called action plans (Spain). In the case of Finland, implementation plans have been drawn up by sector. Additionally, in Austria, the strategic and operational dimensions of adaptation policy are included in one document. It is also worth noting that some countries are adopting a joint document on energy, climate change,

and adaptation. In Lithuania, one action plan has been adopted for these three areas, while a separate climate change adaptation strategy is still in place.

This diversity of approaches is probably related to the size of the country and its specificity (e.g., Spain and France have a wide range of problems because they include territories islands or overseas territories) but also the structure of the country's governance. However, the methodology recommended by the European Commission (a strategic document and an implementation document) is commonly used.

3.2. Description of Methods

For empirical analysis, policy instruments are defined as adaptation measures, i.e., are technologies, processes, and activities directed at enhancing our capacity to adapt (building adaptive capacity) and at minimising, adjusting to, and taking advantage of the consequences of climatic change (delivering adaptation) [63]. We included in the analysis instruments described in national adaptation strategies and adaptation plans. However, in many countries, no distinction was made between instruments and directions of activities. Therefore, in the paper, we make no strict theoretical distinction between policy instruments and directions of action and analyse them together. More important was to present what is being done and how it is being done in the analysed countries in the field of adaptation to climate change.

Instrument mixes denote packages (bundles) of individual policy instruments used by governments in response to certain policy problems. These mixes are created as a result of deliberate policy planning or successively over time [42,81].

We applied a typology of adaptation policy instruments based on the approach of Howlett and Rayner [29], which was used, among others, by Lesnikowski et al. [42,43] for the analysis of local adaptation policies. This approach allowed us to classify and compare strategies in terms of the characteristics of the instruments they use.

We systematically classified all adaptation policy instruments according to the set of criteria adopted from Lesnikowski et al. [43]:

- The sector they refer to;
- Their basic policy aim;
- Resources used;
- Governing logic.

All instruments were classified into 11 sectors:

1. Agriculture and forestry;
2. Buildings and urban areas, land use;
3. Energy and industry;
4. Environmental protection and biodiversity;
5. Fisheries;
6. Health;
7. Tourism;
8. Transport, telecommunications, and infrastructure;
9. Water management, marine areas;
10. Management system/general;
11. The financial sector.

Four main policy aims were distinguished:

- Climate change adaptation, i.e., focus on adapting to specific impacts of anthropogenic climate change;
- Vulnerability-centred adaptation, i.e., reducing structural factors contributing to vulnerability to climate change impacts;
- Resilience, i.e., increasing ability to recover from sudden shocks related to climate variability;
- Sustainability, i.e., adaptation linked to sustainable development objectives and better balance between economic, social, and environmental objectives.

Policy instruments were categorized using the NATO framework [25,82] as adopted by Henstra [83] and applied by Lesnikowski et al. [43]:

1. Nodality: information-based instruments; dependent on voluntary compliance.
2. Authority: use of state power to command, prohibit, or permit behaviour.
3. Treasure: use of public funds to (dis)incentivize, produce, and maintain public goods and services, impose costs.
4. Organisation: direct delivery of programmes and services and government operations.

Then, instruments were classified as either substantive and procedural and assigned to a specific category in a given group following the approach of Lesnikowski et al. [43], as shown in the Table 2.

Table 2. Types of adaptation policy instruments according to governing logic and resources used.

Principal Governing Logic and Resources	Substantive	Procedural
Nodality	Advice (Sharing of knowledge and experience) Education and training Reports and assessments Monitoring and evaluation	Exhortation Public outreach Labelling
Authority	Regulation Inter-governmental mandate Spatial planning Infrastructure performance standards Building regulations Strategic planning Adaptation planning	Agreements Advisory groups Public hearings Climate adaptation networks
Treasure	User charges Grants or subsidies Loans Direct expenditures Demonstration projects	Research funding Interest group funding
Organisation	Public procurement Operations Facilities	Conferences and workshops Institutional reforms
	Other	Other

We systematically applied these classification criteria to classify all adaptation policy instruments. The results of classification and doubts were discussed on an ongoing basis to maintain the uniformity of the interpretation of qualitative data. Analysis of the policy instruments portfolio was based on relative data (the proportion of the number of instruments in a given category of the total number of instruments identified in a given country). This is because reading of the NASs suggests that the number of instruments identified in each country is indicative not of the policy itself but of the way the text of a strategy was written—more or less synthetic. An example of such a synthetic approach is the Netherlands, and a very detailed one is Austria.

A proportion of the number of instruments in each category of those identified in each country were subject to structural and hierarchical cluster analysis. Hierarchical cluster analysis was applied to discover similarities between countries in the structure of instruments used. The method of mean linkage and square of Euclidean distance was applied (however, other methods generated the same clusters). IBM SPSS Statistics 28.0.1.0 software was used.

4. Results

4.1. Sectoral Stucture of Adaptation Policy Instruments

As a first step, we compared the NASs in terms of sectors they focus on as well as general characteristics of the instruments used. When analysing the differences between adaptation strategies and plans in different countries, one should remember that individual countries have different environmental and socioeconomic conditions and are also at different stages of implementing adaptation policies. Poland is a special case here because the NAS we analysed was approved in 2013 and was not in fact the subject of coordinated implementation activities.

All instruments were divided into 11 sectors important for climate change adaptation (Table 3), most of which coincide with the guidelines of the European Commission [63]. However, it should be noted that in each country, these sectors are presented in different layouts according to the importance of their problems and to the country's management structures. Although there are no grounds for generalization here, the example of Finland shows that if the planning and management of adaptation to climate change is delegated to a greater extent to lower levels of management (ministries, regional authorities), there are more management-related instruments in the country's NAS.

Table 3. Structure of adaptation policy instruments found in National Adaptation Strategies and Plans by sector.

Country Sector	Austria	Finland	France	Germany	Lithuania	Netherlands	Poland	Spain	Switzerland
Agriculture and forestry	25 (17%)	0 (0%)	13 (17%)	9 (27%)	18 (29%)	3 (13%)	10 (24%)	8 (4%)	18 (36%)
Buildings and urban areas, land use	25 (17%)	8 (16%)	0 (0%)	2 (6%)	0 (0%)	3 (13%)	9 (22%)	22 (12%)	0 (0%)
Energy and industry	14 (9%)	2 (4%)	0 (0%)	2 (6%)	2 (3%)	0 (0%)	5 (12%)	27 (14%)	7 (14%)
Environmental protection and biodiversity	19 (13%)	7 (14%)	9 (12%)	2 (6%)	7 (11%)	2 (9%)	4 (10%)	27 (14%)	5 (10%)
Fisheries	0 (0%)	0 (0%)	2 (3%)	6 (18%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Health	17 (11%)	0 (0%)	6 (8%)	6 (18%)	7 (11%)	5 (22%)	1 (2%)	6 (3%)	7 (14%)
Tourism	16 (11%)	0 (0%)	2 (3%)	2 (6%)	0 (0%)	0 (0%)	0 (0%)	9 (5%)	4 (8%)
Transport, telecommunications and infrastructure	13 (9%)	0 (0%)	0 (0%)	2 (6%)	9 (15%)	1 (4%)	2 (5%)	8 (4%)	0 (0%)
Water management, marine areas	21 (14%)	2 (4%)	4 (5%)	2 (6%)	9 (15%)	8 (35%)	2 (5%)	6 (3%)	9 (18%)
Management system/general	0 (0%)	31 (61%)	38 (50%)	0 (0%)	10 (16%)	1 (4%)	7 (17%)	67 (36%)	0 (0%)
Financial sector	0 (0%)	1 (2%)	2 (3%)	0 (0%)	0 (0%)	0 (0%)	1 (2%)	7 (4%)	0 (0%)
Total	150 (100%)	51 (100%)	76 (100%)	33 (100%)	62 (100%)	23 (100%)	41 (100%)	187 (100%)	50 (100%)

A total of 673 instruments of adaptation to climate change were identified. The countries with the largest number of instruments found are Spain and Austria and with the lowest—the Netherlands and Germany. These differences result from different target groups of the strategic documents. In case of the Netherlands, NAS is synthetic and easy to read in order to reach the widest possible audience. On the contrary, German's documents are extensive and detailed, but they focus on management of adaptation actions and highlight the role and responsibilities of central, regional, and local governments.

Sectors that are covered in all analysed countries are (1) environmental protection and biodiversity and (2) water management and marine areas. For other sectors, not all countries have formulated adaptation instruments.

Where environmental protection and biodiversity are concerned, the impact of climate change on ecosystems is common and evident. In this area, primarily management instruments are proposed: planning, coordination and cooperation, and information. Actions in the area of information relate primarily to the creation of a knowledge base—the monitoring, research, analysis, and development of appropriate methods.

Water management is one of sectors most affected by climate change, and it is analysed in all strategic documents on adaptation (in the case of the Netherlands, there is a separate programme devoted to water management and spatial planning). In this area, in all analysed countries, solutions are planned or implemented in monitoring the state of water, flood hazards, and improvement of the management system, including flood risk management. Attention is also paid to the problem of rainwater, especially in cities, and the resilience of technical infrastructure to heavy rains.

Agriculture is an area identified as particularly sensitive to climate change in most of the analysed countries. The impact of various manifestations of climate change is concentrated in changes in temperature during the year, changes in the growing season, water availability, and extreme weather phenomena. The proposed solutions cover a whole range of instruments: from providing knowledge on climate change and forecasts, research into new plant varieties, diseases and pests, and the dissemination of information and good practice to the creation of water management infrastructure. Moreover, insurance as a risk transfer instrument is addressed in all countries analysed. In forestry, threat analysis focuses on losses caused by pests, fires, and water deficits. The proposed instruments concern the development of forest monitoring systems, stand structure management, forest education, and research.

Adaptation to climate change in relation to buildings and urbanised areas is addressed in most of the analysed strategic documents. The range of proposed solutions is quite similar, but diversity owing to the geographical location of the country is noticeable: in Southern European countries, heat waves and the impact of high temperatures in buildings on human health are more of a problem, while in countries located in northern and central Europe, the issue is torrential rains. Regardless, the instruments used are similar: introducing adequate technical requirements for buildings, requirements for renovations, location of low storeys, and integrating adaptation issues in spatial planning.

Public health solutions address two main groups of issues: diseases related to climate change, including vector-borne diseases, and urban living comfort in the face of possibly more frequent heatwaves. At the same time, in countries located further to the north, attention is paid to tick-borne diseases, while in Southern European countries, to diseases transmitted by mosquitoes, including malaria.

The fisheries sector is discussed in detail in the documents of Spain and Germany, as it is significant sector in their economies. The proposed solutions concern the research on the impact of climate change on the environmental and economic system. The need to develop a network for long-term monitoring of the marine environment is also indicated.

The development of the energy sector is closely related to climate policy. Instruments in this area concern the integration of energy and climate issues both in legal regulations and in planning documents. It also promotes the use of incentives for energy-saving activities for consumers and for improving energy efficiency for producers and the public sector. It is also necessary to cooperate with various stakeholder groups and to raise the society's environmental awareness.

In the transport sector, the impact of climate change on its infrastructure concerned roads, railroads, and waterways. Legal instruments are proposed for the review and update of regulations on technical conditions for transport infrastructure (roads, bridges, earthworks, railways, ports, cableways, airports) considering resilience to natural disasters and extreme weather events. The need to conduct research is highlighted, especially on new materials and technologies for constructing transport infrastructure elements that minimise the effects of climate change.

The tourism sector has been widely analysed, especially in the documents from Austria and Spain. Instruments supporting the modification of certain forms of tourism and the adaptation of the tourist offer to the changing environmental conditions prevail.

Except for sectors in the strict sense, we also distinguished cross-cutting instruments—management system/general instruments that cannot be assigned to a specific field. They cover for example crisis management or monitoring systems. We found the largest share of this type of instruments in Finland (61%), France (50%), and Spain (36%). Given that in Finland and France, other types of instruments are rather poorly represented, it proves that climate change adaptation policy in these countries is more horizontally oriented than sectoral. A different approach is visible in countries with the lowest share of this group of instruments (the Netherlands, Lithuania, and Poland). In Poland, it may be significant that the NAS comes from 2013, when there was less awareness of the need to create more adaptive social, political, and economic structures.

4.2. Structural Characteristics of Adaptation Policies

As a second step, we compared the NASs' policy aims. In most countries, the largest proportion of the policy instruments focused on broadly understood adaptation to climate change (Figure 1). This may be related to the fact that the effects of climate change are already clearly felt in various sectors and that individual countries focus on solving existing problems, planning long-term actions (sustainability) less frequently.

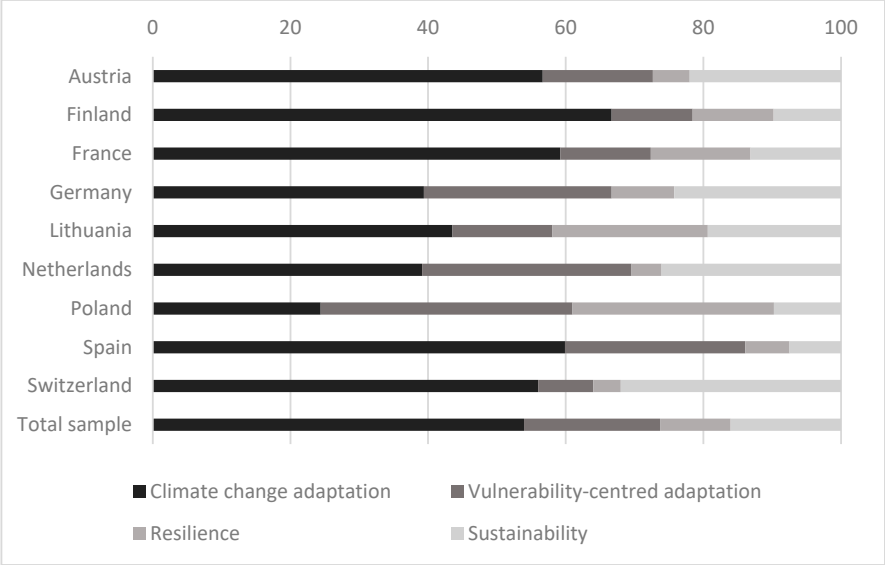

Figure 1. Adaptation policy instruments grouped by policy aims (%).

In Switzerland, Germany, and the Netherlands, a significant proportion of instruments were classified as sustainability-oriented. In Poland, we have identified more instruments that were specifically focused on resilience and climate change vulnerability rather than sustainability as a horizontal goal. This suggests that in Poland, where the policy document is a relatively "old" one, the sectoral approach prevails. A significant share of sustainability-oriented instruments suggests a higher level of environmental awareness among decision makers. It results in more holistic approach to adaptation policy.

In the third step, all identified adaptation instruments were categorized using the NATO framework (Figure 2).

There is a clear difference in governing logic between the approaches of different countries to implementing climate change adaptation policies. In most of them, about 50% are instruments from the Nodality group, i.e., information-based instruments. This is understandable, since each of the analysed countries recognizes the necessity of building an appropriate information base for adequate and effective adaptation policies.

Detailed data on proportion of instruments in each NATO category are shown in Table 4.

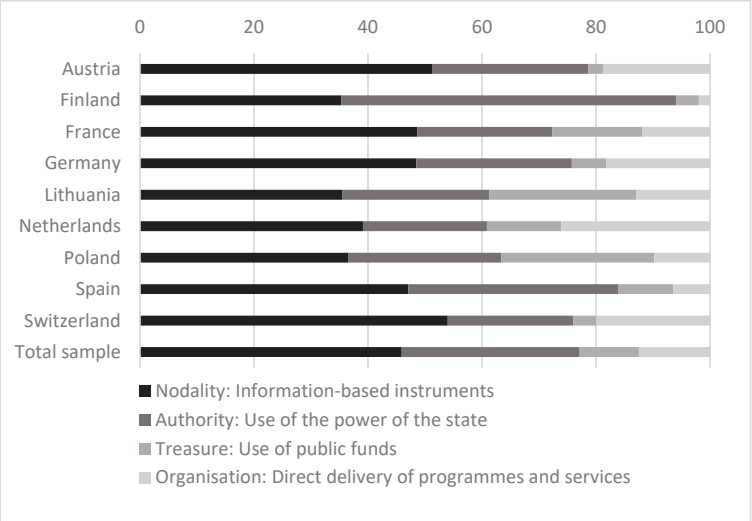

Figure 2. Adaptation policy instruments grouped according to NATO framework (%).

Table 4. Adaptation policy instruments grouped by NATO framework and instrument types (%).

Country Type of Instrument		Austria	Finland	France	Germany	Lithuania	Netherlands	Poland	Spain	Switzerland
Nodality	Advice	7.3	2.0	2.6	6.1	1.6	8.7	0.0	1.1	14.0
	Education and training	6.7	3.9	1.3	0.0	0.0	0.0	7.3	5.9	8.0
	Reports and assessments	**14.7**	**15.7**	**11.8**	**21.2**	12.9	**17.4**	4.9	**23.5**	10.0
	Monitoring and evaluation	13.3	2.0	3.9	9.1	8.1	0.0	14.6	4.8	12.0
Authority	Inter-governmental mandate	1.3	**15.7**	5.3	0.0	0.0	0.0	0.0	0.5	0.0
	Spatial planning	3.3	9.8	1.3	3.0	0.0	4.3	0.0	1.1	4.0
	Infrastructure performance standards	3.3	0.0	0.0	0.0	4.8	4.3	2.4	0.0	2.0
	Building regulations	2.0	11.8	2.6	9.1	1.6	0.0	7.3	4.3	0.0
	Strategic planning	3.3	15.7	7.9	6.1	4.8	0.0	2.4	21.9	0.0
	Adaptation planning	5.3	2.0	2.6	6.1	6.5	13.0	4.9	4.8	8.0
Treasure	User charges	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Grants or subsidies	2.0	0.0	3.9	0.0	1.6	4.3	4.9	0.0	2.0
	Direct expenditures	0.0	0.0	5.3	0.0	**21.0**	8.7	**24.4**	7.5	2.0
	Demonstration projects	0.7	5.9	1.3	0.0	0.0	4.3	0.0	2.1	0.0
Organisation	Operations	10.7	0.0	5.3	15.2	12.9	0.0	12.2	4.3	10.0
	Facilities	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	10.0	2.0	1.3	18.2	0.0	13.0	0.0	0.0	**16.0**

The biggest share of the instruments in six out of nine countries is observed in the Nodality group (with the dominating role of reports and assessments). This demonstrates the attention that these states pay to raising public awareness of the consequences of climate change as well as adaptation measures.

In Finland, instruments from the Authority group clearly dominate, with a small share of instruments related to the direct activity of the state apparatus. Thus, an approach to policy as the creation of an organisational and legal framework rather than as undertakings carried out by state institutions is evident here.

In Switzerland, instruments related to international cooperation (other) from the Organisation group play a significant role. This clearly indicates a cross-cutting approach to adaptation policy and reflects the need for adaptation efforts on a global scale.

Treasure instruments cover mainly economic instruments. They must have a transparent mechanism for operation and control so that the intervention is relevant and avoids abuse and the generation of unexpected negative side effects. Instruments related to the direct actions of the government (Treasure and Organisation) represent a large percentage in Poland and Lithuania. At the same time, the two countries have the lowest share of information-based instruments. These two characteristics may be a result of historic processes and a relatively short history of building democratic institutions and civil society after transformation. The political heritage of these two countries results in a persistent belief that government should generally play a main role in policy.

4.3. Similarity of Adaptation Policy Portfolios

Hierarchical cluster analysis allowed us to confirm qualitative conclusions discussed above. We found some pattern in the groupings based on the classification of instruments by policy aims, sectors, and types (Figure 3).

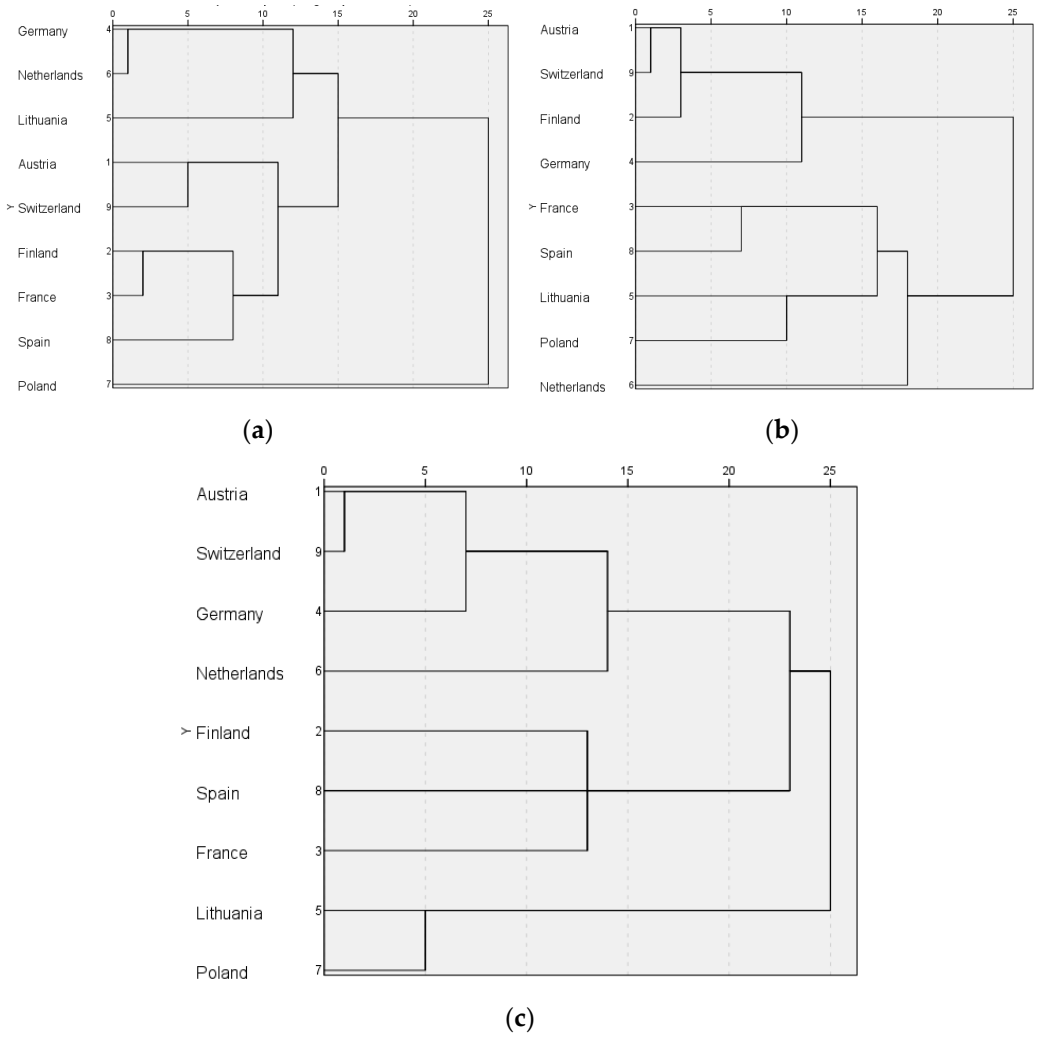

Figure 3. Similarity among policy mixes in terms of: (**a**) policy aims, (**b**) sectors, (**c**) instrument types.

Clustering based on the structure of instruments grouped by sector and type shows that in Poland, the structure of the adaptation policy instrument mix most resembles that of Lithuania. Instrument mixes of three neighbouring German-speaking countries and France and Spain were also classified as having similar structure. This result is generally in line with our expectations—neighbouring countries have similar natural conditions, i.e., they experience similar climate risks and impacts. To some extent, they also have a similar political and historical background (German speaking countries; Poland and Lithuania). The two countries of the former Soviet Bloc (Poland and Lithuania) are relatively young democracies where perception of institutions and the government's role differs from that in countries with longer democratic traditions.

5. Discussion and Conclusions

The observations we made are to a great extent similar to those made by Biesbroek and Delaney in their study on adaptation policy instruments in Europe [58] (although we analysed source documents while their study was a meta-analysis). We also observed a large share of Authority-type instruments in Finland and the Netherlands. In our study, we also confirmed the conclusion of these authors that organisational instruments are the least frequently applied group. This is because the analysis we made concerned the national level, where such instruments are usually not used (they are more frequent in local adaptation policies, as shown by Lesnikowski et al. [43]).

Our study suggests, based on a case of Poland and Lithuania, that CEE countries are different from Western European countries in terms of adaptation policy instruments provided for in national strategic plans on adaptation. This finding is to some extent in line with the conclusions of Biesbroek et al. [47]. In their study on the impact of administrative traditions on adaptation, they found that less corporatist and less legalistic countries tend to be different from more corporatist and legalistic countries—the CEE countries belong to this first group. Interestingly, these authors did not consider any variable related to the systemic transformation in their model, although most socioeconomic and political analyses emphasise this factor.

In the CEE countries we studied, the impact of historical conditions, i.e., systemic transformation from a socialist to a market economy, was evident: instruments related to state power and direct actions of the government (Treasure and Organisation) play a large role. At the same time, in Poland and Lithuania, we found the lowest share of information-based instruments. These two characteristics are particularly relevant when it comes to policy recommendations. They are worth formulating, as Poland is at the stage of preparing a new climate change adaptation strategy. In particular, our research shows that:

1. It is important to pay more attention to a horizontal (sustainability-oriented) approach to adaptation policy. Adaptation policy should be integrated with other policies (and not just be a sectoral policy).
2. Forms and the scope of direct government actions should be re-examined in accordance with the principle of subsidiarity. Of course, ensuring adequate funding mechanisms is crucial to the effectiveness of adaptation efforts, but direct public spending is not the only solution here. A comparison to Western European countries shows that more intermediate instruments are also an option. In particular, the importance of insurance-related mechanisms and financial sector involvement should be recognized.
3. Nodality instruments, especially creating and disseminating knowledge and information as well as raising public awareness of adaptation, should be given more attention. These instruments assume an active attitude in all actors involved. Their basic premise is that based on reliable and complete information, all actors of socioeconomic life will make proper decisions supporting adaptation. Informational and educational instruments are widely used in all WE countries analysed, and we are convinced that broader use of Nodality instruments is key to creating a socioeconomic system that is more resilient and adaptable.

4. Organisation instruments are hardly visible in the Polish NAS. Forms such as voluntary commitments, public–private partnerships, and management systems should also be used to involve the business sector in adaptation actions.

Our study, of course, has some limitations: it covered a relatively small group of countries, so the possibility of generalizing our conclusions is limited. However, our findings confirmed by the literature suggest that the specificity of the adaptation policy in CEE should be the subject of further research. Our study also focused on one region—the European Union. However, this was our intentional choice to compare countries with relatively similar natural conditions to limit the impact of this factor on policy differences. In this way, we were able to draw more concrete conclusions.

We did not evaluate the adequacy of policy instruments to a country's particular conditions nor their effectiveness in achieving policy goals. This also may be the subject of further study.

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