Mitig Adapt Strateg Glob Change
https://doi.org/10.1007/s11027-018-9794-z

ORIGINAL ARTICLE

Quality of national adaptation plans and opportunities for improvement

Sierra C. Woodruff[1] · **Patrick Regan**[2]

Received: 10 November 2017 / Accepted: 15 February 2018

Abstract National adaptation plans (NAPs) are intended to provide an evidence-based, coordinated, and systematic approach to climate preparedness initiatives. In order to identify how NAPs could be improved, this paper analyzes 38 national adaptation plans using plan quality evaluation methods and explores national characteristics that are associated with high-quality plans. We find that NAPs typically include multiple data sources, explore current impacts and future vulnerabilities, establish goals, and identify potential adaptation strategies. Plans are weaker in the articulation of implementation and monitoring measures, raising concerns about whether plans will translate into action and how success will be measured. In addition, plans generally do not include a broad range of stakeholders in the planning process. The institutional authorship is a strong predictor of plan quality. Plans written by multi-agency committees are significantly higher quality than those written by single agencies, especially on engagement of stakeholders. Based on these results, we recommend that countries form multi-agency teams to lead the adaptation planning process and intentionally address components that are commonly overlooked including implementation guidance and evaluation metrics.

Keywords Climate change · Adaptation · National adaptation plans · UNFCCC · Plan evaluation

Patrick Regan, Director of Notre Dame's Global Adaptation Initiative (ND-GAIN)

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11027-018-9794-z) contains supplementary material, which is available to authorized users.

✉ Sierra C. Woodruff
swoodruff@tamu.edu

[1] Department of Landscape Architecture and Urban Planning, Texas A&M University, College Station, TX, USA

[2] Department of Political Science, University of Notre Dame, Notre Dame, IN, USA

Published online: 07 March 2018

1 Introduction

As the impacts of climate change begin to be felt around the globe, climate adaptation has become a priority of climate policy. Climate adaptation, defined as actions to moderate the potential damages from climate change, occurs at all scales of government from municipal to national (Bierbaum et al. 2012; Preston et al. 2011). National governments play a vital role in determining their countries' success at preparing for the effects of a changing climate (Mullan et al. 2013). While implementation is frequently framed as a local issue (Nalau et al. 2015), national governments can raise awareness, provide technical expertise and funding, and create the appropriate incentives for local action (Mullan et al. 2013).

National governments are increasingly undertaking national adaptation planning to provide an evidence-based, coordinated, and systematic approach to climate preparedness initiatives (Mullan et al. 2013). The objective of this study is to assess the quality of national adaptation plans using plan quality evaluation methods and explore national characteristics that are associated with high-quality plans. Evaluating plan quality allows us to document content of plans and identify specific strengths and weaknesses by comparing plans to established criteria (e.g., defining goals, public participation, and implementation guidance; Berke and Godschalk 2009; Lyles and Stevens 2014). Researchers have used plan evaluation to analyze plans from multiple domains, including hazard mitigation (Lyles et al. 2014), sustainability (Conroy and Conroy and Berke 2004), and climate adaptation (Woodruff and Stults 2016), and at multiple scales (Berke et al. 2012). A number of studies have examined the content of national adaptation plans; however, they have primarily been descriptive and focused on a small sample of plans (Mullan et al. 2013). Plan evaluation offers a more detailed analysis that can help identify specific recommendations for improvement. Moreover, plan evaluation converts the qualitative text of plans into a quantitative measure that allows for more rigorous comparisons and analysis across larger samples of plans (Lyles and Stevens 2014).

The call for plan evaluation rests on the idea that better plans are more able to advance the goals of the community (Lyles and Stevens 2014)—whether it be an entire nation, state, municipality, or neighborhood. High-quality plans have been found to decrease the cost of disasters relative to lower-quality plans (Burby 2006; Nelson and French 2002). Preston et al. (2010) argue that, "the best method to ensuring robust adaptation is to ensure rigorous adaptation planning processes" (p. 426).

In this study, we evaluate the quality of national adaptation plans (NAPs) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) by systematically scoring each plan as well as explore characteristics that may help create stronger plans. Specifically, we address two questions: (1) What are the strengths and weaknesses of national adaptation plans submitted to UNFCCC? (2) What characteristics—financial resources, vulnerability, governance, and planning processes—are associated with high-quality national adaptation plans? Based on this analysis, we provide recommendations on how to improve national adaptation plans moving forward that countries across the globe could employ.

2 National adaptation plans

The 2001 Marrakech Accords was the first Conference of Parties to the UNFCCC that recognized climate change adaptation. The Accord created new funding mechanisms to help developing nations adapt to climate impacts. Most of this funding was focused

on supporting the creation of National Adaptation Programs of Action (NAPA) in the least developed countries (Adger et al. 2003). NAPA aimed to build the adaptive capacity of the most vulnerable communities in the most vulnerable countries by identifying immediate and specific adaptation needs. The most urgent activities identified during the NAPA process were submitted to the Global Environment Fund (GEF) and other funding sources for support. Of the 49 least developed countries, 41 submitted a NAPA to UNFCCC (Hardee and Mutunga 2010).

The NAPA planning process was intended to be participatory and involve stakeholders from different levels and sectors (Adger et al. 2003), however, analyses of the plans found that they focused on small scale projects in single sectors (Hardee and Mutunga 2010). The plans typically failed to build upon and integrate with existing national development and poverty reduction strategies (Hardee and Mutunga 2010).

Meanwhile the increasing evidence of climate impacts resulted in growing interest in adaptation action in industrialized nations (Westerhoff et al. 2011). From 2005 onwards, developed countries started to write and adopt comprehensive national adaptation strategies, which provide long-term plans to reduce climate change impacts.

Recognizing the limitation of NAPA and the importance of adaptation planning in developed nations, the 2010 Conference of Parties in Cancun established the National Adaptation Plan (NAP) process. NAPs are intended to identify medium- and long-term adaptation needs and enable countries to develop and implement strategies to address those imperatives. NAPs are one of the key vehicles through which Parties can communicate their adaptation needs. The NAP process is intended to be comprehensive and provide a system in which countries can iteratively create and update adaptation plans (LDC Expert Group 2012). In addition, NAPs are a tool to coordinate national adaptation efforts by providing guidance to government agencies, communities, the private sector, and other relevant stakeholders. Undertaking national planning can provide an evidence-based and systematic approach to preparing for climate change (Mullan et al. 2013). As of 2017, 44 nations have submitted NAPs to UNFCCC. The existence of a NAP does not, however, ensure quality planning. If we assume that quality of planning bears some influence on future climate vulnerability, countries and the NAP process have an interest in understanding variation in quality across plans and planning processes.

2.1 Current understanding of National Plans

Past studies have noted the wide variation in national adaptation plans, including the varying levels of technical information, sectors, and topics (Biesbroek et al. 2010). In part, this diversity of approaches reflects the variation in political systems and climate risks across countries (Biesbroek et al. 2010). Despite this variation, existing studies of national adaptation plans consistently note similar limitations.

National adaptation planning does not often engage multiple sectors or scales (Termeer et al. 2012; Biesbroek et al. 2010; Hardee and Mutunga 2010), most plans are developed by an environmental agency (Osman-Elasha and Downing 2007; Mullan et al. 2013) or small group of experts (Biesbroek et al. 2010). Consequently, some studies have argued that existing national plans fail to achieve the UNFCCC goal of being multidisciplinary and integrating adaptation with existing planning processes (Hardee and Mutunga 2010).

National adaptation plans have also been criticized for collating existing strategies without proposing new strategies to advance future adaptation (Termeer et al. 2012), and when new strategies are included, they often are not prioritized (Mullan et al. 2013). Moreover, proposed actions predominately focus on developing capacity through improving climate projections, assessing vulnerability, and creating an enabling environment for adaptation (Mullan et al. 2013). The emphasis on capacity building has been repeatedly cited in the adaptation literature (Stults and Woodruff 2016; Fidelman et al. 2013; Bierbaum et al. 2012; Preston et al. 2011). Biagini et al. (2014) classified 158 adaptation projects financed through the Global Environment Fund; their results indicate that every project included capacity-building actions. While capacity building is important in laying the groundwork for future adaptation, the emphasis on capacity building raises concerns about the potential for existing adaptation plans to tangibly reduce vulnerability.

Previous studies suggest that national adaptation plans emphasize adaptive processes, where lessons learned and new information are iteratively incorporated into plans and policy (Termeer et al. 2012). Many plans, however, lack clear monitoring and evaluation information to assess the success of the plan (Biesbroek et al. 2010; Mullan et al. 2013) that may be critical for a successful adaptive process. Plans also often lack important information for implementation; in particular, they often do not discuss funding needs or mechanisms that are required to facilitate the articulated implementation actions (Mullan et al. 2013).

While there have been a number of studies on national adaptation plans, none provide a broad cross section of the population of plans or systematically analyze the quality of those plans. Hardee and Mutunga (2010) and Osman-Elasha and Downing (2007) focus exclusively on NAPAs written by the least developed countries. Evaluations of NAPs have had small sample sizes and used more qualitative approaches: Mullan et al. (2013) relied on data from surveys and forums, Termeer et al. (2012) consider only four European countries, and Biesbroek et al. (2010) analyze seven countries in the EU. Moreover, these previous studies have all taken different approaches limiting the ability to compile and compare data. The paucity of systematic analyses of plans from across nations accents the need to investigate national adaptation plans in a comparative framework (Mullan et al. 2013). Given the increased emphasis UNFCCC is placing on adaptation plans, it is critical to address this gap. We extend the current state of knowledge by developing a systematic mechanism for comparing NAPs that can allow for more detailed analysis and identify factors that may improve plan quality. The results of our analysis will have implications for countries developing plans and for the UNFCCC planning process and evaluation.

2.2 Social and political determinants of plan quality

Not all countries have the same ability to develop a NAP; variation in national characteristics is expected to describe variation in plan quality. Developing a high-quality plan requires resources, organizational skill, perception and understanding of risk, and political will. In other words, countries need adaptive capacity (Yohe and Tol 2002) to develop high-quality adaptation programs and plans. In theory, the best plans will come from those countries that can organize and marshal these social assets in a way that produces a coordinated and comprehensive plan. We emphasize four

different factors that can influence the overall quality of a national adaptation plan: financial resources, vulnerability, governance, and planning process.

2.2.1 Financial resources

Although national wealth does not guarantee quality, nations that have more financial resources available to dedicate to planning are expected to produce better plans (Brody et al. 2010). Funding is needed to support staff time, acquire technical expertise, build networks, and promote outreach (Carmin et al. 2012). Even with external funding to produce a NAPA, least developed countries found funding to be a major limitation (Osman-Elasha and Downing 2007; LDC Expert Group 2012). Moreover, because adaptation planning is targeted at managing future risk, wealthier countries are better able to expend scarce resources today in pursuit of future risk reduction than are poorer countries for which immediate needs take precedent over future outcomes. We hypothesize that nations with greater financial resources will produce higher quality plans.

2.2.2 Vulnerability to climate change

Prior experience with and impacts from climate change may also encourage national adaptation (Lesnikowski et al. 2015). In particular, disasters can act as "focusing events" increasing public awareness and government action. In the USA, for example, extreme flooding has driven national flood legislation. Hurricane Betsy in 1965 motivated the National Flood Insurance Act of 1968, Hurricane Camille in 1969 motivated the Disaster Relief Act of 1969, Hurricane Agnes in 1972 motivated the Flood Disaster Protection Act of 1973, and Hurricane Frederic in 1979 and Hurricane David 1980 motivated the Coastal Barrier Resources Act of 1982 (Butler 2012).

Disaster experience has been shown to spark climate change adaptation (Anguelovski and Carmin 2011; Baynham and Stevens 2014). First-hand experience with disasters can transform climate change from a temporally and spatially remote risk to one that is immediate and personal (Weber 2010). Following Hurricane Sandy in 2012, the US Federal government took significant steps to better prepare for natural disasters and climate change. For example, the Federal Flood Risk Management Standard established in 2015 extended recommendations from the Hurricane Sandy Rebuilding Strategy to the entire country. The Standard is intended to accelerate the development of programs to increase the resilience to flooding and help prepare for the impacts of climate change by requiring federally funded projects to consider future risk of flooding (the standard was recently rescinded by President Trump; FEMA 2016).

Disaster events may not only serve as a focusing event but also demonstrate the value and cost-effectiveness of adaptation. The distribution of scarce resources to address future vulnerabilities, as is often the goal of adaptation planning, is more politically difficult when the benefits accrue at some future time and under the conditions of some level of uncertainty of those future payouts (Regan 2015). Vulnerable countries that are already confronting climate disruptions may have any easier case justifying adaptation action and garnering support. We hypothesize that countries with greater vulnerability to climate change will produce higher quality plans.

2.2.3 Governance

Studies of national adaptation action have found that good governance is the strongest predictor of action (Berrang-Ford et al. 2014). Good governance is important in every stage of adaptation from problem detection to assessment of adaptation options to communicating with stakeholders (Moser and Ekstrom 2010). Berrang-Ford et al. (2014) found good governance, measured by the Corruption Perception Index, explained 19% of the variation in country adaptation action. In addition, other determinants of national adaptation may be predicated by good national governance. For example, good governance was found to interact with population size, which is highly correlated with national wealth suggesting that greater financial resources only increased adaptation action when a country had good governance. Moreover, good governance is associated with openness, transparency, and inclusivity, among other factors, which is consistent with the NAP guidance articulated by the UNFCCC. When diverse stakeholders have access to the planning process and when different social or cultural heritages are afforded input in the adaptation planning processes, we are more likely to see an output that reflects the breadth of issues and concerns. We hypothesize that the better the quality of governance the higher the quality of the NAP.

2.2.4 Planning process

The planning process, specifically who led the planning effort, is a fundamental condition for a quality plan. Functionally an ad hoc process with minimal community involvement should produce a less encompassing plan than one with an articulated and inclusive process. The highest quality plans will include a range of interested and affected members of the community in the planning process that can identify vulnerability across different sectors and promote a breadth of adaptation strategies. Agencies will have varying ability to bring together stakeholders and lead a planning process. Multi-agency committees and taskforces may be more adept at addressing the breadth of climate impacts. Therefore, we expect differences across plans based on who leads a country adaptation process.

3 Research design

3.1 Sample selection

We analyzed all national adaptation plans submitted in English on the United Nations Framework Convention for Climate Change website by May 2017. As such, the plans included in this study do not represent a sample of the population but rather is a population of submitted plans. Countries, however, may have adaptation plans that they have not submitted to UNFCCC, and it remains an open question why countries choose to submit a NAP to the international community. We leave that question for another paper. There were a total of 48 plans submitted to the UNFCCC of which 39 were available in English. All 39 plans were analyzed. After reading the document on the UNFCCC website for Malawi, it was determined to be an implementation report and not a plan that offered future adaptation strategies; consequently, it was dropped from the analysis bringing the sample size to 38 (See Appendix for full list of plans).

The countries in our sample are diverse. They range from China with a population of 1.3 billion to Vanuatu with under 300,000 people, from Somalia with a GDP/capita of $549 to Australia with a per capita GDP of over $56,000. The sample includes highly autocratic and highly democratic countries. Eight of the countries are in the NATO alliance, 11 are on the African continent, and eight are in Asia. One, Palestine, does not hold official state status. Three were part of the former Soviet Union, although Russia has not submitted a plan, neither has the USA. No countries from Central or South America have submitted plans to the UNFCCC.

3.2 Coding methods

For this study, we modified the coding protocol used by Woodruff and Stults (2016) to analyze local climate change adaptation plans in the USA. The original protocol included 124 indicators drawn from adaptation planning guidance provided by international, national, and nonprofit organizations as well as common themes discussed in the peer-reviewed literature. We refined this set of indicators to those that are applicable at a national scale and best capture the UNFCCC adaptation planning guidance. We pretested the coding protocol on three national plans and further refined the indicators.

The final protocol includes 72 indicators—each coded dichotomously—divided into seven well-established plan quality *principles*: (1) goals that describe future desired conditions; (2) a fact base that identifies community issues, providing the empirical foundation for strategies; (3) strategies that guide decision making to ensure plan goals are achieved; (4) public participation in plan creation; (5) inter-organizational coordination; (6) details regarding implementation and monitoring (Berke and Godschalk 2009; Lyles and Stevens 2014); and (7) how plans address uncertainty given uncertainty in climate change projections, as well as the timing and magnitude of climate impacts (Woodruff 2016; Berke and Lyles 2013).

Assessing the presence/absence of indicators associated with these plan principles allows the conversion of text to a quantitative measurement of plan quality. We calculate a score for each principle based on the percentage of the principle indicators included in the plan; for example, if a plan includes four of the five goal indicators, it would score an 80% on the goal principle. Overall quality for the plan is then calculated by averaging the score on each principle. Principles include different numbers of indicators meaning that indicators are not equally weighted (see Table 1). Calculating scores for each principle and an overall quality score eases comparisons between plans, enables identification of trends across plans, and permits statistical analyses. This scoring mechanism also allows for comparison across NAPs, which is critical for UNFCCC initiatives and for adaptation funding evaluation.

3.3 Data sources and indicators

Our unit of observation is the submitted national adaptation plan. To examine the country characteristics that are associated with high-quality plans, we compiled national political, demographic, and economic data from multiple sources. Our theoretical framework points to four conceptual drivers of plan quality: financial resources, vulnerability, governance, and planning process. We operationalize financial resources in terms of gross domestic product per capita in 2015 (World Bank 2018), population in 2015 (World Bank 2018), and a dummy variable indicating if the country received funding to prepare the plan based on the

Table 1 Definition and components of plan principles included in the analysis

Principle	Definition	Metrics	Components of principle
Goals	Future desired conditions	5	Plan purpose, vision, goals, and objectives
Fact base	Empirical foundation that identifies issues and their severity to ensure that strategies are well informed	27	Data sources; analysis of current conditions; climate change exposure; vulnerability and risk assessment
Strategies	Guide to decision making to assure plan goals are achieved	16	Capacity building, land use, green infrastructure, etc.; cost and co-benefits of strategy options; prioritization of strategies
Public participation	Recognition of actors engaged in preparing the plan	7	Description of planning process and techniques to engage stakeholders; identify individuals involved in preparation of the plan
Coordination	Recognition of the interdependent actions of multiple organizations and the need for coordination	6	Engagement of multiple agencies, non-profits, businesses, universities, etc. in the planning process
Implementation and monitoring	Guidance to translate plan strategies into action and track progress toward goals	6	Organizational responsibilities, timelines, and funds for implementation and monitoring
Uncertainty	Plans recognition of and approaches to overcome uncertainty in future climate projections	5	Recognize sources of uncertainty; consider multiple future scenarios; robust strategies

Metrics indicates the number of indicators included for the principle

documentation in the plan itself. Since GDP and population are highly skewed, we used log transformation of both in our analysis.

Vulnerability is operationalized with the Climate Risk Index and the Notre Dame Global Adaptation Index (ND-GAIN) exposure measure. The Climate Risk Index ranks countries based on their casualties and financial losses from extreme weather from 1996 to 2015 (Kreft et al. 2017). Exposure is a composite measure from the Notre Dame Global Adaptation Index (ND-GAIN) that captures projected biophysical impacts due to climate change along with social and political sensitivity and adaptive capacity (Chen et al. 2016).

Good governance is operationalized in terms of the World Bank Control of Corruption index and ND-GAIN readiness measure. Readiness is a composite measure that captures a country's ability to leverage investment to implement adaptation (Chen et al. 2016). It combines economic, governance, and social indicators including doing business, political stability, and social inequality. Control of corruption captures the extent to which public power is exercised for private gain and is an aggregate of multiple surveys of experts, citizens, and business. The data are developed by the World Bank (Kaufmann et al. 2010).

Finally, based on the information provided by the plan, we identified the plan author and created three mutually exclusive dummy variables that capture aspects of the planning process. The first dummy variable indicates if the plan was written by a single national agency ($n = 17$). In all but two cases, these were environmental agencies. The second variable indicates if the plan was prepared by multi-agency team or committee ($n = 16$). The third and final variable records whether groups external to national government such as NGOs, universities, and

consultants were principally responsible for plan development ($n = 5$; for a full list of variables, variable definition, and sources, see Appendix).

3.4 Empirical analysis

To identify common strengths and weaknesses across plans, we calculate multiple descriptive statistics, including average scores for each plan principle and average plan quality. To further dissect which components of plans could be improved in the future to increase plan quality, we also calculate bivariate correlations between plan quality and individual principle scores.

To determine the national characteristics that are associated with plan quality, we calculated Pearson correlation coefficients for overall plan quality and each plan principle. Due to our small sample size and missing data for Somalia, which has been particularly unstable, and the State of Palestine, which does not have official state status, the statistical tools available to us are limited. Correlation coefficients allow us to examine the relationship between individual national characteristics and plan quality; however, using this approach, we cannot determine the unique variation that each variable describes or calculate how we expect plan scores to change based on a unit change in GDP for example. To address these shortcomings, we fit a regression model with a subset of the independent variables, namely, per capita GDP, climate risk index, control of corruption, and the dummy variable for plan author. Diagnostics did not raise any issues with multicollinearity or heteroscedasticity.

4 Results

4.1 Plan quality scores

We start with a systematic description of how components of plan quality distribute across countries. Plan quality varies significantly across countries as illustrated in Fig. 1. For example, Iceland's plan focuses predominately on climate mitigation efforts with very limited attention dedicated to adaptation and, consequently, it is the lowest scoring plan in the sample receiving just 31% of the possible points. Vanuatu has the highest scoring plan, with 92% of the possible points. Vanuatu's plan, which was developed by a multidisciplinary team, describes climate impacts and adaptation options for each region of the country. In addition, the plan provides detailed description of adaptation projects, outlining the rationale for the project, the goal, the implementation responsibilities, costs, and outcomes. The mean score for a NAP is 63% of possible points.

Plan principle scores (Fig. 2) provide a more nuanced picture of strengths and weaknesses of national adaptation plans. Across the plans, the strongest principle is *Goals*, scoring on average 73% of the possible points in that category, followed by the *Fact Base* (72%) and *Strategies* (70%). The weakest principles are *Participation* (48%) and *Coordination* (52%). *Implementation* is also relatively weak, scoring on average 58%. It is important to note that there is considerable variation within the plan principles. For *Goals* (73%), *Participation* (48%), *Uncertainty* (70%), and *Implementation* (58%), there are plans that include all the indicators and plans that include none. This variation demonstrates that countries are taking very different approaches to adaptation planning.

National adaptation plans generally have strong *Fact Base*, indicating that plans typically include multiple data sources, discuss current conditions, describe climate projections, and identify

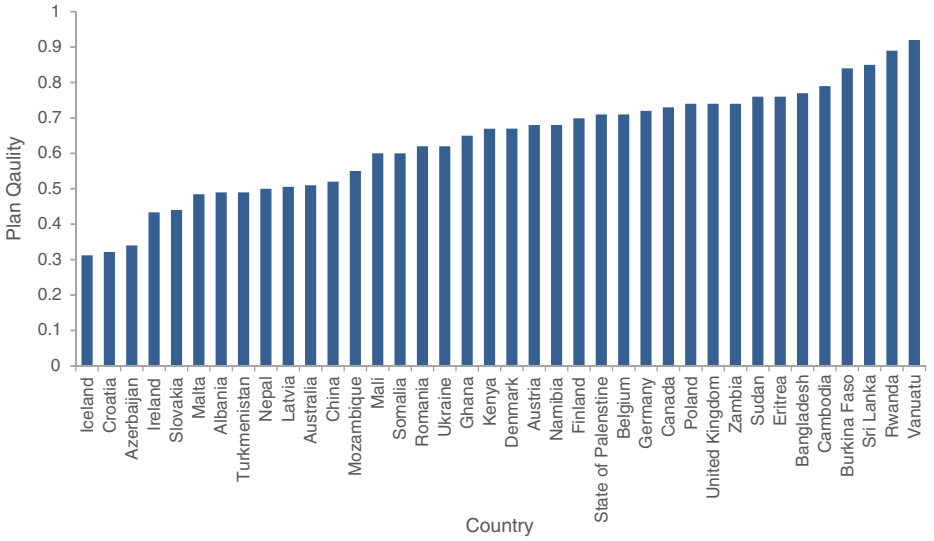

Fig. 1 National adaptation plan quality by country

vulnerable sectors and resources. Every plan in our sample references international climate studies, such as the IPCC, and 95% reference national climate studies. Most plans (81% of plans) indicate that their country is already experiencing the impacts of climate change and 89% discuss actions that are currently being taken to adapt. National adaptation plans most commonly discuss how climate change will affect the built environment (92% of plans), followed by impacts to natural systems (89%), public health (89%), and the economy (86%). Relatively few plans, however, discuss the consequences for climate change on public services (30%), such as disaster response, or cultural assets (41%). Most plans (73%) recognize that vulnerable populations will be disproportionately affected by climate change. Moreover, plans commonly discuss how the impacts of climate change will be magnified by existing conditions (86%), though relatively fewer draw attention to the need for actions that address the underlying causes of vulnerability (57% of plans).

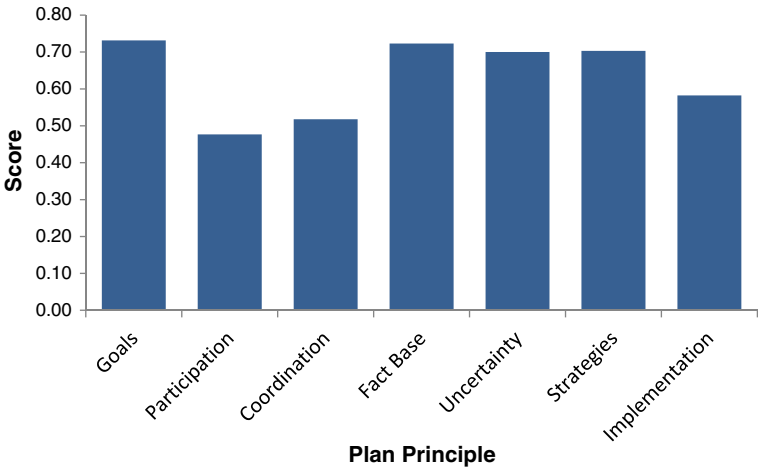

Fig. 2 Plan principle scores. Scores represent the percent of indicators that plans include

Under the *Strategy* principle, NAPs commonly include education strategies (92% of plans), which focus efforts on public education about climate change and adaptation. Other strategies that lay the groundwork for future adaptation such as capacity building, planning, and research are also common (76%). Even more prevalent are action-oriented strategies such as technology, physical infrastructure, and building codes (84, 84, and 76%, respectively). The least common type of strategy is financing (65%). Even though most plans (73%) prioritize the strategies for moving forward, they are much less likely to identify the cost of strategies (38%) or the cost of inaction (35%).

While the *Strategy* principle is generally strong across our sample, attention to *Implementation and Monitoring* is more limited. Plans score on average 58% on *Implementation and Monitoring*, but most plans (84% of plans) describe who has implementation responsibility. Few plans articulate a method for evaluating progress (38%) or specifying reporting requirements (42%). If we assume that the monitoring of NAPs is key to climate preparedness, these low scores may jeopardize their ability to manage climate risk because they do not have in place the mechanisms to evaluate progress.

Across the plans in our sample, *Participation* and *Coordination* are the weakest two principles. Plans infrequently describe the techniques used to engage the public in the planning process (30% of plans) or if they engaged disadvantaged populations. International organizations (89%) and federal agencies (86%) are the stakeholders most commonly recognized as contributing to national adaptation plans. The private sector (27%), non-profits (35%), universities (38%), and elected officials (41%) are much less frequently involved in the planning process.

The general picture is one in which plan quality varies considerably across countries, and this variation illustrates different emphases across the principles and their constituent components. Several plans focus on describing projected climate change or the potential consequences for the county from the expected impact of climate change. Finland (70% of possible points), for example, provides extensive discussion on how different economic sectors may be affected by projected changes to their climate but lacks specificity on adaptation projects. Other plans, such as Mozambique (55% of possible), focus predominately on action, articulating specific projects and assigning implementation responsibilities, timelines, and evaluation criteria.

4.2 Importance of plan principles for overall plan quality

We next explore the relationship between the plan principles and the overall quality of NAPs. A strong plan must address all plan principles. For example, a plan with strong goals but no strategies to realize those goals will have limited ability to advance national interests. Since all principles are critical to advance national adaptation, overall quality is calculated by weighing principles equally (rather than metrics). Still, particular components or principles of a plan may be associated with high overall quality. We calculated the bivariate correlations between plan principle scores and plan quality scores (Table 2).

At a basic level, the correlations highlight which principles differ most across high and low quality plans. The principle with the strongest correlation with plan quality is articulation of strategies (0.74), but the spread across bivariate correlations is not large ranging from 0.74 to 0.56. The relatively strong, positive relationship across all principles indicates that there are no principles that are strong across all plans nor any principles that are weak across all plans (since these would produce weak associations close to 0). Rather, the correlations suggest that

Table 2 Bivariate correlations between plan principles and overall plan quality scores

	Quality	Goals	Participation	Coordination	Fact Base	Uncertainty	Strategies	Implementation
Goals	0.56	–						
Participation	0.59	0.10	–					
Coordination	0.62	0.28	0.50	–				
Fact base	0.67	0.35	0.05	0.37	–			
Uncertainty	0.61	0.15	0.12	0.05	0.62	–		
Strategies	0.74	0.16	0.37	0.53	0.55	0.45	–	
Implementation	0.59	0.41	0.17	0.02	0.25	0.36	0.28	–

high-quality plans consistently score higher across all principles. While it is tempting to use this analysis to determine if any single principle predicts high-quality plans, we discourage that interpretation. Rather the bivariate correlations help identify trends across plans.

4.3 Country characteristics associated with high-quality plans

Next, we advance our analysis to examine the relationship between plan quality and financial resources, vulnerability, governance, and planning process. We expected that financial resources available to a country—operationalized by per capita GDP, population, and funding for adaptation planning—would be positively associated with plan quality. Surprisingly, per capita GDP is negatively correlated with plan quality (−0.33) and most plan principles, with particularly strong, negative relationships with goals, participation, coordination, and implementation (Table 3). These negative correlations suggest that wealth does not correspond to higher quality plans. Population is positively correlated with overall plan quality (0.22) but has mixed relationships with plan quality principles. Population has a relatively strong, positive relationship with goals, fact base, and strategies but a negative relationship with participation and coordination. External funding has a weak, positive relationship with plan quality (0.11). Financial resources seem to be particularly important for the implementation principle. External funding has a relatively strong, positive

Table 3 Correlation coefficients for aggregate plan quality and each plan principle and national characteristics—financial resources, governance, vulnerability and planning process

	Quality	Goals	Participation	Coordination	Fact Base	Uncertainty	Strategies	Implementation
Funding	0.11	0.07	−0.03	0.09	0.11	0.05	−0.07	0.26
Log (GDP)	−0.33	−0.32	−0.28	−0.30	−0.09	0.12	−0.03	−0.48
Log (population)	0.22	0.29	−0.11	−0.04	0.44	0.13	0.25	0.14
Exposure	0.17	0.23	0.23	0.21	0.06	−0.18	−0.06	0.20
Climate Risk Index	−0.29	−0.39	0.01	−0.21	−0.48	−0.08	−0.18	−0.08
Readiness	−0.27	−0.19	−0.25	−0.36	−0.10	0.19	−0.08	−0.35
Corruption	−0.11	−0.12	−0.06	−0.20	−0.09	0.18	0.04	−0.26
Single	−0.33	−0.11	−0.53	−0.41	−0.21	−0.01	−0.16	−0.02
Multi-agency	0.56	0.22	0.57	0.60	0.32	0.16	0.47	0.15
External	−0.32	−0.16	−0.06	−0.26	−0.16	−0.21	−0.43	−0.17

relationship with implementation (0.26). GDP in contrast has a relatively strong, negative relationship (− 0.48). This may illustrate an important difference in how developed countries with high GDPs and developing countries that rely on external funding are approaching national adaptation plans—developed countries may view adaptation plans as long-term direction setting strategies, while developing countries are more focused on short-term projects with clear responsibilities, timelines, and funding streams for implementation.

Correlations of the vulnerability indicators suggest that more vulnerable countries produce higher quality plans. High scores on exposure indicate greater vulnerability, so we expect positive correlations with plan quality. For the climate risk index, higher scores indicate fewer casualties and financial losses due to extreme weather, so we expect negative correlations. The relatively strong correlations with the goals principle (0.23 and − 0.39, respectively) suggest that vulnerable countries that have experienced high disaster damage produce plans with stronger goals. Disaster experience (Climate Risk Index) also has a strong relationship with the fact base (− 0.48), indicating that countries that have experienced disaster losses provide more complete assessment of the consequences of climate change for the nation such as identifying impacts to vulnerable populations, human health, and the economy.

We hypothesized that good governance would improve plan quality but our results provide limited evidence to support that conclusion. High scores on the readiness index correspond to better governance. Similarly, higher scores on control of corruption correspond to less corruption so we expect positive correlations with plan quality in both cases. Surprisingly, both readiness and control of corruption have negative relationships with overall plan quality (− 0.27 and − 0.11, respectively) and most plan principles. This suggests that better governance does not improve plan quality. Readiness has relatively strong, negative relationships with participation (− 0.25), coordination (− 0.36), and implementation (− 0.35).

Plan author variables have the strongest relationship with plan quality. Multi-agency teams produce higher quality plans, while single agencies and external authors produce lower-quality plans. Multi-agency team has a positive correlation with all plan principles. Figure 3 illustrates how principle scores vary by plan author. The relationship with participation and coordination is particularly strong (0.57 and 0.60, respectively, Table 3), suggesting that multi-agency teams are better at engaging the public and a variety of stakeholders in the planning process.

In addition to the calculating the bivariate correlation between national characteristics and plan quality, we also fit a regression model with a subset of the national characteristics. We selected one variable from each category—financial resources, vulnerability, governance, and plan author. For the most part, the regression shows the same trends as the correlation analysis. Per capita GDP is significantly negatively associated with overall plan quality, more vulnerability countries produce significantly higher quality plans, and multi-agency teams produce significantly higher quality plans than external or single agencies (Table 4). A key difference between the regression and correlation analysis is that the sign for control of corruption changes. The correlation suggests that control of corruption is negatively associated with plan quality, while the regression suggests that control of corruption is significantly positively associated with plan quality. This suggests that accounting for country wealth control of corruption has a positive relationship with plan quality, but our small sample size makes it difficult to draw conclusions.

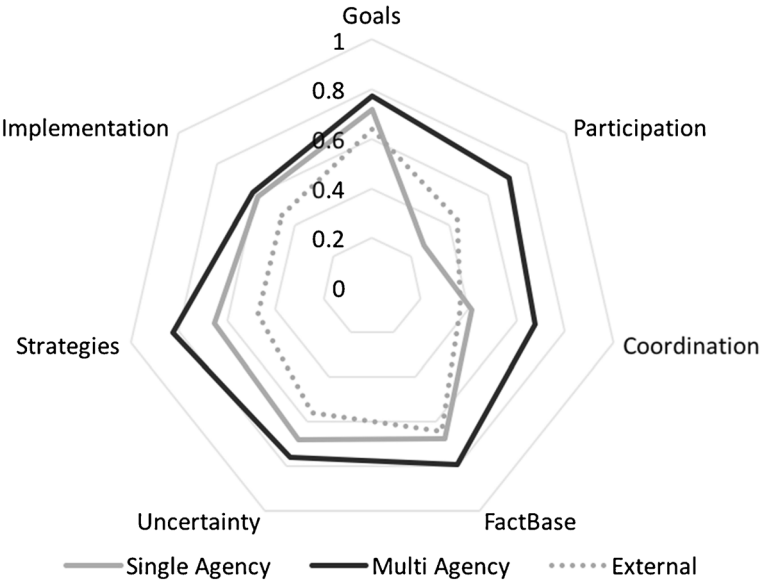

Fig. 3 Principle scores for plans written by a single government agency, a multi-agency team, and external authors. Higher scoring principles are closer to edge and plans with higher overall quality will take up a larger area

5 Discussion

Using plan evaluation, we systematically analyzed 38 national adaptation plans. This approach allows us to identify specific strengths and weaknesses of plans. For example, every plan references international climate studies and nearly all reference national climate studies. This suggests that countries engaged in adaptation have access to climate information. Further, countries recognize the potential impacts to the economy, infrastructure, public health, and natural systems. Generally, the *Fact Base* of plans could be improved by considering additional impacts such as the consequences for public services. In addition, plans commonly recognize vulnerable populations but do not propose strategies that address underlying causes of vulnerability.

In contrast to previous studies that noted the limited attention given to new adaptation strategies (Termeer et al. 2012; Mullan et al. 2013), we find that national plans have strong *Strategy* components. Our results indicate the countries include numerous strategies to build on-the-ground resilience (i.e., physical infrastructure) in addition to capacity building strategies that lay the foundation for future action. Low scores on implementation and monitoring, however, raise concerns about the ability to translate plan strategies into action. As Mullan et al. (2013) noted, plans frequently lack information about costs, funding needs, or how progress will be evaluated. Score on the implementation principle has strong correlations with external funding, GDP, readiness, and corruption. This may illustrate an important difference in how developed countries and developing countries, which rely on external funding for adaptation planning, are approaching national adaptation plans. Our results suggest that developed countries may view adaptation plans as long-term direction setting strategies, while developing countries are more project based with clear responsibilities, timelines, and funding streams for implementation. Specification of implementation may also be a requirement for

Table 4 Regression coefficients for overall plan quality and national characteristics.

	Regression Coefficient (Standard Error)
Intercept	1.284* (0.239)
Log (GDP)	− 0.067* (0.026)
Climate Risk Index	− 0.001* (0.0006)
Corruption	0.080* (0.038)
Multi-agency	0.110* (0.046)
External	− 0.096 (0.065)
N	35
R^2	0.320

Asterisk indicates significant coefficients at $p < 0.05$ level

external funding, explaining the strong, positive relationship. The weakness of this implementation and monitoring principle, generally, and the paucity of indicators to track progress in particular, may also hinder iterative, adaptive planning.

Consistent with previous studies that noted the failure of plans to engage multiple sectors and stakeholders (Termeer et al. 2012; Biesbroek et al. 2010; Hardee and Mutunga 2010), we find that the weakest components of the plans submitted to the UNFCCC are *Coordination* and *Participation*. This suggests that current national planning processes are not as participatory or multidisciplinary as intended. Moreover, we find that these components are strongly associated with the institutional leadership of the planning process.

Recognizing the variation across countries and the importance of a country-driven approach to build buy-in, the UNFCCC guidance indicates who should lead the planning process is driven by national circumstances and existing institutional arrangements (LDC Expert Group 2012). In most cases, adaptation has been delegated to an environmental agency. The earlier NAPA process involved the establishment of multidisciplinary teams that included a range of experts from government agencies, to representatives of civil society and local communities. Countries that took this approach and formed multidisciplinary committees have significantly higher *Participation* and *Coordination* scores. While it is important for countries to have flexibility to tailor the adaptation process to their circumstances, it is also critical for countries to choose a lead institution that has the authority to convene and coordinate multiple stakeholders, including multiple government agencies. Multi-agency teams may be better positioned to serve this convening role.

While we hypothesized countries with greater financial resources would produce higher quality plans, our results suggest the opposite. GDP and population consistently have a negative relationship with plan quality. This finding could be viewed as encouraging—all countries regardless of financial resources can have high-quality adaptation plans. Again, this may reflect developed and developing countries taking different approaches to adaptation planning. In addition, these results may partially be a function of the countries that choose to complete and contribute national adaptation plans to UNFCCC—a question that should be addressed in future research.

We also anticipated governance resources to influence plan quality; however, we found limited support for this hypothesis. Despite being the strongest predictor of adaptation action in other studies (Berrang-Ford et al. 2014), control of corruption had negative correlations with most plan principles. Similarly, readiness is negatively correlated with most plan principles. These negative associations between governance and plan quality may reflect the limitations of correlation, which does not account for the influence of other variables. In the regression, which controls for GDP and disaster losses, control of corruption is significantly, positively

associated with plan quality. Ultimately or limited sample size and statistical power makes it difficult to draw conclusions about the relationship between governance and plan quality.

Our analysis focuses on only four of many national characteristics that may influence the quality of national adaptation plans. Future studies should consider additional characteristics, such as public awareness. Public awareness of climate change and a higher perception of the risk generally increase public support for climate change policy (Weber 2010). In an analysis of adaptation efforts in four developed European countries, Westerhoff et al. (2011) conclude that greater public awareness of climate change foster national adaptation. Cross-national survey data point to public awareness as a key factor in acceptance of targeted restrictions on CO_2 emissions and it is likely that public awareness of the vulnerabilities to climate stress will lead to more enduring commitment to the adaptation planning process.

Based on our findings, we propose the following recommendations for countries improve their national adaptation plans. Countries can take actions to improve the planning process as well as consider specific plan components that currently are not well addressed in national adaptation plans:

- Create a multi-departmental taskforce to lead the planning process. Our results provide strong evidence that multi-agency teams produce higher quality plans than single agencies or external authors such as aid organizations, universities, or consultants.
- Include diverse stakeholders in the planning process including businesses and universities and create opportunities for public engagement and feedback in the process. Public participation and coordination are the weakest principles of NAPs and represent an opportunity for improving future plans.
- Recognize the broad impacts of climate change. While the fact base of NAPs is relatively strong, key impacts of climate change are consistently neglected such as the consequences for public services.
- Consider strategies and actions that address the underlying processes and systems that produce vulnerability. Plans commonly identify vulnerable populations but fail to more deeply examine how adaptation plans can address causes of vulnerability.
- Prioritize adaptation strategies and include metrics to evaluate their implementation and success. Weak implementation and monitoring components of plans raises questions about whether strategies will be translated into action and lead to iterative adaptation processes. Providing clear implementation and monitoring guidance may be particularly important in developed countries that tend to focus more on long-term strategies without providing specific projects.

While countries can take multiple actions to improve national adaptation plans, UNFCCC and aid organizations that provide funding can also support improvements in national adaptation plans:

- When providing funding to countries, ensure that the planning process is inclusive and participatory.
- Develop financial strategies and tools to advance adaptation. We found countries are considering a breadth of strategies, but financial strategies such as taxes and incentives are underrepresented. Financial strategies will be critical in scaling up adaptation and encouraging private action. Greater attention should be dedicated to the strategies and tools available to countries.

- Continue to research and develop approaches to evaluate and track adaptation progress. Significant effort has been dedicated to developing indices to measure resilience (Cutter 2016); however we continue to see a lack of clear metrics and processes to measure adaptation in practice.
- Frame adaptation as an opportunity to address underlying causes of inequity and vulnerability. UNFCCC and international aid organization can play an important role in framing adaptation,

6 Conclusion

A systematic analysis of 38 of the 44 national adaptation plans submitted to the UNFCCC points to systematic variation in (1) plan quality and (2) national characteristics that account for this variation. The variation across plan quality is to be expected, but the relationship between national attributes and plan quality is somewhat surprising. It is not wealth or good governance that is the strongest predictor of plan quality. Rather, the organization that developed the plan is most highly associated with NAP quality.

It is important to note that, regardless of plan quality, planning provides additional benefits other than the plan itself. Officials from countries that have developed plans consistently discuss how the planning process helped clarify and codify adaptation efforts (Mullan et al. 2013). In addition, the planning process can help build support, creating networks between relevant actors, and better communicate roles and responsibilities (Mullan et al. 2013; Osman-Elasha and Downing 2007). Higher quality plans, however, can arguably better advance country goals.

Our results suggest that greater attention needs to be given to increasing participation and coordination in the national adaptation planning processes. While UNFCCC aims for adaptation planning to be inclusive and multidisciplinary, submitted NAP score low on corresponding metrics. Decisions about who leads the planning process may be critical for these plan components.

Acknowledgements We would like to recognize Natalie Rivas and Mary Hilton for helping to code plans and collect data.

References

Adger WN, Huq S, Brown K, Conway D, Hulme M (2003) Adaptation to climate change in the developing world. Prog Dev Stud 3(3):179–195. https://doi.org/10.1191/1464993403ps060oa

Anguelovski I, Carmin JA (2011) Something borrowed, everything new: innovation and institutionalization in urban climate governance. Curr Opin Environ Sustain 3(3):169–175. https://doi.org/10.1016/j.cosust.2010.12.017

Baynham M, Stevens M (2014) Are we planning effectively for climate change? An evaluation of official community plans in British Columbia. Jouranl of Environmental Planning and Management 57(4):557–587. https://doi.org/10.1080/09640568.2012.756805

Berke P, Godschalk D (2009) Searching for the good plan: a meta-analysis of plan quality studies. J Plan Lit 23(3):227–240. https://doi.org/10.1177/0885412208327014

Berke P, Lyles W (2013) Public risks and the challenges to climate-change adaptation: a proposed framework for planning in the age of uncertainty. Cityscape: J Policy Dev Res 15(1):189–216

Berke P, Smith G, Lyles W (2012) Planning for resiliency: evaluation of state hazard mitigation plans under the disaster mitigation act. Natural Hazards Review 13(2):139–149. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000063

Berrang-Ford L, Ford JD, Lesnikowski A, Poutiainen C, Barrera M, Jody Heymann S (2014) What drives national adaptation? A global assessment. Clim Chang 124(1–2):441–450. https://doi.org/10.1007/s10584-014-1078-3

Biagini B, Bierbaum R, Stults M, Dobardzic S, McNeeley SM (2014) A typology of adaptation actions: a global look at climate adaptation actions financed through the global environment facility. Glob Environ Chang 25: 97–108. https://doi.org/10.1016/j.gloenvcha.2014.01.003

Bierbaum R, Smith JB, Lee A, Blair M, Lynne C, Stuart Chapin F, Fleming P et al (2012) A comprehensive review of climate adaptation in the United States: more than before, but less than needed. Mitig Adapt Strat Glob Chang 18:361–406. https://doi.org/10.1007/s11027-012-9423-1

Biesbroek GR, Swart RJ, Carter TR, Cowan C, Henrichs T, Mela H, Morecroft MD, Rey D (2010) Europe adapts to climate change: comparing national adaptation strategies. Glob Environ Chang 20(3):440–450. https://doi.org/10.1016/j.gloenvcha.2010.03.005

Brody SD, Kang JE, Bernhardt S (2010) Identifying factors influencing flood mitigation at the local level in Texas and Florida: the role of organizational capacity. Nat Hazards 52(1):167–184. https://doi.org/10.1007/s11069-009-9364-5

Burby RJ (2006) Hurricane Katrina and the paradoxes of government disaster policy: bringing about wise governmental decisions for hazardous areas. The ANNALS of the American Academy of Political and Social Science 604(1):171–191. https://doi.org/10.1177/0002716205284676

Butler D (2012) Focusing events in the early twentieth century a hurricane, two earthquakes and a pandemic. In: Rubin C (eds) Emergency management. 13–50. CRC Press. https://doi.org/10.1201/b11887-3

Carmin JA, Nadkarni N, Rhie C (2012) Progress and challenges in urban climate adaptation planning: results of a global survey. Cambridge, MA: MIT. http://web.mit.edu/jcarmin/www/carmin/Urban%20Adaptation%20Report%20FINAL.pdf

Chen C, Hellmann J, Berrang-Ford L, Noble I, Regan P, (2016) A global assessment of adaptation investment from the perspectives of equity and efficiency. Mitig Adapt Strateg Glob Chang 23(1):101–122

Conroy MM, Berke PR (2004) What makes a good sustainable development plan? An analysis of factors that influence principles of sustainable development. Environ Plan A 36(8):1381–1396. https://doi.org/10.1068/a367

Cutter SL (2016) The landscape of disaster resilience indicators in the USA. Nat Hazards 80(2):741–758. https://doi.org/10.1007/s11069-015-1993-2

FEMA (2016) Federal Flood Risk Management Standard (FFRMS). 2016. https://www.fema.gov/federal-flood-risk-management-standard-ffrms

Fidelman PIJ, Leitch AM, Nelson DR (2013) Unpacking multilevel adaptation to climate change in the great barrier reef, Australia. Glob Environ Chang 23(4):800–812. https://doi.org/10.1016/j.gloenvcha.2013.02.016

Hardee K, Mutunga C (2010) Strengthening the link between climate change adaptation and national development plans: lessons from the case of population in National Adaptation Programmes of Action (NAPAs). Mitig Adapt Strat Glob Chang 15(2):113–126. https://doi.org/10.1007/s11027-009-9208-3

Kaufmann D, Kraay A, Massimo M (2010) The worldwide governance indicators: methodology and analytical issues. World Bank Policy Research Working Paper No. 5430. https://ssrn.com/abstract=1682130

Kreft S, Eckstein D, Melchior I (2017) Global climate risk index 2017: who suffers most from extreme weather events? Weather-related loss events in 2015 and 1996 to 2015. German Watch. www.germanwatch.org/en/cri

LDC Expert Group (2012) The national adaptation plan process: a brief overview. United Nations Framework Convention on Climate Change, Bonn

Lesnikowski A, Ford J, Biesbroek R, Berrang-Ford L, Jody Heymann S (2015) National-level progress on adaptation. Nat Clim Chang 6(3):261–264. https://doi.org/10.1038/nclimate2863

Lyles W, Stevens M (2014) Plan quality evaluation 1994-2012: growth and contributions, limitations, and new directions. J Plan Educ Res 34(4):433–450. https://doi.org/10.1177/0739456X14549752

Lyles W, Berke P, Smith G (2014) A comparison of local hazard mitigation plan quality in six states, USA. Landsc Urban Plan 122(February):89–99. https://doi.org/10.1016/j.landurbplan.2013.11.010

Moser SC, Ekstrom JA (2010) A framework to diagnose barriers to climate change adaptation. Proc Natl Acad Sci 107(51):22026–22031. https://doi.org/10.1073/pnas.1007887107

Mullan M, Kramer AM, Agrawala S, Kingsmill N (2013) National Adaptation Planning. OECD Environment Working Papers 54. https://doi.org/10.1787/5k483jpfpsq1-en

Nalau J, Preston BL, Maloney MC (2015) Is adaptation a local responsibility? Environ Sci Pol 48(April):89–98. https://doi.org/10.1016/j.envsci.2014.12.011

Nelson AC, French SP (2002) Plan quality and mitigating damage from natural disasters—a case study of the Northridge earthquake with planning policy considerations. J Am Plan Assoc 68(2):194–207

Osman-Elasha B, Downing TE (2007) Lessons learned in preparing National Adaptation Programmes of action in eastern and southern Africa. Oxford: European Capacity Building Initiative. http://www.eurocapacity.org/downloads/ecbi_NAPA_PA_Project_2007.pdf

Preston BL, Westaway RM, Yuen EJ (2010) Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. Mitig Adapt Strat Glob Chang 16:407–438. https://doi.org/10.1007/s11027-010-9270-x

Regan PM (2015) The politics of global climate change. Paradigm Publishers, Boulder

Preston BL, Westaway RM, Yuen EJ (2011) Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. Mitig Adapt Strateg Glob Chang 16(4):407–438. https://doi.org/10.1007/s11027-010-9270-x

Stults M, Woodruff SC (2016) Looking under the hood of local adaptation plans: shedding light on the actions prioritized to build local resilience to climate change. Mitig Adapt Strat Glob Chang. https://doi.org/10.1007/s11027-016-9725-9

Termeer C, Biesbroek R, van den Brink M (2012) Institutions for adaptation to climate change: comparing National Adaptation Strategies in Europe. European Political Science 11(1):41–53. https://doi.org/10.1057/eps.2011.7

Weber EU (2010) What shapes perceptions of climate change? Wiley Interdiscip Rev Clim Chang 1(3):332–342

Westerhoff L, Keskitalo ECH, Juhola S (2011) Capacities across scales: local to National Adaptation Policy in four European countries. Clim Pol 11(4):1071–1085. https://doi.org/10.1080/14693062.2011.579258

Woodruff SC (2016) Planning for an unknowable future: uncertainty in climate change adaptation planning. Clim Chang 139:445–459. https://doi.org/10.1007/s10584-016-1822-y

Woodruff SC, Stults M (2016) Numerous strategies but limited implementation guidance in US local adaptation plans. Nat Clim Chang 6:796–802. https://doi.org/10.1038/nclimate3012

World Bank (2018) World bank open data. https://data.worldbank.org/

Yohe G, Tol RSJ (2002) Indicators for social and economic coping capacity: moving toward a working definition of adaptive capacity. Glob Environ Chang 12:25–40