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# Who is adapting and how? Identifying actors and roles in climate change adaptation

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### Analysis

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### Abstract

An assessment of the global progress in climate change adaptation is urgently needed. Despite a rising awareness that adaptation should involve diverse societal actors and a shared sense of responsibility, little is known about the types of actors involved and their roles—particularly between state and non-state actors and different regions. Based on a large n-structured analysis of case studies, we show that, although individuals or households are the most prominent actors implementing adaptation, they are the least involved in institutional responses, particularly in the Global South. Governments are most often involved in planning and civil society in coordinating responses. Our findings show that state actors often do not deliver the formal and institutional adaptation required to organise cross-actor collaboration and enable more transformative adaptation. Civil society organisations and individual actors may compensate for that lack, but with limited capacity. These findings should inform more effective future adaptation governance.

### Main text

The realisation that climate change adaptation is urgent has entered mainstream planning and policymaking, and people and institutions are adapting.<sup>1–3</sup> The recent Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) stresses the need to identify 'who needs to take what actions and when in order that transformations unfold at sufficient speed and scale to meet the Paris, SDG and other policy goals'.<sup>4</sup> While climate change adaptation<sup>1</sup> is understood to be place-based, the roles and responsibility for action across actors, scales, and diverse geographies are often unclear.<sup>5–8</sup> Adaptation occurs in multi-actor settings, often blurring the traditional boundaries between national and sub-national scale and public and private actors.<sup>9,10</sup>

The constellation of actors, institutional arrangements, and policy instruments that characterise climate change adaptation governance in a given location are highly context-specific.<sup>8,11</sup> Institutional and technological capacities as well as socioeconomic characteristics may differ greatly between urban and rural areas and between settlements in the Global South and the Global North.<sup>1,12,13</sup> While city governments can be active and interconnected frontrunners in climate change adaptation planning and implementation, on the one hand, in many Global South urban areas there is a lack of local adaptation planning, and implementation often involves informal activities.<sup>14</sup> Rural areas, on the other hand, predominantly in the Global South, are characterised by high degrees of poverty, limited infrastructure, a strong focus on agriculture, and a degree of neglect by national policymakers. However, rural populations and actors draw on rich Indigenous knowledge to cope with environmental and climatic hazards.<sup>15</sup>

When considering the diverse actors across geographic contexts as agents who implement adaptation rather than as mere entities exposed to climate change impacts,<sup>16</sup> it becomes necessary to consider the range of roles these actors play in the adaptation cycle, including assessing impacts, vulnerability, risks, and resilience; planning of adaptation; implementing adaptation measures; and monitoring and

evaluating adaptation.<sup>17</sup> In addition, further roles can be defined through the responsibility lens, such as agenda setting/awareness raising, and initiation of policy/coordination of interaction, target setting, strategy making, financing, enforcement, and policy adjustment.<sup>7</sup> These roles can be fulfilled by multiple actors, and some actors can fulfil multiple roles.

Findings from the Global Adaptation Mapping Initiative (GAMI)—the first global systematic mapping of peer-reviewed literature on climate change adaptation—indicate that households are described more often in climate change adaptation research than government actors, but that relative prominence varies across global contexts.<sup>1</sup> Additionally, governments tend to prioritise different adaptation interventions than businesses or civil society organisations, often based on their ability to create regulatory or market-based adaptation interventions.<sup>8</sup> Other reviews on actors in adaptation demonstrate how unclear divisions of responsibility across governance levels result in barriers to implementation at local level,<sup>18</sup> and how sociocultural backgrounds and individual hazard experiences affect perceptions of responsibility for adaptation.<sup>19</sup> Overcoming such barriers is a crucial step towards transformational adaptation, which relates to changing 'the fundamental attributes of a social-ecological system in anticipation of climate change and its impacts'.<sup>20</sup> This perspective on transformational adaptation is also associated with calls for a shift towards more polycentric climate governance systems<sup>21</sup> that bridge adaptation actions and agendas across stakeholders and scales.<sup>22</sup>

This article aims to contribute to a deeper understanding of the types of actors involved, their roles and collaboration in climate change adaptation across geographical contexts, including urban and rural settlements, in order to support more effective and less fragmented responses.<sup>23–26</sup> We ask what roles do particular actors play in climate change adaptation? Which actors intersect or collaborate in specific adaptation practices? To what extent can geographical patterns be identified in relation to specific actor types? How are different climate-related responses associated with specific actor types? To what extent are specific actor types associated with more transformational forms of adaptation?

To find answers to these questions, we built on GAMI's global stocktake of human adaptation-related responses to climate-related change by re-coding the GAMI database according to actors, roles, and settlement types and synthesising the data through descriptive and regression analysis. A team of 21 researchers carried out the systematic screening and re-coding of all 1,682 articles included in the GAMI database. The results of the remaining 1,472 articles that met our specific inclusion criteria (see Methods and Supplementary Material 1) were synthesised and interpreted in a team of 17 experienced researchers.

### Results

# Actors and roles in adaptation

Our findings reveal several significant patterns in the distribution of specific roles in adaptation across different actor types. Overall, individuals or households are the most frequently reported actor type

(representing 64% of coded articles), and by far the most documented actors for the implementation of adaptation (Fig. 1). The role of financing is mainly associated with international or multinational governance institutions, the private sector, civil society organisations, and national governments. Planning is more often done by government actors, with no particular pattern discernible at different government levels. Civil society organisations are important actors who coordinate the interaction between various actors and raise awareness. Awareness raising is also a relevant role associated with academia, along with assessing climate impacts and monitoring adaptation efforts. While there is little reporting on private sector actors across all regions, their documented roles are mainly related to financing and implementing adaptation.

# Multi-actor constellations in adaptation

In almost a third of the coded articles (404 articles), individuals or households are the sole reported actor type. The most common combination of actors is individuals or households with national governments (79 articles). The second most common combination of actor types is individuals or households with local government or subnational civil society (46 articles each). There is limited evidence of cases that involve both national and local governments and of constellations that involve a diversity of actor types (e.g., constellations involving governance actors together with the private sector or civil society actors and individuals or households). The most common example of such a constellation links individuals or households with local civil society and the national government (17 articles). There is also little reported evidence of small and medium sized enterprises (SMEs) collaborating with government actors (seven articles with SMEs and national government; six articles with SMEs and local government). Although there are some examples of activities involving private households and SMEs (16 articles), reports of SMEs and other actor types are rare. Actors from academia mainly appear in collaboration with individuals or households (20 articles) and local government (five articles) (Fig. 2).

# Geographical actor patterns

Overall, the majority of the publications (65%) deal with adaptation in rural areas. The distribution of actors across different settlement types shows that, in urban contexts, the actor type most reported is local governments (25%), followed closely by individuals or households, and then by national governments and subnational civil societies (Fig. 3a). In rural contexts, individuals or households are by far the most frequently reported actors (47%); national governments and subnational civil society actors are reported in rural contexts more often than local governments. There is little difference between urban and rural case studies regarding the other actor types. In ambiguous studies—those with midsized populations that are neither clearly urban or rural or mixed-case studies—individuals or households are reported most often (26%), followed by national government and local government. International or multinational governance institutions and the private sector (SMEs) are slightly more common in ambiguous studies than civil society actors (Fig. 3a).

The distribution of actors reported in adaptation studies is heterogeneous across regions. Although individuals or households are the most frequently mentioned actors across all regions, they account for nearly half of the total share of actor types reported in African and Asian countries compared to only approximately a quarter in the other regions (see Fig. 3b). In Africa, Asia, Central and South America, and the Small Island States national governments are the second most common actor type. In Europe, national and local governments are at the same ratio (both 19%), and, in North America and Australasia, local government is slightly more often mentioned. Civil society actors are reported particularly frequently in Central and South America and the Small Island States, international or multinational governance institutions are also reported frequently, in 14% of the cases, which is the largest fraction across all regions.

We observed some commonalities and differences concerning the regional patterns of actor roles. Individuals or households are by far the most reported actors for the implementation of adaptation measures in all world regions. However, higher rates of individuals or households are involved in implementation in Asia and Africa, as compared to Europe and North America. In all regions, government actors are mainly involved in planning and implementation processes. Especially in Europe, more so than in other regions, local governments are associated with planning. Sub-national governments play a greater role in planning, implementing, monitoring, and evaluating in North America compared to other regions. In contrast, in Africa, sub-national governments are less involved in planning (Table 1).

#### Table 1

**Patterns in actor-role combinations across world regions**. Results of the chi-square test calculating the residuals, that is, the differences between the observed and the expected frequency of each combination of actor and adaptation role per region. Here showing all results of combinations with high significance, that is, residuals below – 2 and above 2 are shown (see Supplementary Material 1 for the full list of test results).

Region	Actor/Role Combination	Residuals	Obser- vations	% of regional obser-vations
Africa	Government (sub-national) + Planning	-4.09	2	0.16
Africa	Individuals or households + Implementing	7.87	333	26.51
Asia	Individuals or households + Implementing	4.27	337	22.63
Europe	Government (local) + Planning	4.39	40	7.34
Europe	Individuals or households + Implementing	-5.76	54	9.91
North America	Government (sub-national) + Implementing	4.9	24	3.65
North America	Government (sub-national) + Monitoring and evaluating	4.51	7	1.07
North America	Government (sub-national) + Planning	4.38	20	3.04
North America	Individuals or households + Implementing	-5.13	77	11.72
North America	Other + Coordinating interaction	4.32	4	0.61

## Nature of responses by actors

With the exception of government or international governance institutions, behavioural/cultural responses are the most common response of all actor types. However, there are differences in relation to the relative association of actors and responses (Fig. 4). Individuals and households are mainly associated with responses related to behavioural/cultural adaptation and less with institutional responses, compared to all other actor types. For government actors, including international and multinational governance institutions, institutional responses rather than behavioural/cultural and ecosystem-based responses are the most common.

Overall, there is limited evidence in the GAMI database of deeper, potentially more transformational, forms of adaptation. All actor types are most often associated with low-depth adaptations, that is, responses that are characterised by continuation or only small changes to existing practices. The observations reveal that responses of medium or high depth are frequently associated with case studies in Small Island States, institutional adaptation, international governance institutions, and the role of

coordinating interaction. They are less likely to be associated with studies that report on behavioural/cultural responses and the role of monitoring and evaluating (see Table 2).

### Table 2

**Characteristics of medium-to-high-depth responses**. Statistically significant (p < 0.05) odds ratios of the ordered logistic regression predict depth levels. The coefficients (ORs) are the odds ratios of low versus medium depth or medium versus high depth when there is a given variable. Studies that mention Small Island States, for instance, have a 1.3 times higher likelihood to be associated with higher depth levels than studies that do not mention Small Island States.

	Ordered regression coefficient	Standard error	p- value
Small Island States	1.308	0.401	0.001
Behavioural/cultural	-0.651	0.180	0.000
Institutional	0.553	0.161	0.001
International or multinational governance institutions	0.569	0.269	0.034
Coordinating interaction	0.392	0.185	0.034
Monitoring and evaluating	-0.736	0.260	0.005

### Discussion

Our findings reveal several crucial mismatches and implementation gaps in climate change adaptation. On the one hand, individuals and households are implementing adaptation the most but are not involved in institutional responses. On the other hand, government actors are helping plan and fund adaptation, but may not be recognizing the need to implement climate change adaptation measures. Furthermore, it is concerning that the required coordinated and transformative adaptation is by no means the norm globally as yet.

Our finding of strong evidence for individuals or households implementing adaptation aligns with the concept of adaptation as a highly localised phenomenon, as well as a tendency towards autonomous and incremental adaptation.<sup>27,28</sup> While we define implementation in a broad sense (i.e., including the implementation of policies and strategies beyond the physical implementation), our findings reflect a bias in studies that examine behavioural adaptation.<sup>1</sup> However, the fact that the implementation of responses is mainly in the hands of individuals or households, some of whom have limited resources, represents a crucial implementation gap, given that the (non-binding) agreements were ratified by state actors (e.g., UN SDG 13 on Climate Action).

There is limited evidence of individuals being involved in institutional responses. This is problematic considering the need to develop a better understanding of how institutions can adjust to climate changerelated challenges in an inclusive and fair manner<sup>29</sup> and our findings that institutional responses are more transformative. Similarly, the emphasis on behavioural responses rather than ecosystem-based adaptation highlights the urgency for more research on the role of local stakeholders in ecosystem-based adaptation, given the evidence that such measures rely significantly on the involvement of local communities.<sup>30,31</sup>

This actor mapping shows that the most vulnerable people are the most visible in the literature. This also indicates that vulnerable people and communities are taking on roles that should belong to state actors. Despite the general role of government actors in planning, there is a mismatch between rural and urban areas. The lesser attention of national governments to rural areas links to general questions related to the relationship between governmental planning and local adaptation, especially when national plans do not result in tangible adaptation at the local level.<sup>18</sup>

While adaptation is generally considered a multi-actor process,<sup>4</sup> there is limited evidence of collaboration between more than two different actor types (i.e., public, private, governmental). Local civil society actors appear to play important coordinating roles in support of climate-related responses. In the absence of governmental action, non-state actors eventually engage in implementation processes.<sup>32</sup> The dominance of studies that refer to only one actor type as being explicitly involved in adaptation raises the question of whether this is due to a research bias of focusing on individual actor types or relates to government programmes that incentivise individual action. Future research should thus aim to explore the relationships between actors working on climate change adaptation in different contexts.

Our findings clearly identify actors that are underrepresented in climate change adaptation research, such as the private sector. Indeed, there is evidence of a lack of implemented adaptation by the private sector.<sup>33</sup> Exploring the implications of greater participation by private sector actors in adaptation measures, especially in financing and implementation processes, would be important to understand the enablers, barriers, and responsibility-shifts in climate change adaptation.<sup>34,35</sup> Academia is more prominently documented as being involved in monitoring and evaluation; a role that is underrepresented in research on more transformative responses. This shortcoming raises concerns over why this important step in adaptation is not mainstreamed into implementation action by government, civil society, and private actors, or in explicit collaboration with academia. The reliance on academia to take this role highlights the problems with evaluating how and for whom adaptation is effective.

We found a high proportion of studies on rural areas, which may reflect that documented adaptation is mainly occurring in the agricultural sector. Moreover, we also found mainly rural case studies related to the Global South, the regions where the effects of climate change are already clearly felt and, thus, adaptation measures seem particularly relevant.<sup>1,36</sup> However, with increasing urbanisation and tangible impacts on urban populations, this research focus is already shifting towards urban areas.<sup>14,37</sup> Differences regarding certain actors, such as government actors being more often documented in the Global North and individuals or households in the Global South, highlight the relevance of regionally sensitive reporting on climate change adaptation progress. Nevertheless, it raises questions related to

'local' versus 'public' or national responsibility in rural versus urban contexts that are crucial to ensure equitable and effective adaptation action.<sup>18</sup>

The global synthesis reports limited evidence of transformational adaptation.<sup>1</sup> Our findings that individual and behavioural responses are mainly related to a low depth of adaptation clearly show the discrepancy between what is reported as actually needed—local community support and multi-actor adaptation<sup>38</sup>—and what is happening and documented in the most comprehensive databases. Our findings also align with the existing evidence base by confirming that Small Island States are climate change hotspots and are already confronted with more transformative responses, such as relocation, which involves collaboration among formal and informal actors and institutions.<sup>39–41</sup>

# Online methods

We built on GAMI's systematic literature mapping, which provides a global stocktake of human adaptation-related responses to climate-related changes in human systems.<sup>1</sup> Combining a novel approach that integrates systematic reviewing and machine-learning, diverse databases were searched, including Web of Science, Scopus, PubMed, and Google Scholar, to assess 48,316 scientific documents on adaptation published in peer-reviewed literature between 2013 and 2020. With this method, only evidence on adaptation documented in this body of literature is included, and other forms of literature (e.g., grey literature) are excluded. After screening was done, based on the applied inclusion criteria, the data corpus was narrowed down to 1,682 publications relevant to human adaptation responses to climate change.<sup>1</sup>

# Screening

To explore the types of actors and the roles they play in climate change adaptation in greater detail, we conducted a further screening and coding of the GAMI literature. In the screening step, we filtered for articles with sufficient empirical information about the actors and/or the roles in the observed adaptation case studies and for articles of which full texts were available. Out of the 1,682 articles in the GAMI literature corpus, we selected 1,472 in this step (see Supplementary Material 1, Figure SM1.1) Our coding scheme included two main categories—actors and roles. The development of the coding scheme was inspired by a qualitative review approach<sup>42,43</sup> whereby at least two independent reviewers read a sample of the full texts and generated codes in response to the research questions independently. The authors then generated broad categories internally and applied the emergent framework to the remaining data corpus, while returning to previously coded documents to update the coding to reflect newly developed categories.

# Coding

The categorisation of 'actors' in climate change adaptation built closely on the GAMI methodology to provide the highest possible consistency. In the GAMI database, actors in climate change adaptation are

categorised into nine groups (organised by sector and level): individuals or households, civil society (subnational or local; international, multinational, or national), government (local; subnational; national), international or multinational governance institutions, and private sector (SMEs, corporations).

During a test coding phase in the development of the coding scheme, we coded a sample of the GAMI literature to identify whether additional codes should be added. In several case studies from the GAMI database, academic institutions were reported as having an explicit role in contributing to local climate change adaptation initiatives, so, therefore, we added 'academia' as a specific actor type. The definition of an actor for the coding is 'a social entity, that is, a person or organization, or a collective of persons and organizations, which is able to act'<sup>44</sup>. Moreover, we focused on 'operators' exercising adaptation, rather than 'receptors' of adaptation or 'exposure units', while acknowledging that these might overlap.<sup>16</sup>

Roles in adaptation—the key aspect of this review—were not coded in GAMI. Articles in GAMI provide extreme diversity in the degree of detail provided for particular actors and potential roles. We started with a broad categorisation of stages in the adaptation process,<sup>17</sup> on the one hand, and a particularly detailed conceptualisation of roles and responsibilities in adaptation,<sup>7</sup> on the other hand. This process resulted in a coding framework with seven roles. We distinguished the roles awareness raising, assessing, planning, financing, implementing, coordinating interaction, and monitoring and evaluating as relevant phases in climate change adaptation that may build on each other (see Supplementary Information 1, Figure SM1.2). However, the respective roles do not always follow in the sequence shown but may also overlap or performed in parallel by different actors. For example, the roles financing and coordinating interactions were found to be important foundations for any action, but can also run throughout the phases.

While the GAMI database provides information about regions and sectors, including evidence from urban and rural areas, it does not systematically distinguish between these settlement types. Since the roles of different actors may differ greatly in urban and rural areas, we added an additional code for settlement type, distinguishing urban, rural, and ambiguous settlements.<sup>45</sup>

Two independent reviewers did the screening and coding of each article to minimise bias, using the online platform 'Sysrev'.<sup>46</sup> A third reviewer resolved conflicting codes. After these were resolved, the new dataset was merged with the GAMI dataset. To address the question regarding regional patterns, we used the GAMI category geography, which categorises the papers according to the IPCC regions. Regarding different types of responses, we used the GAMI categories, which distinguish behavioural/cultural, ecosystem-based, institutional, and technological/infrastructural responses. Finally, to address the question of potentially transformational adaptation, we used the variable 'depth', which categorises adaptations as involving a low, medium, or high level of change. A high level of depth can serve as an indicator for transformational adaptation since it 'reflect(s) entirely new practices that involve deep structural reform, complete changes in mindset, major shifts in perceptions or values, and changing institutional or behavioural norms'.<sup>1</sup>

# Analysis

All analyses were performed using R Statistical Software.<sup>47</sup> We merged the GAMI database with our additional coding regarding actors and roles. This resulted in a data frame that contains various categorical variables, for which we calculated descriptive statistics. First, we cross-tabulated each actor type with the role, settlement, region, response, and depth variables. In cases where records mentioned more than one category per variable (such as more than one actor type), the record was treated as multiple observations, with each given a new row in the data frame. To determine whether certain variable combinations occur more or less frequently than expected if the null hypothesis were correct, we performed the chi-square test of independence. We calculated the residuals to identify which category combinations make the greatest contribution to the chi-square test results. The tests were performed for various variable combinations, such as actor-actor combinations, actor-role combinations, and actor-role combinations between regions.

To understand variables associated with higher depth levels, we conducted an ordered logistic regression using R's MASS package.<sup>48</sup> We specifically included the variables geography, response types, adaptation roles, actors, and settlement type as predictors for depth levels. All categorical predictor variables were dummy-encoded as binary variables to allow for ordered logistic regression, and the response variable (depth) was encoded as an ordered factor containing the levels 'low', 'medium', and 'high'.

# Limitations

Data from GAMI only consider evidence from responses documented in peer-reviewed literature and excludes mere commitments, strategies, or visions. Many on-the-ground responses to climate-related hazards may not be included in peer-reviewed literature but documented in other forms of literature (i.e., grey literature), for example, reports by the private sector or civil society actors. Similarly, GAMI is strongly biased towards English-language literature due to the search string, which excludes evidence published in other languages, and, thus, potentially implies an underrepresentation of evidence on adaptation from non-English speaking countries. Inclusion of languages other than English would therefore be a valuable step in future projects mapping global adaptation.<sup>49,50</sup>

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### **Figures**



### Figure 1

Actors and their roles in adapting to climate change. Results of the chi-square test calculating the residuals, that is, the difference between the observed and the expected frequency of each combination of actor and adaptation role, are shown. Residuals below -2 and above 2 can be considered significant. Positive residuals (blue) indicate a higher observed frequency of an actor-role combination, and negative residuals (red) indicate a lower than expected frequency. The size of the circles corresponds to the value of the residuals. X-squared = 610.77, df = 70, p-value < 0.001.



### Figure 2

**Multi-actor constellations in adaptation.** Frequency (vertical bars) of actor types reported (horizontal bars), as well as how often they were reported as single actor type in a study (single dots and vertical bar) or in combination with other actor types (connected dots, and vertical bars).



### Figure 3

Relative frequency of actor types as reported in publications per a) settlement type and b) region.



### Figure 4

Actor types per response type. Results of the chi-square test calculating the residuals, that is, the difference between the observed and the expected frequency of each combination of actor and response type. Residuals below -2 and above 2 can be considered significant. Positive residuals (blue) indicate a higher observed frequency of a respective actor-response type combination, and negative residuals (red) indicate a lower frequency than expected. The size of the circles corresponds to the value of the residuals. X-squared = 87.552, df = 30, p-value < 0.001.

### **Supplementary Files**

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- SupplementaryMaterial1.docx
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