

## Article

# Transformational Adaptation in Least Developed Countries: Does Expanded Stakeholder Participation Make a Difference?

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**Abstract:** Did the novel planning arrangements in the National Adaptation Programmes of Action (NAPAs) enable stakeholders to substantively influence adaptation planning? If so, does the observed influence have potential for more transformational adaptation? We inform these questions by reviewing and coding the first 50 NAPAs, prepared by the world's poorest nations with support from the United Nations Framework Convention on Climate Change (UNFCCC). We then apply categorical statistics and qualitative comparative analysis to test for stakeholder influence on the planning process and outcomes. We find little evidence that the composition of stakeholder participation influenced climate vulnerability analysis or adaptation planning in the NAPAs. Although the NAPAs were designed to be participatory and country-driven, they were constrained by limited budgets, prescribed guidelines from the UNFCCC, and the challenges of cultivating effective stakeholder participation. Key aspects of NAPAs even worked against generating transformational adaptation. Chief amongst these, risk exposure and sensitivity were emphasized over adaptive capacity in assessing vulnerability, and cost-effectiveness and synergies with existing development and environmental policies were priorities for selecting adaptation actions. These barriers to effective stakeholder engagement and transformational adaptation are timely reminders for those countries currently in the process of preparing their National Adaptation Plans to the UNFCCC.

**Keywords:** adaptive capacity; climate change adaptation; governance; justice; Least Developed Countries (LDCs); National Adaptation Programmes of Action (NAPAs); planning; scale; stakeholder; transformational adaptation; United Nations Framework Convention on Climate Change (UNFCCC); vulnerability

## 1. Introduction

The world's poorest countries are least responsible for global greenhouse gas emissions and have the least capacity to adapt to climate change [1]. They are failing to avoid harm induced by climate change and variability, including devastating droughts and floods, cyclones, and coral bleaching [2,3]. Incremental adaptations are no longer adequate to cope with the unprecedented scale of climate change impacts, requiring transformational adaptation [4]. How can countries with low adaptive capacity plan for this scale of adaptation?

The United Nations Framework Convention on Climate Change (UNFCCC) created the Least Developed Countries Work Programme at the Seventh Conference of the Parties (COP7) in Marrakesh in 2001 for the implementation of Article 4.9 of the Convention ("Parties shall take full account

of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology”). The Work Programme supports Least Developed Countries (LDCs) in planning and implementing adaptation. It specifically provides technical support for preparing National Adaptation Programmes of Action (NAPAs) through the Least Developed Countries Expert Group (LEG) and financing for NAPAs and urgent adaptation projects through the Least Developed Countries Fund (LDCF). NAPAs established novel institutional arrangements for climate adaptation planning in LDCs and set national agendas for financing adaptation through the LDCF and international aid. NAPA processes and outcomes are gaining relevance over time as LDCs develop National Adaptation Plans and tap into expanding sources of international adaptation financing like the Green Climate Fund [5]. Principles of global environmental justice undergirded the NAPAs, resulting in novel planning arrangements emphasizing equity and inclusion of vulnerable stakeholders in participatory processes at the sub-national scale [6,7]. NAPA planning guidelines [8] called for multi-sectoral national planning teams inclusive of civil society, the private sector, and vulnerable groups. Vulnerable groups were to influence the assessment of climate vulnerability, specification of adaptation needs, selection of criteria for prioritizing adaptations, and selection of projects for urgent funding. The extent to which these planning arrangements were successful in achieving their objectives is understudied in the academic literature. This paper helps to fill this gap by analyzing the adaptation planning process in 50 LDCs.

This paper contributes to the special issue, *Climate policy in fragmented political environments—transformative governance interactions at multiple levels*, investigating the most effective vertical and horizontal configurations of stakeholder engagement and participation for achieving transformational climate change adaptation. Adaptations to climate change are adjustments to reduce harm from current or expected climate changes [9]. Transformational adaptations occur at greater scales than incremental adjustments [4]. Examples include introducing new technologies or new governance systems, relocating human settlements and economic activities, changing social norms and cultural beliefs, and changing the relations of economic production and exchange [4,10]. Transformational adaptations recognize and confront the root causes of vulnerability in human—environment systems to open up alternative—safer—development pathways [11].

In this context, we ask: did the novel planning arrangements in the NAPAs enable stakeholders to substantively influence national climate change adaptation planning processes? If so, does the observed influence have potential for transformational adaptation? To address these questions, we first review the concept of transformational adaptation and its requirements for stakeholder participation in national-level governance and planning. We review the NAPA legal and operational framework, including UNFCCC resolutions and the LEG documents for guiding, training, and evaluating NAPAs. We also reviewed literature on the NAPAs, including empirical case studies of the process and their outcomes. We systematically read and code the first 50 NAPAs submitted to the UNFCCC; and we apply categorical statistics and qualitative comparative analysis (QCA) to test for stakeholder participation and influence on national adaptation planning processes and outcomes. We find very limited evidence of stakeholder influence in NAPA processes, suggesting that NAPAs have failed to achieve transformational adaptation. Our findings can inform more deliberate conversations about the necessity and difficulty of achieving transformational adaptation in the context of developing and implementing climate policy in fragmented political environments.

## 2. Literature Review

Transformational adaptation is increasingly recognized as a necessary response to climate change, as the magnitude and impacts of global warming become increasingly severe and incremental adaptations prove insufficient for alleviating the vulnerability of the global poor [4,12]. For ecologists, transformation involves fundamental changes in the form and function of socio-ecological systems [13]. From our social science perspective, transformational adaptation begins with a conceptualization of vulnerability recognizing structural causes of socio-economic inequality, social marginalization,

and governance failures across spatial scales and time, extending beyond the proximate climatic conditions and their effects [12,14]. Root causes must be understood [15–18] and challenged in order to achieve sustainable adaptation outcomes [12,19]. Addressing the root causes of vulnerability through an analysis of adaptive capacity is necessary to avoid reproducing or extenuating existing inequalities [20,21]; it is a prerequisite for achieving transformational adaptation [18,22]. Nevertheless, most adaptations remain incremental—they are minor adjustments to social systems to sustain their fundamental qualities in the face of climate disturbances [4,12]. Governments tend to avoid transformation in favor of incremental adaptation, defending or even solidifying the status quo of existing political and economic structures [12,23], to the detriment of the poor [21].

Transformational adaptation responds to conceptualizations of vulnerability as linked social and environmental processes independent of, and preexisting, particular climate risks. Authors have variously labeled these vulnerability conceptualizations as social, dynamic, and contextual [17,24]. In contrast, biophysical or “outcome” conceptualizations of vulnerability take exposure to biophysical risks as the starting point and tend to consider adaptations as responses to specific exposures, exemplified by the well-known formula used by the Intergovernmental Panel on Climate Change: vulnerability = exposure + sensitivity – adaptive capacity [25]. With biophysical conceptualizations, planned adaptation depends on modelling future climate risks and tends to recommend engineered ‘hard’ adaptations to resist harm to existing infrastructure and development projects [9,24–26], e.g., construction of unsustainable seawalls and other coastal protections [27]. The NAPAs take a biophysical approach to framing climate change vulnerability. As a result of this, significant emphasis on the root causes of low adaptive capacity becomes essential for local stakeholders to advance a transformational adaptation agenda within the context of the NAPA process and its outcome.

As transformational adaptation attempts to bring emphasis to and address social inequalities, the analysis of representational, procedural, and distributive justice can be useful lens for understanding the impacts of stakeholder participation on adaptation planning outcomes [28–30]. For representational justice, vulnerable groups need meaningful representation in adaptation planning. For procedural justice, vulnerable groups need an influential stake in planning and decision-making processes. For distributive justice, vulnerable groups should be the first to benefit from planned adaptation and should not be harmed by any intervention. Each form of justice should be evaluated across different scales of analysis [31] and addressed across different levels of organization [32].

### *2.1. Stakeholder Role in Transformational Adaptation*

Stakeholder engagement and participation are central to climate adaptation planning and implementation [21,32–34]. International institutions such as the UNFCCC and the World Bank have various reasons for promoting stakeholder engagement in planning processes, from normative (emphasis on procedural justice) to practical (raising awareness and soliciting knowledge and participation for the implementation of sustainable solutions). Greater participation increases the ability to “foster the will, intention and means to engage in adaptive behavior” [33]; but there is insufficient understanding of—and emphasis on—the impacts of such engagement on the outcomes of adaptation efforts [32]. A better understanding of the interactions of stakeholders within and across multiple levels of organization (international, national, and local) is essential for understanding how processes such as the NAPAs can contribute to transformational adaptation. In this paper, we build on previous work by Hafezi et al. [34] and Sherman and Ford [32], among others, by analyzing the relationship between models of stakeholder engagement and the quality of the NAPA process and the NAPA documents prepared and submitted by the LDCs.

Adaptive governance requires coordination of stakeholders both within and across scales, but this inevitably encounters tensions due to different levels of power and capacity among stakeholders [35–37]. For example, early evidence on climate change policy making found tensions over ownership between international and national stakeholders, with powerful donors and international institutions pushing governments with little capacity to take action [38–40]. External stakeholders may drive the agenda,

“result[ing] in many—at times, confusing and overlapping—messaging frameworks about vulnerability, adaptation and risks, which are not context-sensitive, do not support a coordinated approach and are not necessarily based on country priorities and needs” [41]. Further, the multi-level governance necessary for dealing with climate change brings together actors who may have competing policy ideas and be subject to institutional path dependence that impedes progress towards nominally shared goals [42].

While a central tenet of the global climate justice framing emphasizes equity and the inclusion of diverse stakeholders in participatory processes at the sub-national scale [6], many scholars have critiqued the role that ‘experts’ and donors play in these processes and their participation in the development of technocratic solutions. There is limited space in these multi-stakeholder negotiating fora for outside voices. Climate change adaptation fora are particularly susceptible to ‘managerial containment’—the attempt by influential actors to direct stakeholders towards predetermined goals in which local priorities are ignored in favor of technocratic solutions [43,44]. A global review of adaptation projects found that project consultation often included only high—level officials and that adaptation projects often diverged from local priorities [33]. In Mozambique, for example, civil society groups reported not being aware of a climate resilient development project funded by the World Bank, even though they were listed as having been consulted [45].

Coordination of government agencies and other actors within the national level of organization requires new modalities of thinking and collaboration. At an interpersonal and organization level, this may require developing social capital—relations of trust and reciprocity between stakeholders [46,47]. Coordination can be at odds with political priorities [38] and pressures to maintain existing governance structures and departmental silos [48]. International donors often contribute to isolation and competition between government ministries. In a survey of 1714 adaptation projects between 2006 and 2009, donors were found to have contributed to ministries that had already received large shares of funding rather than helping the most vulnerable economic or social sectors [38]. In the end, problematic relations between stakeholders at the national level can be a severe barrier to effective adaptation policy development and implementation.

## 2.2. NAPAs: A Novel Form of Adaptation Governance

The 1992 UNFCCC required its Parties to support financing and technology transfer to vulnerable developing countries (Article 4—Commitments) [49]; but the operationalization of Article 4.9 with respect to multi—level adaptation governance through NAPAs and financing mechanisms was not codified until COP7 in Marrakesh in 2001 [50]. NAPAs are a form of multi-level adaptation governance in LDCs, designed to enable local stakeholders within each LDC to participate in a country-driven climate change adaptation planning process supported by the UNFCCC through the LEG. Decision 28 taken at COP7 established guidelines for NAPA preparation, which the LEG annotated [8] and supplemented with the NAPA Primer [51] and a series of publications [52]. The Decision calls for NAPAs to “serve as simplified and direct channels of communication for information relating to the urgent and immediate adaptation needs of the LDCs” [50]. The NAPAs were to be a country-driven planning process to identify urgent national adaptation needs for which delays would increase losses and/or future adaptation costs.

The LDCs meet three criteria: (1) low gross national income per capita; (2) weak human assets characterized by poor health, education, and literacy; and (3) high economic vulnerability to shocks in global trade or natural disasters [53]. The LDCs are thus seen as being highly vulnerable to climate change [30]. Our analysis includes 50 of the 51 countries that have prepared and submitted their NAPAs to the UNFCCC Secretariat. We exclude only the most recent submission from South Sudan in 2017 (see Appendix A.1), but also include the submissions of Cabo Verde, Equatorial Guinea, Maldives, and Samoa, though they have since graduated from the LDC category. Most LDCs are currently in the process of implementing their NAPAs alongside international implementing agencies such as the

United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP) and the World Bank [54].

Once an LDC submits its NAPA to the UNFCCC Secretariat, it can apply for implementation funding through the LDCF [55,56]. The LDCF only finances *new and additional* costs of climate change, however, requiring projects to estimate the base costs of a project, plus the additional costs due to future climate change [26]. The LDCF finances those additional costs, while base costs are to be co-financed by other funds or donors or with local resources [57]. Cost estimation is more straightforward for hard adaptations such as seawalls than it is for building adaptive capacity for *uncertain* future climate conditions, making it easier to propose hard adaptation projects. Moreover, the requirement of co-financing would make it easier to finance projects similar to donors' existing expertise, interest and portfolios, suggesting that adaptation would be more development-as-usual than transformational.

The NAPA process calls for in-country stakeholders at the national, subnational, or community scale to collaborate to identify priority adaptation actions [8,51]. In placing an emphasis on grassroots data sources and contributions to policy- and decision-making, the NAPA document is based on existing data and presented in a simple format that is easily understood by the lay person [8,51]. Architects of the NAPA system envisioned them as mobilizing processes and living documents for guiding urgent action in response to dangerous climate change within a context of global climate justice [6].

The budgetary constraints (US\$200,000) on the preparation of NAPAs contrasts with the high costs of enabling vulnerable groups or diverse national stakeholders to participate substantively in the process. Substantive participation requires building human capital in terms of climate change knowledge and skills in collaboration and management, as well as building social capital and relationships of trust between stakeholders. Multi-disciplinary problem solving for adaptation requires time to build common vocabularies and problem understanding among stakeholders, particularly when those stakeholders have competing interests in gaining political power and control over international aid (also see discussions in Few et al [43]). And indeed, there are a number of paradoxes [58]. Stakeholder participation is challenging when trying to involve vulnerable groups who cannot afford missing productive time, are marginalized by local leaders, or are in political opposition to the national government [59]. The meteorology and/or environmental divisions responsible for leading the NAPAs did not necessarily have the capacity to lead a multi-disciplinary and participatory planning process or access LDCF resources [55,56]. Additionally, slow bureaucratic and political processes of proposing, reviewing, and financing LDCF projects eroded trust amongst the NAPA stakeholders, who expected to see quicker action on their demands and input [55,56,60].

**NAPA global reviews:** Previous global reviews of the NAPAs have found problems in their participatory processes and trends of piecemeal sectoral approaches to adaptation that broadly fail to recognize and address the interconnected and cross-scale root causes of vulnerability to climate change. Agarwal and colleagues [61] reviewed the first 47 NAPAs, critiquing the distance between priorities at the local level and adaptation plans finalized at the national level, and finding that 85% of projects made no mention of a role for local institutions. Mutunga and Hardee [62,63] reviewed 44 submitted NAPAs, finding that 38 countries consider rapid population growth as a root cause of vulnerability to climate change through mechanisms of ecosystem degradation, food insecurity, and migration. However, less than half of the 44 propose any public health projects; only 11 clearly integrate national development planning with the NAPA; and just two integrate reproductive health into adaptation plans to address the root cause of rapid population growth. Pramova et al. [64] found that ecosystem services are considered in 30 of 44 NAPA as sources of livelihood security and adaptive capacity, and 77 out of 468 total projects include ecosystem services with some application of social adaptation to climate change. Of the other 37 ecosystem-based projects, "none of them considers [sic] social vulnerabilities and well-being and the role of ecosystems in social adaptation. Owing to their focus on nature only, they resemble typical conservation projects." [64] Reading the African NAPAs, Weisser et al. [60] "[get] the impression that earlier development papers have simply been amended by

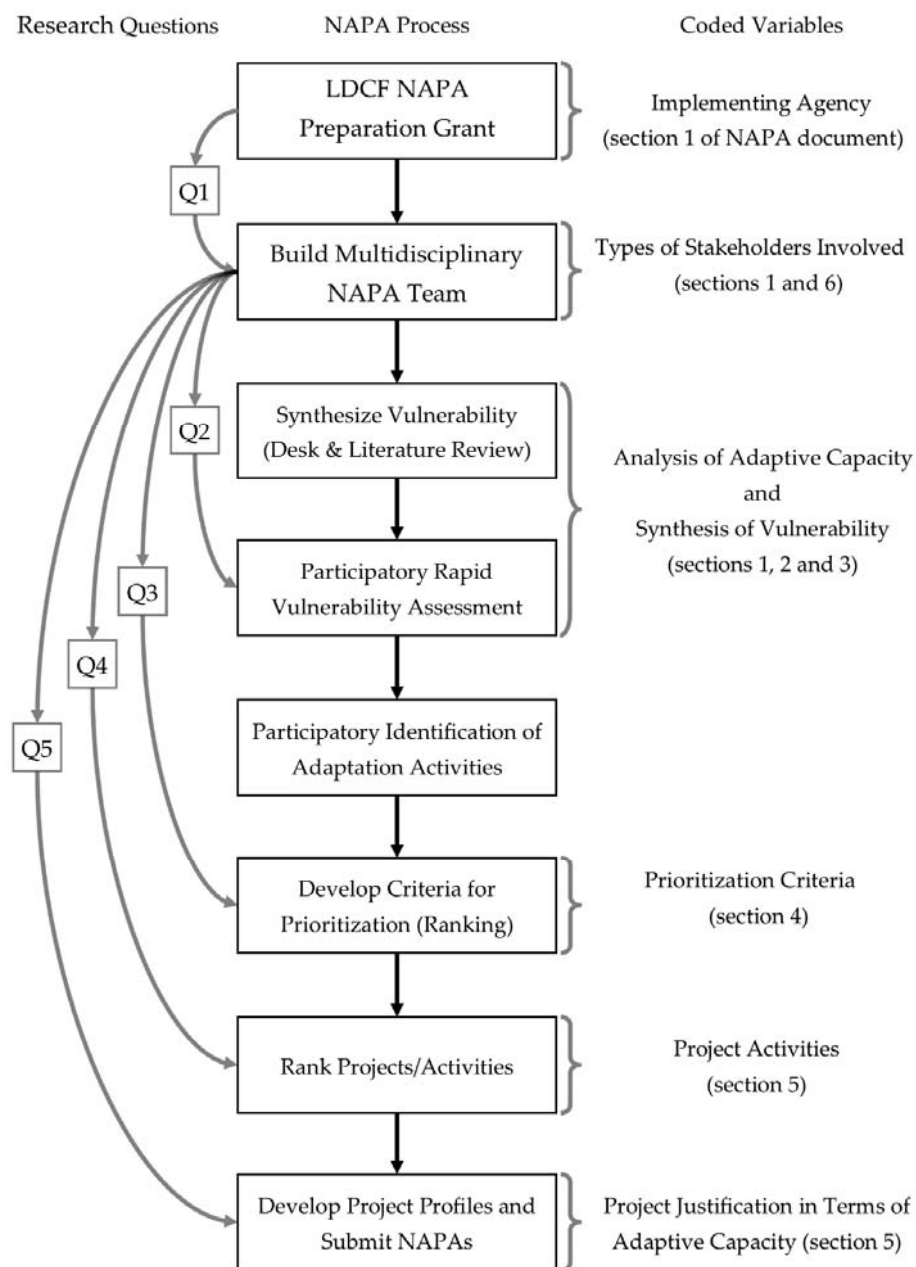


a section on the regional consequences of climate change” suggesting that NAPAs are reproducing development as usual.

**NAPA case studies:** Empirical studies of climate adaptation in several LDCs all reflect common trends of NAPA processes failing to use stakeholder participation to articulate the structural root causes of climate change vulnerability and to address those causes through transformational adaptation. In Bangladesh, technocratic expertise and problem framing marginalized local knowledge and the political implications of adaptation plans, proposing ecological adaptations in direct conflict with the root causes of vulnerability expressed in local workshops [65]. In Burkina Faso, researchers returned to communities who were listed as being consulted in the NAPA process. They found that stakeholder participation was limited to selective workshops in which external experts outnumbered participants. The workshops had little influence on the decision-making process and adaptation project design [66]. In Tanzania, the proposed adaptation projects aligned with existing sectoral strategies of decentralized natural resources governance [23], while the technical planning process depoliticized the root causes of local conflicts over natural resources [67].

**Research questions:** Our reading of the previous literature leads us to ask whether the novel planning arrangements in the NAPAs enabled stakeholders to overcome (or not) the challenges of coordination between stakeholders at various scales and in differing positions of power in order to substantively influence national climate change adaptation planning processes and achieve transformational adaptation. Specifically, we will test five research questions with regard to stakeholder influence that follow the sequence of the NAPA adaptation planning process (see Figure 1), and considering their potential implications for transformational adaptation in our discussion:

- Q1: Is the implementation agency associated with the composition or diversity of stakeholders participating in the NAPA team?
- Q2: Is the composition of stakeholders associated with more comprehensive vulnerability synthesis, and with more focus on adaptive capacity?
- Q3: Is the composition of stakeholders associated with adaptation prioritization criteria relevant to adaptive capacity?
- Q4: Is the composition of stakeholders associated with projects prioritizing capacity building?
- Q5: Is the composition of stakeholders associated with projects justified by the context of low adaptive capacity?



**Figure 1.** NAPA planning process. The flow diagram at center is adapted from the Annotated Guidelines for the Preparation of NAPAs [8]. Q1 through Q5 represent the relationships tested in each of our five research questions, using variables coded from each submitted NAPA, illustrated on the right. Variables were coded using the sections of the NAPA noted in parenthesis.

### 3. Materials and Methods

In order to answer the five research questions, we reviewed and coded the first 50 NAPAs submitted to the UNFCCC Secretariat [68], which included 505 prioritized adaptation projects. Variables follow the NAPA process and documentation structure established in Decision 28/CP.7 and the LEG's Annotated Guidelines (see Figure 1). We then assessed the composition of stakeholders, their assessment of vulnerability, prioritization of adaptations, and the final selection and justification of adaptation projects.

**LDCF NAPA Preparation Grant:** Each NAPA planning process was supported by a grant of approximately US\$200,000 managed by one of three implementing agencies: UNEP (15 countries),

UNDP (33 countries), or the World Bank (two countries). For the purposes of analyzing the influence of stakeholders more interested in assessing and building adaptive capacity (as opposed to biophysical climate exposure and sensitivity), we grouped the two World Bank countries with the UNDP countries.

**NAPA team:** NAPAs formed multi-disciplinary national teams of stakeholders from government and civil society. The composition of stakeholders is credited in Section 1 (introduction and setting) and/or enumerated in Section 6 (preparation process) of NAPA documents. We used binary variables to code for the participation of stakeholder types most likely to focus on concerns related to the root causes of social vulnerability and lack of adaptive capacity through their work in social development and welfare. Those stakeholder types were represented by non-governmental organizations (NGOs, 44 countries), universities or researchers (27 countries); or government agencies in the sectors of agriculture (37 countries), development (27 countries), public health (27 countries), disaster management (12 countries), or gender or women's rights (17 countries). We selected this set of stakeholder types based on our qualitative reading of the NAPAs, professional and research experience in LDCs, and consultations with other researchers and colleagues. Other stakeholder types focused on environmental exposure and sensitivity to climate change and technical conservation or infrastructural adaptations.

**Vulnerability assessment:** Each NAPA team analyzed vulnerability to climate change through a desk review of literature and a participatory rapid vulnerability assessment, usually consisting of a series of regional workshops or surveys. The results were described in Section 1 (introduction and setting) and Section 2 (framework for adaptation programme) of NAPA documents. Countries used various combinations of geographic regions, economic sectors, and/or population groups as exposure units in their vulnerability analyses. We considered countries to have fulfilled an adaptive capacity analysis if they included at least some discussion of capacity in the analysis of each of their exposure units. Thirty-one of the 50 countries met this standard. Adaptive capacity was always the least complete of the three components of vulnerability, reflecting the biophysical outcome-based conceptualization of vulnerability in the NAPAs.

**Vulnerability synthesis:** Beyond the individual assessment of exposure units, we sought evidence of synthesizing cross-sectoral patterns and processes of vulnerability, inclusive of each dimension: exposure, sensitivity, and lacking adaptive capacity. Countries may have achieved this with multi-criteria analysis of each climate risk and exposure unit; with geographic analysis integrating maps or spatial data layers of climate exposure, sensitivity, and adaptive capacity; with qualitative analysis thoroughly synthesizing causality between vulnerability components and sectors; or with a flow diagram of causality synthesizing vulnerability components and sectors. Twenty-nine of the 50 countries showed evidence of synthesizing vulnerability.

Next, NAPA planning included public participation for the identification of potential adaptation activities. Forty-eight of the 50 documents we reviewed explicitly discussed elements of public participation in the NAPA development process in Section 6 (preparation process), but without enough consistency to reliably code the quality or quantity of participation [61].

**Prioritization criteria:** Each NAPA team developed a set of criteria for prioritizing the most important adaptation activities for development into project profiles for financing through the LDCF. These criteria were typically used in a multi-criteria analysis to rank potential activities, and so they represent a powerful step in the planning process, reported in Section 4 (criteria for selecting priority activities) of the NAPA. We coded binary variables for countries, including each of the five criteria most likely to advance an agenda of transformational adaptation or at least building adaptive capacity. Sustainable development or poverty reduction were criteria for 47 countries. Vulnerable groups were a criterion for 32 countries. Sixteen countries included criteria with concern for sustainability of the adaptation, either through public participation or use of feasible technology. Fifteen countries included criteria related to public health, nutrition or food security, and 13 included criteria related to gender equity or women's rights. An index of "prioritization criteria" sums the five binary criteria codes. In possible conflict with transformational adaptation, we found that 45 countries prioritized synergies



with existing multi-lateral environmental agreements, 42 prioritized cheaper cost-effective adaptations, and 40 prioritized urgency of risk reduction needs.

**Ranking project activities:** Each country chose to prioritize an average of 10 projects (ranging from two to 26), enumerated and described in Section 5 of NAPA documents. We coded for 20 different types of activities in these adaptation projects with binary variables: (1) community based, (2) economic diversification, (3) extension and education, (4) conservation, (5) vulnerability needs mapping, (6) research and technology development, (7) resettlement, (8) data collection and dissemination, (9) institutional capacity, (10) law and policy, (11) water resources, (12) coast/flood control infrastructure, (13) public health/nutrition, (14) housing, (15) agriculture and fisheries, (16) climate monitoring, (17) hydrological monitoring, (18) emergency preparedness, (19) infrastructure, and (20) renewable energy. In order to reduce the data complexity of the project activity database, we applied qualitative principal components analysis [69] to reduce the 20 project activities to six principal components, which explain 56.6% of variability in project activities by combining information from correlated activities. The principal components can be interpreted as the most common archetypes of adaptation projects. These included (1) community-based conservation projects with components of economic diversification and education, (2) vulnerability and needs mapping combined with research and technology development and some resettlement programs, (3) new institutions and communication systems, including data collection and sharing, and law and policy, (4) control of floods and coastal erosion with conservation, (5) urban housing and infrastructure, and (6) emergency and monitoring systems. Each project was assigned a score for each principal component, and for each country. We found the maximum principal component score from its portfolio of projects (see explanation in Appendix A.2 and full software output in supplementary materials).

**Project profiles and justification:** Each prioritized project profile also included a justification or rationale in the context of climate change. We coded each project justified with evidence of lacking adaptive capacity and calculated the ratio of each country's projects that had been justified this way. Twelve countries justified all of their projects in terms of lacking adaptive capacity, and on average countries justified 65% of their projects in such terms.

**Contextual Variables:** Recognizing heterogeneity within the LDC category, we sought variables to control for the political and economic context of adaptation planning in each country, reflecting concerns about elite political influence, planning capacity, urban bias, and overall resource constraints [70]. We measured political context with the World Bank's control of corruption index, which "captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as 'capture' of the State by elites and private interests" [71]. We measured development and economic context with the percent of a country's urban population in the year 2000 and the gross domestic product for the year 2008. For use in crisp-set QCA, we dichotomized each control variable at the 75th percentile.

Most of our data is composed of qualitative binary variables; therefore, we applied categorical statistics to test bivariate relationships and QCA to explore configurations of multiple conditions (see Table 1). For bivariate relationships, we used SPSS version 24 [72] for cross-tabulations with chi-square tests with categorical data, Spearman's Rho correlations with ordinal and/or interval data, and difference of means tests with categorical data against interval or ordinal data. For configurations of multiple conditions, we applied crisp-set QCA with the fuzzy program for STATA version 15 [73]. QCA uses Boolean algebra to determine clusters of causal and outcome conditions [74]. Whereas logistic regression determines a coefficient for each independent variable predicting categorical events, QCA uses dichotomous data to identify logical patterns in the conditions necessary for a categorical outcome, finding the sets of necessary and sufficient conditions most commonly associated with the outcomes of interest [75,76]. See Appendix A for details of the bivariate analysis and Appendix B for details of the QCA analysis.

#### 4. Results

In Table 1 below, we briefly highlight the five research questions that we posed, the variables used to operationalize them, the statistical methods used, and our findings. We then proceed to assess the evidence from these methods in answering the five questions.

**Table 1.** Organizational guide to research questions, operational variables, methods, and findings.

Questions	Variables	Methods	Findings
Q1: Is the implementation agency associated with the composition or diversity of stakeholders participating in the NAPA team?	Implementing agency and stakeholders	Chi-square <sup>a</sup> and difference of means tests	No significant relationship
Q2: Is the composition of stakeholders associated with more comprehensive vulnerability synthesis, with more focus on adaptive capacity?	Stakeholders, implementing agency, and vulnerability synthesis	Difference of means test and QCA	No, with contradictory significance
Q3: Is the composition of stakeholders associated with adaptation prioritization criteria relevant to adaptive capacity?	Stakeholders, implementing agency, and prioritization criteria	Chi-square <sup>a</sup> test and QCA	Mixed results
Q4: Is the composition of stakeholders associated with projects prioritizing capacity building?	Stakeholders, implementing agency, and archetypes of priority projects	Spearman's Rho	Yes, limited to one project type and two stakeholder types
Q5: Is the composition of stakeholders associated with projects justified by the context of low adaptive capacity?	Stakeholders, implementing agency, and projects justified by lack of adaptive capacity	Spearman's Rho and QCA	Yes, significantly

<sup>a</sup> Fisher's exact test is used in place of chi-square for expected frequencies less than five.

**Question 1:** *Is the implementation agency associated with the composition or diversity of stakeholders participating in the NAPA team?* The implementing agency linking each country's NAPA process to the UNFCCC did not contribute to the composition or diversity of stakeholders in each country. We characterized stakeholder diversity by counting the number of different types of stakeholders with an interest in adaptive capacity for each country. We divided countries into two groups by implementing agency (UNEP or UNDP and World Bank) and tested for differences of means, finding no significant difference in overall diversity or adaptive capacity diversity. Countries with UNEP as their implementing agency had a mean of 3.3 different types of adaptive capacity stakeholders, compared to a mean of 3.2 for countries with UNDP as their implementing agency.

We also tested for bivariate relationships between implementing agencies and particular stakeholder types using chi-square or Fisher's exact tests (see Table A2). Of 16 possible associations, only two had evidence of significance: fewer countries using the UNDP or World Bank involved academics or researchers ( $p = 0.029$ ), or development ministries or departments ( $p = 0.121$ ). This contradicts the expected relationship, where implementing agencies oriented toward development and adaptive capacity would involve similarly-oriented stakeholders.

**Question 2:** *Is the composition of stakeholders associated with more comprehensive vulnerability synthesis, with more focus on adaptive capacity?* A greater diversity of stakeholder types did not contribute to improved vulnerability analysis, particularly regarding the analysis of adaptive capacity. We divided countries into two groups: 31 with a comprehensive assessment of adaptive capacity and 29 with incomplete assessments. Countries with complete adaptive capacity analysis involved, on average, fewer types of stakeholders favoring adaptive capacity (3.16) than countries with incomplete analyses (3.47). Likewise, bivariate relationships between individual stakeholders and adaptive capacity analysis did not yield any significant results based on chi-square and Fisher's exact test (see Table A3).

Women/gender, disaster management, and agriculture stakeholders had negative relationships, while health had a positive relationship.

Contradicting expectations, greater diversity of stakeholders favoring adaptive capacity was associated with *less thorough* vulnerability synthesis. The 29 countries with thorough vulnerability synthesis involved an average of 2.66 different stakeholder types, while 31 countries without this synthesis involved an average of 4.14. The difference is significant ( $p = 0.001$ ), indicating that an increase in breadth of stakeholder types is associated with incomplete synthesis of vulnerability. The agriculture ( $p = 0.004$ ), disaster management ( $p = 0.017$ ), health ( $p = 0.002$ ), and gender/women's rights ( $p = 0.084$ ) sectors all individually exhibited negative relationships with vulnerability synthesis (see Table A3).

QCA analysis confirms that both of these outcomes can occur in the absence of greater participation from stakeholders and without the facilitation of the UNDP or World Bank as the implementing agency (see Appendix B and Table A7). This contradicts our expectations that the participation of stakeholders prioritizing vulnerable groups and adaptive capacity will necessarily improve the synthesis of vulnerability and inclusion of adaptive capacity.

**Question 3:** *Is the composition of stakeholders associated with adaptation prioritization criteria relevant to adaptive capacity?* The presence of stakeholders with interests in vulnerable groups and adaptive capacity did not lead to associated prioritization criteria (see Table A4). We calculated the chi-square statistic for each possible combination of stakeholder type and prioritization criteria. The evidence for stakeholder influence was generally very weak:  $p$ -values were less than 0.1 for only four of 35 possible associations. Two associations contradicted the expected relationship: neither countries with agriculture stakeholders nor countries with gender and women's rights stakeholders tended to prioritize vulnerable groups. Two others followed the expected relationships: countries with health stakeholders were associated with prioritizing both sustainable development and gender.

With QCA analysis (see Table A7), we explored whether breadth of stakeholders and the UNDP's facilitation as the implementing agency were conditions associated with prioritization criteria focused on equity and adaptive capacity. Here, we found stronger evidence for the role of the UNDP or greater stakeholder participation (or both) in contributing to NAPA planning processes that placed greater emphasis on equity criteria, as these conditions were present in all but one of the consistent pathways identified in the data. *Individual* stakeholders evidenced no significant relationship with *individual* criteria, but in aggregate, there was more participation from stakeholders in countries with more adaptive capacity criteria.

**Question 4:** *Is the composition of stakeholders associated with projects prioritizing capacity building?* We ranked countries based on their breadth of adaptive capacity stakeholders and based on their maximum score for each of six archetypical adaptation project types and tested for bivariate relationships with Spearman's Rho (see Table A5). We found that the diversity of adaptive capacity stakeholders was significantly correlated with only one of six project archetypes: vulnerability mapping and research (Spearman's Rho of 0.399 and  $p = 0.004$ ). We grouped countries by the presence of individual stakeholders and compared their average archetypical project scores, finding that this relationship was driven by the presence of health or disaster management stakeholders. Thus, one of six project types had evidence of significant stakeholder influence by two of seven stakeholder types: disaster management and public health stakeholders were associated with further research and analysis into conditions of vulnerability.

**Question 5:** *Is the composition of stakeholders associated with projects justified by the context of low adaptive capacity?* Countries ranked with high diversity in stakeholder types also ranked highly in the consistency with which they justified final adaptation projects in terms of a lack of adaptive capacity. The relationship is significant, with a Spearman's rank correlation coefficient of 0.405 and a  $p$ -value of 0.004. The relationship was most significant for countries with health stakeholders, which justified 23% more of their projects ( $p = 0.002$ , see Table A6). Countries with disaster management justified 13% more of their projects ( $p = 0.052$ ); and those with agriculture justified 16% more ( $p = 0.066$ ). NGOs,

women/gender, development, and academic/research stakeholders all made a positive difference of 10% or less.

The QCA results (see Table A7) largely confirm that there are several pathways related to justifying projects in terms of lacking adaptive capacity. The most striking finding of this analysis is that UNDP facilitation is critical for all pathways related to this outcome, more so than the breadth of national and domestic actors, which only appeared in one of the pathways identified.

## 5. Discussion

Overall, we found limited evidence that the NAPA planning process contributed to influential participation and representation of vulnerable groups necessary for transformational adaptation. Despite the efforts to include a greater breadth of stakeholders, they had little influence on the planning process, particularly on the vitally important problem framing and prioritization planning phases. Commitment to broad stakeholder participation did not translate into hoped-for procedural justice in the form of influence on the NAPA process [7]. Vulnerability was defined and framed in a way that constrained possible adaptation solutions [24,77], which were then prioritized with criteria contradictory to transformational adaptation. Transformational adaptation requires self-learning to recognize the root causes of social vulnerability or a lack of adaptive capacity [12], which the NAPA synthesis of vulnerability failed to accomplish.

While we expected to see that greater stakeholder involvement would lead to greater representation of vulnerable voices, we did not find that this participation necessarily shaped these results. Our synthesis of 50 LDCs confirms and supports the generalization of findings from case study research in Burkina Faso [66], Cambodia [78], Bangladesh [65], Tanzania [23,67], and Nepal [77]. In particular, each of the aforementioned case studies found that vulnerable people in local communities did not succeed in having their knowledge and experience of climate change vulnerability or their priorities for adaptation represented in their respective country's National Adaptation Plans. Osman-Elasha and Downing's [79] interviews with NAPA teams for seven African LDCs confirm that financing, time, technical capacities, and communication were insufficient. The authors found scarce evidence for transformational adaptation as projects failed to target specific vulnerable social groups and "actions for reducing conflict, institutional and structural reforms, and empowerment of disadvantaged communities [were] not widely reflected in the NAPAs." [79] Our findings also confirm Osman-Elasha and Downing's [79] results that institutional barriers and NAPA prioritization criteria tended to produce sectoral adaptation projects "fairly typical of a development portfolio". Weisser and others explain these findings as strategic moves to reframe existing development to qualify for new streams of financing for climate change adaptation [60], which for Nagoda's [77] study of Nepal are rooted in outcome-based conceptualizations of vulnerability incapable of recognizing social root causes and an inability to achieve transformational adaptation.

Given these challenges, it is not surprising that we found that in the course of producing NAPAs, countries with more diverse representation of stakeholders interested in adaptive capacity seemed to have had slightly more difficulty synthesizing their vulnerability analysis. Further, there was no measurable influence of stakeholders on adaptation prioritization criteria or on adaptation project archetypes with material outcomes. In other words, stakeholders did not seem to have the influence over the adaptation planning process necessary to frame vulnerability or prioritize material action for transformational adaptation. Stakeholder participation did not translate into strong evidence of procedural or distributive justice.

Several aspects of the UNFCCC framework for NAPAs likely worked against more substantive participation of stakeholders for voicing root causes of social vulnerability and advocating for more transformational adaptation. Guidelines suggested several adaptation criteria for the country-driven process, which were almost universally adopted. Cost-effectiveness prioritizes low-cost adaptations even though transformational adaptations for the most vulnerable groups will be more costly due to their lack of adaptive capacity. This criterion imposes a utilitarian philosophy of equity from the

international scale [32], reducing the competitiveness of more costly and progressive adaptation projects. Priorities emphasizing complementarity with existing poverty reduction strategies and multi-lateral environmental agreements encourage adaptation as path-dependent resilience over transformational adaptation [12]. Whereas NAPAs ideally created novel arrangements that enabled stakeholders to substantively influence national adaptation planning, the planning guidelines apparently prioritized routine development and conservation goals.

Three other synthetic studies of NAPAs were focused on particular outcomes rather than on the comprehensive review of the planning process, but their results are nonetheless consistent with our findings that NAPA planning processes did not necessarily contribute to planning processes focused on transformational adaptation. Agrawal and others [61] found that the NAPA planning processes developed overwhelmingly rural and sectoral projects at the national level, noting a failure of local participation to lead to projects inclusive of local institutions and protective of the interests of vulnerable groups. Hardee and Mutunga [62] found disconnects between conceptualizations of the causes of vulnerability and the proposed adaptations with regard to population health. Pramova and others [64] found that vulnerability analysis and synthesis often failed to account for ecosystem services and that these were rarely integrated with social adaptation to climate change in final projects, supporting our finding of a lack of synthesis and integration of environmental and social adaptive capacity concerns.

These results are not entirely surprising. The LDCs are the poorest nations in the world and huge expectations were put on their shoulders to prepare NAPAs to adapt to a whole new phenomenon with tremendous scientific complexity and profound and uncertain implications for national development planning. Funding for preparing these plans was limited to US\$200,000 and countries began with little to no capacity for assessing climate change or planning adaptation, so it should be no surprise that problems and deficiencies are apparent [55,56,79]. What is useful is understanding patterns in their relative successes and failures, to inform future adaptation and resilience planning, particularly for the preparation of National Adaptation Plans.

The NAPAs do have some promise for incremental steps toward transformational adaptation, however. In terms of adaptation governance, the NAPAs were an important step in the participation of diverse stakeholders in dialogue about climate change vulnerability and adaptation in LDCs. Although they had minimal influence on an important problem-framing and prioritization steps—some stakeholders (health and disaster management) apparently succeeded in promoting project activities focused on further research of climate change vulnerability. This implies recognition of the insufficient understanding of vulnerability in NAPAs and could lead to knowledge in support of transformational adaptation. Finally, stakeholders with interest in adaptive capacity were associated with more consistent presence of adaptive capacity in final project justifications. This framing comes after project activities have already been decided, and the justification and may be purely discursive [60]. However, it could also indicate an opening for more meaningful stakeholder participation in future adaptation project development [61].

The research presented here is limited to empirical data coded from NAPA documents. Documents submitted by individual countries to the UNFCCC provide the comprehensiveness and standardization required to identify global patterns [80]. However, documents also miss any unwritten dimensions of the planning process, including the intensity and degree of participation. More in-depth knowledge of adaptation planning can be gathered through interviews and ethnographic fieldwork, but studies using such data collection methods are necessarily limited to comparative case studies or single countries. The strengths and limitations of this synthesis of 50 countries complement the case studies of a few specific countries, enabling us to more confidently generalize our findings than if we relied on documentary evidence alone.



## 6. Conclusions

This analysis was motivated by a need to understand whether the novel planning arrangements in the NAPAs enabled stakeholders to substantively influence adaptation planning. To answer this, we first systemically reviewed the first 50 NAPAs. We then asked five questions about stakeholder processes that align with the sequence of development of the NAPAs. Finally, for each question, we considered the evidence for how stakeholders can influence adaptation planning outcomes and the implications of these findings for transformational adaptation.

First, is the type of linkage between the UNFCCC and LDCs associated with patterns of diversity in stakeholder group composition? The evidence we found is that the NAPA implementing agency (UNDP or World Bank vs. UNEP) did not lead to significant differences in the number of stakeholders likely emphasizing adaptive capacity involved in the NAPA process. While the process may have been top-down, we did not find evidence that the choice of implementing agency either increased or depressed stakeholder representation.

Second, does a greater diversity of stakeholders associated with the NAPA process result in a more comprehensive vulnerability synthesis? We found little support here for the relationship between greater participation and outcomes that prioritize more comprehensive vulnerability assessments, regardless of the facilitating implementing agency. While the participation of these stakeholders satisfied the requirements of representational justice, their inclusion did not seem influential, which hinders greater procedural justice and transformation.

Third, is a greater breadth of stakeholder participation associated with NAPAs with normative criteria that prioritize projects in favor of equity and vulnerable groups? Here, we found mixed and inconclusive evidence that the diversity of stakeholders involved with an emphasis on adaptive capacity contributed to a greater focus on equity. Some stakeholders were positively associated; some were negatively associated; and in aggregate, the diversity of stakeholders together with the UNDP were positively associated with criteria favoring vulnerable groups. At the same time, countries most consistently selected criteria in contradiction to supporting vulnerable groups with transformational adaptation.

Fourth, is a greater breadth of stakeholders associated with certain archetypes of climate change adaptation projects? The breadth of stakeholders included in NAPA teams was correlated with those projects prioritizing additional vulnerability mapping and research. So, we see here limited evidence that greater stakeholder involvement could lead to knowledge in support of future transformational adaptation. However, it appears that the distributional justice aspects of these projects were limited, as stakeholders only influenced the non-material project activities.

Finally, is a greater breadth of stakeholders associated with projects that prioritize adaptive capacity? Our qualitative statistics highlight the association of diverse stakeholders with improved justification of projects in terms of adaptive capacity, while QCA results highlight the importance of UNDP facilitation. Here, we find evidence that both stakeholder involvement and UNDP facilitation support justification of adaptation projects in terms of adaptive capacity.

In total, our research questions, coding, and statistical tests amount to an exhaustive search for evidence of promise that stakeholder influence on the NAPA process and outcomes might lead to transformational adaptation. We have presented what emerged as very weak and contradictory evidence for stakeholder influence on national adaptation planning processes and outcomes. We caution that the more broadly inclusive participation has not intrinsically produced a more comprehensive understanding of the root causes of vulnerability to climate change, nor has it led to transformational adaptations. The stakeholders with most interest in describing and redressing the root causes of vulnerability have not succeeded in doing so, but we found evidence that they have promoted projects with activities to conduct further vulnerability research in the future.

Nonetheless, the NAPAs were a preliminary step in transforming the institutional environment for adaptation at the state level. The planning process initiated new multi-sectoral relationships and partnerships, situated in a global framework for country-driven adaptation planning matched to

international climate financing and infused with values of climate justice. Bilateral and multi-lateral funds like the Green Climate Fund have expanded international adaptation financing, while National Adaptation Plans are taking a slower, iterative approach to planning long-term climate change adaptation. From this study, it is clear that the UNFCCC and implementing agencies need to create more space for national and subnational stakeholders to influence adaptation planning, and for deliberate transformational adaptations to address the root causes of social vulnerability.

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## Appendix A. LDCs and NAPAs

### *Appendix A.1. LDCs and NAPAs*

As of 31 October 2019, the 47 LDCs are: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Timor-Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen, and Zambia.

Four countries that submitted NAPAs have since graduated from the LDC category: Cabo Verde (2007), Maldives (2011), Samoa (2014), and Equatorial Guinea (2017), and all four are included in our analysis. Two countries joined the LDC category after the program for NAPAs was established in 2001 and have since submitted a NAPA: Timor-Leste (2003), and South Sudan (2012). Our analysis includes Sudan's NAPA from 2007—before the independence of South Sudan—but does not include the new submission of South Sudan. For more information on the LDC category, see the United Nations Department of Economic and Social Affairs LDCs section [53]. For the NAPA submissions, see the UNFCCC Submitted NAPAs [68].

### *Appendix A.2. Qualitative Principal Components of Project Activities*

Recognizing that many projects contained similar profiles of activities, we applied qualitative principal component analysis to the database of 505 projects, each with 20 binary variables—one for each possible activity.

Qualitative principal component analysis is a dimensionality reduction technique to simplify large nominal datasets into a series of their significant components with correlated activities. We used Factor Analysis software version 10.5.03 [69] on the 505 prioritized NAPA projects to reduce 20 project activities into six principal components, explaining 56.6% of all variance in project activities. Each principal component was composed of factors for each activity type ranging from −1 to 1. Values near zero are neutral. These factors can be multiplied against the original data to compute scores for each adaptation project. For each country and principal component, we found the maximum score of any of the country's projects.

The first principal component was composed of community-based conservation projects with components of economic diversification and education, and this combination of activities explained 15.9% of variability in adaptation projects. Removing this information from the data, the second component explained a further 10.2% of variability, representing vulnerability and needs mapping combined with research and technology development and some resettlement programs. The third component represented new institutions and systems, including data collection and sharing, and law and policy. The fourth was control of floods and coastal erosion with conservation. The fifth was urban housing and infrastructure, and the sixth was emergency and monitoring systems. Full results are available in supplementary materials.

**Table A1.** Archetypical adaptation project types based on qualitative principal components of activities in each NAPA project.

Project Activity	Projects count	Principal Components and Factor Loading					
		first	Second	third	fourth	fifth	sixth
Variance Explained		15.9%	10.2%	9.4%	7.4%	7.0%	6.6%
Community Based	224	0.71	−0.09	−0.14	0.17	−0.14	−0.09
Economic Diversification	158	0.56	0.15	0.05	−0.09	−0.24	−0.30
Extension and Education	368	0.53	−0.07	0.24	−0.14	0.02	0.04
Conservation	211	0.48	0.09	−0.02	0.48	−0.02	−0.34
Vulnerability Needs Mapping	138	0.08	0.74	−0.06	0.06	0.05	0.18
Research and Technology Development	135	−0.17	0.57	0.19	−0.07	−0.24	0.01
Resettlement	15	−0.28	0.48	0.02	0.16	0.58	0.13
Data Collection and Dissemination	105	−0.17	0.21	0.65	0.03	−0.24	0.06
Institutional Capacity	322	0.20	−0.11	0.61	−0.13	0.00	0.32
Law and Policy	94	0.10	0.39	0.49	0.28	0.21	0.01
Water Resources	147	0.16	0.34	−0.54	−0.14	−0.08	0.04
Coast/Flood Control Infrastructure	41	0.03	0.06	0.05	0.77	0.20	0.04
Public Health/Nutrition	103	−0.03	−0.02	0.01	−0.67	0.24	−0.05
Housing	12	0.00	0.02	−0.18	−0.13	0.80	−0.22
Agriculture and Fisheries	193	0.15	0.13	−0.17	−0.15	−0.71	−0.22
Climate Monitoring	65	−0.24	−0.01	0.14	−0.01	−0.07	0.89
Hydrological Monitoring	56	0.11	0.14	−0.20	0.16	−0.06	0.84
Emergency Preparedness	82	−0.04	0.06	0.18	−0.11	0.15	0.83
Infrastructure	133	0.15	−0.05	0.15	−0.02	0.35	0.07
Renewable Energy	41	0.26	0.22	−0.09	−0.39	0.09	−0.18

The data is based on analysis of 505 total projects. The projects count reports the number of projects involved in each type of adaptation activity. The qualitative principal component analysis used optimal implementation of parallel analysis to choose the number of components, polychoric correlation to create the dispersion matrix, and raw varimax rotation to create the factors. The correlation matrix had a Bartlett's statistic of 972.2 ( $p < 0.00$ ) and Kaiser–Meyer–Olkin test of 0.606 (mediocre). The root mean square of residuals was 0.0861. See supplementary materials for full details.

## Appendix A.3. Bivariate Analysis

**Table A2.** Implementing agencies and stakeholder participation.

Stakeholder		UNEP	UNDP or World Bank
Academic/Research	No	3	20
	Yes	12	15
	<i>p</i>	0.029	
Agriculture	No	5	8
	Yes	10	27
	<i>p</i>	0.493	
Development	No	4	19
	Yes	11	16
	<i>p</i>	0.121	
Disaster Management	No	12	26
	Yes	3	9
	<i>p</i>	1	
Public Health	No	8	15
	Yes	7	20
	<i>p</i>	0.548	
NGOs	No	3	3
	Yes	12	32
	<i>p</i>	0.348	
Women/Gender	No	10	23
	Yes	5	12
	<i>p</i>	1	

*p*-values were calculated with chi-square statistic or, if any cell frequencies were less than 5, the Fisher's exact test. UNEP, United Nations Environment Programme; UNDP, United Nations Development Programme; NGO, non-governmental organizations.

**Table A3.** Chi-square residuals and significance between presence of adaptive capacity stakeholders, low adaptive capacity, and vulnerability synthesis.

Adaptive Capacity Stakeholder	Low Adaptive Capacity <sup>a</sup>	Vulnerability Synthesis
Academic/Research	0.3	−1.7
Agriculture	0.1	−4.5 (0.004)
Development	−0.7	−0.7
Disaster Management	−1.4	−4 (0.017)
Public Health	2.3	−5.7 (0.002)
NGOs	−1.3	−0.5
Women/Gender	−2.5	−2.9 (0.084)

<sup>a</sup> Values are chi-square residuals (expected frequency−observed frequency) for positive association between stakeholders and prioritization criteria. Positive values indicate more than the frequency expected based on the number of countries with the stakeholder and prioritization criteria. Significance values for  $p < 0.1$  are indicated in brackets.

**Table A4.** Relationships between stakeholders and prioritization criteria.

Stakeholder	Prioritization Criteria				
	Sustainable Development <sup>a</sup>	Vulnerable Groups	Public Participation	Public Health	Gender
Academic/Research	0.62	−0.28	−1.64	−0.1	−0.02
Agriculture	1.22	−3.68 (0.012)	−0.84	0.9	1.38
Development	0.62	0.72	1.36	1.9	0.98
Disaster Management	0.72	0.32	0.16	1.4	0.88
Public Health	1.62 (0.090)	−1.28	0.36	1.9	2.98 (0.053)
NGOs	−0.36	0.84	0.92	0.8	1.56
Women/Gender	1.02	−2.88 (0.07)	0.56	−0.1	1.58

<sup>a</sup> Values are chi-square residuals (expected frequency–observed frequency) for positive association between stakeholders and prioritization criteria. Positive values indicate more than the frequency expected based on the number of countries with the stakeholder and prioritization criteria. Significance values for  $p < 0.1$  are indicated in brackets.

**Table A5.** Correlation of adaptive capacity stakeholders with final project types.

Project Archetypes	Spearman's Rho	<i>p</i>
Conservation	0.183	0.202
Vulnerability Mapping	0.399	0.004
Policy	0.135	0.350
Flood Management	0.006	0.968
Urban/Housing	0.090	0.535
Monitoring and Early Warning	0.083	0.565

(Source: Authors).

**Table A6.** Stakeholder influence on percentage of projects justified by lack of adaptive capacity.

Stakeholder	Difference in Projects Justified <sup>a</sup>	Significance ( <i>p</i> )
Academic/Research	7%	0.349
Agriculture	16%	0.066
Development	8%	0.274
Disaster Management	13%	0.052
Public Health	23%	0.002
NGOs	10%	0.412
Women/Gender	9%	0.256

<sup>a</sup> Percentage of projects justified for countries with stakeholders—percentage of projects justified for countries without stakeholders

## Appendix B. Multivariate Analysis with QCA

We used QCA to supplement the categorical statistics because our questions implicitly assume that there might be multiple and conjectural causation leading to similar policy outcomes, with various necessary and sufficient conditions [76]. QCA attempts to explain heterogeneity in responses and outcomes, e.g., by linking NAPA team composition, and leadership with social, political, and economic factors that have been hypothesized to prevent transformational changes at a country level (see Table A7 below).



**Table A7.** QCA pathways for Questions 2, 3, and 5.

Outcome	Pathways <sup>a</sup>
Q2: Vulnerability Synthesis (see Tables A9 and A10)	wealthier × CORRUPTION × urban × undp_led × ADAPTIVE CAPACITY STAKEHOLDERS
	Wealthier × corruption × URBAN × undp_led
	Corruption × undp_led × adaptive capacity stakeholders
	wealthier × URBAN × adaptive capacity stakeholders
	corruption × URBAN × adaptive capacity stakeholders
Q2: Comprehensive Adaptive Capacity (see Tables A11 and A12)	URBAN × undp_led × adaptive capacity stakeholders
	wealthier × corruption × URBAN × undp_led
	wealthier × CORRUPTION × urban × ADAPTIVE CAPACITY STAKEHOLDERS
	wealthier × CORRUPTION × URBAN × adaptive capacity stakeholders
Q3: Equity Criteria (see Tables A13 and A14)	WEALTHIER × corruption × urban × adaptive capacity stakeholders
	WEALTHIER × corruption × urban × undp led × adaptive capacity stakeholders
	WEALTHIER × corruption × urban × UNDP LED × ADAPTIVE CAPACITY STAKEHOLDERS
	wealthier × corruption × undp led × ADAPTIVE CAPACITY STAKEHOLDERS
	wealthier × URBAN × UNDP LED × adaptive capacity stakeholders
Q5: Adaptive Capacity Project Justification (see Tables A15 and A16)	wealthier × CORRUPTION × urban × ADAPTIVE CAPACITY STAKEHOLDERS
	wealthier × CORRUPTION × URBAN × UNDP LED × adaptive capacity stakeholders
	WEALTHIER × corruption × urban × UNDP LED × ADAPTIVE CAPACITY STAKEHOLDERS
	WEALTHIER × corruption × URBAN × UNDP LED × adaptive capacity stakeholders
	WEALTHIER × CORRUPTION × urban × UNDP LED × adaptive capacity stakeholders

<sup>a</sup> Capitalization indicates the variable is positive or present in the pathway while lower case indicates the variable is negative or not present.

Three basic technical steps structure crisp-set QCA. First, all the independent and dependent variables (here termed conditions) were dichotomized into binary variables. Then, a truth table was produced (see Table A8), which shows the various configurations (sets) that are possible from these conditions and which conditions are associated with the outcomes of interests. Then, each case (here a country's NAPA document) was assigned membership into a particular set, based on the presence or absence of the conditions [75]. Using Boolean logic, these sets were compared to the other sets, with the goal of identifying the conditions (or sets of conditions) that are more consistently associated with the outcomes of interest.

**Table A8.** Truth table: Conditions associated with each outcome.

Outcomes <sup>a</sup>	Number of Total Cases	Vulnerability Synthesis	Adaptive Capacity	Equity Prioritization	Adaptive Capacity Project Justification
EFHIs	3	2	2	0	1
EFHIs	2	2	0	1	0
EFhIS	3	0	1	2	1
EFhIs	2	0	1	0	2
EfHIs	1	1	1	0	1
EfHIs	1	1	0	0	0
EfhIS	1	1	0	1	1
EfhIs	2	1	2	1	1
Efhis	1	1	1	1	0
eFHIs	1	1	1	1	1
eFHiS	1	0	0	0	0
eFHIs	1	1	1	0	0
eFhIS	1	0	1	1	0
eFhIs	7	2	4	3	1
eFhiS	1	1	1	1	0
eFhis	3	2	3	1	1
efHIs	1	1	1	1	0
efHiS	1	1	0	1	0
efHIs	1	1	0	0	0
efhIS	3	1	2	0	2
efhIs	8	5	6	3	0
efhiS	1	0	0	1	0
efhis	4	4	3	3	1
Total	50	29	31	22	13

<sup>a</sup> E = Wealthier; F = Corruption; H = Urban, I = UNDP Led; S = More Adaptive Capacity Stakeholders.

After producing the truth table, we explored the necessary conditions for each of our outcomes of interest. Causal conditions are necessary if they must be present (or usually present for an outcome to occur). In this, we assessed the consistency of the condition, which is “the degree to which instances of an outcome agree in displaying the causal condition thought to be necessary” [81]. We note that none of the conditions we explored passed the thresholds considered to be acceptable for consistency test for necessary conditions [75].

The third step reduced the number of sufficient causes (a condition or combination of conditions) that produces an outcome. In order to determine which solutions from the truth table to reduce, we relied on the “fuzzy” program written for STATA by Longest and Vaisey [73]. Here, we utilized the option *yvo*, which runs a test between each set’s consistency in the outcome against the consistency of all other configurations. In Tables A9, A11, A13 and A15, “Set” is the configuration, “YCons” is the consistency or proportion of cases in that set that have the outcome, “OthYCons” is the consistency for all other sets, “F” indicates the F-distribution, “P” is the result of a Wald test comparing the consistency scores (significance means “YCons” and “OthYCons” are significantly different), and NBestFit is the number of cases in a set [73].

In the complex and parsimonious solutions presented in Tables A10, A12, A14 and A16, “Raw Coverage” is the proportion of cases with the outcome that fit the causal conditions of each path, while “Unique Coverage” is the proportion of cases that are only covered by that solution. “Consistency” is the proportion of cases in a path that have the outcome. “Solution Consistency” is the average consistency score across all causal paths and “Total Coverage” is the proportion of cases with the outcome covered by all paths [73].

**Table A9.** Reduced set configurations for vulnerability synthesis.

Set	YCons	OthYCons	F	P	NumBestFit
efhis	1	0.543	37.87	0	4
efHis	1	0.571	36.02	0	1
efHiS	1	0.571	36.02	0	1
efHIs	1	0.571	36.02	0	1
eFhiS	1	0.571	36.02	0	1
eFHis	1	0.571	36.02	0	1
eFHIs	1	0.571	36.02	0	1
Efhis	1	0.571	36.02	0	1
EFHis	1	0.571	36.02	0	1
EfHIs	1	0.571	36.02	0	1
EFHIs	1	0.562	36.59	0	2

**Table A10.** Final reduction set for vulnerability synthesis.

Set	Set Raw Coverage	Unique Coverage	Solution Consistency
$e \times F \times h \times i \times S$	0.034	0.034	1
$e \times f \times H \times i$	0.069	0.034	1
$f \times i \times s$	0.241	0.172	1
$e \times H \times s$	0.138	0.034	1
$f \times H \times s$	0.138	0.034	1

Total Coverage = 0.517; Solution Consistency = 1.000.

**Table A11.** Reduced set configurations for adaptive capacity synthesis.

Set	YCons	OthYCons	F	P	NumBestFit
efHis	1	0.612	30.41	0	1
efHiS	1	0.612	30.41	0	1
eFhis	1	0.596	31.26	0	3
eFhiS	1	0.612	30.41	0	1
eFhIS	1	0.612	30.41	0	1
eFHis	1	0.612	30.41	0	1
eFHIs	1	0.612	30.41	0	1
Efhis	1	0.612	30.41	0	1
EfhIs	1	0.604	30.82	0	2

**Table A12.** Final reduction set for adaptive capacity.

Set	Raw Coverage	Unique Coverage	Solution Consistency
$e \times f \times H \times i$	0.065	0.065	1
$e \times F \times h \times S$	0.065	0.065	1
$e \times F \times H \times s$	0.065	0.065	1
$E \times f \times h \times s$	0.097	0.097	1

Total Coverage = 0.290; Solution Consistency = 1.000.

**Table A13.** Reduced set configurations for equity criteria prioritization.

Set	YCons	OthYCons	F	P	NumBestFit
efhiS	1	0.429	64.03	0	1
efHiS	1	0.429	64.03	0	1
efHIs	1	0.429	64.03	0	1
eFhiS	1	0.429	64.03	0	1
eFhIS	1	0.429	64.03	0	1
eFHIs	1	0.429	64.03	0	1
Efhis	1	0.429	64.03	0	1
EfhIS	1	0.429	64.03	0	1

**Table A14.** Final reduction set for equity prioritization.

Set	Raw Coverage	Unique Coverage	Solution Consistency
$E \times f \times h \times i \times s$	0.045	0.045	1
$E \times f \times h \times I \times S$	0.045	0.045	1
$e \times f \times i \times S$	0.091	0.091	1
$e \times H \times I \times s$	0.091	0.091	1
$e \times F \times h \times S$	0.091	0.091	1

Total Coverage = 0.364; Solution Consistency = 1.000.

**Table A15.** Reduced set configurations for adaptive capacity justification.

Set	YCons	OthYCons	F	P	NumBestFit
eFHIs	1	0.245	148.06	0	1
EfhIS	1	0.245	148.06	0	1
EfHIs	1	0.245	148.06	0	1
EFhIs	1	0.229	158.23	0	2

**Table A16.** Final reduction set configurations for adaptive capacity justification.

Set	Raw Coverage	Unique Coverage	Solution Consistency
$e \times F \times H \times I \times s$	0.077	0.077	1
$E \times f \times h \times I \times S$	0.077	0.077	1
$E \times f \times H \times I \times s$	0.077	0.077	1
$E \times F \times h \times I \times s$	0.154	0.154	1

Total Coverage = 0.385; Solution Consistency = 1.000.

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