



Towards a deeper understanding of barriers to national climate change adaptation policy: A systematic review

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ABSTRACT

As adaptation have received increasing attention, national adaptation policies and plans have been substantially developed. Despite the significant roles of national policy for adaptation, barriers to national adaptation policy have been overlooked and our understanding of the barriers is not sufficient as we expect. Also, the barriers are pointed out a reason of the current adaptation gaps. To address this situation, we use a systematic literature review to examine the barriers to adaptation policy specifically at the national level, as well as their origin, impact, and solutions to overcome them, considering the importance of national-level adaptation for the overall adaptation. Scrutinising a sample of eighteen articles, we identify eight categories of barriers to national adaptation policy. Lack of resources, fragmentation, and lack of awareness and communication are the most commonly identified barriers to national adaptation policy. We also find that the literature does not provide sufficient detail on the underlying causes of the barriers, the relationships between them and their consequences. The literature also gives limited attention to solutions for overcoming barriers, and the suggestions made are too general and normative to be helpful in practice. But the existing literature helps to interrogate and visualise the interlinkages between the origins, barriers and impacts, as well as between different barriers. This highlights that barriers should be addressed simultaneously and provides preliminary insights into a deeper understanding of the barriers. We conclude by outlining the key knowledge gaps and future research priorities to help support national adaptation policy processes.

1. Introduction

Adapting to a changing climate and managing climate risks are increasing concerns across the world (Moss et al., 2013; IPCC, 2014). Evidence of climatic changes and increasing frequency and intensity of extreme weather events is mounting, as recognised in the Assessment Reports (AR) of the Intergovernmental Panel on Climate Change (IPCC). It is also clear that climate change will accelerate under current and projected greenhouse gas emissions (Bauer et al., 2012; Adger et al., 2007; CCC, 2017). As the importance of adaptation has been emphasised through international agreements (Lesnikowski et al., 2017), the functions and roles of national level adaptation actions also have been emphasised (Storbjörk and Hedrén, 2011; Mullan et al., 2013; Eisenack et al., 2014; Waters

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et al., 2014; Berrang-Ford et al., 2014). Also, a number of national adaptation policies and plans have been developed since 2007 (IPCC, 2014). Despite the substantial progress of national adaptation policy, issues related to the effectiveness of national adaptation policies have been being raised, and ‘adaptation gaps’ are constantly reported (UNEP, 2018).

Barriers to adaptation are pointed out as one of major reasons for the adaptation gaps (Simoes et al., 2017; Valente and Veloso-Gomes, 2020), but barriers to adaptation policy have been largely overlooked in national adaptation processes (Waters et al., 2014; Biesbroek et al., 2015). Most research on barriers to adaptation has focused on barriers to adaptation actions at local or project level. Research on national adaptation policy has been mostly carried out in the field of implementation research, which has moved away from notions of barriers to climate change adaptation (Biesbroek et al., 2015). Yet, nations are experiencing a variety of barriers which significantly hinder the effectiveness and efficiency of their adaptation policies (Agrawala and Van Aalst, 2005; OECD, 2009; Bauer et al., 2012; Park, 2013; Biesbroek, 2014; IPCC, 2014; Mullan et al., 2013). Although many studies have been published on barriers, we don’t really know what barriers to national adaptation policy exist, what the origins and influence of these barriers are, and how they can be overcome (Biesbroek et al., 2011; Eisenack et al., 2014; Waters et al., 2014). This is quite odd considering the significant roles of national policy for adaptation and the amount of resources and efforts put into it. There are two more critical research gaps related to barriers to national adaptation policy. First, the number of research on barriers to national adaptation policy is too small compared to the research focusing on adaptation actions and barriers to them at the local or project level. Although there is some research on barriers to national adaptation policy, they are highly fragmented and difficult to produce general knowledge. Second, as previous research focused on only identifying the barriers and describing them, assuming that identifying the barriers will lead to devising solutions to overcoming the barrier, they have produced limited insights into what national-level stakeholders specifically can do to address the barriers.

To address these research gaps, we review the barriers to national adaptation policy using a systematic literature review (SLR). We will scrutinise the characteristics of barriers in the published literature by categorising them and analysing their origins, impacts, and presented solutions for overcoming them. Also, we will clarify the key knowledge gaps of the literature and suggest future research priorities to help support national adaptation policy processes. The three main research questions we seek to answer through the SLR are 1) what are the barriers to adaptation policy at the national level? 2) what are the characteristics of the barriers? 3) what are the limitations of the current research on barriers to national adaptation policy?

2. Methodology

2.1. Key terms

With the term “national adaptation policy” we refer to a formal national policy for identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address them (UNFCCC). It includes national adaptation policies labelled ‘national adaptation policy’, ‘national adaptation plan’, ‘national adaptation strategy’, ‘national adaptation programme’ as well as ‘national adaptation programmes of action (NAPAs)’. A barrier to adaptation is an impediment to specified adaptations for specified actors in their given context that arises from a condition or a set of conditions (Eisenack et al., 2014). A barrier can be valued differently by different actors. In light of this definition, “a barrier to national adaptation policy” refers to an impediment to national adaptation policy for a nation in the nation’s specific context. A barrier to adaptation can be overcome with concrete efforts, creative management, new ways of thinking, prioritisation, and changes in resources, land uses, institutions, etc. (IPCC, 2007; 2014; Moser and Ekstrom, 2010; Dow et al., 2013; Biesbroek et al., 2013, Biesbroek, 2014). It is different from ‘limits’ which also hinder adaptation, but cannot be overcome (Adger et al., 2008; Clar et al., 2013).

2.2. Systematic literature review

SLR is a valuable research methodology when some research has been conducted on an issue, but key questions remain unanswered, and an overall picture of the evidence in a topic area is needed to direct future research efforts (Petticrew and Roberts, 2006). SLRs are increasingly used in the field of climate change to synthesise and assess the status of knowledge on a given topic or research question (Berrang-Ford et al., 2011; Ford et al., 2011; Spires et al., 2014). Indeed, several SLRs focusing on climate change adaptation have been conducted (Berrang-Ford et al., 2011; Berrang-Ford et al., 2015; Ford et al., 2011; Hofmann et al., 2011; Biesbroek et al., 2013; Lorenz et al., 2014; Porter et al., 2014; Spires et al., 2014; Sud et al., 2015; Sherman et al., 2016). However, to date, no SLR has focused on barriers to national adaptation policy. The methodology is also useful to find key answers to research gaps and research questions above. By systematically collecting and analysing research on barriers to national adaptation policy, it is possible to identify barriers to adaptation policy at the national level and their common characteristics, so as to contribute to a knowledge base on the barriers. It can also help diagnose the limitations of current research and clarify future research directions so as to foster national adaptation policy processes. Thus, we conduct an SLR following the seven stages of SLRs suggested by Petticrew and Roberts (2006): 1) define the question that the review is setting out to answer, 2) determine the types of studies that need to be located in order to answer the question, 3) carry out a comprehensive literature search to locate those studies, 4) Screen the results of that search based on the inclusion/exclusion criteria, 5) critically appraise the included studies, 6) synthesise the studies, 7) disseminate the findings of the review (see Petticrew and Roberts, 2006, p.27).

2.3. Document selection

We used Scopus and Web of Science for searches, and the choice of search keyword combinations was based on an initial review of relevant literature.¹ The keywords and keyword combinations used in the searches were: [Barrier* OR Constraint* OR Obstacle* OR Limit*] AND [Climat* chang*] AND [Adapt*] AND [Nation*]. To include synonyms, ‘constraint’, ‘obstacle’, and ‘limit’ were also used. Although the concept of ‘limit’ is different from ‘barrier’ as mentioned above, ‘limit’ was used as a keyword because some studies use the terms interchangeably. After searching, we excluded the literature which focuses on factors that cannot be overcome.

The terms ‘barrier’ and ‘limit’ were first used in Chapter 18 of the IPCC Working Group II contribution to the AR3, which reviewed research on climate change research published in the latter half of the 1990s (IPCC, 2001). Accordingly, we set the literature publication period from January 1995 until June 2018 (when this SLR is conducted) in order to cover all possible related studies since the terms were used. Also, we searched for peer-reviewed journal articles to review the literature which is subjectively evaluated, although there are related reports and grey literature publications from such as OECD or UNFCCC. The other criteria used for inclusion and exclusion of articles to the SLR are presented in Table 1.

The searches conducted in Scopus and Web of Science using the above keyword combinations yielded an initial list of 2,234 articles. The first screening applied the inclusion and exclusion criteria to the title, keywords, and abstract of the articles in the initial list, which reduced the number of articles to 195. The use of the inclusion and exclusion criteria to the full text of these 195 articles then left 18 articles to the sample.

2.4. Analysis

Qualitative content analysis was performed on four aspects of the articles: 1) general information on the article, 2) the conceptualisation of the barriers to adaptation, 3) characteristics of the identified barriers, and; 4) solutions for overcoming the barriers (see Table 2). We examined how the articles conceptualise the barriers to adaptation by analysing the used terms and definitions in the articles. In order to see what barriers to national adaptation policy are, we collected every factor that is identified as a barrier in the final 18 articles. Based on the identified barriers to national adaptation policy and related content in the final articles, we also investigated the barrier types and their origins and impacts at the national level to see the characteristics of the barriers. Identified barriers were classified into eight categories. Biesbroek et al. (2011) suggested seven clusters² of social barriers, and we considered that the clusters can provide useful insights about categories of barriers to national adaptation policy, including various aspects such as political, social, and institutional issues. Based on the clusters and the final articles, we develop eight categories of barriers to adaptation at the national level: conflicting time scales and priorities; uncertainty; institutional crowding and voids; fragmentation; lack of awareness and communication; resource; lack of authorities of the main department; and others. ‘Conflicting timescales and priorities’ are mainly about the priority of adaptation issues in the wider national policy agenda. Because the main government department responsible for adaptation policy generally suffers from a lack of authorities (Park, 2013), we added the category of ‘lack of authorities of the main department’. We also removed the motive and willingness to act cluster from Biesbroek et al. (2011) because related issues and barriers are addressed in the ‘conflicting timescales and priorities’ in terms of national-level policy issues. We also created space for barriers that cannot be clearly classified with the ‘others’ category. ‘Origin’ refers to a factor described or explained as causing the identified barriers in the final articles. ‘Impact’ refers to a factor (a result) influenced by the identified barriers, which shows national adaptation policy problems caused by the barriers. In addition, To see solutions for addressing the barriers, we analysed the final articles with two questions: is there any solution that was used to address the barriers? If yes, what are the results of the solution?; what solutions are suggested to address the barriers?

All processes and decisions are summarised in Fig. 1.

3. Results

3.1. Background information of final data

An overwhelming majority of the articles (17 of 18) were published after 2010, and more than half of them (10 of 18) were published after 2015, indicating that research on barriers to national adaptation policy is of very recent vintage on the whole. All of the articles were inductive and qualitative case studies using policy documents, interviews and surveys as their primary data. A total of 11 articles analysed a single country case, the majority of them focusing on the Least Developed Countries (LDCs). The other seven articles focused on groups of countries such as those of the OECD, EU, LDC-SIDS³, Central and Eastern Europe (CEE) and Commonwealth of Independent States (CIS), and Caribbean small island developing states. Most research focused on the Global North, and cases from the Global South are rarely mentioned. One-half of the articles examined barriers to comprehensive national adaptation policy, and the other half examined barriers to a specific sector of national adaptation policy (forest & ecosystem; land & coast; agriculture; industry;

¹ References in IPCC AR4 ch17, 18, 19, and AR5 ch14, 15, 16, 17 Results of searching ‘Climate change’ AND ‘Adaptation’ AND ‘Systematic review’ at Web of Science

² Conflicting timescales; Substantive, strategic and institutional uncertainty; Institutional crowdedness and institutional voids; Fragmentation; Lack of awareness and communication; Motives and willingness to act; Resource

³ Small Island Developing States

Table 1
Criteria for inclusion and exclusion of articles.

Criteria	Excluded	Included
Date of publication	Articles published prior to January 1995	Articles published between January 1995 – July 2018
Language of Publication	Articles that were published in language other than English	Articles published in English
Main theme of publication	Articles that did not give attention to barriers to climate adaptation, Articles that focused on general barriers to climate adaptation, or barriers at global level or sub-national levels (local, community, etc)	Articles that focused on barriers (limits, constraints, obstacles) to climate adaptation at national level
Availability of article	Articles that are not available in the Web of Science and Scopus	Articles that are available in the Web of Science and Scopus
Study subject	Articles that focused on barriers to adaptation measure or projects at global or sub-national level (main actor is not a nation or nations)	Articles that focused on barriers to a whole process of national adaptation policy (main actor is a nation or nations)
Type of article	Grey literature such as conference proceedings or reports of an institute	Only peer-reviewed and published articles

Table 2
Analysis criteria.

Category	Description
General information of the article	●Reference●Relevance of the article●Year of publication●Research site (Country/Countries)●The name of the national policy●Sector●General aims of the article
Conceptualisation of barriers to adaptation	●The term as a synonym of barrier●Definition of barrier to adaptation●Definition of limit to adaptation●Additional information related to the concept of barrier to adaptation
Characteristics of identified barriers (types, origins, influences)	●Large categories of identified barriers (Biophysical, Social, or Both)●Direct relevance to climate change (climate change adaptation)●Detailed categories of identified barriers (Conflicting timescales and priorities/ Substantive, Strategic, and institutional uncertainty/Institutional crowdedness or institutional voids/ Fragmentation/Lack of awareness and communication/Resources/lack of authorities of the main department/ etc)●Policy phases (process) and barriers●Origin of the barrier●Influence of the barrier
Solutions to the barriers to adaptation	●Solutions that have been used●Results of the solutions●Suggested solutions●Additional information related to solutions to the barriers to adaptation
The detailed categories of barriers are developed based on Biesbroek et al. (2011) 's 7 clusters of barriers to adaptation.	

and water).

3.2. Concept of barrier to adaptation

The articles used a variety of terms to refer to a barrier to adaptation, including barrier, challenge, constraint, limit and problem. Some articles used the terms interchangeably, and three articles did not use any specific term. 'Barrier' was the most frequently used term and the second most common term was 'challenge' (barrier: 8, challenge: 3, constraint: 3, limit: 1, problem: 1). Only two articles ([Bauer et al., 2012](#); [Kuruppu and Willie, 2015](#)) explicitly defined a barrier to adaptation by referring previous research, and only [Bauer et al. \(2012\)](#) explicitly distinguished between the terms "barrier" and "limit" to adaptation.

3.3. Characteristics of identified barriers

3.3.1. Type

Conflicting timescales and priorities

Eight articles identified a total of eleven barriers related to conflicting timescales and priorities. These barriers suggest that adaptation has a lower priority than other national policy issues in short-term policy cycles. For example, economic development, poverty alleviation and development of infrastructure can be more salient issues in the LDCs ([Koch et al., 2007](#); [Hickey and Weis, 2012](#); [Hambira and Saarinen, 2015](#); [Orru et al., 2018](#)). Hickey and Weis (2012) suggest that investments in adaptation get trumped by the 'mountain' of other immediate social and economic priorities. [Waters et al. \(2014\)](#) and [Vincent et al. \(2017\)](#) in turn highlight a mismatch between the time horizons of adaptation and the political and management practices of government departments as a barrier to national adaptation policy.

Uncertainty

Only two articles identified barriers related to uncertainty, specifically to uncertainties about the significance of environmental changes, policy change in the future, and their effects on society. [Hambira and Saarinen \(2015\)](#) refer to uncertainties of policymakers' perceptions and scales and [Nalau et al. \(2016\)](#) highlight uncertainties in the interaction between growing exposure and the means for climate change adaptation activities and agency practices.

Institutional crowding and voids

Nine articles brought up institutional crowding and voids as barriers. The articles suggest that lack of institutional capacity and weak institutions of a country are barriers to national adaptation policy. Examples include weak supporting legislation, absence of an

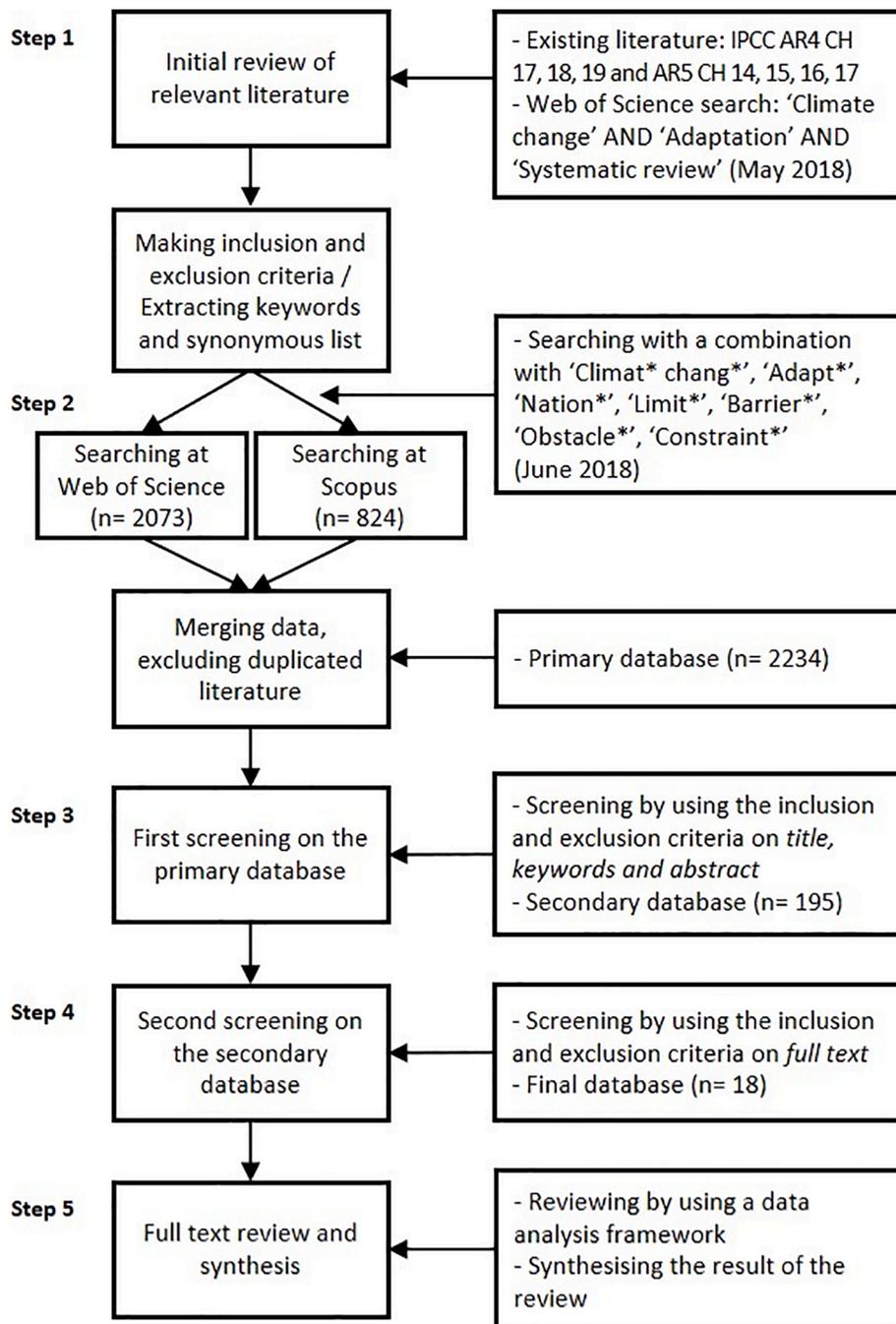


Fig. 1. Systematic literature review process.

integrated approach to adaptation and absence of clear rules and responsibilities for monitoring and evaluation (Massey et al., 2014; Waters et al., 2014; Nalau et al., 2016; Azhoni et al., 2017; Robinson, 2018; Pardoe et al., 2018; Orru et al., 2018; Ranabhat et al., 2018). Biesbroek et al. (2010) also suggest that unclear and overlapping responsibilities complicate the implementation of national adaptation policies. Only Nalau et al. (2016) observed that institutions for adaptation overlap with other policy responsibilities, which can complicate capacity building within Climate Change Adaptation and Disaster Risk Reduction sectors.

Fragmentation

Twelve articles identified fragmentation as a barrier in four different ways: 1) poor integration of adaptation policies across government departments (sectors); 2) poor integration of adaptation policies across jurisdictional levels; 3) poor integration of relevant knowledge; and 4) poor involvement of stakeholders. Poor integration of adaptation policies across jurisdictional levels and

poor involvement of stakeholders was highlighted most often. Kalame et al. (2011) suggest that although there are gaps between national level priorities and local or community priorities, national adaptation policies usually reflect only national level priorities. Bajec (2011) highlight in turn that local adaptation plans could not reflect national adaptation policies. Kuruppu and Willie (2015) call attention to limited engagement of communities and local authorities with national adaptation policies. In an analysis of EU member state policies, Biesbroek et al. (2010) found that most national adaptation policies focus on domestic issues and pay little attention to the role of the EU. Massey et al. (2014) consider the lack of transnational networks a barrier to national adaptation policy.

The articles also highlight that national adaptation policy processes often involve only a small number of stakeholders. Biesbroek et al. (2010) and Kalame et al. (2011) found that only a small circle of experts and governmental and sectoral representatives are involved in the NAPA processes and the development of National Adaptation Strategies in EU countries. Kalame et al. (2011) found that the Ministry of Finance was not involved in the national adaptation policy process, while it has an important role in allocating budget to government departments: the lack of participation of such important actors in national adaptation policy may become a barrier. Lack of involvement of non-state actors is also commonly identified as a barrier to national adaptation policy (Koch et al., 2007; Bauer et al., 2012; Waters et al., 2014; Bizikova et al., 2015; Azhoni et al., 2017).

Lack of awareness and communication

Twelve articles identified two types of barriers related to lack of awareness and communication. First, lack of communication or information sharing between stakeholders is frequently observed, including limited communication or knowledge dissemination between experts and policymakers or among departments (Koch et al., 2007; Biesbroek et al., 2010; Kalame et al., 2011; Bizikova et al., 2015; Nalau et al., 2016; Ranabhat et al., 2018). Massey et al. (2014) consider that the language used in a national adaptation policy is sometimes a barrier. Second, low or no awareness among the public or politicians can be a barrier to national adaptation policy (Hickey and Weis, 2012; Massey et al., 2014; Kuruppu and Willie, 2015; Robinson, 2018; Orru et al., 2018). Hambira and Saarinen (2015) suggest that there are denial and fatalism about climate change and that some actors believe that nature will manage itself at the end.

Resources

Almost all articles (16 of 18) identified resource barriers related to either information, finance or human resources. Lack of information about climate change and its effects was brought up in several articles (Hambira and Saarinen, 2015; Bizikova et al., 2015; Azhoni et al., 2017). Vincent et al. (2017) considered that existing information about future climate change is not appropriate for decision making, and Kuruppu and Willie (2015) and Robinson (2018) highlight the lack of baseline data and records as barriers to national adaptation policy processes. Lack of funding for national adaptation policy is an often-noted barrier (Kalame et al., 2011; Bajec, 2011; Massey et al., 2014; Robinson, 2018; Pardoe et al., 2018; Orru et al., 2018; Ranabhat et al., 2018). Kuruppu and Willie (2015) view that international funds for adaptation policy in LDCs are unpredictable and that the funds are often not appropriate for addressing the country's root vulnerabilities. Biesbroek et al. (2010) highlight that none of the national adaptation strategies of the EU member states considers how the implementation of the NAS should be financed. Lack of human resources (both qualitative and quantitative) was also frequently identified as a barrier (Koch et al., 2007; Massey et al., 2014; Robinson, 2018; Orru et al., 2018; Ranabhat et al., 2018). Koch et al. (2007) highlighted that staff turnover can be a critical barrier to national adaptation policy.

Lack of authorities of a main department

Three articles identified barriers related to the lack of authorities of the main department responsible for national adaptation policy. They can have little or no authority to ensure that adaptation policy is implemented as they do not have the means to force other agencies to focus or commit their resources on climate change adaptation (Koch et al., 2007; Orru et al., 2018). Azhoni et al. (2017) also indicate that giving additional responsibility without additional resources to organisations, such as Climate Change Cells of India, can render them ineffective.

Others

Additional barriers reported in the articles included a lack of high-level political commitment and national leadership (Bauer et al., 2012; Bizikova et al., 2015; Vincent et al., 2017). Dearth of multidisciplinary research on vulnerability was also considered a barrier in five articles (Biesbroek et al., 2010; Bajec, 2011; Hickey and Weis, 2012; Kuruppu and Willie, 2015; Orru et al., 2018). Kalame et al. (2011) and Massey et al. (2014) also consider that there is insufficient time to make adequate national adaptation policy.

3.3.2. Origin and impact of the barriers -

This research analysed the interactions between barriers in the context of the articles, to better understand the characteristics of the barriers. There was some evidence of origins that cause barriers to adaptation, but none of the articles explicitly focused on them. Thirteen articles mentioned factors which create other barriers or aggravate them, although the causation was not considered in detail. Resource barriers (finance and human) are seen to cause barriers that hinder long-term policymaking and its implementation (Koch et al., 2007; Hickey and Weis, 2012; Bizikova et al., 2015; Azhoni et al., 2017; Orru et al., 2018). For example, an interviewee of Vincent et al. (2017)'s study said that "they do not have long-term plans based on long-term climate scenarios due to resource constraints." (Vincent et al., 2017, p.192). Lack of communication between stakeholders leads to lack of participation of government departments and key stakeholders as well as to deficiency of information and knowledge (Koch et al., 2007; Bizikova et al., 2015; Azhoni et al., 2017). Kuruppu and Wille (2015) mentioned that "this (weak linkages and poor coordination between the tiers of government) gave rise to poor communication between communities and government, which often led to local or community needs being overlooked in adaptation efforts." (Kuruppu and Wille, 2015, p.77). Weak institutions, as well as uncertain methodology, for national climate change adaptation not only is the main reason of unclear roles and responsibilities of stakeholders, which results in weak participation, but it also makes it difficult to adopt an integrated approach for national adaptation policy (Kalame et al., 2010; Bajec, 2011; Azhoni et al., 2017). Koch et al. (2007) and Ranabhat et al. (2018) indicate that low priority of adaptation in a country

gives rise to barriers that impede the establishment and implementation of a consistent and integrated policy. Culture of a country such as a lack of cooperative culture, a culture of dependency, or administrative culture can be reasons for horizontal and vertical fragmentation barriers (Bizikova et al., 2015; Robinson, 2018). For example, Orru et al. (2018) analysed as “The absence of an integrated approach to climate adaptation can be explained by the nature of the administrative culture of the institutions involved in the Estonian health system.” (Orru et al., 2018, p.7).

We also examined the impact of barriers in the articles. Although causation was not given much attention, nine articles touched upon the consequences and impacts of the barriers. Unclear and overlapping (ambiguous) division of responsibilities was found to complicate roles and responsibilities of each sector or department in making and implementing adaptation policy (Biesbroek et al., 2010; Azhoni et al., 2017). Lack of coordination and lack of policy coherence between sectors (Pardoe et al., 2018) result in conflicts over resources and incentives between sectors or departments. Massey et al. (2014) and Orru et al. (2018) indicate that lack of political and public interest and awareness delays actions to make and implement adaptation policy and weaken motivation to act. Kuruppu and Willie (2015) note that financial barriers make developing countries more dependent on external funds and Nalau et al. (2016) suggest that greater external dependency makes policy progress slow, increases uncertainties for programmes and staff, and limits effective integration of adaptation policies. Koch et al. (2007) consider that staff turnover and low staff capacity increase cost of education and training and Kuruppu and Willie (2015) view that cultural barriers create mistrust of climate information and low ownership of adaptation policy. Vincent et al. (2017) highlighted how short planning horizon and policy cycle results in difficulties for integrating adaptation policy with mid- and long-term climate projections. The relations between origins (or root barriers), barriers, and impacts above are presented in Fig. 2.

3.4. Solutions

3.4.1. Used solutions

There is little evidence in the articles about what nations have done to overcome the barriers they have encountered. Only Biesbroek et al. (2010) and Bauer et al. (2012) discuss solutions used to overcome barriers; they highlight the establishment of coordination bodies, temporary consultations and networks and partnerships to overcome fragmentation barriers in some countries (Bauer et al., 2012). To address communication barriers between scientists and policymakers in particular, specialist organisations which can be described as ‘bridging’ or ‘boundary’ organisations have been established, and monitoring and evaluation schemes have been created (Biesbroek et al., 2010; Bauer et al., 2012). However, the two articles do not discuss whether these solutions were effective or

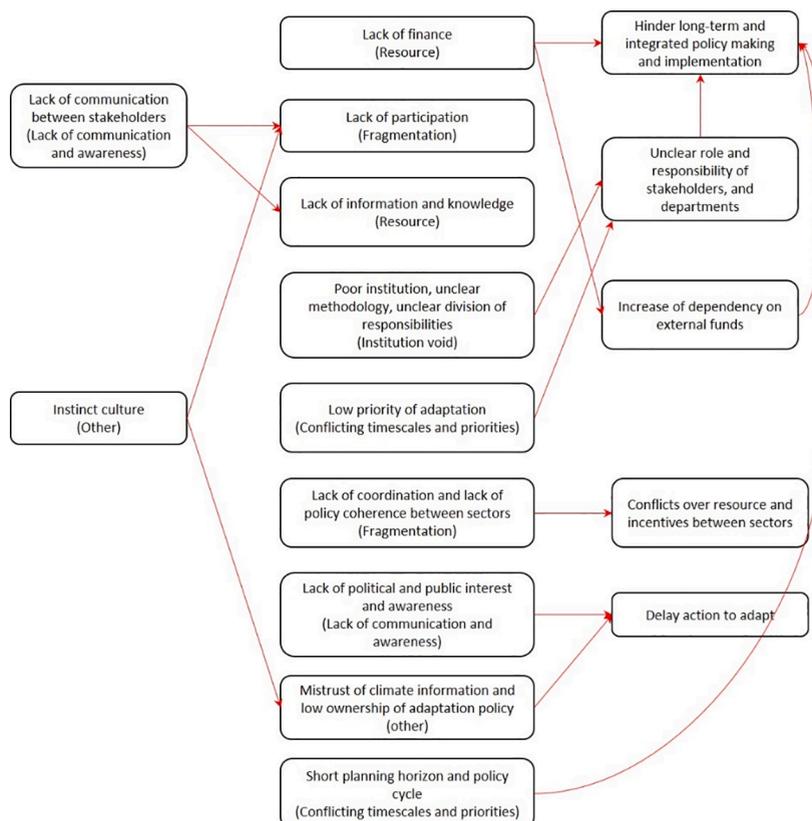


Fig. 2. Relations between origins, barriers, and impacts.

not, nor on whether the nations overcame or could reduce the barriers.

3.4.2. Suggested solutions

Twelve of the eighteen articles suggested solutions for overcoming the barriers. Strengthening networks and coordination schemes is commonly suggested for overcoming poor integration and poor communication between stakeholders of national adaptation policy, both in the making and implementation national adaptation policy (Koch et al., 2007; Bajec, 2011; Bizikova et al., 2015; Azhoni et al., 2017; Ranabhat et al., 2018). Establishment and roles of boundary organisations are also emphasised (Bajec, 2011; Vincent et al., 2017). Generating robust climate information and sharing it widely is also suggested as a solution (Hambira and Saarinen, 2015; Vincent et al., 2017; Azhoni et al., 2017). However, the suggested solutions are rather general and normative and little is said about how to deploy them, and there is no discussion of what outcomes they could produce.

4. Discussion

As adapting to climate change and managing climate risk have become an urgent concern, barriers to adaptation have been given more attention. This SLR focused on the barriers to national adaptation policy in peer-reviewed journal articles published from January 1995 to July 2018, given that although the roles and function of national adaptation policy for overall adaptation, barriers to national adaptation policy have been limitedly studied. After searching with keyword combinations and applying inclusion and exclusion criteria, the final data included eighteen articles. This SLR scrutinised them to discern 1) what are the barriers to adaptation policy at the national level? 2) what are the characteristics of these barriers? 3) what are the limitations of current research on these barriers?

4.1. Background information on articles and concept of barrier

This SLR confirmed that research on barriers to national adaptation policy is much more limited than research on barriers to local or project level adaptation actions. Most studies on barriers to national adaptation policy have been published after 2015. In comparison, a large number of studies on barriers to adaptation actions have been published since the early 2000 s. This is striking considering how significant the role of national policy for adaptation is considered to be (Adger et al., 2009; OECD, 2009; Biesbroek et al., 2010; Storbjörk and Hedrén, 2011; Eisenack et al., 2014; IPCC, 2014; Waters et al., 2014; Mullan et al., 2013). Also, most reviewed articles focus on national adaptation policy in the LDCs: there is surprisingly little evidence on barriers to national adaptation policy in developed countries and how they can be overcome. For example, barriers that Annex 1 countries have experienced are not discussed in their Seventh national communications (NC7s), whereas Non-Annex 1 countries report on the barriers they have encountered in their NCs. Developed countries may be aware of or consider barriers to their adaptation policy, but it is difficult to find an official effort to analyse and address them. This may reflect an assumption that lower vulnerability and greater adaptive capacity in developed countries make barriers less significant (O'Brien et al., 2006; Moser and Ekstrom, 2010). However, in reality, most countries experience comparable barriers which hinder effective national-level adaptation and more research on them is needed.

This SLR also verified that there is still no consensus over the definition of the barriers to adaptation (Biesbroek et al., 2013; Eisenack et al., 2014). The reviewed articles use several synonyms of barriers to explain the same factor that impedes adaptation processes, and even IPCC AR4 and AR5 used different terms to refer to the same notion. However, clear and explicit definitions of key terms are needed to ensure a consistent approach and common understanding of barriers to adaptation. They will also play an essential role in understanding adaptation policy processes (Biesbroek et al., 2013) and implementing adaptation policy.

Most barriers mentioned in the eighteen articles are social barriers caused in the context or circumstances of adaptation policy (Adger et al., 2007; Barnett, 2010; Biesbroek, 2014). This SLR could thus affirm that most barriers to national adaptation policy we experience are related to social factors, not to physical aspects of climate change (Moser and Ekstrom, 2010; Biesbroek et al., 2013; Eisenack et al., 2014). We suggested that barriers to adaptation at the national level fall onto eight categories, drawing from the clusters suggested by Biesbroek et al. (2011).

4.2. Analysed data

4.2.1. What do we know?

This SLR generated important answers to the research questions we posed. First, the articles report on similar barriers to the national adaptation policy, most often on resource barriers (16 of 18), fragmentation barriers (12 of 18), and barriers related to lack of awareness and communication (12 of 18). Our results confirm that financial barriers are the most common form of resource barriers, frequently reported in the literature since the early 2000s (Adger et al., 2007, IPCC, 2007; 2014; Moser and Ekstrom, 2010; Australia Government, 2011; Biesborek, 2014; Waters et al., 2014). The articles highlight the lack of a specific fund for national adaptation policy is highlighted. Biesbroek et al. (2010) suggested that institutionalised financial support is required for consistent national adaptation policy, and nations need to consider how their national adaptation policy is financed from early on. Although this result arises from a small sample, it is significant as it is established by a robust SLR methodology and as the most common and highest priority barrier at national level.

Secondly, our SLR uncovered interactions between the identified barriers by analysing the contexts of the articles, which has not been done in existing literature before. For example, informational barriers have several important sub-types and links to other barriers. The currently dominant form of climate information (climate projections) is not appropriate for decision-making (information resource), which leads to communication gaps between stakeholders (lack of awareness and communication). The lack of

communication between stakeholders, especially between information producers and users, results in information that is not practically useful for policymaking, and it is also associated with the poor integration of relevant knowledge from diverse stakeholders (fragmentation). The barriers related to poor integration of vertical and horizontal stakeholders (fragmentation) are linked to several other barriers such as weak institutions for adaptation policy (institutional voids) and conflicts between different priorities of different stakeholders (conflicting timescales and priorities). Low or lacking awareness among the public and politicians (lack of awareness and communication) is in turn associated with lack of high-level political commitment (others) and poor involvement of a broad range of stakeholders (fragmentation). Previous studies have stressed that barriers need to be addressed simultaneously (Spires & Shackleton, 2018), without evidencing this claim. Although our SLR can evidence the interactions between barriers and thus provide the evidence base in support of simultaneous addressing of barriers. Fig. 3 highlights that solutions addressing national-level fragmentation barriers have to consider the barriers of lack of awareness and communication at the same time.

Third, this SLR provided preliminary insights into the origins and impacts of the barriers to national adaptation policy. First, we identified several root barriers that create or aggravate other barriers: these include resource barriers, lack of communication between stakeholders, weak institutions of national adaptation policy, low priority of adaptation in a country, and intrinsic culture of a country. Secondly, we identified impacts of barriers to national adaptation policy. For example, barriers make the roles and responsibilities of sectors/departments complicated, cause conflicts over resources and impair coherence between sectors/departments, delay actions to make and implement adaptation policies, increase uncertainties to do with related programmes and staff, and weaken the integration and cooperation of adaptation policies. This does not mean that this article shows all origins and impacts of identified barriers to national adaptation policy, and the causation between them is still unclear. However, this approach could be a milestone to address the points discussed in the next section.

4.2.2. What do we not know?

Although this SLR could generate answers, many important questions remain unanswered. We could determine the most frequent (or common) barriers to the national adaptation policy reported in the eighteen articles and identified financial barriers as a key. However, it remains an open question of what are the most common and significant barriers to national adaptation policy in practice, outside of our relatively small sample of articles. The amount of literature on barriers to national adaptation policy is still very limited, and the existing studies are very context-specific (Biesborek et al., 2011; 2013; Eisenack et al., 2014; Prabhakar et al., 2014). Moreover, most of them focus on developing countries. We still do not have enough evidence on barriers to adaptation in developed countries and Asian countries. In addition, differences between barriers to local-level adaptation and barriers to national-level adaptation remain unanswered. Although a number of studies have been conducted on local-level adaptation, there is no SLR on barriers to local-level adaptation yet. Thus, a comparison of the barriers at the two level is not yet possible.

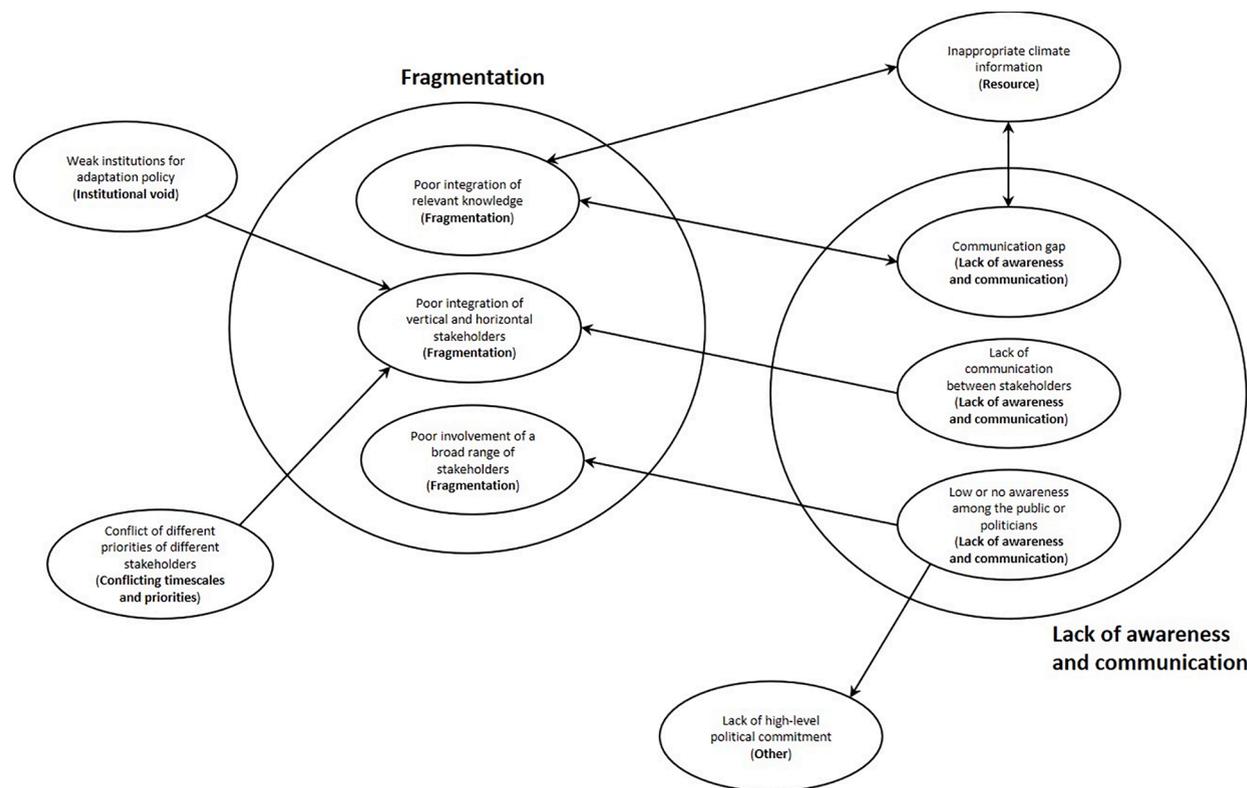


Fig. 3. Interactions between barriers.

Secondly, the causation between origins, barriers, and impacts at the national level remains unclear. The reviewed articles are rather descriptive and do not explain the occurrence of barriers (Eisenack et al., 2014). They do not provide sufficient account of the underlying causes giving rise to the barriers, the relationships between them, and their consequences. That is, why barriers occur, how they influence national adaptation policy and how the barriers can be overcome remain unanswered questions (Biesbroek et al., 2011; Eisenack et al., 2014; Waters et al., 2014).

There are also notable limitations in the existing literature. The articles did not go beyond identifying the barriers. They gave limited attention to solutions for overcoming barriers and offer suggestions for solutions which are too general and normative to be useful. A few articles touched upon solutions such as establishing boundary organisations but did not provide evidence on their effectiveness or functioning. In other words, there is little evidence and guidance in the literature that practitioners and policy-maker could put to use in real-world adaptation policymaking and implementation. Moreover, none of the articles analyses how the identified barriers are dealt with by stakeholders and how they are changed in adaptation processes, after identifying them.

4.3. Research agenda

To solve the unanswered questions, a shift is needed in research focus from identifying barriers to understanding the circumstances where they occur and how they can be effectively addressed and overcome (Waters et al., 2014). We identify four key areas of future research in light of our systematic review. First, we need more case studies on national adaptation policy and barriers to it, in both developed and developing countries, to generate more robust evidence about what are the most common and significant barriers to national adaptation policy. Second, there is a need for research on the complex underlying web of reasons for the emergence and existence of barriers (Agrawala, 2005) which should analyse causation between origins, barriers, and impacts. This will be challenging because it is hard to uncover causation, and there are complex relationships between barriers and varied social factors. However, we need evidence of causation to map the origins, barriers, and impacts to obtain a deeper understanding of the barriers and to identify solutions for overcoming them. Third, there is a need for research tracking barriers in the whole process of national adaptation policymaking to identify how they occur, what impact they have and how, and how they change. This would help manage identified barriers in real adaptation processes. Fourth, there is a need for research on what solutions are effective for overcoming or reducing barriers in real adaptation policy processes. Generation of evidence on practical solutions would not only deepen understanding of barriers but also play an important role in fostering the development of solutions.

National adaptation policies and plans have advanced substantially after IPCC AR4 (IPCC, 2014), but nations are struggling with similar barriers to their adaptation policy (Thomas and Twyman, 2005). Given the key roles of national governments in adaptation from steering society towards long-term outcomes to coordinating adaptation actions, sharing information, and supporting other levels' adaptation policy (Adger et al., 2009; OECD, 2009; Storbjörk and Hedrén, 2011; Mullan et al., 2013; Berrang-Ford et al., 2014; IPCC, 2014), paying more attention to barriers to national adaptation policy is essential.

5. Conclusion

This systematic review uncovered critical limitations in the existing literature on barriers to national adaptation policy. First, the volume of research is very small, particularly considering the rapid progress with national adaptation policies and plans since IPCC AR4 (IPCC, 2014) and their recognised importance (Storbjörk and Hedrén, 2011; Mullan et al., 2013; Berrang-Ford et al., 2014). Because of the small volume of research, we could not extract robust evidence of the barriers to national adaptation policies. Second, the literature does not go beyond identifying barriers to provide explanations for the origin and impacts of the barriers. There is a lack of progress in understanding the barriers, interrelations between origins, barriers and impacts as well as between barriers. Long lists of context-specific barriers have now been made for two decades. Third, the solutions presented in the literature for overcoming barriers are not sufficiently grounded on evidence to be of use for guiding real adaptation policy processes.

We conclude by outlining key future research needs. First, there is a need for more research on barriers to national adaptation policy that acknowledges their differing importance and priority for actors at different levels of governance and for different sectors, to identify the most common and significant barriers so as to address with them more systematically. Second, explanatory research is needed on the barriers to mapping their origins, links and impacts, as well as how they change over the course of policymaking and implementation processes. Third, there is a need for in-depth research on solutions for overcoming barriers as well as evaluating their effectiveness.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

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