Co-creating adaptation solutions: A critical review of participatory instruments in climate change adaptation laws and policies

Nadejda Komendantova [a], Dmitry Erokhin [a,*], Anna Scolobig [b], Enora Bruley [b], Marina Mattera [c,d], Madeline Baldelli [d]

[a] *International Institute for Applied Systems Analysis, Laxenburg, Austria*
[b] *Institute for Environmental Sciences, University of Geneva, Geneva, Switzerland*
[c] *EAE Business School, Barcelona, Spain*
[d] *Centro Euro-Mediterraneo sui Cambiamenti Climatici, Lecce, Italy*

A B S T R A C T

Amid growing climate risks and evolving adaptation-mitigation dynamics, this study analyzes how participatory instruments are integrated into climate change adaptation laws and policies. Reviewing legal and policy documents from the EU, Germany, and Spain since 2020, and using Arnstein's ladder of citizen participation to assess participation levels ranging from tokenistic consultation to partnership, the study identifies common gaps in accessibility, communication, capacity building, feedback, funding, and coordination. Insights from a co-creation workshop with experts further support these findings. Although innovative instruments have been introduced, most practices remain confined to mid-level participation. The study concludes with policy recommendations aimed at bridging the gap between participatory rhetoric and practice. The recommendations advocate for decentralization, diversified communication, enhanced capacity building, institutionalized accountability, sustainable funding, and improved multi-level coordination. Implementing these changes will be critical to transform adaptation laws and policies into genuine co-production platforms for addressing climate change.

1. Introduction

Effectively addressing escalating climate impacts requires an integrated approach that combines both adaptation and mitigation strategies, particularly in light of the slow progress in emissions reduction (IPCC, 2022). While mitigation has historically received more focus, there is growing recognition that adaptation is crucial, particularly for vulnerable regions experiencing localized climate impacts (Nwedu, 2020). Defined as the process of adjustment to actual or expected climate and its impacts, in order to moderate harm or exploit beneficial opportunities (IPCC, 2022), adaptation is crucial for reducing socio-economic vulnerability and risks associated with climate change. In their own turn, climate change adaptation laws and policies[1] aim to improve societies' preparedness and capacities to address climate change (Boswell et al., 2012; Street et al., 2015).

Participation and co-production have become central concepts in climate change adaptation governance, since they can improve both the legitimacy and the effectiveness of actions by integrating diverse knowledge, values, and lived experience. At the same time, a consistent finding in the literature is that participation can remain a symbolic "illusion of inclusion", e.g. when engagement is limited to one-off consultation, when capacity constraints prevent meaningful involvement, or when institutions do not clearly account for how public input influences decisions (Few et al., 2007; Hügel and Davies, 2020; Mees and Driessen, 2019). These shortcomings shape implementation, trust, and the risk of undesirable outcomes when engagement processes are poorly designed (Wamsler et al., 2020).

To analyze participation, scholars have proposed frameworks that emphasize different dimensions including the distribution of power (Arnstein, 1969), the role of learning and iterative governance (Collins and Ison, 2009), and design principles that support the implementation of engagement processes (Reed et al., 2018). However, these perspectives are not always operationalized for systematic, comparative analysis of how participation is institutionalized in legal and policy

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* Corresponding author.
E-mail address: erokhin@iiasa.ac.at (D. Erokhin).

[1] This study examines both binding laws and regulations on climate change adaptation and non-binding policy documents, including strategies, plans, communications, and reports.

instruments across jurisdictions. Empirical work frequently focuses on single plans, projects, or participatory processes. There is little comparative research aimed at analyzing which participatory instruments are included in recent climate change adaptation legal and policy documents and which design gaps persist across governance levels (Uittenbroek et al., 2019).

Integrating top-down (often expert- and authority-driven) and bottom-up (grounded in local priorities and knowledge) adaptation approaches is frequently presented as a pathway to more robust and legitimate adaptation planning but doing so depends on the participatory instruments that determine who participates, how, and with what influence (Butler et al., 2015). Furthermore, power imbalances, conflicting interests, and limitations in technical, financial, and participatory capacities of both citizens and authorities can hinder effective implementation and even result in maladaptation (Loeffler and Bovaird, 2021; Wamsler et al., 2020; Scolobig and Lilliestam, 2016). The call for a more participatory approach in policymaking is hardly new, evidenced by milestones such as the Rio Declarations, IPCC assessments, and the Paris Agreement. While participation is explicitly featured in frameworks like UNFCCC's National Adaptation Programmes of Action (NAPAs) and many municipal-level adaptation strategies, the extent and consistency of this inclusive strategy's integration into climate change adaptation laws and policies varies widely across governance levels and regions.

Little research has been conducted to analyze what instruments can support the inclusion of participatory and deliberative practices within the policymaking process for climate change adaptation. Addressing this gap requires moving beyond broad calls for more participation toward an instrument-level understanding of how participation is operationalized in formal regulation designs, particularly regarding capacity building, transparency, feedback, and accountability, which strongly condition whether participation can progress beyond tokenism (Mees and Driessen, 2019; Hügel and Davies, 2020). This study therefore develops a practical, theory-informed analytical framework that translates core participation elements into a document-based coding approach that enables a systematic comparison across regulations and jurisdictions. This generated empirically grounded contributions for future research on why certain participatory designs persist and how they relate to implementation outcomes (Reed et al., 2018; Wamsler et al., 2020).

While climate change adaptation laws and policies comprise a range of substantive instruments (e.g., regulations, funding, technical requirements), this study specifically focuses on participatory instruments, i.e., procedural instruments that facilitate stakeholder identification, public consultation, capacity building, transparency and information sharing, and monitoring and feedback within adaptation governance.[2] Through an empirical, document-based review of 21 recent adaptation laws and policies from the European Union, Germany, and Spain, the analysis systematically identifies, maps, and evaluates the instruments that structure participation across different governance levels.

The analysis is guided by four main objectives: (1) to document relevant participatory instruments, (2) to evaluate the depth and nature of stakeholder engagement, (3) to identify key gaps within current legal and policy frameworks, and (4) to propose recommendations for more effective, inclusive, and sustained participation in climate change adaptation. By situating these findings within broader debates about the challenges and limitations of participation such as persistent technical, financial, and institutional constraints the study highlights where current practices fall short of ambitious participatory ideals and where opportunities exist for more meaningful engagement and co-production in the future.

The paper is structured as follows. Section 2 details the methodology. Section 3 examines relevant EU-level laws and policies. Section 4 and 5 present an in-depth look at selected adaptation laws and policies, respectively in Germany and Spain. Section 6 synthesizes these findings to identify recurring gaps and challenges. Section 7 offers a comprehensive set of policy recommendations. Finally, Section 8 concludes by reflecting on the broader implications of this analysis for the future of climate change adaptation governance in Europe.

2. Methodology

This study draws on an extensive corpus of climate change adaptation laws and policies selected from the Climate Change Laws of the

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[2] For clarity, several key concepts are defined as they are used in this study:

➤ Stakeholder engagement is used as an umbrella term for efforts to involve relevant actors in adaptation governance.

➤ Participation refers to engagement processes through which stakeholders provide input into decision-making, planning, or implementation.

➤ Co-production refers to higher-intensity engagement in which stakeholders and public authorities jointly develop, implement, or manage adaptation measures, implying shared responsibility and mutual learning.

➤ Deliberative practices are structured participatory formats (e.g., assemblies, mini-publics, facilitated forums) designed to support collective reflection and reasoned judgement.

➤ In this study, the primary unit of analysis is participatory instruments, defined as procedural provisions (e.g., consultation requirements, councils, assemblies, reporting and feedback rules) that structure who participates, when, how, and with what influence in adaptation governance.

➤ Adaptation governance refers to the institutional arrangements, decision-making procedures, and multi-level coordination through which adaptation priorities are set, implemented, monitored, and revised.

➤ Capacity building is treated both as a foundational adaptation objective and as a design feature of participatory instruments that conditions whether stakeholders can participate meaningfully. Strengthening stakeholders' knowledge, skills, and resources not only supports adaptation outcomes but also facilitates more inclusive, co-productive, and bottom-up engagement. This aspect is particularly relevant to the interplay between top-down outreach and grassroots agenda-setting.

World database,[3] a comprehensive repository that includes legal and policy documents from all over the world. Given the vast array of potential documents, strict selection criteria were applied to ensure relevance. The primary requirement was that the document explicitly refers to "adaptation" in the context of climate change. Documents that mentioned adaptation only tangentially – such as those focusing primarily on other areas or referring to adaptation in generic terms (e.g., adaptation to new legislation) – were excluded. Furthermore, the study focused on laws and policies published or amended after 2020, with the aim of capturing the most current approaches to climate change adaptation. Beginning with a pool of over 150 laws and policies, the final sample included five EU-level, ten German, and six Spanish laws and policies (see Fig. 1 for an overview of the selection process).

The selection of the EU-level and two national-level (Germany and Spain) sets of regulation is deliberately designed to enable a meaningful analysis of how participatory processes in climate change adaptation unfold across multiple scales of governance. EU-level adaptation laws and policies establish an overarching framework and set normative expectations for participation, but their implementation is mediated by Member States' own legal, administrative, and cultural contexts. Germany and Spain were chosen as national cases because they represent contrasting governance traditions, administrative structures (federal vs. decentralized unitary), and adaptation challenges, yet both are bound by the same EU obligations. This multi-level analysis is highly relevant for understanding the diverse pathways through which participation is operationalized in climate change adaptation, revealing not only recurring challenges but also context-specific innovations. Ultimately, this approach clarifies how the interplay between EU guidance and national practice influences both the processes and effectiveness of stakeholder engagement in climate change adaptation policymaking.

Upon closer examination of the selected laws and policies, it became evident that some also address mitigation objectives. This overlap highlights the interconnected nature of adaptation and mitigation within climate laws and policies. The integration of both aspects underscores their complementary roles in fostering climate resilience and achieving long-term sustainability. Acknowledging this overlap enriches the analysis by providing insights into how laws and policies can simultaneously address multiple dimensions of climate action.

To evaluate the nature and extent of participatory instruments in the selected laws and policies, the study employed Arnstein's ladder of citizen participation (Arnstein, 1969). This framework illustrates an eight-rung spectrum of citizen involvement ranging from non-participation (manipulation and therapy) through tokenism (informing, consultation, and placation) to more substantive forms of citizen power (partnership, delegated power, and citizen control) (see Fig. 2 for an overview). Although Arnstein's framework emerged over fifty years ago, it remains a useful heuristic for analyzing the depth of stakeholder involvement in modern policymaking. In this study, the ladder served to differentiate between laws and policies that merely inform or consult stakeholders and those that genuinely share decision-making power or delegate substantial authority to citizens.

As part of the analysis, all rungs of Arnstein's ladder were explicitly considered, including the bottom two rungs manipulation and therapy, which represent non-participatory or potentially maladaptive approaches. However, no evidence of these forms of participation was found in the documents reviewed. To the best of the author's knowledge, this reflects an absence of such practices, which is a notable finding. This implies that overtly tokenistic or manipulative participatory instruments are not present in the current sample of EU, German, and Spanish climate change adaptation laws and policies.

The documents were subjected to a multi-stage qualitative content analysis. To enhance the robustness and transparency of this process, a Large Language Model (LLM) Artificial Intelligence (AI) tool, Copula AI, was employed to extract relevant information dynamically. Unlike traditional deductive coding, which is rigorous but time-consuming, LLM-assisted content analysis enhances efficiency while maintaining analytical flexibility (Chew et al., 2023).

Copula AI utilizes vector similarity search, converting both queries and texts into mathematical vectors to identify and retrieve the most relevant document sections. This approach allows for the dynamic exploration of documents, capturing key words, phrases, and topics beyond predefined keywords. The AI applied pre-identified analytical criteria (stakeholder identification, consultation instruments, capacity building, transparency and information sharing as well as monitoring and feedback as described below) and retrieved the most relevant passages through similarity-based ranking. The extracted content was then used in the Retrieval-Augmented Generation (RAG) process, ensuring that responses remained directly grounded in the texts.

For each document, the AI was prompted with targeted questions corresponding to each analytical dimension to ensure focused retrieval of relevant passages. For example, for stakeholder identification, the AI was asked "Which stakeholder groups are explicitly targeted by the participatory instruments in this document? Provide specific textual references". Similar targeted questions were used for the other dimensions. This approach enabled the AI to extract concrete, contextually relevant segments that were then manually verified by the researchers against the research objectives.

To check the AI's accuracy, one of the authors reviewed all AI-extracted passages against the original texts, verifying both relevance and fidelity to the source material. Any discrepancies or ambiguities were noted and addressed. The results from the manual analysis showed the excerpts were mostly accurate and relevant. The discrepancies that were noted involved minor omissions or broader contextual interpretation and no substantive errors were identified. The manual verification reinforces the applicability of using AI for policy analysis in this particular context.

The qualitative content analysis focused on five analytical dimensions:

- Stakeholder identification: This dimension assesses which entities (e. g., government bodies, civil society organizations, private sector actors, local communities) are recognized or involved in the document. It examines how it defines and categorizes these stakeholders.
- Consultation instruments: This dimension evaluates the methods used to engage stakeholders, such as public hearings, workshops, advisory committees, and online consultations. The analysis
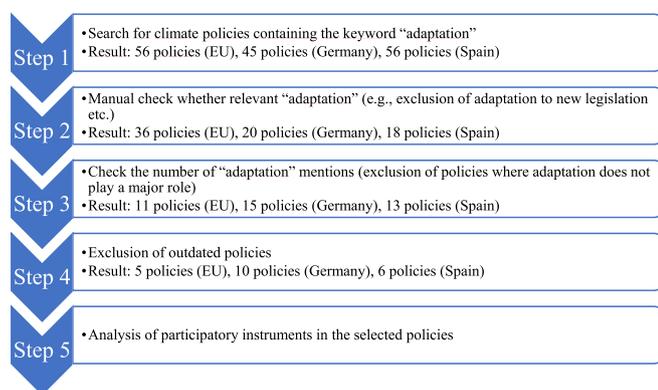
Fig. 1. Document selection process.

Step 1
- Search for climate policies containing the keyword "adaptation"
- Result: 56 policies (EU), 45 policies (Germany), 56 policies (Spain)

Step 2
- Manual check whether relevant "adaptation" (e.g., exclusion of adaptation to new legislation etc.)
- Result: 36 policies (EU), 20 policies (Germany), 18 policies (Spain)

Step 3
- Check the number of "adaptation" mentions (exclusion of policies where adaptation does not play a major role)
- Result: 11 policies (EU), 15 policies (Germany), 13 policies (Spain)

Step 4
- Exclusion of outdated policies
- Result: 5 policies (EU), 10 policies (Germany), 6 policies (Spain)

Step 5
- Analysis of participatory instruments in the selected policies

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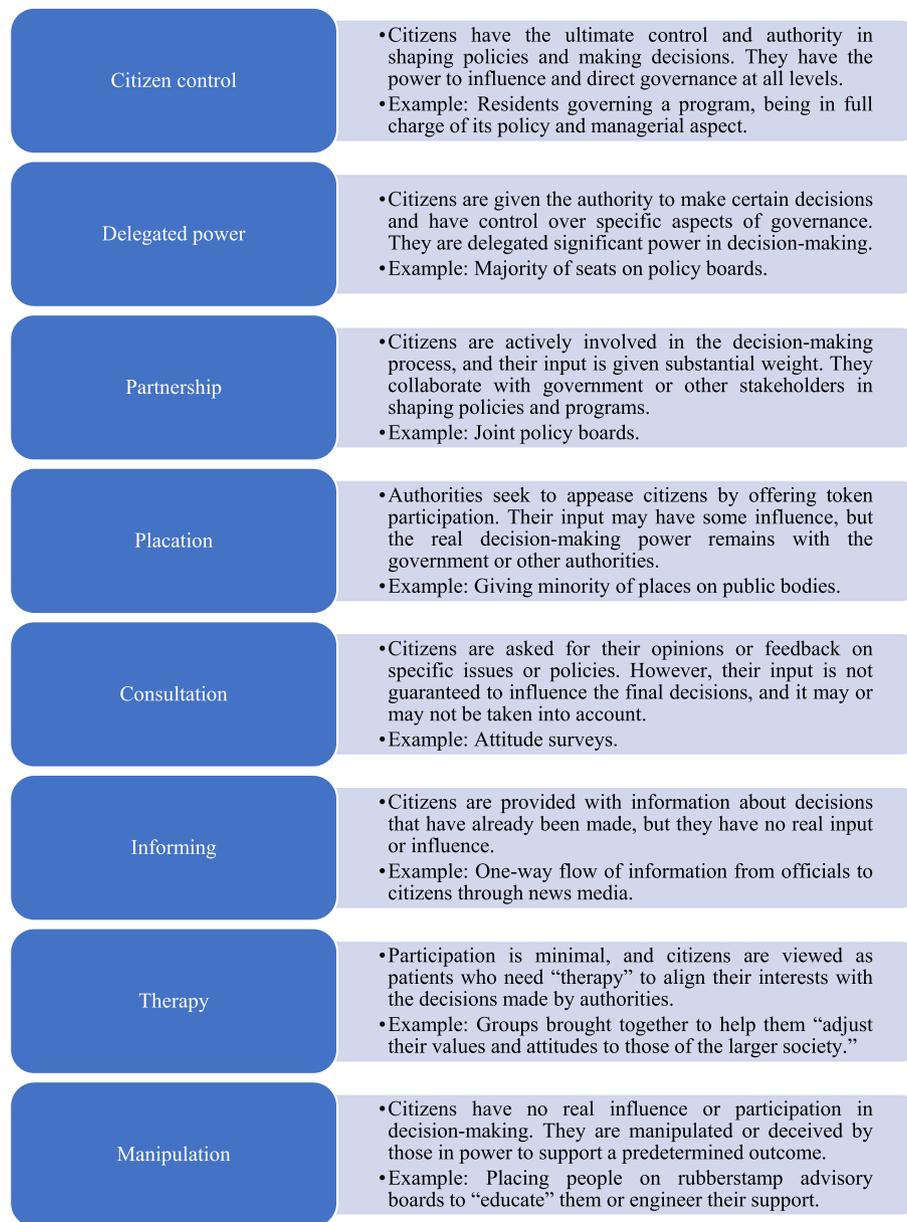| Citizen control	• Citizens have the ultimate control and authority in shaping policies and making decisions. They have the power to influence and direct governance at all levels. • Example: Residents governing a program, being in full charge of its policy and managerial aspect.
Delegated power	• Citizens are given the authority to make certain decisions and have control over specific aspects of governance. They are delegated significant power in decision-making. • Example: Majority of seats on policy boards.
Partnership	• Citizens are actively involved in the decision-making process, and their input is given substantial weight. They collaborate with government or other stakeholders in shaping policies and programs. • Example: Joint policy boards.
Placation	• Authorities seek to appease citizens by offering token participation. Their input may have some influence, but the real decision-making power remains with the government or other authorities. • Example: Giving minority of places on public bodies.
Consultation	• Citizens are asked for their opinions or feedback on specific issues or policies. However, their input is not guaranteed to influence the final decisions, and it may or may not be taken into account. • Example: Attitude surveys.
Informing	• Citizens are provided with information about decisions that have already been made, but they have no real input or influence. • Example: One-way flow of information from officials to citizens through news media.
Therapy	• Participation is minimal, and citizens are viewed as patients who need "therapy" to align their interests with the decisions made by authorities. • Example: Groups brought together to help them "adjust their values and attitudes to those of the larger society."
Manipulation	• Citizens have no real influence or participation in decision-making. They are manipulated or deceived by those in power to support a predetermined outcome. • Example: Placing people on rubberstamp advisory boards to "educate" them or engineer their support.

Fig. 2. Rungs of the Arnstein's ladder of citizen participation.

considers whether these methods are described in sufficient detail to determine the depth and frequency of engagement.

- Capacity building: This dimension investigates how laws and policies aim to enhance stakeholders' abilities to participate meaningfully. It looks at initiatives such as training programs, technical assistance, resource support, or educational efforts.
- Transparency and information sharing: This aspect examines the extent to which laws and policies encourage or mandate clear and accessible communication regarding adaptation strategies, progress, and outcomes. It also considers whether there are requirements for publishing relevant data and reporting on implementation.
- Monitoring and feedback: This dimension focuses on the systems in place to track the implementation of adaptation measures and integrate stakeholder feedback. The analysis distinguishes between institutionalized, recurring feedback loops and more ad hoc instruments.

In addition to the document analysis, the study incorporated insights from a co-creation workshop held in January 2024 at the 2nd in-person Project General Assembly. During this event, several workshops were conducted to maximize the ability to interact face to face and members of the consortium took part in diverse activities. Approximately 15 members of the Project consortium attended the co-creation session. The participants represented research institutions from a range of European countries, including Italy, the UK, Sweden, Greece, Spain, Austria, Germany, and Estonia.

All workshop procedures adhered to the ethical guidelines of the project, which are consistent with standard protocols for research involving human participants. The workshop served as a validation step, providing an opportunity for participants to review preliminary findings from the document analysis and to discuss the identified gaps in participatory practices. Participants were provided with a summary of the identified gaps and a presentation on the main results of the document analysis. The workshop agenda was developed and facilitated by the author team. Through guided discussions, participants offered concrete suggestions and potential solutions for enhancing stakeholder engagement in climate change adaptation laws and policies. The insights from the co-creation workshop were then integrated into the overall

analysis, ensuring that the policy recommendations reflect both expert interpretation of the documents and practical perspectives from stakeholders directly involved in adaptation processes.

Despite this systematic approach, the analysis has certain limitations. Analyzed documents vary in the level of detail provided on participatory instruments, which may lead to underestimations or overestimations of actual stakeholder engagement. Additionally, laws and policies are subject to frequent amendments and revisions. Therefore, this study offers a snapshot based on the documents available as of late 2023 and early 2024. The potential impact of elections during this period was also outside the scope of this analysis. Finally, while Arnstein's ladder is a valuable tool for distinguishing degrees of participation, it is also important to acknowledge its potential limitations including its overly linear and hierarchical framing, its narrow focus on power redistribution that may overlook the dynamic, context-dependent nature of participation and social learning, and its tendency to oversimplify the multifaceted strategies involved in stakeholder engagement (Murunga et al., 2024; Reed et al., 2018; Collins and Ison, 2009). Nevertheless, it remains a useful heuristic for examining the broad spectrum of engagement strategies across diverse policy environments.

3. EU-level adaptation laws and policies

The European Union has positioned itself at the forefront of climate action by setting ambitious targets for both mitigation and adaptation, supported by a multi-layered governance structure. The laws and policies reviewed in this study comprising:

- The European Union Biennial Report 4,
- Regulation 2021/1119 (the European Climate Law),
- The European Union Adaptation Communication,
- The EU Strategy on Adaptation to Climate Change, and
- The Managing Climate Risks – Protecting People and Prosperity Communication

reflect the EU's commitment to fostering resilience across Member States. They place emphasis on the principle of subsidiarity, wherein decisions are made at the most appropriate level of governance. Additionally, they call for robust stakeholder participation to ensure inclusive planning and implementation (see Table 1 for an overview of participatory instruments).

Across the selected EU-level laws and policies, the notion of inclusive governance is repeatedly underscored. For example, references are made to public authorities, NGOs, private sector operators, and academic institutions as key partners. Citizens are recognized as essential stakeholders, though the specific instruments for their direct involvement often lack detailed elaboration. The European Climate Law, for instance, commits to promoting public and social dialogue, but it tends to frame citizen participation more as consultation than as delegated power. Similarly, the EU Strategy on Adaptation to Climate Change highlights collaboration with local communities yet remains vague on operational details. Stakeholder inclusion here appears broad, but deeper forms of citizen-driven policy shaping – such as devolving decisions on local adaptation priorities – are less commonly emphasized.

At present, most instruments reflect consultation and informing strategies rather than genuine power-sharing arrangements. The EU adaptation policy framework incorporates multiple consultation instruments, including formal public consultations on draft legislative proposals, the use of online portals for feedback, and structured dialogues such as the European Climate Pact. Deliberative methods like citizen assemblies have been piloted in a few Member States, but these are not mandated by EU-level laws and policies. Such deliberative processes, if systematically integrated, could push EU adaptation governance higher up Arnstein's ladder.

Capacity building is addressed through technical assistance programs, knowledge platforms (e.g., Climate-ADAPT), and funding sources such as the Horizon Europe research program. These initiatives aim to equip Member States and local authorities with the skills and tools necessary to develop and implement context-specific adaptation measures. While these provisions support meaningful engagement from subnational governments, they do not always extend directly to civil society organizations or individual citizens. Consequently, the capacity gap can be particularly evident in smaller municipalities or in marginalized communities lacking dedicated resources or expertise.

Transparency is recognized in EU documents as a cornerstone of successful adaptation. Provisions typically include requirements for Member States to publish national adaptation strategies and to report periodically on progress. The EU also fosters digital platforms to disseminate data and best practices, such as the Covenant of Mayors initiative. Yet, the accessibility of these databases varies, and stakeholders with limited digital literacy or bandwidth may find it challenging to participate actively. Moreover, the sheer complexity of certain European adaptation directives – often composed of intricate legal language – can deter non-specialist stakeholders from fully engaging.

EU-level laws and policies generally mandate that Member States monitor and evaluate the implementation of adaptation measures. The EU also places emphasis on involving stakeholders in monitoring climate policies, a process facilitated by establishing Monitoring Groups for Adaptation Plans at the national level. Reporting occurs primarily through instruments like National Energy and Climate Plans (NECPs) and other specialized communications. However, the link between these monitoring processes and public feedback remains tenuous. Citizens and civil society organizations, for instance, rarely have formalized routes for influencing subsequent policy iterations, even though some consultation windows exist.

When categorizing the participatory instruments in the analyzed EU laws and policies along Arnstein's ladder of citizen participation (see Fig. 3), many arrangements appear to lean toward tokenism rather than genuine partnership – stakeholder inputs are often welcomed but not

Table 1
Overview of participatory instruments in the selected EU laws and policies.

Dimension	Stakeholders	Consultation instruments	Capacity building	Transparency and information sharing	Monitoring and feedback
Instruments	• EU institutions • Member States • Government bodies (national, regional, local) • Private sector (businesses and industries) • Civil society organizations (NGOs, community groups) • Research institutions • Citizens	• Public consultations • Multilevel climate and energy dialogues	• Technical cooperation and institutional capacity building • Infrastructure and sustainability programs • Sectoral initiatives for resilience • National and regional adaptation strategies • Engagement and knowledge sharing platforms	• Financial reporting • Multi-stakeholder engagement platforms • Regulatory frameworks for transparency Information sharing and science-based dialogue	• Collaborative monitoring systems • Financial resource tracking • Stakeholder engagement platforms • Communications and reporting • Impact assessments and digital tools

Fig. 3. Arnstein's ladder of citizen participation: Overview of participatory instruments in the selected EU laws and policies.

always meaningfully integrated to shift policy directions. At the partnership level, initiatives like the European Climate Pact foster collaboration across government levels and sectors, enabling stakeholders to influence policy outcomes. Programs such as the EU Covenant of Mayors highlight efforts to empower local authorities in climate change adaptation.

Placation involves multi-stakeholder platforms and capacity building initiatives that allow stakeholder input but do not grant decision-making power, as seen in sectoral roadmaps for climate-neutrality and initiatives like Erasmus+ and the European Social Fund Plus. Consultation instruments, such as public consultations and climate dialogues, gather stakeholder feedback from various sectors, though decision-making remains in the hands of authorities. Finally, at the informing level, the EU disseminates climate-related information through platforms like Climate-ADAPT and national monitoring systems, equipping stakeholders with data and resources to understand adaptation efforts without necessarily influencing policy.

4. German climate change adaptation laws and policies

Germany's climate change adaptation documents analyzed encompassed.

- The Immediate Climate Adaptation Program and the Federal Climate Adaptation Act,
- The Measures Program for the Implementation of the Agenda on the Adaptation of Land Use, Land Use Change and Forestry, Fisheries and Aquaculture to Climate Change,
- The Forest Strategy 2050,
- The Federal Action Plan on Nature-Based Solutions for Climate and Biodiversity,
- The Arable Farming Strategy 2035,
- The Climate Action Program 2030
- The Eighth National Communication and Fifth Biennial Report of the Federal Republic of Germany under the United Nations Framework Convention on Climate Change,
- Germany's Recovery and Resilience Plan, and
- The Action Plan for the Dialogue and Work Process on the Middle Class, Climate Protection and Transformation (see Table 2 for an overview of participatory instruments).

German laws and policies articulate a strong recognition of diverse stakeholder groups, including federal agencies, state governments, municipal authorities, scientific bodies, industry associations, and civil society organizations. There are frequent references to collaborative

councils or forums aimed at inclusive dialogue. Yet, within this recognized breadth, certain gaps emerge. Although low-income populations, migrants, and other vulnerable demographics are occasionally mentioned as deserving of protective measures, explicit requirements for their involvement in adaptation planning are often absent. Similarly, while youth engagement is championed rhetorically, few documents institutionalize channels for young people to influence adaptation decisions significantly.

Consultation processes in Germany often revolve around formal public hearings, stakeholder workshops, and task forces that unite technical experts, landowners, and industry representatives. For instance, the Measures Program on Land Use emphasizes iterative engagement with agricultural stakeholders and environmental NGOs to address land-management challenges induced by climate variability. Municipalities frequently host local forums, and some states have explored participatory budgeting or consensus-building processes linked to adaptation measures.

The Federal Climate Adaptation Act and related participatory instruments promote capacity building measures through training programs, digital resources, and direct funding for municipal adaptation managers. Germany's strong tradition of vocational education sometimes extends to the climate sector, supporting technical training in areas such as flood-risk management and climate-resilient agriculture. However, even where capacity building measures exist, they often focus more on technical proficiency than on participatory governance skills.

Germany maintains a relatively transparent system of reporting on adaptation measures, partly due to commitments under the EU's Monitoring Mechanism Regulation. National communications on climate change adaptation are published in detail, and data on climate impacts and adaptation status are made available through platforms such as the Climate-Fact Sheets. However, while the legal framework encourages openness, the complexity of Germany's federal system can result in bureaucratic silos, where adaptation-related data are scattered across different administrative bodies.

Monitoring and evaluation instruments in Germany typically rely on performance indicators embedded in legislative acts or within the periodic climate action progress reports. Federal-state working groups often serve as key forums for exchanging feedback on policy implementation. The question is whether these feedback channels truly integrate citizen perspectives or primarily revolve around governmental and expert consultations.

Analyzing the participatory instruments in German climate change adaptation through the lens of Arnstein's ladder (see Fig. 4) reveals that many processes remain at the consultation or placation levels, with only sporadic moves toward partnership. Delegated power is reflected in

Table 2
Overview of participatory instruments in the selected German laws and policies.

Dimension	Stakeholders	Consultation instruments	Capacity building	Transparency and information sharing	Monitoring and feedback
Instruments	• Government bodies (national, regional, local) • Scientific institutions • Civil society organizations • Industry • Farmers • Landowners • General public	• Public consultations • Stakeholder dialogues • Thematic workshops	• Funding and financial support programs • Education and training initiatives • Networking and knowledge exchange platforms • Digitalization and technological innovation • Sector-specific strategies and risk management • Youth engagement and public awareness	• Information hubs and digital platforms • Advisory services and sectoral support • Workshops, events, and public awareness initiatives • Stakeholder dialogue and coordination instruments • Communication and support in specific sectors	• Monitoring and evaluation frameworks • Legislative instruments and measurable goals • Stakeholder engagement and feedback instruments • Financial assessments and resource allocation

Delegated power
• Empowering local communities to implement tailored climate change adaptation measures
• Delegating decision-making authority to specific groups or task forces

Partnership
• Collaborations with local and regional actors for climate action
• Multi-level governance and inter-governmental collaborations
• Sector-specific and international partnerships with stakeholders

Placation
• Engaging citizens by considering their perspectives and feedback in policy refinement
• Acknowledging and utilizing citizens' expertise through initiatives

Consultation
• Conducting broad stakeholder consultations to incorporate diverse viewpoints
• Engaging the public in dialogue and participation in action plans

Informing
• Public information campaigns and support
• Education and learning resources

Fig. 4. Arnstein's ladder of citizen participation: Overview of participatory instruments in the selected German laws and policies.

initiatives like lead farms implementing new measures, task forces for approval procedures, and referendums such as the Berlin 2030 climate neutrality vote, granting citizens and stakeholders a degree of decision-making authority.

Partnerships foster collaboration between government bodies, research institutions, businesses, and local actors, as seen in networks like "Leitbetriebe Pflanzenbau" ("Leading companies in crop production") and municipal partnerships. These efforts emphasize joint decision-making and shared responsibility in climate change adaptation. Placation is evident in efforts to engage citizens in sustainable farming initiatives and stakeholder networks, where input is considered but decision-making remains with authorities. Consultation is embedded in expert analyses, stakeholder dialogues, and public feedback arrangements, such as consultations with research institutions and action plan discussions, ensuring broad participation but limited influence on final laws and policies. Finally, informing plays a key role in raising awareness through digital tools, educational programs, and public campaigns, enhancing transparency and accessibility without necessarily granting decision-making power.

5. Spanish climate change adaptation laws and policies

Spain's key documents analyzed were.

• Spain's Adaptation Communication,
• The National Climate Change Adaptation Plan 2021–2030 (PNACC),
• The Long Term Decarbonization Street et al., 2015,
• Law 7/2021 on Climate Change and Energy Transition,
• The Integrated National Energy and Climate Plan (INECP) 2021–2030, and
• Spain's Recovery and Resilience Plan (see Table 3 for an overview of participatory instruments).

Spanish laws and policies reference a range of stakeholders, including national and regional governments, civil society organizations, academic and research institutions, and private sector actors in key sectors such as agriculture, tourism, and energy. The National Climate Change Adaptation Plan is explicit about engaging autonomous communities (regions) and municipalities, recognizing the significant climatic variability across the Spanish territory. Yet, there is comparatively less detail regarding how communities or citizen groups are empowered to shape adaptation priorities. Additionally, there are regional cultural differences and a de-centralized approach in each Autonomous Community leading to specific methodologies and tools that are more effective in citizen engagement while in some regions individuals have a more active approach and call for greater involvement in decision-making and co-creation initiatives.

Consultation in Spain's adaptation policymaking typically involves public comment periods, stakeholder workshops, and multi-stakeholder advisory committees such as the National Climate Council. Online platforms and forums have been utilized to disseminate information and collect feedback on drafts of major documents, including the Integrated

Table 3
Overview of participatory instruments in the selected Spanish laws and policies.

Dimension	Stakeholders	Consultation instruments	Capacity building	Transparency and information sharing	Monitoring and feedback
Instruments	• Government bodies (national, regional, local) • Research and academic institutions • Civil society organizations and communities • Private sector and industry • International organizations	• National Climate Council • Working groups • Committees • Deliberative workshops • Social dialogue and public consultations	• Targeted training and workshops • Ongoing education and professional requalification • Public awareness campaigns and support • Digital skills development and educational modernization	• Adaptecca platform for data and sector-specific assessments • Workshops and consultations • Efforts to inform and engage vulnerable populations • Clear communication of technical information • National citizens' assembly on climate change	• Climate risk and adaptation reports • Region-specific indicators and variables • Evaluation reports • Evaluation of economic costs and benefits • Systematic observation systems and regionalized climate scenarios • High-level councils, working groups, and citizen participation platforms

National Energy and Climate Plan. Some innovative practices, such as local adaptation pilots and citizen consultations on coastal resilience, have emerged in specific regions like Catalonia or the Basque Country. However, these remain exceptions rather than mandated norms. From the perspective of Arnstein's ladder, these forms of engagement frequently align with informing, consultation, or, at best, placation, rather than genuine decision-sharing.

Capacity building in Spain's context often focuses on equipping regional and local authorities with technical expertise through programs managed by the national Ministry for Ecological Transition and the Demographic Challenge (MITECO). The PNACC includes proposals for training local officials in climate risk assessments and integrating adaptation into urban planning. Despite these efforts, small municipalities may face severe resource shortages, inhibiting their ability to effectively engage in participatory adaptation projects. Moreover, while some national funds are earmarked for adaptation, these budgets may be absorbed by infrastructure or engineering projects rather than directed toward participatory processes.

Spanish adaptation laws and policies endeavor to foster transparency through platforms such as AdapteCCa, an online portal providing data on climate impacts and best practices. National reports, such as Adaptation Communication, offer a high-level overview of progress. However, accessibility issues persist, particularly for citizens unfamiliar with policy jargon or lacking digital literacy. Although Spain has advanced e-Government tools, many rural areas and vulnerable communities remain under-served, which creates a gap between policy aspirations of inclusivity and actual accessibility for stakeholder engagement.

Spain's monitoring and evaluation systems are governed in part by the PNACC and are supplemented by regional adaptation plans in places like Andalusia or Valencia. These typically outline indicators for climate risks and adaptation measures. Formal arrangements for integrating public feedback vary. Some regions have climate councils or citizen observatories, while others rely on ad hoc consultations that may not consistently inform document revisions.

Analyzing the participatory instruments in the selected Spanish climate change adaptation laws and policies through Arnstein's ladder reveals that many processes remain largely tokenistic (see Fig. 5). Nonetheless, the documents incorporate varied participatory approaches. Partnerships play a central role, as seen in the National Climate Council, which brings together government departments, municipalities, research institutions, and NGOs to shape climate change adaptation laws and policies. The documents promote collaboration across administrative levels and the private sector, supporting initiatives like local energy communities and inter-sectoral forums for shared decision-making. Placation is evident in stakeholder engagement through bodies like the Spanish Federation of Municipalities and the Impacts, Risks, and Adaptation Committee, which provide expert recommendations while ultimate decision-making remains with the
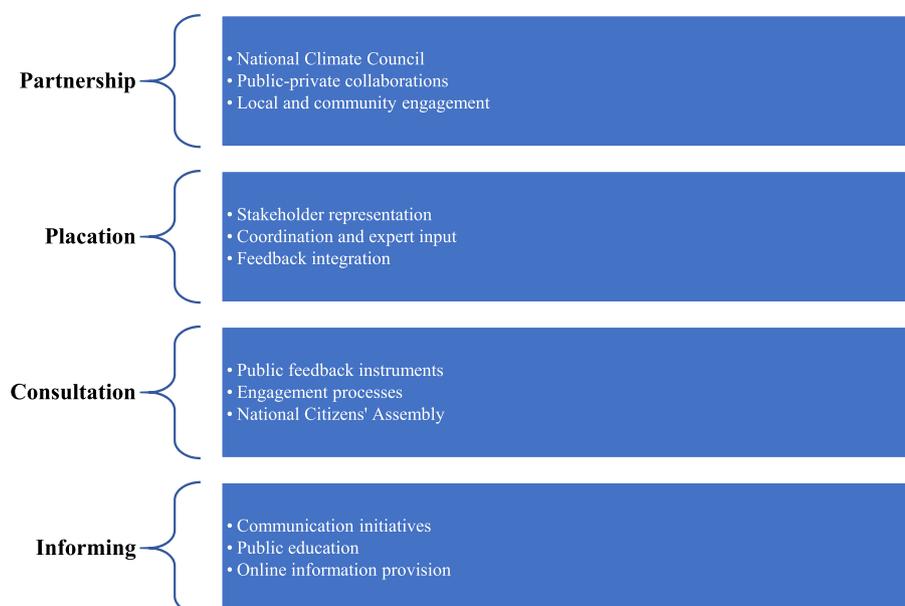

Fig. 5. Arnstein's ladder of citizen participation: Overview of participatory instruments in the selected Spanish laws and policies.

government.

The Committee of Expert Persons on Climate Change allows for stakeholder influence, though final authority still lies with policy-makers. Consultation instruments, such as public consultations and sectoral discussions, ensure input from diverse stakeholders, exemplified by the participatory development of the National Adaptation Plan and the National Citizens' Assembly on Climate Change. In addition, several citizen climate assemblies have been established at the regional and municipal levels in Spain, for example, the Catalan Climate Assembly, which operated with a budget of 1.3 million euros across five cities in Catalonia and was subsequently followed by the CLIMAS project. However, while stakeholders contribute extensively, decision-making power mostly remains with the authorities. Lastly, informing efforts focus on communication strategies, transparency measures, and educational campaigns to raise awareness about climate change adaptation, energy transition, and participation opportunities, ensuring citizens are well-informed but without direct influence on policy outcomes.

6. Recurring gaps and challenges

The majority of participatory processes uncovered in the analyzed climate change adaptation laws and policies tend to align with informing, consultation, or placation, situated firmly within the middle rungs of Arnstein's ladder (see Fig. 6, which was constructed using scores assigned by the authors as part of their document analysis[4]). Genuine partnership, delegated power, or citizen control appear only in isolated instances, often linked to local pilot projects or specific progressive municipalities. While the rhetoric of adaptation laws and policies often highlights broad stakeholder engagement, the actual power granted to citizens and vulnerable groups remains constrained by legal, institutional, and resource barriers.

For each group of laws and policies (EU, Germany, Spain), an average participation score was calculated by taking the mean of the participation type values across all laws and policies within that group. The Likert scale system was implemented with a range from 0 to 5, with 0 being "not present" and 5 being "dominant participation type in the document". This provides a summary indicator of the overall intensity and depth of participatory instruments for each governance level. The results show that the average participation score is very similar for the EU and Germany (both 2.83), while Spain has a slightly lower average score of 2.75, suggesting broadly comparable but slightly less intensive participatory provisions in the Spanish case.

As summarized in Table 4, an analysis of participatory dimensions across jurisdictions further illustrates these findings. Overall, climate change adaptation laws and policies in the EU, Germany, and Spain have institutionalized stakeholder participation as a guiding principle, yet the depth of this engagement tends to be moderate. Each context emphasizes multi-level involvement and formal consultation processes, but most participatory instruments remain consultative rather than empowering. The EU's frameworks and funding instruments support broad inclusion, Germany's national strategies embed participation at various levels, and Spain's regional structures and recent innovations

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[4] To construct Fig. 6, each document was systematically analyzed for the presence and intensity of different types of participatory instruments, following the levels of Arnstein's ladder of citizen participation (Informing, Consultation, Placation, Partnership, Delegated Power, Citizen Control). For each document, a score on a scale from 0 to 5 was assigned for each participation type, where: 0 = not present, 1 = marginal mention or very weak presence, 2 = minor but identifiable presence, 3 = moderate presence, 4 = strong presence (multiple references, substantial instruments), 5 = dominant participation type in the document. A higher score for a participation type indicates that the document relies more heavily on instruments corresponding to that level. For example, a document coded as 5 for "Informing" and 4 for "Consultation" relies primarily on informing stakeholders but also includes strong elements of consultation.

such as its national climate assembly provide promising models. However, substantial barriers persist, including limited decision-making power for citizens, challenges with inclusivity and accessibility, and disparities in local capacity, particularly in smaller municipalities. These patterns underscore the need for further decentralization, improved communication, local capacity-building, and stronger feedback loops to advance beyond the current mid-level engagement.

The integrative review of the documents, combined with in-depth discussions during the co-creation session, enabled an identification and clustering of recurring gaps in participatory climate change adaptation practices into seven major thematic topics: accessibility and inclusion, communication and comprehension, capacity building, feedback and accountability, funding, sustainability and coordination as well as depth of participation (see Table 5 for an overview). Below is a discussion of the identified gaps in climate change adaptation participation, which is grounded in existing literature.

A common gap across climate change adaptation laws and policies is the challenge of making participatory processes accessible to all. Digital platforms for public participation, while promising, risk excluding certain groups. Older individuals, low-income populations, and those with limited digital literacy or internet access are particularly vulnerable to digital under-participation (Hespanhol et al., 2017). Despite the potential of e-consultation to enhance inclusive governance, challenges such as infrastructure limitations and low information and communication technology literacy persist (Oni et al., 2020). Studies show that online political participation tends to be biased towards resource-rich individuals, with distrust and lack of interest being significant barriers to engagement (Rottinghaus and Escher, 2020).

The digitalization of public services can further exacerbate exclusion, as vulnerable citizens may face obstacles in accessing and navigating online governmental portals and applications (Ranchordás, 2022). While personalized invitations can increase participation to some extent (Rottinghaus and Escher, 2020), addressing digital exclusion requires a comprehensive approach that considers the underlying causes and legal implications of this growing divide (Ranchordás, 2022). While national governments are focusing on the digital gap, some of these comprehensive initiatives have been deployed in the last few years, such as the Spanish Digitalization Plan (2021-2025), but the results will not be impacting citizen's digital skillset in the short term.

In addition, climate change adaptation laws and policies often face barriers such as complex language, limited public understanding, and insufficient integration into formal education (Clar et al., 2013). People may conflate adaptation with mitigation and struggle to interpret expert terminology (Harcourt et al., 2019), whereas easy-to-read climate change adaptation documents are generally more comprehensible (Pujadas-Farreras and McDonagh, 2024). Research indicates that formal education plays a crucial role in enhancing adaptive capacity to climate change (Wamsler et al., 2012). Education levels have both direct risk-reducing effects and mitigating effects on risk-increasing factors.

While often advocated, participatory processes may result in symbolic rather than genuine engagement, undermining trust and discouraging civic involvement (Few et al., 2007). The approach is often instrumental, expecting citizens to adopt prescribed behaviors and consent to proposed measures (Höppner, 2009). The absence of clear accountability instruments, such as requirements for policymakers to justify decisions, can limit the influence of public input on final outcomes (Mees and Driessen, 2019). Moreover, the design of participatory processes is often contingent and lacks explicitly formulated objectives, potentially hindering effective engagement (Uittenbroek et al., 2019).

Another challenge in participatory instruments in climate change adaptation laws and policies are limited budgets and resources (United Nations Environment Programme, 2024). While participatory budgeting can contribute significantly to climate change adaptation efforts (Cabannes, 2021), limited resources often hinder the effective implementation of decision-support tools and participatory processes (Fünfgeld et al., 2019). Recognizing the differences between local and
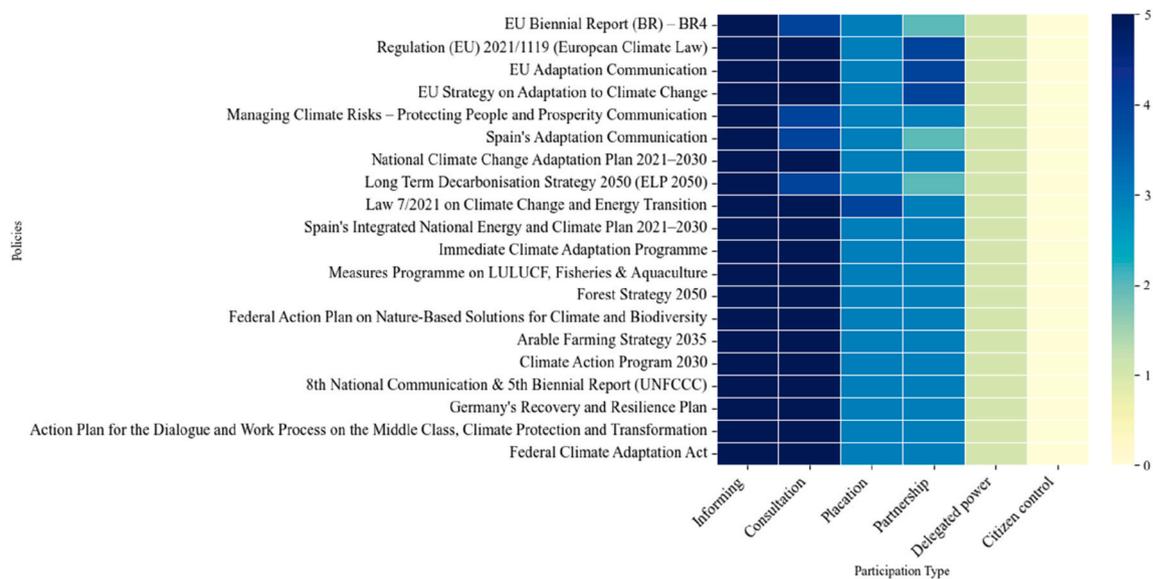
Fig. 6. Participation levels in climate change adaptation laws and policies.

regional budgeting practices, where local budgets tend to offer greater community-specific flexibility but operate on a smaller scale, while regional budgets provide broader strategic funding yet often involve more rigid procedures, is essential for developing targeted policy recommendations that enhance resource allocation and stakeholder engagement. The localization of participatory budgeting can be influenced by institutional arrangements and political backing, potentially affecting its impact on vulnerable populations (Ahn et al., 2023). Limited budgets and prescribed guidelines constrain stakeholder participation and transformational adaptation outcomes (Holler et al., 2020).

Sustaining public engagement throughout policy implementation also remains challenging (Khatibi et al., 2021; Hügel and Davies, 2020). However, engaging citizens throughout the policy cycle, rather than just one-time participation, is essential for successful implementation (Chitsa et al., 2022). While initial enthusiasm may be high during regulation drafting, it often wanes during implementation, leading to a disconnect between regulation and practice (Newig and Koontz, 2014). Multi-level governance further complicates this issue, as lack of synchronization between different levels can result in stakeholder fatigue (Keskitalo et al., 2016).

7. Policy recommendations

The results of the co-creation workshop largely supported the main findings of the document analysis, with participants confirming the identified gaps in participatory climate change adaptation practices ranging from limited accessibility to insufficient coordination and funding and reinforcing the relevance of the analytical dimensions applied. The workshop also contributed additional practical insights by highlighting implementation challenges and offering concrete examples and solutions from diverse national contexts.

Building on both the document analysis and practitioner input, the following recommendations are presented as practical responses to these persistent barriers, each mapped to a specific gap and intended audience. Concrete instruments and examples are provided where possible to support direct application in regulation and practice. The recommendations are structured around five categories: (1) strengthening accessibility and representation, (2) enhancing communication and education, (3) institutionalizing robust feedback and accountability, (4) ensuring sustainable resource allocation, and (5) fostering cross-sectoral and multi-level integration.

7.1. Strengthening accessibility and representation

Gap addressed: Accessibility and inclusion gaps.

Target audience: National, regional and local governments, civil society organizations.

Action: Establish permanent local and regional adaptation councils or assemblies with diverse and equitable representation including marginalized groups, youth, and indigenous populations (e.g., through open calls); empower local communities by increasing their autonomy in adaptation planning and implementation, using municipal ordinances or by-laws, with support and oversight from national governments.

How this recommendation fills the gap: Establishing permanent local and regional adaptation councils or assemblies with diverse and equitable representation, including marginalized groups, youth, and indigenous populations, explicitly addresses the lack of meaningful inclusion. The action supports movement from consultation/placation upwards to partnership, as these groups are given formal seats and real roles in shaping adaptation priorities and allocating resources.

Expected result: If fully implemented, this can help laws and policies move from tokenism (consultation/placation) toward genuine partnership on Arnstein's ladder, where stakeholders share power and responsibility with authorities.

Decentralization of engagement structures for climate change adaptation is essential. Establishing permanent local and regional adaptation councils or assemblies with diverse representation is crucial for shaping priorities and allocating resources (Agrawal et al., 2013; Ziervogel et al., 2019). These bodies should include marginalized groups, youth, and indigenous populations to ensure equitable representation (Chu et al., 2016). Empowering local communities and governments by increasing autonomy in adaptation planning and implementation is essential as there is greater understanding of the risks, cultural nuances, and other factors key to successful climate change adaptation laws and policies (Agarwal et al., 2013). These councils could be formally established with mandates, membership criteria, and dedicated funding to ensure consistent implementation across regions. Other instruments such as municipal ordinances or by-laws may further define local adaptation priorities or frameworks.

It is important to note that the benefits and challenges of decentralized governance for participatory adaptation have been extensively explored in the Global South, particularly in the context of natural resource management (Ziervogel et al., 2019). Decentralization can promote local ownership and draw on context-specific knowledge, as

Table 4

Participatory instruments in climate change adaptation laws and policies across the EU, Germany, and Spain.

Dimension	EU	Germany	Spain
Stakeholders	Broad multi-level inclusion of stakeholders, from EU institutions down to local authorities, private sector actors, NGOs, academia, and individual citizens, reflecting an inclusive, multi-level governance approach.	Multi-level engagement of stakeholders at federal, state, and local tiers, including government bodies, scientific institutions, civil society organizations, industry (e.g., agriculture), and the general public. This integrated approach fosters cross-sector collaboration and shared ownership of adaptation initiatives.	Involves stakeholders across national, regional (Autonomous Communities), and local governments, alongside civil society, research institutions, and private sectors (e.g. agriculture, tourism, energy). A National Climate Council and other forums link these actors, though direct empowerment of local communities in shaping adaptation priorities remains limited. Public consultation in Spain's adaptation policy includes open comment periods, stakeholder workshops, and multi-stakeholder advisory bodies (e.g., the National Climate Council). Online platforms are used to circulate drafts and collect feedback, and some innovative practices (like regional climate assemblies and local pilot consultations) have emerged.
Consultation instruments	Formal and wide-reaching consultation processes, with public consultations serving as a cornerstone to gather input at all governance levels. The EU also leverages participatory platforms like the European Climate Pact and multi-level climate dialogues, which engage citizens, local authorities, businesses, and civil society in discussing and co-designing climate actions.	Institutionalized consultation instruments such as public comment periods, stakeholder dialogues, and thematic workshops ensure continuous dialogue and information exchange with diverse stakeholders. These inclusive forums are built into policy development and implementation, helping to integrate varied expertise and build consensus on adaptation measures.	
Capacity building	Emphasis on empowering stakeholders through dedicated funding and programs. EU initiatives (e.g., a Technical Cooperation and Capacity-Building Facility) finance training, technical assistance, and institutional support to enhance stakeholders' ability to participate in and implement adaptation measures. Funding	Strong focus on bolstering capacities at local and sectoral levels. Germany provides resources for hiring local climate change adaptation managers and organizing training programs and networks (e.g., national resilience conferences, "Sponge Cities" workshops) to build municipal and community expertise. Sector-specific initiatives (such as pilot farm	Targeted training programs (under the National Adaptation Plan) equip regional and local officials with technical skills in climate risk assessment and adaptation planning. However, limited funding and capacity at the municipal level constrain these efforts – many small communities lack resources to engage fully in

Table 4 (*continued*)

Dimension	EU	Germany	Spain
	instruments back local resilience projects with capacity-building components, ensuring communities have the knowledge and resources to co-develop adaptation solutions.	networks with scientific support) and digital tools facilitate knowledge exchange and equip stakeholders with practical skills for climate risk management.	participatory projects, and available adaptation funds are often absorbed by infrastructure works rather than local empowerment initiatives.
Transparency & information sharing	Multi-faceted transparency measures are in place to inform and involve the public. The EU deploys information platforms and tools (e.g., Climate-ADAPT, sustainable finance taxonomy) to disseminate climate data and best practices, ensuring stakeholders have access to science-based information. A Regulation on the European Climate Pact underpins broad societal engagement and dialogue, promoting open sharing of climate knowledge and progress across member states.	A proactive approach to information dissemination through dedicated hubs and portals provides guidance on adaptation to local actors (e.g., municipalities). Germany complements these with regional workshops, thematic climate weeks, public information campaigns, and permanent working groups, which together raise awareness and allow continuous two-way communication between authorities and stakeholders on adaptation progress.	Robust knowledge-sharing infrastructure centered on the AdapteCCa platform, an online hub led by national agencies that connects government, scientists, planners, and practitioners while offering open-access data and tools. Transparency efforts include translating technical climate information into accessible language and integrating gender perspectives, alongside public workshops and even a National Citizens' Climate Assembly to ensure that diverse groups are informed and can voice input in adaptation planning.
Monitoring & feedback	Comprehensive, multi-level monitoring and evaluation system. The EU coordinates with Member States, the European Commission, and the European Environment Agency to track adaptation actions, financial flows, and outcomes across Europe. Formal reporting (e.g., through National communications and Climate Adaptation reports) is coupled with stakeholder feedback via consultations and	Well-established frameworks for monitoring and evaluation are embedded in law (e.g., Germany's Climate Adaptation Act sets measurable targets) and supported by national adaptation plans and working groups. Progress is regularly assessed across sectors, and feedback loops are institutionalized: dedicated platforms (such as the Zentrum KlimaAnpassung), networking conferences, and public consultations enable stakeholders from industry associations to local	A structured Monitoring, Reporting, and Evaluation system underpins Spain's adaptation policy. National climate risk and adaptation progress reports are produced at least every five years, synthesizing impacts and tracking resilience-building measures. Regional adaptation plans add specific indicators and periodic evaluations,

Table 4 (*continued*)

Dimension	EU	Germany	Spain
	platforms, so policy effectiveness is reviewed iteratively and transparently with input from scientists, citizens, and other partners.	communities to provide input, which is used to adjust strategies and ensure accountability in implementation.	while the PNACC oversees nationwide vulnerability assessments and convenes cross-sector councils and working groups to incorporate feedback from government, private sector, civil society, and community stakeholders in refining adaptation actions.

Table 5

Summary of gaps and recommended actions.

Gaps in participation	Recommended actions
Accessibility and inclusion gaps	Strengthening accessibility and representation
Communication and comprehension gaps	Enhancing communication and education
Capacity building gaps	
Weak feedback and accountability	Institutionalizing robust feedback and accountability
Funding limitation for participation	Ensuring sustainable resource allocation
Sustainability and institutional coordination gaps	Fostering cross-sectoral and multi-level integration
Limited depth of participation	

well as improve the effectiveness (e.g., through more efficient implementation) and legitimacy of adaptation actions. While the institutional settings in Europe may differ, many of the core principles such as the subsidiarity principle, meaningful community engagement, and the integration of local expertise are highly relevant for European climate change adaptation regulation (Menga, 2025; European Commission, 2021). Thus, strengthening decentralized participation in Europe can benefit from both regional experiences and international lessons learned from decentralized governance in other parts of the world.

7.2. Enhancing communication and education

Gap addressed: Communication and comprehension gaps, capacity building gaps.

Target audience: Regional and local governments, educational authorities and institutions, civil society organizations.

Action: Require that local adaptation strategies include guidelines for multi-channel communication (radio, print, in-person forums); pilot easy-to-read climate guides and host climate education days in schools or community centers; integrate climate change adaptation and participatory skills into national and local curricula and provide teacher training and co-created materials with local communities and civil society organizations.

How this recommendation fills the gap: Requiring multi-channel communication, easy-to-read guides, integration of participatory skills into education, and providing teacher training and co-created materials, ensures all stakeholders, especially digitally excluded and low-literacy groups, can access, understand, and engage with adaptation planning. Building participatory skills through targeted education and training empowers stakeholders to participate more fully, moving engagement beyond mere information provision.

Expected result: These measures help laws and policies progress from informing up to consultation, and support movement toward placation when combined with instruments for two-way feedback. Over time, strengthened education and communication may lay the groundwork for higher-level engagement such as partnership.

Multiple communication channels should be employed to reach individuals who are digitally excluded or have limited literacy. For instance, local governments might broadcast climate change adaptation forums on community radio stations, distribute printed information in simplified language, and organize in-person dialogues in community centers, libraries, or religious institutions that serve as local gathering points. National-level adaptation strategies should explicitly call for these alternative communication formats, providing guidelines and resources so that communities do not have to innovate from scratch. Governments can require local authorities to incorporate a range of communication channels in their adaptation strategies. Other instruments such as philanthropic grants or civil society initiatives can supplement these channels with targeted outreach efforts.

In addition, climate change adaptation communication requires careful consideration of language, framing, and audience needs. Using relatable local experiences, like flooding events, can make climate change more salient to communities (Gotangco and Ponce de Leon, 2018). Effective communication should balance scientific knowledge with practical, action-oriented messages tailored to specific cultural contexts (Moser, 2014). To improve accessibility, climate information can be adapted into easy-to-read formats, simplifying complex vocabulary and sentence structures (Pujadas-Farreras and McDonagh, 2024). These formats can be tested in focus groups that reflect different literacy levels, linguistic backgrounds, and cultural contexts. Official guidelines could specify best practices for language and framing to ensure clarity and inclusivity. Other instruments, such as professional networks or NGO-led training programs, can further refine these communication strategies.

Educational systems also need reform to effectively address climate change. Comprehensive climate education should cover climate science, geography, social studies, and civics (Mitchell, 2023). Where relevant, vocational training programs in fields like agriculture, construction, or disaster risk management can incorporate participatory skills related to consensus building and stakeholder facilitation (Kwauk, 2022). National curricula requirements can be set to integrate climate change adaptation and participatory skills, while other instruments like teacher training programs or educational NGO initiatives can complement these efforts.

Moreover, capacity building for local officials should encompass developing abilities in stakeholder engagement, conflict resolution, and adaptive governance (Susskind and Kim, 2022). Funding instruments at the EU, national, and regional level should prioritize cross-cutting capacity building projects that merge technical training with participatory governance training. An example are the numerous initiatives undertaken by the EU Centre on Participatory and Deliberative Democracy, even if not all are focused on climate change adaptation. Partnerships between governments and academic institutions can enhance climate change adaptation efforts through collaborative governance and participatory approaches. These partnerships can foster knowledge exchange, improve decision-making, and increase social capacity (Rieckmann et al., 2021; Munaretto et al., 2014). Capacity-building objectives could be codified through formal training requirements or dedicated budget, while other instruments like philanthropic programs or inter-municipal knowledge-sharing platforms can provide additional resources or specialized training.

7.3. Institutionalizing robust feedback and accountability

Gap addressed: Weak feedback and accountability.

Target audience: National and regional governments, civil society organizations.

Action: Institute a comply or explain rule for public consultations,

requiring written justifications for policy decisions and publication of public feedback summaries alongside final adaptation plans; create formal opportunities for follow-up consultations and support civil society organizations in monitoring the incorporation of stakeholder input; at higher participation levels, pilot permanent citizen assemblies (at local or national level) with random, stratified selection, granting advisory or decision-making powers over adaptation budgets, and enshrine participation in legal frameworks.

How this recommendation fills the gap: Introducing a comply or explain rule for public consultations, formal opportunities for follow-up, and piloting permanent citizen assemblies, directly responds to the lack of influence stakeholders have on final decisions. These instruments increase the likelihood that stakeholder input is not just received, but actually reflected in outcomes, advancing toward partnership and potentially delegated power.

Expected result: Formalizing robust feedback and accountability instruments can move participation from placation to partnership and, if citizen assemblies or similar bodies are given real decision-making authority, toward delegated power on Arnstein's ladder.

There is a need for improved transparency and accountability in public consultation processes. While stakeholder engagement is increasingly prevalent in policymaking (Rixon, 2010), current practices often lack clear instruments for demonstrating how inputs shape law and policy revisions (Langhof et al., 2016). Policymaking bodies should provide written justifications responding to major themes raised during consultations, implementing a comply or explain principle (Wardeh et al., 2013). Additionally, follow-up consultations after initial law and policy adoption could offer stakeholders opportunities to assess the integration of their feedback and propose adjustments. Formal procedures can require that stakeholder feedback be addressed in final documents. Other instruments such as NGO watchdog platforms can track compliance and highlight any lack of responsiveness.

At more advanced rungs of participation, governments should explore permanent deliberative forums or citizen assemblies focusing on adaptation. Members of such assemblies could be randomly selected in a stratified manner to ensure demographic diversity (Gastil and Richards, 2013). These assemblies could be granted a degree of decision-making authority over local adaptation budgets, thus moving towards delegated power. Administrative reforms can increase direct accountability and citizen participation, including decentralization, legal frameworks for grievances (such as ombudsman systems), and collaborative governance strategies (Ansell and Gingrich, 2003). Legal frameworks can be established to define the scope and authority of these forums, while other instruments such as local charters or NGO-led pilots can support the rollout and experimentation of deliberative assemblies.

7.4. Ensuring sustainable resource allocation

Gap addressed: Funding limitation for participation.

Target audience: National, regional, and local governments, inter-ministerial/inter-agency bodies.

Action: Establish multi-year, dedicated funding streams for participatory adaptation programs; simplify grant access for local governments and community groups; prioritize bottom-up funding allocations; encourage participatory budgeting; pilot innovative finance tools (e.g., adaptation bonds, earmarked taxes) to increase resources available at the local/community level.

How this recommendation fills the gap: Establishing multi-year, dedicated funding streams, enabling participatory budgeting, and piloting innovative finance tools empowers local actors with the resources to engage substantively. Access to stable funding supports not just symbolic or one-off consultation, but the ability for communities to refine, sustain, and institutionalize participation instruments over time.

Expected result: Stable and equitable funding enables sustained, empowered engagement, allowing communities to move from one-off consultation up to partnership or delegated power if they are involved

in resource allocation decisions.

Long-term, dedicated funding is crucial for sustaining participatory climate change adaptation programs. National governments should establish multi-year funding cycles and simplify access procedures to support local engagement (Colenbrander et al., 2018). This approach allows communities to refine participation instruments over time and enhances program stability (Chu et al., 2016). Funding should prioritize bottom-up approaches that uphold community autonomy and support local decision-making (Rubin et al., 2023). While public-private partnerships may co-fund projects, government oversight is necessary to ensure equitable and independent engagement processes. Explicit mandates for stable, multi-year funding can be included to ensure continuity, while other instruments such as philanthropic organizations or corporate sponsorship might supplement these efforts with additional resources.

Participatory budgeting can significantly contribute to climate change adaptation and mitigation, with local communities deciding on substantial investments in climate-related projects (Cabannes, 2021). To finance such adaptation initiatives, innovative instruments like climate change adaptation bonds, specialized taxes, and carbon tax revenue earmarking could be employed (Colenbrander et al., 2018). These financial tools can help channel resources to local levels, addressing power imbalances and enhancing distributive and procedural justice. Legislative provisions can define thresholds or guidelines for participatory budgeting, while other instruments (e.g., local referenda or philanthropic grants) may support additional climate initiatives outside the formal budget process.

7.5. Fostering cross-sectoral and multi-level integration

Gap addressed: Sustainability and institutional coordination gaps, limited depth of participation.

Target audience: National, regional and local governments, inter-ministerial/inter-agency bodies, civil society organizations.

Action: Mandate inter-agency and inter-ministerial climate change adaptation committees with diverse representation; formalize coordination among ministries, agencies, and across levels of government; establish regular cross-level forums for sharing experiences; support peer learning networks among municipalities, with meaningful participation from civil society organizations.

How this recommendation fills the gaps: Mandating inter-agency and inter-ministerial committees, regular cross-level forums, and supporting peer learning networks, addresses both fragmentation and the shallow nature of engagement. By embedding participation in multi-sector and multi-level decision-making, stakeholders are included in strategic and ongoing processes, not just isolated events.

Expected result: Such integration is essential for moving participation from isolated, surface-level engagement (consultation or placation) toward meaningful partnership and, where real power is shared, delegated power.

Given the inherently multi-sectoral nature of climate change adaptation, stronger coordination among diverse policy domains is essential. Effective climate change adaptation requires mainstreaming across multiple sectors and greater law and policy coherence (England et al., 2018). While some countries show awareness of cross-sectoral relationships, implementation often faces challenges due to fragmented mandates and resource constraints (Hlahla et al., 2023). Laws and policies tend to focus on immediate disaster management rather than long-term adaptation strategies (England et al., 2018). To improve synergies between sectors like agriculture and health, a comprehensive framework is essential, focusing on strategic issues and recognizing bidirectional links (Bos, 2006). Inter-ministerial committees at the national level, or inter-departmental teams at the municipal level, can align overlapping goals and reduce the duplication of consultation efforts that lead to stakeholder fatigue. An integrated framework can set mandatory coordination structures among ministries, while other

instruments like inter-agency agreements or NGO-led coalitions can facilitate cross-sector collaboration and knowledge exchange.

Additionally, multi-level governance is crucial for effective climate change law and policy implementation, requiring coordination between national, regional, and local governments (Corfee-Morlot et al., 2009). This approach allows for vertical integration of laws and policies and horizontal learning between institutions, combining top-down and bottom-up strategies. Coordinated efforts between different levels of government and stakeholder networks are important to enhance the effectiveness of climate initiatives and reduce costs (Fernández et al., 2018). Collaborative relationships between different government levels are essential for sustainable climate change adaptation (Leck and Simon, 2013). Formal mandates can require cooperation among national, regional, and local authorities, while other instruments such as transnational networks or partnerships can support knowledge sharing and capacity building across different governance levels.

While the recommendations build on challenges that have been widely discussed in the literature, they are shaped by the specific patterns and practical experiences observed across recent EU, German, and Spanish adaptation laws and policies, as well as insights gained through engagement with project stakeholders.

8. Conclusion

The analysis underscores that while European climate change adaptation laws and policies increasingly acknowledge the importance of stakeholder engagement, a divergence exists between the aspirational language of these documents and their practical implementation. Across the European Union, Germany, and Spain, current frameworks tend to emphasize consultation and information dissemination rather than fully empowering communities through genuine co-production. The application of Arnstein's ladder of citizen participation reveals that most climate change adaptation laws and policies remain rooted in mid-level engagement, wherein stakeholders and citizens are primarily informed and consulted but rarely granted substantial decision-making authority.

The review identifies critical gaps in the participatory landscape, including issues of accessibility, limited capacity building initiatives, inadequate feedback loops, insufficient long-term funding, and fragmented coordination across governance levels. These challenges not only risk undermining the social legitimacy of adaptation measures but also perpetuate existing inequalities, as vulnerable and marginalized groups often lack effective channels to influence laws and policies. The review was complemented by a thorough analysis and insights provided by different expert stakeholder groups to expand the range of potential solutions for increasing the engagement of citizens in climate change law and policy design and development.

The study proposes a comprehensive set of policy recommendations that advocate for decentralizing engagement structures, enhancing communication strategies, institutionalizing accountability measures, and ensuring sustainable resource allocation. Such reforms are deemed essential for transitioning from tokenistic participation to genuinely empowered stakeholder collaboration. Ultimately, if these recommendations are adopted, adaptation laws and policies may be transformed into dynamic, co-produced strategies that are better equipped to address the complex and evolving nature of climate change.

An important avenue for future research lies in exploring the historical, political, and institutional contexts that shape participatory climate change adaptation across the EU, Germany, and Spain. Comparative studies could also examine the interactions between EU-level frameworks and national policy processes, investigating how multi-level governance arrangements and local dynamics influence the design and effectiveness of participatory instruments. Furthermore, understanding regional differences and government structure within each of the country's regulatory systems could also provide valuable insights to better comprehend the most effective mechanisms. Such extensions would enrich the understanding of the diverse pathways through which stakeholder engagement develops and is translated into practice within different governance settings.

CRediT authorship contribution statement

Nadejda Komendantova: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Dmitry Erokhin:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Anna Scolobig:** Writing – review & editing, Validation, Methodology, Conceptualization. **Enora Bruley:** Writing – review & editing, Validation, Methodology, Conceptualization. **Marina Mattera:** Writing – review & editing, Validation, Methodology, Conceptualization. **Madeline Baldelli:** Writing – review & editing, Validation, Methodology, Conceptualization.

Declaration of competing interest

The authors have no conflicts of interest to declare.

Data availability

The data is publicly available.

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