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Erratum: In the original publication of this paper there was an error in the author affiliations. The paper was updated on 24 February 2025.

Dichotomy or continuum? A global review of the interaction between autonomous and planned adaptations

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ABSTRACT. Adaptation to climate change is often conceptualized as a dichotomy, with responses being either planned (formal and structured) or autonomous (organic and self-organized, often known as "everyday adaptation"). Recent literature on adaptation responses has highlighted the existence and importance of the interplay between autonomous and planned adaptation, but examination of this interaction has been limited to date. We use a global database of 1682 peer-reviewed articles on adaptation responses to systematically examine autonomous and planned adaptations, with an emphasis on how these types of adaptations interact with one another. We propose a third category, mixed adaptation, which demonstrates characteristics of both autonomous and planned types, and which recognizes nuances in how organization, external support, formality, and autonomy manifest in the fuzzy space between the two. We find that more than one-third of articles reporting on adaptation responses fall into this mixed category, with cases across sectors and world regions. We develop a qualitative typology of mixed adaptation that identifies nine ways that autonomous and planned adaptation interact and influence each other both positively and negatively. Based on these findings, we argue for more nuanced examinations of the interplay between autonomous and planned adaptation and for conceptualizing adaptation planning as a continuum between the two rather than a dichotomy. Exploring the patterns of interplay from a large database of adaptation responses offers new insights on the relative roles of both autonomous and planned adaptation for mobilizing adaptation pathways in locally relevant, scalable, effective, and equitable ways.

Key Words: *climate; adaptation; everyday; governance; autonomous; planned*

INTRODUCTION

Climate change adaptation, which we define as any human response that could reduce risks related to actual or expected climate change, has evolved beyond a simplistic view of a singular action and is being increasingly recognized as a multifaceted, interdependent, and complex process (Adger et al. 2005, Singh et al. 2016, Eriksen et al. 2021, Orlove 2022). To explore and better understand this complexity, adaptation scholarship has identified several categorical conceptualizations of adaptation based on intent, function, spatial scales, spatial scope, depth, timing, duration of benefits, and spontaneity (Smit et al. 2000, Kates et al. 2012, Rickards et al. 2012, Pelling et al. 2015, Berrang-Ford et al. 2015, 2021, Magnan et al. 2016, Wilson et al. 2020, Singh et al. 2021). As communities worldwide face the impacts of climate change, there is growing attention on the relative roles of these different types of adaptation to help reduce current and projected climatic risk (Eisenack and Stecker 2012, Berrang-Ford et al. 2021, Eriksen et al. 2021, Singh et al. 2021). In parallel, there is also a growing theoretical basis (Magnan et al. 2020, Schipper 2020), supported by anecdotal evidence (Rahman et al. 2021), that actual adaptation often cannot be categorized dichotomously.

In this study, we focus on one common conceptualization of adaptation: autonomous adaptation - sometimes known as "everyday adaptation" - and planned adaptation. The literature

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presents a range of diverse and evolving definitions (and terminology) for these types of adaptations, which we synthesize in the subsequent section. Autonomous adaptations are most often described as "everyday," local, or self-organized practices that are undertaken by actors without external support or explicit consideration of external causes; for example, a farmer adjusts planting times or locations to deal with changes in growing season. In contrast, planned adaptations often emerge from strategic and formal processes designed to respond to external changes, such as climate change, and they tend to be larger in scope and scale with higher levels of organization and institutional support (Biagini et al. 2014); for example: national programs to develop and implement heat-resistant crop varieties. Though both adaptation types can be crucial for reducing climate risk depending on the context, the two have often been perceived and defined as the opposite or in negation of the other (Adger et al. 2007, Easterling 2007, Kates et al. 2012, Rahman and Hickey 2019, Rahman et al. 2021, Ehsan et al. 2022).

A few recent case studies have criticized this dichotomous representation, highlighting the potential of interplay or interaction between these two types of adaptation (Doherty et al. 2017, Mersha and van Laerhoven 2018, Rahman et al. 2021, Juhola et al. 2022, Lindegaard and Sen 2022). Such studies suggest that rather than the two types of adaptation occurring in isolation, there are instead interdependencies, trade-offs, and potential for collaboration between them. Scholars have hence argued that future adaptation policies and actions need to be informed by a deeper understanding of the interactions between planned and autonomous adaptation (Eriksen et al. 2021, Juhola et al. 2022).

Understanding interactions between autonomous and planned adaptation matters intellectually and for adaptation policymaking. These understandings impact the kinds of activities that we recognize as adaptation, what we choose to monitor and evaluate, and who receives financial and technical resources. National governments and multilateral organizations, which shape adaptation policymaking and fund specific programs and projects, tend to rely on the dichotomous framing of autonomous and planned adaptation. For example, the Global Stocktake process conducted under the UN Framework Convention on Climate Change (UNFCCC) currently focuses on adaptation indicators for stocktaking planned adaptation, which do not necessarily account for autonomous adaptation and the spectrum of responses between autonomous and planned. There is thus a need to continually examine and interrogate these conceptualizations and how we transfer them into policy framing, funding, and monitoring global progress on adaptation.

Although a handful of case studies have highlighted the interplay between autonomous and planned adaptations, there has not yet been a systematic global assessment of the prevalence of these interactions and the form(s) they take. This study systematically examines a global database of 1682 peer-reviewed articles to determine whether and how planned and autonomous adaptation interact and to characterize those interactions. Based on quantitative analyses, we first illustrate that many adaptation responses often thought to be purely autonomous or planned are in fact "mixed," in that they demonstrate characteristics of both. We also present quantitative results on how adaptation outcomes may differ across autonomous, planned, and mixed adaptation. Finally, based on a qualitative typology of mixed adaptation, we introduce the concept of a "continuum" of autonomous and planned adaption and identify different ways in which the two types of adaptation complement, support, resist, constrain, or even co-exist with each other. Overall, our results highlight the relative roles that both planning as well as everyday strategies and autonomy can play in enabling adaptation in locally relevant, scalable, effective, and equitable ways.

Understanding autonomous and planned adaptation

There are multiple definitions, terminologies, and understandings of autonomous and planned adaptation (Noble et al. 2015). The first mention of autonomous adaptation in the IPCC's second assessment report (SAR) refers to autonomous adaptation as occurring "without specific human intervention," i.e., only in reference to adaptation in natural or ecological systems (Watson et al. 1997). This emphasis could be the result of the earlier focus on biophysical systems of the IPCC reports, or it could point to autonomous adaptation originating in natural or ecological science. In this study, we do not use this early definition focusing on ecological system, as we analyze adaptation responses in human systems. The subsequent third (TAR), fourth (AR4), and sixth (AR6) IPCC assessment report glossaries define autonomous adaptation (broadly) as "adaptation that does not constitute a conscious response to climatic stimuli" (Parry et al. 2007, Field et al. 2014, IPCC 2023). This definition better accounts for human systems, but aligns more with terms such as "agnostic," in that it assumes an action is undertaken without implicit or explicit reference to climate change as a driver of a response (Koslov 2019). The IPCC definition overlaps with Smit et al. (2000), who define autonomous as "automatic, spontaneous, and passive" and planned as "strategic, deliberate, and active." However, even within the various IPCC report chapters, there are references to slightly different understandings of autonomous adaptation. For example, in TAR Ch. 1 autonomous is referred to as "without external intervention" (p. 88), similar to other definitions (e.g., Smit et al. 1996, Thorn et al. 2015). The IPCC reports also make many references to literature which imply autonomous adaptation to be individual and community adaptation, without governmental influence or intervention (Stringer et al. 2010, Forsyth and Evans 2013, Leclère et al. 2013, Bawakyillenuo et al. 2016, Khanal et al. 2019, Rahman and Hickey 2019, Berrang-Ford et al. 2021).

Another understanding of autonomous that has emerged in recent literature is "everyday adaptation" (Artur and Hilhorst 2012, Strengers and Maller 2017, Castro and Sen 2022, Juhola et al. 2022, Lindegaard and Sen 2022), which has also been documented under other closely-related terms such as everyday resistance (Scott 1986, Johansson and Vinthagen 2016), everyday practices (Ross 1996), everyday agency (McMichael et al. 2019), and coping (Nunn and Kumar 2019, Korovulavula et al. 2020). This understanding is "based on how affected communities perceive and frame their vulnerability" (Forsyth and Evans 2013, Rahman and Hickey 2019) and focuses on routine, daily, often overlooked actions related to changing social-ecological conditions (Lindegaard and Sen 2022). These slight distinctions in definitions and understandings of autonomous adaptation are related to differing understandings of spontaneity and action that

occurs without apparent external intervention as: a) without influence of an external actor or agent or b) without reference to a climatic stimulus. Similarly, Noble et al. (2015) also note two camps for defining autonomous adaptation: a) actions that can be described as bottom-up, carried out by agents without external inputs, or, b) actions that are in reaction to experienced climate impacts (stimuli) and can be considered routine or automatic. The prior is aligned more with the definitions given by the IPCC, whereas the latter aligns more with recent definitions and conceptualizations of everyday adaptation. Recent discussions on autonomous or everyday adaptations are starting to acknowledge that there may not be a perfect way to conceptualize all the complex spatial, temporal, and actor dimensions of this type of adaptation (Lindegaard and Sen 2022). Whether actions are "truly autonomous" or not will likely continue to be debated. For this study, we draw on more recent understandings of autonomous adaptation: self-organized responses, drawn from lived experiences of those affected, and without influence of external actors. We elaborate on the process by which we determined a definition for this analysis in the methods section.

The definition of planned adaptation is more clear-cut than autonomous adaptation. The TAR and AR4 glossaries define planned adaptation as "the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change" (McCarthy et al. 2001, Parry et al. 2007, Field et al. 2014, IPCC 2023). Planned adaptations are commonly initiated by governmental and other public bodies, as interventions through projects, programs, policies, or strategies (Rahman et al. 2021). They can include capacity-building interventions, provision of climate information services, development of climate-resilient infrastructure projects, and adaptation finance strategies, in addition to climate-related policies and regulations (Biagini et al. 2014). In this light, they are often conceived as "top-down." However, planned adaptation is not always top-down and recent literature has highlighted planned responses that are led by communities or grassroot organizations, where government agencies serve as a supporter or facilitator of bottom-up actions (Yarina et al. 2019, Ajibade et al. 2022). The one sticky aspect of defining planned adaptation is its association with deliberateness or intentionality. We discuss this issue in the next section.

Dichotomous framing and its consequences for undervaluing autonomous adaptation

Since planned adaptation has often been defined as "intentional" or "deliberate" (Smit et al. 2000, Dupuis and Biesbroek 2013, Boeckmann and Rohn 2014), this has led to the frequent portrayal of autonomous as not deliberate or non-intentional, and further as reactive, short-term, low-impact, and largely ineffective (Eisenack 2012, Forsyth and Evans 2013, Preston et al. 2015). This narrow understanding of autonomous adaptation is misleading, both definitionally and contextually (Christoplos et al. 2009, Thornton and Manasfi 2010, Bonzanigo et al. 2016). It overlooks the fact that a large proportion of adaptation actions occur autonomously, at the individual and household level (intentionally or not), without formal institutional support (Ziervogel and Taylor 2008, Berrang-Ford et al. 2011, 2021, Noll et al. 2022). These actions are not only locally relevant, but often effective (Christoplos et al. 2009, Olazabal and Ruiz De Gopegui 2021, Rahman et al. 2023, Vincent 2023). Recent literature also shows that groups impacted by climate change can view autonomous adaptations as acts of sovereignty, where they draw on their own experiential knowledge and exercise agency, independent of outside intervention (Forsyth and Evans 2013, Orlove et al. 2019, Ford et al. 2020, Araos et al. 2021, Pisor et al. 2022). Despite growing recognition of its local relevance and effectiveness under some circumstances, the value of autonomous adaptation is not widely acknowledged (Füssel 2007, Goklany 2007, Klein and Juhola 2018, Rahman and Hickey 2019, Orlove et al. 2023). The definitional inconsistencies and dichotomous framing have led to normative misunderstandings of autonomous as less effective (Rahman et al. 2023, Vincent 2023) and, therefore, not as valuable for future adaptation pathways (Easterling 2007, Füssel 2007, Kala et al. 2023). Both planned and autonomous can be effective and ineffective for risk reduction, depending on the circumstances and, potentially, the ways in which they interact.

Another consequence of the dichotomous framing is that the concurrent existence of, and interaction between, autonomous and planned adaptations is often overlooked. A handful of studies examine the interaction between autonomous and planned adaptations and have shed light on the complex nature of the interplay that can occur between the two. For instance, planned adaptations, such as regulations or subsidies, may facilitate and encourage autonomous actions, but can also be at odds with autonomous local strategies, especially where cultural, traditional, and context-specific factors are ignored (Chambwera et al. 2014). This was the case, for example, in Ethiopian farming communities, where the interactions between planned and autonomous adaptation led to positive impacts at a community level by expanding autonomous options through additional resources. At the same time, the interactions also negatively impacted female-headed households for whom the time and labor demands of planned actions constrained their ability to undertake autonomous actions (Mersha and van Laerhoven 2018). Thus, the study suggests that "planned adaptation policy intervention needs to recognize the heterogeneity of actors and their autonomous adaptation to minimize the trade-offs across members of the community and to ensure [gender] equity." In another example in Australian montane forest communities, Doherty et al. (2017) show how a hierarchy of adaptation strategies may be used to adapt to changing fire regimes over time, starting with autonomous fuel reduction strategies that evolve into more planned land use responses to cope with the increasing scale and degree of climate impacts (Doherty et al. 2017). Other recent literature emphasizes how planned adaptation can interact with and learn from Indigenous Knowledge-based and local innovation-based autonomous adaptation actions to avoid government policy-driven maladaptation (Singh et al. 2018, Wang et al. 2020, Gianelli et al. 2021, Rahman et al. 2021). Several scholars have called for broader and more nuanced examination of adaptation actions to identify how autonomous and planned actions may occur independently, and how they connect and interplay with each other (Malik and Smith 2012, Forsyth and Evans 2013, Mersha and van Laerhoven 2018, Juhola et al. 2022, Lindegaard and Sen 2022, Orlove et al. 2023). This study contributes to this literature through a systematic empirical inquiry that quantitatively and qualitatively reviews a global database on adaptation research, investigating the space between autonomous and planned types of adaptation.

METHODS

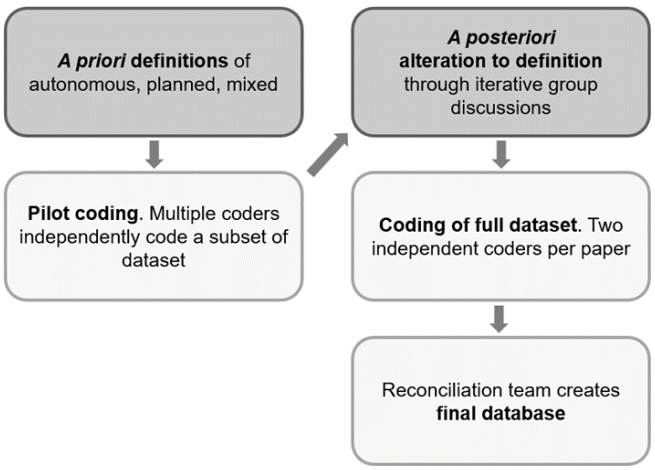
Global database of adaptation-related responses

To examine autonomous and planned adaptations, and their interplay (i.e., mixed adaptations), we use a large database of adaptation responses, collated as part of the Global Adaptation Mapping Initiative (GAMI; Berrang-Ford et al. 2021). GAMI is a global research collaboration that systematically documented adaptation-related responses in human systems described in peer-reviewed articles published between 2013 and 2019. The GAMI team comprises over 120 researchers worldwide with expertise in adaptation research and practice. A total of 1682 articles reporting on adaptation responses were included in the final GAMI dataset and were coded for 70 variables. Inclusion was predicated on four criteria: that the article focuses on human systems; documents actual adaptation (not theoretical or simulated); has a clear conceptual link to climate change (as opposed to other environmental stressors); and has a majority focus on adaptation (as opposed to mitigation or impact). Each article in the GAMI database was coded by at least two members of the coding team. Coding focused on a few fundamental questions: What climate hazards are driving responses? Who is responding? What types of responses are documented? Do adaptations have transformative potential? The final GAMI database includes answers to closed questions as well as open-ended narrative questions (these are termed as GAMI entries). The former facilitated quantitative categorical analysis (for example, descriptive statistics and summarizing studies in ordered tables), whereas the latter facilitated qualitative analysis and a contextual understanding of adaptation. More details on the screening and coding protocol of the GAMI are database discussed in Appendix 1 Section 1.1. The GAMI questions and codes used in this analysis are described in Appendix 1 Section 1.2.

Additional Coding for autonomous, planned, and mixed adaptation

The GAMI database was not systematically coded for autonomous, planned, and mixed types of adaptation, so a team of nine coders and three reconcilers (from this manuscript's author team) conducted an additional set of coding for this study, based on the entries in the GAMI database. Following a detailed coding and reconciliation protocol (Fig. 1), each of the 1682 GAMI articles was coded for: (i) whether the response was autonomous, planned, or mixed; and (ii) details on adaptation response type or the specific action (hereafter referred to as detailed response type). Coding for autonomous, planned, and mixed followed definitions refined through an iterative process described in the next paragraph. Coders also provided an open-ended, written rationale for the classification, which often included supporting text or quotes drawn from the GAMI database entries, and specified a confidence level (low, medium, or high) based on the quantity and quality of the evidence. Coding for the detailed response type allowed for further specification of the "adaptation response type" coded in the original GAMI database, which had only four broad response types (behavioral, technological, institutional, and ecosystem-based). The detailed information on response type was coded by extracting terms directly stated in the GAMI database (e.g., climate-smart agriculture, climate information services, soil conservation, etc.) and were not specific to any one sector or actor type (details in Appendix 1, Table S1).

Fig. 1. Iterative process followed for developing the coding protocol (including defining autonomous, planned, and mixed adaptation) and coding the articles.



We specified definitions of autonomous, planned, and mixed adaptation through an iterative process. First, we drew on the literature to develop *a priori* definitions of autonomous and planned adaptation (e.g., Smit et al. 2000, Forsyth and Evans 2013, Rahman and Hickey 2019). Our *a priori* definitions are provided in Appendix 1 Section 1.1 and the *a posteriori* definitions, the final definitions used to code adaptation responses in GAMI entries, are provided in Table 1. We refined the definitions and examples for each of the three types through a three-phase pilot coding exercise. First, the nine coders and three reconcilers participated in a workshop to discuss and reach a common understanding of the definitions. Second, each coder coded the same batch of 25 article entries in the GAMI database. To ensure that GAMI entries provided sufficient information to accurately code, each coder also revisited the original text of the 25 articles to verify that the complete information aligned with codes based on GAMI database entries. Finally, we reconvened in a follow-up meeting to check consistency across coders. In this iterative definition setting and coding quality assurance process, we paid particular attention to the debates surrounding what is "truly" an autonomous or a planned action (as we detail in section 1.1) and deliberated the ambiguities that arise when dealing with the response and actor-type related complexities that manifest in adaptation responses. Hence, we discussed several gray areas and edge cases in order to resolve lingering discrepancies in coders' understanding of our definitions. We also discussed how nuances in external support, formality, and autonomy often manifest in the fuzzy space between autonomous and planned. Considering the nuances of the definitions, we also decided to have each GAMI entry coded by two independent coders, followed by a code-reconciliation process (detailed in the next section).

A posteriori definitions of key words and reference examples formed the basis for our detailed coding protocol (Table 1), which guided the full coding exercise. Our *a posteriori* definition of autonomous adaptation is aligned with more recent understandings of autonomous adaptation (as outlined in section 1.1), which focus on self-organization, lack of external agents,

Table 1. Final definitions in the coding protocol for autonomous, planned, and mixed, including examples and key words.

	Autonomous	Planned	Mixed
Code definition	An article was coded as autonomous if the response(s) is primarily self-driven and initiated by the actor/s who are impacted (individual, household, community, or other groups) without any external support (from outside the impacted group/s). These adaptations are often undertaken without any structured or organized governance or funding or external support.	An article was coded as planned adaptation if the response is undertaken in a more organized manner within the structure of a project, program, financial mechanism, policy, etc. Many of these responses receive formal means of support or funding i.e., from governmental agencies, aid agencies, NGOs, etc. These efforts are often intentional, planned, and coordinated.	An article was coded as mixed if it demonstrated characteristics of both autonomous and planned adaptation, i.e., if articles described clearly self-driven autonomous responses which co-occurred with more planned or structured adaptation measures.
		The difference between autonomous and planned is less about the type of action or actor but rather how it is implemented, i.e., soil conservation undertaken independently by farmer or through an incentive program.	The key distinction between categorizing this fully as planned versus mixed is that there are clearly some actions that are self-driven responses without support, but then there are also additional structured measures.
Key words and ideas	Self-driven responses; Occurs independent of external support or agencies outside of those impacted; Often occur more organically and are self-organizing; Often are driven by immediate needs; Sometimes but not always described as coping;	Actions are often undertaken as part of a formal project or program or policy; Responses are often supported by an external agent or a formal organization; Dependent on external support or formal agencies; Mobilize institutions or policy; Are often more deliberate/ intentionally designed responses rather than immediate coping measures;	Autonomous and planned undertaken simultaneously; Some actors are undertaking actions under a program, while others undertake actions autonomously; Autonomous responses are supported or supplemented by planned; Other such examples of interactions or interplay between autonomous & planned responses;
Examples	Farmer-driven change in planting dates; Farmers undertake soil or water conservation measures; Farmers migrating to find other part-time work	Climate resilient agriculture program; Payment for Ecosystem Services (PES)	Change in planting dates and soil conservation (autonomous) supplemented by capacity building from extension or governmental agencies on soil conservation

and everyday experience. We do also draw, however, on the notion of autonomous adaptation as spontaneous. Overall, our detailed definitions and protocol were simply a means to conduct a consistent, empirical investigation, rather than a proposal for new definitions or framing for autonomous or planned adaptation. Our primary goal was to examine the extent to which there was an interplay between the two i.e., where and to what extent "mixed" responses were present.

During the full coding exercise, the 9 coders each coded 350–400 articles. Each entry was coded by two individuals. Following completion of all coding, three authors reconciled the entries where the two codes did not match or at least one coder had entered "unclear" or NA (n = 426 out of 1682 total articles coded; intercoder reliability of 75%). Out of the 426 articles that were reconciled, 217 articles had at least one coder suggesting that there was not enough information to code the article. So, the true errors, in terms of reliability of the autonomous, mixed, and planned coding, only occurred in 209 of the 1682 articles i.e., 12% error. For these 426 entries, the three reconcilers drew on the coders' confidence level and open-ended justification to assign a final code. If the coding and GAMI entries provided insufficient information, the reconciler revisited the full text of the article. We excluded 94 articles during reconciliation because of insufficient information to code for adaptation type. The final database for this analysis is thus 1588 entries, each representing an academic article that documents an adaptation response in human systems.

It is important to note that though we refer to autonomous, planned, and mixed adaptation up to this point, our final database consists of codes referring to academic articles reporting on adaptation responses, not adaptation responses *per se*. This distinction has implications for how we interpret our results, particularly our quantitative results where the numbers refer to academic articles and not number of adaptation responses. We call attention to four key limitations of our database. First, because the GAMI database captures only peer-reviewed literature, it is more likely to identify some types of adaptation than others. For example, the GAMI database does not elucidate adaptations documented in gray literature or adaptations being realized completely autonomously with no formal documentation (Torhan et al. 2022). Second, because academic articles have their own research focus, there is likely to be information missing about the systems that are being studied. Third, the GAMI database only includes peer-reviewed articles that explicitly mention or have a clear conceptual link to climate change. This means that while certain actions could be considered adaptation, such as agroforestry, if the peer-reviewed article only labels it as a sustainability practice and not as climate adaptation, it is not included in the database. Fourth, only a few articles in the GAMI database specifically focus on the interplay of autonomous and planned adaptation, again limiting the information available. We further elaborate these limitations and their implications for our findings in the discussion. We emphasize, however, that even with these caveats, the use of a large database allows us to develop a deeper theoretical understanding of how different adaptation types occur and interact with each other across a broad range of contexts.

Quantitative and qualitative analysis

We analyzed the coded data using three different methods: basic descriptive statistics, regression analysis, and development of a qualitative typology of mixed adaptation through inductive,

thematic synthesis. First, basic counts and descriptive statistics were generated for the new codes of autonomous, planned, and mixed types. We then cross-tabulated these codes with six codes from the GAMI database to examine how autonomous, planned, and mixed adaptation varied across world regions, sectors, actor types, response types, equity in implementation, and adaptation depth and scope. The GAMI database uses the latter two codes - adaptation scope and depth - to assess the transformative potential of adaptation outcomes. This is based on a typology of different dimensions of transformational change developed by Termeer et al. (2017). In addition to these six codes from the GAMI database, we also cross-tabulated against two additional codes which were created as part of other published research conducted by the GAMI author team: the inclusion of overburdened, underserved, or underrepresented groups (hereafter referred to simply as underrepresented groups) in planning and implementing adaptations (Araos et al. 2021) and types of policy implementation tools used in adaptations (Ulibarri et al. 2022). The first allows us to determine the degree to which underrepresented groups are included in autonomous, planned, and mixed adaptation responses; the latter focuses on how policy tools differ across the three. We undertook eight cross-tabulations in total. Detailed definitions of these cross-codes are provided in Appendix 1, Table S2.

Multinomial, ordered, and binary logistic regressions were used (1) to corroborate the conditions under which the three different forms of adaptation occur, as well as their transformative potential through (2) depth, (3) scope, and (4) equity considerations through inclusion of underrepresented groups. First, we conduct two multinomial logistic regression: one that predicts autonomous or planned adaptation (versus mixed adaptation; Model1a, SM Table 3); and another that predicts mixed or planned adaptation (versus autonomous adaptation; model 1b, SM Table S4), with region, sector, actor type, response type, and policy tools for implementation as independent variables. We then conduct two ordered logistic regressions, which predict whether autonomous, planned, and mixed adaptation affects the probability that adaptation responses are medium or high (as opposed to low) in depth (model 2) and scope (model 3). To assess the likelihood of targeting any underrepresented group for autonomous, mixed, and planned, we use a binary logistic regression (model 4). More information on these models can be found in Appendix 1 - Section 2.2. R packages MASS and nnet were employed for regression analyses (Ripley 2021, Ripley and Venables 2022).

Finally, we developed a typology of mixed adaptation through qualitative, thematic synthesis of the narratives and quotes associated with responses coded as mixed. Following an inductive approach, two lead authors identified emergent themes and conceptual categories from all articles coded as "mixed." Themes were cross reviewed by two other lead authors. We did not conduct comprehensive coding for these thematic categories since many entries classified as mixed lacked sufficient detail to characterize the nuanced interaction between autonomous and planned adaptation. The qualitative typology thus includes only articles that provide sufficient detail and, therefore, serves as an illustrative description rather than as a strict categorization.

RESULTS

Prevalence and process of autonomous, planned, and mixed

We found that a significant proportion of the adaptation articles reviewed report on adaptation responses which were mixed, in that they had aspects of both autonomous and planned adaptations. Of the articles in the GAMI database (557/1588 articles), 35% were classified as containing mixed responses, 44% as autonomous (691/1588 articles), and 21% as planned (340/1588 articles). Mixed adaptations were prevalent in adaptation articles across many geographic regions and sectors, ranging from 37% of articles in Australia and Asia to 31% in Europe (Fig. 2) and from 44% in the water sector to 30% in cities (Appendix 1, Fig. S1).

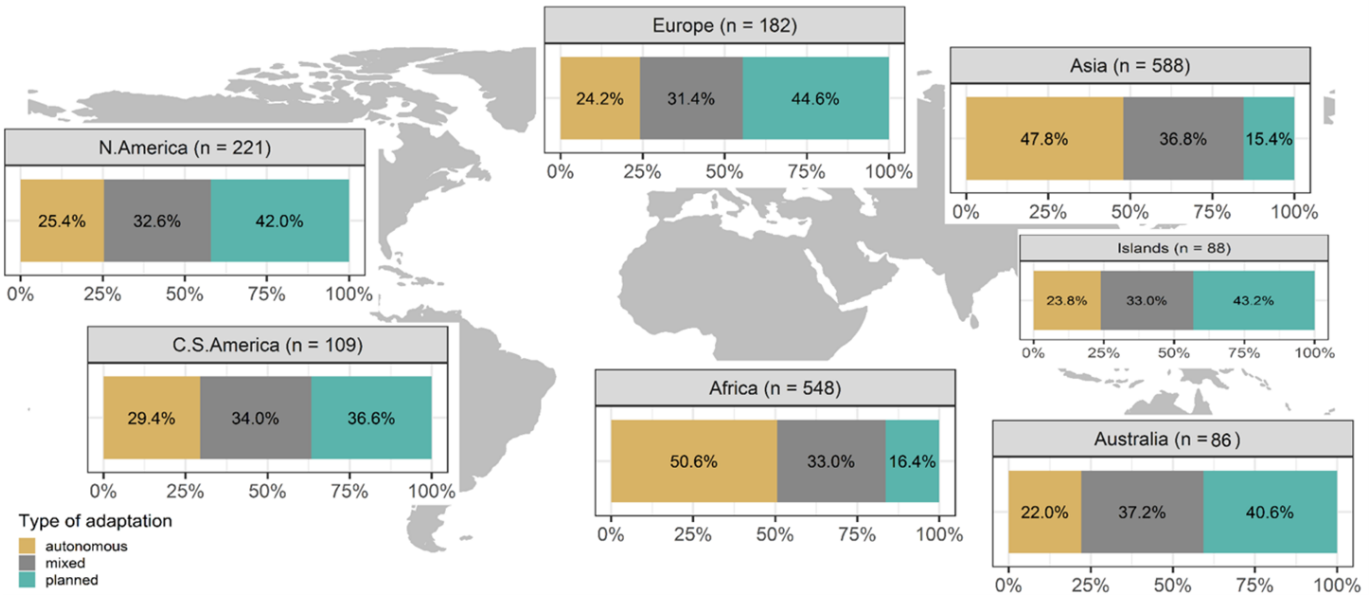
In addition to prevalence, we also investigated the process through which these adaptations unfold in practice. Process was examined through the types of actors involved, types of responses undertaken, and tools used for implementing these responses. The descriptive statistics show that articles coded as containing mixed adaptation more often involve multiple actors and more often combine response type (for instance using both technological and behavioral responses; Appendix 1, Fig. S2). The regression analysis reveals that mixed adaptations are significantly and positively associated with civil society organizations, both international/multi-national (coefficient = 1.421, $p < 0.001$) and subnational/local (coefficient = 0.451, $p < 0.05$), in comparison to autonomous adaptations (Appendix 1, Table S4), indicating the prominent role of non-governmental organizations in many mixed adaptations.

Figure 3 qualitatively shows the breakdown of detailed response types under each of the three types of adaptation. Community-led actions were spread across autonomous, mixed, and planned. For some of these actions, the problem-solving and implementation comes solely from the community, while others involved collaboration with or support from local government bodies. Agriculture-related adaptations such as changes in farming practices, or soil and water conservation, were mostly coded as autonomous or mixed, as are livelihood adaptation, local and Indigenous knowledge-based adaptation, and migration responses. One potential reason for this is that these strategies are typically undertaken by impacted people on their own, and formal processes inadequately engage with local and Indigenous Knowledge systems. Within the mixed category, prominent responses include capacity-building actions and climate information services, which combine local resources and external guidance to support adaptation efforts. This finding is supported by the regression analysis, where mixed adaptation is positively and significantly associated with capacity-building (coefficient = 0.806, $p<0.05$), information sharing (coefficient= 1.425, $p<0.001$), and economic instruments (coefficient= 1.470, $p<0.001$) compared to autonomous adaptation (Appendix 1, Table S4). A more systematic qualitative typology of these mixed actions is presented in the section "Typology of mixed adaptation."

Outcomes of autonomous, planned, and mixed

We also examine how adaptation outcomes (in terms of their transformative potential and equity) varied between articles coded as autonomous, mixed, and planned (Table 2). Transformative potential of outcomes is examined through depth

Fig. 2. Distribution of autonomous, mixed, and planned adaptations across regions. Numbers in the chart represent the percent of total number of articles in that region that were categorized as autonomous, mixed, or planned adaptations. "n" represents the total number of articles in the region. For example, out of 575 articles in Africa, 50.6% were autonomous, 33% mixed, and 16.4% planned.



and scope of adaptation. Depth describes the novelty of an action i.e., the degree to which an action reflects something new and different from existing norms and practices. Scope refers to the scale of the adaptation action either in terms of geographical scale, the number of people affected, the variety of sectors involved, the magnitude of the resources allocated, etc. Equity in outcomes was examined in terms of the inclusion of underrepresented groups in implementation of the adaptation action (GAMI code "equity in implementation"). We find that a majority of articles coded as containing autonomous adaptations have low depth and scope with local, largely incremental actions, while planned adaptations more often have medium to high depth and scope (Table 2; definitions of high, medium and low are in Appendix 1, Table S2). The articles coded as mixed adaptations are situated in the middle of autonomous and planned for depth and scope. The ordered logistic regression models predicting depth (Model 2) and scope (Model 3) statistically support that planned adaptation outcomes are characterized by higher depth (coefficient = 0.817, $p < 0.001$) and scope (coefficient = 1.03, $p < 0.001$) followed by mixed adaptations (depth: coefficient = 0.459, $p < 0.01$; scope: coefficient = 0.508, $p < 0.001$) as compared to the base category of autonomous adaptations. Model intercepts (Appendix 1, Table S5) indicate a likelihood of the depth and scope to be of "high" levels (intercept = 4.910, $p < 0.001$), regardless of the planning type.

With respect to equity, we find that 67% of articles coded as autonomous and 64% coded as mixed explicitly include at least one underrepresented group in the implementation of the adaptation response (Table 2). On the other hand, we see lower numbers for articles coded as planned adaptations, with only 43% explicitly including at least one underrepresented group. In the logistic regression (Appendix 1, Table S5), we see systematic differences in whether equity was considered, with articles coded as planned adaptations being significantly less likely to include underrepresented groups in their implementation than mixed or autonomous (-0.455, $p < 0.05$).

A descriptive summary and comparison of the prevalence, process, and outcomes of the three types of adaptation can be found in Table 3.

Typology of mixed adaptations

In addition to quantitative analyses, we undertook a detailed qualitative analysis of the interplay between autonomous and planned adaptation to classify mixed adaptations into four types and nine subtypes (Table 4). This typology illustrates the *Autonomous-Planned Continuum* and the different ways in which autonomous and planned adaptation shape each other: at times complementing and supporting, co-existing and co-developing, even constraining. While we present different types of interactions, we found that these types were not mutually exclusive, but rather have fluid boundaries with the potential to shift or evolve into other types or subtypes.

The first mixed type is found where planned interventions co-exist with autonomous adaptations. In this case, actors in a system or community employ a *bundle* of distinct adaptations simultaneously, with at least one autonomous and at least one planned. For example, flood-impacted households in north-central Vietnam adapted by utilizing the local government's disaster relief in the form of rice and noodles (planned), and concurrently undertook autonomous adaptive measures to increase off-farm incomes (such as seeking jobs in urban areas; Casse et al. 2015).

The second type of mixed adaptation occurs when planned adaptation influences autonomous adaptation in several distinct ways. Sometimes, we found that planned adaptation can *constrain or conflict with* autonomous adaptation, limiting the range of adaptations available to actors. For instance, in Bangladesh, fishers

Fig. 3. Details on the type of adaptation response and the proportion of each that are autonomous, planned, or mixed. On the left are the detailed response types, and the gold, gray, and teal connectors correspond to the proportion of articles with those response types that are categorized as autonomous, mixed, or planned respectively. Some terms have been shortened for visualization e.g., "traditional knowledge" refers to adaptation responses that include the use of traditional knowledge. An explanation for each of the terms is provided in Appendix 1, Table S1.

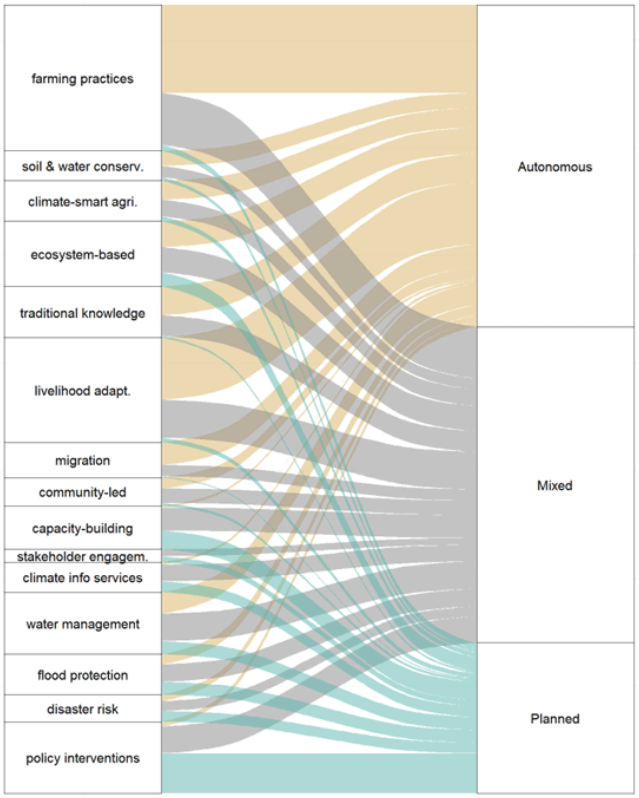


Table 2. Results on how articles reporting Autonomous, Mixed and Planned adaptations vary across (a) Depth, (b) Scope, and (c) Inclusion of underrepresented groups in adaptation implementation. Numbers represent the percentage of total articles for a particular adaptation type. For example, 76% of articles reporting autonomous adaptations were low in depth, 15% were medium, and 10% were of unknown depth. For equity, each article could include more than one type of underrepresented groups, therefore the rows on individual groups do not add to 100%. For instance, 64% of articles on mixed adaptations included at least one underrepresented group in implementation. Of articles on mixed adaptations 21% include women, while 43% include low-income groups.

	Autonomous (% of articles)	Mixed (% of articles)	Planned (% of articles)
(a) Depth of response			
Low	76%	65%	49%
Medium	15%	24%	33%
High	0%	3%	3%
Unknown	10%	9%	16%
(b) Scope of response			
Low	73%	59%	36%
Medium	17%	30%	38%
High	1%	4%	12%
Unknown	8%	7%	14%
(c) Inclusion of underrepresented groups in implementation (multiple options possible per article)			
At least one underrepresented group	67%	64%	43%
Women	24%	21%	13%
Low-income	40%	43%	26%
Disabled	0%	1%	2%
Youth	5%	5%	5%
Migrant	7%	4%	1%
Indigenous	12%	11%	6%
Ethnic minorities	4%	6%	2%
Elderly	9%	9%	5%

undertook autonomous adaption to flood-driven riverbank erosion, by measures such as extending the duration of fishing hours and use of more efficient fishing gears. These adaptations were constrained when the government constructed an embankment (planned measure) which disconnected the river from nearby natural depressions, thereby impacting fish mobility and yield (Khan et al. 2018). We also found many cases where planned adaptation *mobilizes or enables* autonomous, through various forms of support. For example, the Climate Change and Health Adaptation Program of Canada specifically supports the First Nation and Inuit communities of Nunatsiavut and Nunavik to undertake autonomous adaptations based on Indigenous Knowledge (Richards et al. 2019). We also found cases in which planned adaptations *are sustained by* actors behaving autonomously, as they voluntarily continue planned measures, outside of an organized structure, and beyond the duration of a planned intervention. In one case, several measures for improved maize production promoted by the Chinese government (such as drought-tolerant varieties, technologies to manage soil moisture, and building of communal irrigation systems), were reproduced as a central component of autonomous smallholder livelihood strategies long after the programs ended (Burnham and Ma 2018).

In the third type, we find that autonomous adaptation influences planned adaptation in four distinct ways. Autonomous adaptation can *constrain or conflict* with planned adaptation, delaying or preventing implementation of the planned measure, or reducing its effectiveness. For instance, residents in an island community of the central Philippines opposed a planned relocation program by the municipal government that would build permanent houses for island residents on the mainland. The residents wanted to maintain their fishing-based livelihoods, and, therefore, preferred autonomous adaptations (such as building stilted houses, raising floors, and elevating belongings), over the planned relocation measure (Haynes and Tanner 2015). Autonomous adaptations can *drive* planned adaptation, as in cases where planned measures are undertaken specifically to support or scale-up ongoing autonomous adaptations. In Burkina Faso, local farmers autonomously initiated agricultural adaptations in the form of improved "zai pits" which are planting pits or basins that help improve soil fertility and increase water retention. Seeing the success of these autonomous adaptations,

Table 3. Synthesis of prevalence, process, and outcomes from articles coded as autonomous, mixed, and planned actions. Prevalence is examined as the relative distribution of adaptation articles across the three types. Process is examined through the types of implementation tools and the extent to which underrepresented groups are included in planning of responses. Outcomes are examined as the depth (transformative potential) and scope (scale) of adaptations as well as equity in adaptation implementation (the inclusion of underrepresented groups as beneficiaries of adaptation).

		Autonomous	Mixed	Planned
Prevalence	Global distribution	44% of articles	35% of articles	21% of articles
Process	Implementation tools	Include Indigenous, and local knowledge-based adaptations	Supported by tools like incentives, capacity-building, and information services	Use tools like plans and regulations, and legal instruments
Outcomes	Depth and scope	Low depth and scope, i.e. the initiatives and activities are localized, with expansions of current practices rather than innovative or novel approaches	Medium depth and scope compared to autonomous. Overall depth and scope still low with actions beyond the local level by involving multiple stakeholders. They might include regional programs, initiatives that cover multiple communities, or organizational changes that affect several groups	Higher depth and scope compared to autonomous and mixed. Overall depth and scope are medium to high including large-scale geographical activities not limited to small-scale interventions
	Equity in adaptation implementation	67% of articles include at least one underrepresented group in implementation	64% of articles include at least one underrepresented group in implementation	43% of articles include at least one underrepresented group Less likely than mixed and autonomous to include underrepresented groups in implementation of adaptation

other institutions at national, local, and international scales implemented different planned adaptations, such as providing capital and dissemination of knowledge about the improved zai pits which enabled broader diffusion of the autonomous adaptation (Amaru and Chhetri 2013). Autonomous adaptations can also *inform* planned adaptations, in cases where planned measures take guidance from and complement autonomous actions (without providing any direct support). For example, a local NGO in Sitio Ibuan, Philippines, supported the establishment of a community food and health bank as a planned adaptation for the upland Manobo-Mamanwa ethnic minority community. This planned adaptation was informed by autonomous actions undertaken in the community called *"Yuha tu Banwa,"* which is a traditional approach for food stocking led by women of the community (Lebel 2013). Autonomous adaptations, in some cases, *evolve into* planned adaptations over time, either becoming more organized through community-led institutions or institutionalized through external assistance. One example is from coastal fisheries communities in Mozambique who initiated individual adaptations such as investment in improved fishing gear, changing when and where they fish, and diversification. Over time, these individual adaptations evolved into planned adaptation as a local fishers group institutionalized these practices through negotiation among fishers, inter-community conflict resolution, and enforcement of fishing regulations (Blythe et al. 2014).

Finally, there is a fourth type, in which autonomous and planned adaptation influence each other mutually. In these cases, actors and groups adapting autonomously, and actors and groups involved with planned adaptation *collaborate* as equal partners. Such collaborative forms of adaptation allow for autonomy to co-exist with larger structures or organizations (these can also be referred to as co-developed or co-produced adaptations between these two types of actors/groups). For example, government researchers and farmers in the Boucle du Mouhoun region of Burkina Faso worked closely together to develop novel sorghum varieties that are climate resilient (Brocke et al. 2014). Researchers provided farmers with ex-situ seed varieties and supervised on-farm testing and seed production. Farmers seed selection tended to differ among different groups, villages, and years, indicating their agency in the participatory process. Because cases like this represent situations in which autonomous and planned adaptation influence each other relatively equally, we consider them to lie in the middle of autonomous and planned actions. Figure 4 presents these four types and nine subtypes of interactions that illustrate what we term the *Autonomous-Planned Continuum* that highlights the various types of influences between autonomous and planned adaptations.

DISCUSSION

Introducing and characterizing mixed adaptation

Through a large systematic assessment, this study provides evidence to reevaluate the conceptualization of adaptation as *either* autonomous *or* planned, occurring in isolation. We argue that adaptation is better described as a continuum, where a mixed type can capture the interaction between autonomous and planned adaptations. To our knowledge, this is the first large-scale study to find evidence of the prevalence of this interplay, and to illustrate the different ways in which autonomous (everyday) and planned adaptation can shape each other, both positively and negatively. Our results illustrate that, in practice, different adaptation types interact in a myriad of ways which can significantly impact the scale, equity, and transformative potential of adaptation.

A key intellectual contribution of this study is the systematic demonstration of the existence of mixed adaptation and of its presence, across regions and sectors, in reports of adaptation. A full third (35%) of peer-reviewed articles on adaptation responses globally demonstrate characteristics of *both* autonomous and planned adaptation. These results provide robust empirical evidence that reinforce the findings of prior, scattered case studies that have highlighted that autonomous and planned adaptation

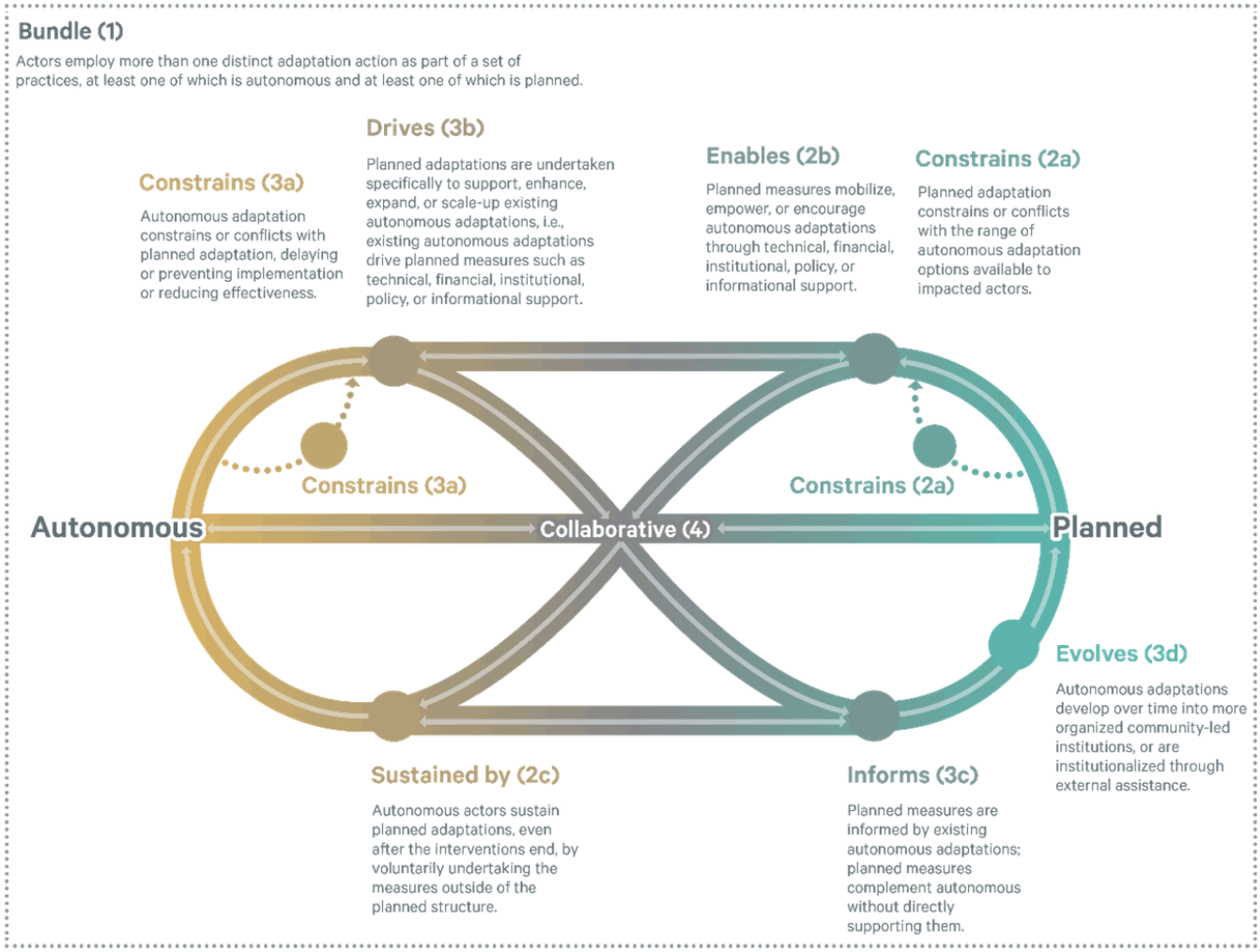
Table 4. Typology of mixed adaptation showing the different types of interplay between autonomous and planned adaptation actions along with a brief description of each type of interaction and some examples of each of these interactions found in the GAMI database.

Typology	Description	Examples
(1) Bundle of autonomous and planned adaptation	Actors employ more than one distinct adaptation action (simultaneously) as part of a set of practices, at least one of which is autonomous and at least one of which is planned.	Households employ a range of strategies to adapt to more frequent flooding: some are autonomous (resettling on higher ground, digging ditches, moving valuables to higher floors), some are planned (relying on early warning systems) (Casse et al. 2015, Jamero et al. 2017, Mulligan et al. 2017, Kamal et al. 2018)
(2) Planned Adaptation influences Autonomous Adaptation		
(2a) Planned constrains autonomous	Planned adaptation constrains or conflicts with the range of autonomous adaptation options available to impacted actors.	Flood protection infrastructure limits individual fishermen's strategies (Khan et al. 2018) Planned resettlement conflicts with communities' resettlement strategies based on ethnohistory, hereditary trading partners, and lineage (Lipset 2013)
(2b) Planned enables autonomous	Planned measures mobilize, empower, or encourage autonomous adaptations through technical, financial, institutional, policy, or informational support.	Subsidies or credit schemes encourage autonomous conservation actions (Wilkes et al. 2017) Government programs encourage voluntary adaptation from actors through opt-in options (Muriu-Ng'ang'a et al. 2017) Training or capacity building enables actors to undertake adaptation measures (Abi et al. 2019, Richards et al. 2019) Adaptation policies issue political signals for private actors to undertake adaptation (Dinarès and Saurí 2015)
(2c) Planned is sustained by autonomous over time	Planned adaptations are sustained by autonomous actors, even after the interventions end, by voluntarily undertaking the measures outside of the planned structure.	Adaptive maize agriculture encouraged by planned actions in 1980s, sustained by farmers over time on a voluntary basis (Burnham and Ma 2018) Participatory video-making project led by an NGO to promote Disaster Risk Reduction practices sustained autonomously beyond the project-term by empowered youth (Haynes and Tanner 2015)
(3) Autonomous Adaptation influences Planned Adaptation		
(3a) Autonomous constrains planned	Autonomous adaptation constrains or conflicts with planned adaptation, delaying or preventing implementation of the planned measures, or reducing their effectiveness.	Flood-prone communities oppose a government relocation program because of concerns over livelihood options. They prefer autonomous actions such as altering evacuation plans, building stilted houses, and raised floors, etc. (Jamero et al. 2017)
(3b) Autonomous drives planned	Existing autonomous adaptations are supported, enhanced, expanded, or scaled-up by planned measures, i.e., existing autonomous adaptations drive planned measures such as technical, financial, institutional, policy, or informational support.	Adaptive cropping practices emerge through experimentation on individual farms, NGOs and governments then support the diffusion of techniques broadly (Amaru and Chhetri 2013) DIY adaptation actions are supported by formal networks (Cloutier et al. 2018) Autonomous actors pressure governments to take action through media campaigns (Karlsson and Hovelsrud, 2015)
(3c) Autonomous informs planned	Existing autonomous adaptations inform planned measures. These planned measures complement autonomous without directly supporting them.	Establishment of community food and health bank based on traditional institution for stocking food (Lebel 2013) Traditional seed conservation scheme influences establishment of seed reserve (Hellin et al. 2018)
(3d) Autonomous evolves into planned over time	Autonomous adaptations develop over time into more organized community-led institutions or are institutionalized through external assistance.	Fishers initiate adaptation measures, which are then streamlined by fishers' groups (Blythe et al. 2014) Crop diversification spreads among farmers via personal connections, broader uptake then supported by local government (Abass et al. 2018)
(4) Collaborative adaptations	Both autonomous and planned actors/groups come together to develop adaptations which allow for autonomy of individuals but also put into place a structure and organization.	Participatory plant breeding program, in which researchers give farmers access to ex-situ national collections along with the opportunity to evaluate recent improved varieties. Researchers and farmers work closely to implement on-farm testing, e.g., varietal selection trials (Brocke et al. 2014)

can be interlinked (Mersha and van Laerhoven 2018, Rahman and Hickey 2019, Juhola et al. 2022, Lindegaard and Sen 2022). Although the GAMI database is one of the largest extant databases on adaptation, these results nevertheless reflect only a small and biased sample of the adaptation responses occurring globally. The reported percentages do not necessarily represent proportions of autonomous, planned, and mixed adaptation on the ground. For example, the higher prevalence of planned adaptations in Europe could be because more funding is available in these regions for studies on planned adaptations. Some regions and sectors also have fewer articles than others, which likely impacts the reported prevalence. It is important to note that the primary objective of our analysis is interpretivist rather than positivist. We do not view our results as providing a precise quantification of how often each type of adaptation occurs in different regions or sectors, but rather use these results to develop a better theoretical understanding of how different types may occur. Therefore, while our database of peer-reviewed articles is neither comprehensive nor fully representative of adaptation across the world, these limitations do not impact our main results: that mixed adaptations are likely prevalent and examining their nature can help to better understand how adaptation actions actually unfold.

A second key intellectual contribution is in providing the first detailed characterization of the interplay between autonomous and planned adaptation. Our findings illustrate that the two types are not solely opposed but rather that they can influence each other both positively and negatively. As we uncovered the nine different ways in which these interactions manifested in the

Fig. 4. Conceptual representation of the Autonomous-Planned Continuum and the nine typologized ways the two can interact and influence each other. The numbers in the figure correspond to the numbers for each type of interaction in Table 4. The box represents the "bundle" (1) where autonomous and planned adaptations co-exist, but do not necessarily act on or interact with each other. The teal to gold arrows show how planned adaptation can act on autonomous: constraining it (2a), enabling it (2b), and being sustained by it (2c). The gold to teal arrows show how autonomous adaptation can act on planned: constraining it (3a), driving it (3b), informing it (3c), and evolving into it (3d). Types on the left of the diagram demonstrate a stronger influence for autonomous adaptation; types on the right a stronger influence for planned. The "collaborative" type (4) falls directly in the middle of the figure because planned and autonomous are exerting equal influence on each other.



database, we were also struck by the number of articles where such interactions existed but had not been explicitly recognized or detailed. We suspect that such interactions are underreported, as the GAMI database (and often peer-reviewed literature more broadly) lacks detailed descriptions of how adaptation responses are implemented and how outcomes manifest (Araos et al. 2021, Berrang-Ford et al. 2021, Owen 2021). While we report our quantitative results, we interpret these numbers with caution due to potential biases and limitations of our dataset.

We also recognize that our qualitative typology of interactions between autonomous and planned adaptations is constrained by some critical limitations of our dataset. Specifically, the articles we reviewed do not explicitly seek to document interactions between autonomous and planned adaptations, information on temporality is limited, and the dataset is unlikely to capture the full-range and details of how adaptive actions are occurring in practice. For example, our typology presents types and subtypes of adaptations as static, when in fact these interactions are dynamic processes that play out over time. We further recognize that additional types and subtypes could occur outside of those analyzed here. We expect that more detailed reporting on how adaptation responses interact and develop over time will lead to the discovery of more mixed types of adaptation. There remains a need to better understand these sequential or temporally dependent pathways of adaptation. Therefore, we present this typology as *a snapshot* with the intention that it will be expanded

and refined through future research. For these reasons, particularly at the risk of extrapolating from a non-representative data set, we choose not to provide quantitative information on the number of types and subtypes identified.

What gets missed in a dichotomy and the policy implications of a continuum

Our quantitative and qualitative analyses of the interactions between autonomous and planned adaptations also reveal the value of viewing these two adaptations as a continuum, and the significant implications for adaptation policymaking. First, our findings counter common normative assumptions about the potential outcomes of adaptation responses. It is commonly assumed that planned adaptations are more beneficial, with greater scale and transformative potential, while autonomous adaptations are only a form of short-term coping. Yet planned adaptation is failing to drive transformation at the necessary speed and scale, and often excludes underrepresented groups. Though we find that reported autonomous responses are indeed lower in depth and scope on average than planned adaptation, we also find that they are widespread and more likely to integrate the considerations of underrepresented groups planning and implementation. Our results add to a growing base of literature that highlights the importance of self-organization and autonomy in enabling transformational change (Ford et al. 2020, Juhola et al. 2022, Pisor et al. 2022, Vincent 2023). These studies have demonstrated that individual, local, traditional knowledge-based, community-based, and other adaptation types associated with autonomous adaptation, can have both individual and collective benefit (Wilson et al. 2020) and are better suited to include underserved groups and address power dynamics (Rahman et al. 2023). In several contexts, such adaptations have promoted transformative learning, built social capital and trust, and generated voluntary, non-coercive schemes (Mavhura 2017, Pisor et al. 2022). Our findings provide further depth and nuance to these studies that suggest that transformative and equitable climate change adaptation can be best achieved when planned measures support or build-on some of these autonomous measures of frontline communities rather than constrain them (Mersha and van Laerhoven 2018, Rahman et al. 2021, Lindegaard and Sen 2022). This raises the question of how the two types of adaptation can strengthen and reinforce each other, and especially how governments and multilateral organizations can support ongoing autonomous adaptation to scale-up and enhance its transformative potential.

A second key policy implication is the need to better recognize autonomous and "mixed" forms of adaptation. Presently, the Global Stocktake under the UNFCCC focuses on tracking progress on planned adaptation, or what is called "global readiness to address risk" (Adaptation Committee 2021). Such an approach emphasizes efforts from governments and multilateral organizations and risks overlooking the large proportion of adaptation that is unfolding autonomously. This shortcoming underscores the need to develop methods and indicators that capture progress on both planned and autonomous adaptation. The current work program on the Global Goal on Adaptation, also under the UNFCCC, presents an important opportunity to develop indicators that better account for the effectiveness and transformative potential of autonomous adaptation. Use of such indicators to inform global assessments will help ensure that autonomous adaptation is visible to the governments and multilateral organizations that lead many planned adaptation initiatives.

The third policy implication of our findings is the opportunity for these governments and multilateral organizations to provide technical and financial resources to support autonomous adaptation on equitable terms, as well as to scale-up and potentially learn from effective autonomous responses. In characterizing the types of interactions between autonomous and planned, particularly the cases where they support and constrain each other our results provide key insights for policymakers. We found that some governmental actors undertake planned responses with the specific objective of supporting and complementing ongoing autonomous adaptation. For example, Amaru and Chhetri (2013) detailed how NGOs and governments support adaptive cropping practices that emerge on individual farms. We also found that some actors and groups sustained and scaled autonomous adaptation responses over time. In some cases, autonomous responses evolve into highly organized, large-scale responses. For example, one study documents how individual fishers initiated autonomous adaptation measures, which were then streamlined by fishers' groups (Johnson and Libecap 2019). These two examples of positive interaction offer potential models for policymakers seeking to amplify the positive consequences of the two approaches by taking advantage of the relative and respective strengths of each. Cases of collaboration also shed light on the conditions under which planned adaptation can provide technical and financial resources aligned with local priorities.

Our close examination of the interactions between autonomous and planned also improves understanding of the contexts in which autonomous and planned adaptation are mutually supportive. We preliminarily suggest four elements that could influence the type of interaction that emerges between the two adaptation types: compatibility of perceived pathways to achieving adaptation goals, channels of communication, actors' flexibility, and initiative. In cases where one adaptation type constrains the other (Table 4, 2a and 3a), actors' pathways to achieving their adaptation goals are incompatible. For example, communities resist government relocation because they perceive strengthened livelihoods as the path to effective adaptation (Jamero et al. 2017). We also see in these cases a lack of flexibility on the part of actors and no evidence of channels of communication to resolve tension. In cases of collaboration (4), we see the opposite: actors share a common pathway to achieving adaptation goals, such as where the development of resilient crops improves farmers' livelihoods (Brocke et al. 2014) and iterative on-farm testing enabled both communication and flexibility. In the case of the bundle (1), actors pursue parallel pathways that do not necessarily overlap but also do not contradict, showing flexibility in balancing the two types in a portfolio of responses (Casse et al. 2015). In cases where autonomous and planned complement each other (2b, 2c, 3b, 3c, 3d) these elements are fuzzier. The key element is initiative: from which actors and/or institutions the response originates. While this preliminary assessment provides a starting point toward identifying the factors that influence the interplay between autonomous and planned adaptations, more detailed reporting of these interactions can help to further elucidate the contextual factors that determine when and where such types of interactions are likely to occur. Though these elements are inductive and

largely hypothetical, they nevertheless help researchers and policymakers alike understand the conditions under which autonomous and planned adaptation support each other. This is a key first step to creating such conditions and ultimately contributing to more equitable and transformational adaptation overall.

CONCLUSION

Neither autonomous nor planned adaptation alone are likely to be sufficient to deal with current and projected climate change impacts. There is a need to move away from dichotomies (such as incremental versus transformational and autonomous versus planned), as they contradict the reality that effective adaptation pathways are complex and at the crossroads of multiple temporal, spatial, and social scales (Magnan et al. 2020). Our results provide valuable examples for both adaptation researchers and policymakers of the many types of interactions that can occur between autonomous and planned adaptations. We argue that understanding the respective roles, contributions of, and relationships between autonomous "everyday" adaptation and planned adaptation on a continuum is a key component in designing just, locally relevant, and scalable adaptation pathways.

Author Contributions:

GM, RS, KJ, and KB jointly led on this manuscript, sharing the first authorship. RS, GM, KJ, and KB coordinated, led the conceptual development, coding, analysis, and writing with support from BO and CS. NU led the quantitative analysis and methodological development. DC, CF, CG, ETJ, CJK, MM, LM, and SS coded and contributed to conceptual development. CS, BO, JA, NC, KJM, DR, BS, and ACS contributed to conceptual development and writing. GNA, KJB, EKG, AJH, JS, JP, and BvB feedbacked the concept and manuscript. CG contributed to conceptual development, feedback, and review of manuscript.

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Data Availability:

The data presented in this manuscript included survey extraction of information on adaptation from peer-reviewed articles. The a priori methodological protocol for the Global Adaptation Mapping Initiative is registered (06-12-2019) and available via the OSF website: https://osf.io/ps6xj.

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Appendix 1: Supplementary Information

SECTION 1. SUPPLEMENTARY INFORMATION ON METHODS

1.1 GAMI (Global Adaptation Mapping Initiative) Database

GAMI Protocols: Detailed protocols on how the GAMI database was created have been published via the Nature Protocol Exchange, and include:

- Part 1—Introduction and overview of methods (https://doi.org/10.21203/rs.3.pex-1240/v1)
- Part 2—Screening protocol (https://doi.org/10.21203/rs.3.pex-1241/v1)
- Part 3—Coding protocol (https://doi.org/10.21203/rs.3.pex-1242/v1)

In addition, the methods section of the Berrang-Ford et al. (2021) paper in Nature Climate Change titled "A systematic global stocktake of evidence on human adaptation to climate change" also presents methodological details of the GAMI database creation. A short summary of these detailed procedures is presented below.

GAMI article selection and screening: To develop the GAMI dataset, the team identified about 50,000 articles from Scopus, Web of Science, and Google Scholar. The team then used a combination of machine learning and manual review to narrow the articles down for inclusion in the GAMI dataset. To be included, the article needed to: (1) be climate change related, (2) report empirical data on adaptation responses, (3) report findings on how human systems are responding to climate change, (4) go beyond examining vulnerability or impacts assessment to document responses, (5) be published between 2013 and 2019, and (6) report tangible responses that people have taken to reduce risks and vulnerabilities. A total of 1,682 articles were included in the final GAMI dataset. The dataset was created by searching English-language abstracts, however, some articles in French, Spanish, Portugese, and Chinese were also coded (that also had an English abstract).

GAMI coding: These articles were coded for 70 variables. Coding focused on a few fundamental questions: What climate hazards are driving responses? Who is responding? What types of responses are documented? Does adaptation have transformational potential? The final GAMI database includes answers to closed and restricted questions as well as open-ended narrative questions. The former facilitated quantitative categorical analysis (for example, descriptive statistics and summarizing studies in ordered tables) and the mapping of

adaptation (breadth), whereas the latter facilitated a contextual understanding of adaptation and qualitative analysis. The coded questions were intended to align with analyses/synthesis under the IPCC. See also Supplementary Table 2 for the GAMI questions and codes that we used in this analysis. Nearly every article was coded by at least two volunteer coders, with a formal quality assurance and reconciliation process based on the quality assurance procedure set out in the Coding Protocol available at the Nature Protocol Exchange (https://doi.org/10.21203/rs.3.pex-1242/v1). The final database contained 1,682 articles (or rows) and 70 columns (70 data points for each article).

1.2 Additional coding and analyses for autonomous, mixed and planned adaptations

Additional coding: Following a detailed coding and reconciliation protocol (Figure 1 in the main text), each of the 1,682 GAMI articles was coded for: (i) whether the response was autonomous, planned, or mixed; and (ii) details on adaptation response type or the specific action (hereafter referred to as detailed response type). Table 1 (in main text) presents an abbreviated coding protocol, for the additional coding of autonomous, planned, and mixed adaptations. We developed this coding protocol through an iterative process (further described in the next section on *quality assurance*). Our *a priori* definitions included a collection of key words and definitions on autonomous and planned adaptation from the literature. The first coding protocol included the following key words for autonomous adaptation: independent, self-organized, organic, reactive, short-term planning, building on existing experience of those directly affected, and needs-based. The *a priori* protocol also included instructions to look for "coping" responses, "individuals/households" in the actor column, and "behavioral" in the response type. These three instructions were removed during the definition setting. Additionally, we removed the key words "reactive" and "short-term planning" during iterations because we found more than one example where autonomous adaptation occurred in a proactive manner.

The preliminary key words for planned adaptation included: dependent, explicit or deliberate planning, long-term, external agents/actors, mobilizing institutions and policies, public and private actors, outcomes-based approach, and anticipatory. We encountered a lot of discussion around "planned" as intentional or deliberate during the initial workshop with coders and reconcilers. While the co-authors of this manuscript do not have a perfect answer, we decided to remove "intentional" as synonymous with planned, for reasons discussed in

detail in section 1.2 of the main text. Additionally, we also removed the words “anticipatory” from the key words list.

The preliminary definition for mixed was more generally defined as “adaptation responses that have characteristics of both autonomous and planned.” The specification of mixed included guidelines such as: including some sort of community aggregation, equal distribution/ happening in parallel, and mostly planned actions under a policy or incentive scheme, but some individuals undertake these responses on their own. One of the main outcomes of the iterative definition setting, the whole coding exercise, and a major result of this paper is to better characterize this “mixed space.”

Supplementary Table S1 presents the terms and codes for the detailed response type. The column “Reported in the coded data” lists the key words assigned to adaptations documented in the GAMI article by coders. The coder instructions were to pull key words used in the GAMI entry/ academic article, which means that terms such as “climate smart agriculture” were not assigned by coders, but taken from the GAMI article. As the key words were often similar in nature, they were re-grouped (re-coded) to have a non-repetitive list for presentation/visualization (figure 3 in main text).

Supplementary Table S1. Detailed response types coded and how they were redefined and regrouped by the reconciliation team.

	Reported in the coded data	**Redefined/ Regrouped codes for detailed response type**
1	farming practices	farming practice modifications
2	climate-smart agriculture	climate-smart agriculture
3	traditional knowledge-based adaptation	traditional knowledge
4	soil and water conservation	soil and water conservation
5	livelihood adaptation	livelihood adaptation
6	ecosystem-based adaptation	ecosystem-based adaptation
7	water resource management	water resource management
8	citizen science-based adaptation	stakeholder engagement

9	capacity building	capacity building
10	policy intervention	policy intervention
11	flood protection household	flood protection
12	disaster risk reduction	disaster risk reduction
13	climate services	climate information services
14	incentive-based	policy intervention
15	community-led	community-led
16	local knowledge-based adaptation	traditional knowledge
17	public participation	stakeholder engagement
18	migration	migration
19	indigenous knowledge-based adaptation	traditional knowledge
20	outreach of climate information	climate information services
21	flood protection infrastructure	flood protection
22	regulatory	policy intervention
23	green infrastructure	ecosystem-based adaptation
24	behavior based regulation	policy intervention
25	livelihood diversification	livelihood adaptation
26	climate smart agriculture	climate-smart agriculture
27	climate resilient agriculture	climate-smart agriculture
28	coastal zone management	flood protection
29	early warning	climate information services

30	climate information sharing	climate information services
31	community based ngo	community-led
32	communication of climate information	climate information services
33	relocation	flood protection
34	nature-based	ecosystem-based adaptation
35	participatory	stakeholder engagement
36	traditional practice	traditional knowledge
37	coastal defense	flood protection
38	community-based	community-led
39	climate information services	climate information services
40	subsidies	policy intervention
41	flood control	flood protection
42	social cohesion	community-led
43	stakeholder engagement	stakeholder engagement

Quality assurance and code reconciliation: Our coding consisted of a workshop to collaboratively set the coding protocol, an initial pilot coding to iterate on definitions, followed by a full coding exercise. First, the 9 coders and 3 reconcilers participated in a workshop to discuss and reach a common understanding of the definitions. Second, each coder coded the same batch of 25 articles' entries in the GAMI database. To ensure that GAMI entries provided sufficient information to accurately code, each coder also revisited the original text of the 25 articles to verify that the complete information aligned with codes based on GAMI database entries. No significant discrepancies were found between the codes and the original articles (9 coders + 3 reconcilers participated); hence it was decided that the full coding can be done on the basis of the GAMI database entries. Finally, we reconvened in

a follow-up meeting to check consistency across coders. We discussed grey areas and edge cases in order to resolve lingering discrepancies in coders' understanding of the definitions. During the full coding exercise, the 9 coders each coded 300-400 articles. Each entry was coded by two individuals. Following completion of all coding, three authors reconciled the entries where the two codes did not match or at least one coder had entered "unclear" or NA (n = 426 out of 1682 total articles coded). Out of the 426 articles that were reconciled, 217 articles had at least one coder suggesting that there was not enough information to code the article, while the other coder entered a code. So, the true errors, in terms of reliability of the autonomous, mixed and planned coding, only occurred in 209 of the 1682 articles i.e., 12% error. For these 426 entries, the 3 reconcilers drew on the coders' confidence level and open-ended justification to assign a final code. If the coding provided insufficient information, the reconciler revisited the full text of the article. We excluded 94 articles during reconciliation because of insufficient information to code for adaptation type.

1.3 Data Analysis- descriptive statistics and regression analysis

Supplementary Table S2 presents the definition and key categories of the different cross-codes that were used for analysis (descriptive statistics and in the regressions).

Supplementary Table S2. Details of cross-codes used in the study along with definitions and descriptions of the cross-codes.

#	Cross-codes	Broader questions/ Definitions	Codes
1	Regions (Berrang-Ford et al. 2021)	What is the geographic focus of reported responses in this article?	● Africa ● Asia ● Australia ● Europe ● Central and South America (C.S. America) ● North America (N. America) ● Small island states (Islands)
2	Sectors (Berrang-Ford	Which sectors/systems are relevant to this article?	● Terrestrial & freshwater ecosystems (Terrestrial) ● Ocean & coastal ecosystems (Oceans)

	et al. 2021)		• Water and Sanitation (Water) • Food, fibre, and other ecosystem products (Food) • Cities, settlements, and key infrastructure (Cities) • Health, well- being, and communities (Health) • Poverty, livelihoods, and sustainable development (Poverty) • **Cross-sectoral** is defined as any adaptation documented in an article that covers multiple sectors listed here.
3	Actor Type (Berrang-Ford et al. 2021)	Who is reported as engaging with the response activities reported in the article?	• International or multinational Governance institutions: Global or regional treaty body or agency (e.g., UN institutions/organizations, EU institutions, Organization of American States, African Union) • Government (national): Countries officially recognized by the UN • Government (sub-national): Domestic, sub-national governing unit. Terms include state, province, territory, department, canton, Lander • Government (local): Terms include municipality, local government, community, urban, urban regions, rural • Private sector (corporations): Large national or international companies • Private sector (SME): Small- and medium-enterprises • Civil society (international, multinational, national): Voluntary civil society organizations. Includes charities, non-profits, faith-based organizations, professional organizations (e.g., labour unions, associations, federations), cultural groups, religious groups, sporting associations, advocacy groups (e.g. NGOs).

			• Civil society (sub-national or local): Formal community associations • Individuals or households: Including informal community networks • Other: Other • **Multi-actors:** Includes multiple actors listed above within one article.
4	Response Type (Berrang-Ford et al. 2021)	What category of broad adaptation is reported?	• Behavioural/cultural: Enabling, implementing, or undertaking lifestyle and/or behavioural change • Ecosystem-based: Enhancing, protecting, or promoting ecosystem services • Institutional: Enhancing multilevel governance or institutional capabilities • Technological/infrastructure: Enabling, implementing, or undertaking technological innovation or infrastructural development
5	Depth* (Berrang-Ford et al. 2021) * GAMI uses the codes of Depth and Scope to examine "transformative potential" based on a categorization of different dimensions of transformational change by Termeer et al.	What depth of change from the responses is reported in the article? The depth of a response relates to the degree to which a change reflects something new, novel, and different from existing norms and practices.	• Low: A change that has limited depth would follow business-as-usual practices, with no real difference in the underlying values, assumptions, and norms. This would include responses that are largely based on expansion of existing practices rather than consideration of entirely new practices. • **Medium:** Medium depth change doesn't entail the radical transformation of the entire system, it acknowledges the need for significant adjustments and a departure from the status quo. It represents a middle ground between minor incremental changes and full-scale systemic transformations, aiming to bring about meaningful progress and address key issues within the existing framework.

	2016		• High: In-depth change, in contrast, might involve radically changing practices by altering frames, values, logics, and assumptions underlying the system. This might involve deep structural reform, complete change in mindset by governments or populations, radical shifts in public perceptions or values, and changing institutional or behavioral norms. • Unknown: Not enough information in the article to ascertain depth
6	Scope* (Berrang-Ford et al. 2021) * GAMI uses the codes of Depth and Scope to examine "transformative potential". Note that depth and scope are not necessarily based on based on evidence of post implementation transformation, but rather of transformative potential of an action.	What is the scope of the activity described in the article? The scope of a response typically refers to the scale of change. A small scope might refer to local initiatives, or activities restricted to particular neighborhoods, communities, groups, or projects.	• Low: A low scope might refer to local initiatives, or activities restricted to particular neighborhoods, communities, groups, or projects. • Medium: Medium scope refers to changes that extend beyond local initiatives or specific communities but are not as extensive as system-wide or large-scale transformations. It encompasses changes that impact a broader range of stakeholders, encompassing multiple organizations, regions, or populations. • High: High scope would refer to large-scale and system-wide changes that might involve an entire organization, a country or large region, and large population. • Unknown: Not enough information in the article to ascertain scope
7.a.	Equity/justice - Planning	Is there evidence that particular underrepresented groups were included during	• Yes • No • If yes, which underrepresented group ○ Women

	Aaros et al. (2021)	response planning?	○ Youth ○ Elderly ○ Low-income ○ Disability ○ Migrants ○ Indigenous communities ○ Ethnic minorities ○ Others
7.b.	Equity/justice - Implementation Aaros et al. (2021)	Is there evidence that particular underrepresented groups were included in implementation of response?	● Yes ● No ● If yes, which underrepresented group ○ Women ○ Youth ○ Elderly ○ Low-income ○ Disability ○ Migrants ○ Indigenous communities ○ Ethnic minorities ○ Others
8	Policy tools Ulibarri et al. (2021)	What types of policy implementation tools/measures/mechanisms/instruments are reported as used?	● Capacity Building: e.g., educational outreach program ● Economic Instruments: e e.g., subsidies or incentives for avoiding development in flood plains or undertaking less risky livelihood strategies ● Network: e e.g., Launching a local cooperative of fishers to change fishing behavior; ● Information provision: eg., implementation of early warning systems; ● Plans: e.g., building infrastructure (e.g., a dam or flood control); ecosystem restoration; ● Regulation: e.g., new regulation, Faster change might involve rapid jumps or what might be called ‘transformative’

			changes in terms of relatively sudden shifts in views, perceptions, attitudes, and norms. policy, or legislation (e.g., land use zoning. A slow or incremental change might include small changes in incremental steps, or a series of small shifts., legal restrictions)

Regression analysis: We conducted four models to support the descriptive numbers. Model 1 was intended to understand how autonomous, planned, and mixed adaptation span across regions, sectors, actors, response type, and policy tool. We used a multinomial logistic regression because the outcome variable has three unordered categories: autonomous, planned, and mixed. The advantage of a multinomial regression over running separate binary logistic regressions (stratified) for each autonomous, planned, and mixed, is that it allows us to compare autonomous v. mixed and autonomous v. planned directly (as opposed to autonomous v. mixed and planned, where the latter two are grouped together). The independent variables in model 1 include all regions, sectors, response types, and policy tools listed in Supplementary Table 2, each coded as a dummy variable (0 or 1). Multinomial regression requires a baseline or reference category for the outcome variable, which the other two categories are then compared against. While we have referred to "Model 1" as a single model, we actually conduct a set of multinomial models: one with autonomous as the reference code and the other with mixed as the reference (SM Equation 1a and 1b). This way we can compare mixed v autonomous, planned v autonomous (with autonomous as the baseline) and planned v mixed (with mixed as baseline). Note that the coefficients are just the inverse for mixed v autonomous (autonomous as baseline) and autonomous v mixed (mixed as baseline). The results from model 1 are presented in Supplementary Table 3 and 4.

SM Equation 1a. $$\ln\left(\frac{Adaptation\ type_{\boldsymbol{mixed}}}{Adaptation\ type_{\ autonomous}}\right) = \beta_0 + \beta_1 X_1 + \cdots + + \beta_k X_k$$

$$\ln\left(\frac{Adaptation\ type_{\boldsymbol{planned}}}{Adaptation\ type_{\ autonomous}}\right) = \beta_0 + \beta_1 X_1 + \cdots + + \beta_k X_k$$

SM Equation 1b. $$\ln\left(\frac{Adaptation\ type_{\boldsymbol{autonomous}}}{Adaptation\ type_{\ mixed}}\right) = \beta_0 + \beta_1 X_1 + \cdots + + \beta_k X_k$$

$$\ln\left(\frac{Adaptation\ type_{\boldsymbol{planned}}}{Adaptation\ type_{\ mixed}}\right) = \beta_0 + \beta_1 X_1 + \cdots + + \beta_k X_k$$

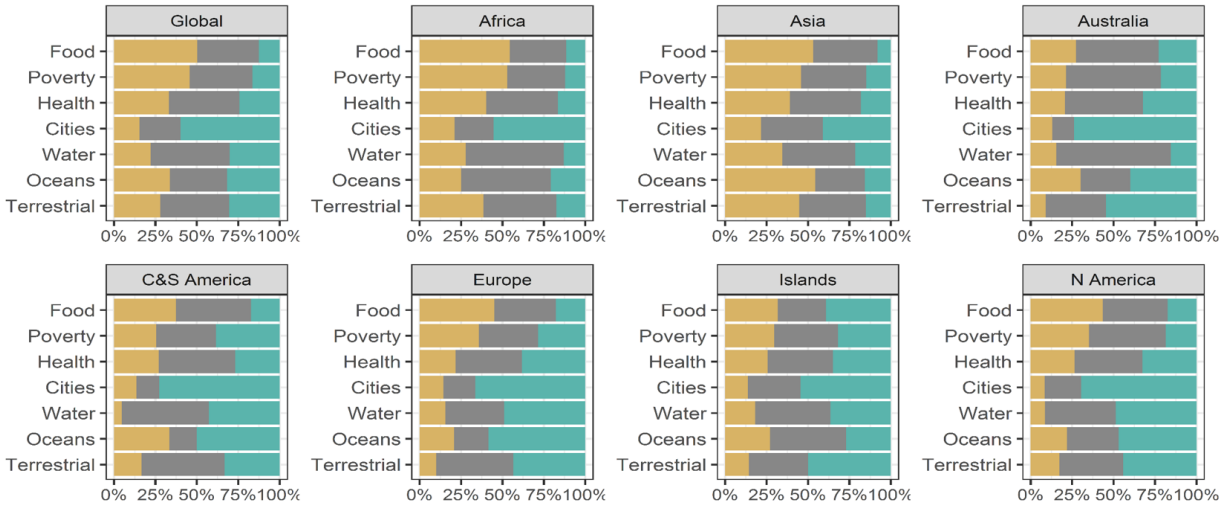
Where β_0 is the intercept, and β_k are the coefficients for all independent variables X_k, which in our case our dummy variables for regions, sectors, actors, and response types.

The relative odds ratios form SM Equation 1a and 1b are the ratio between models with same reference.

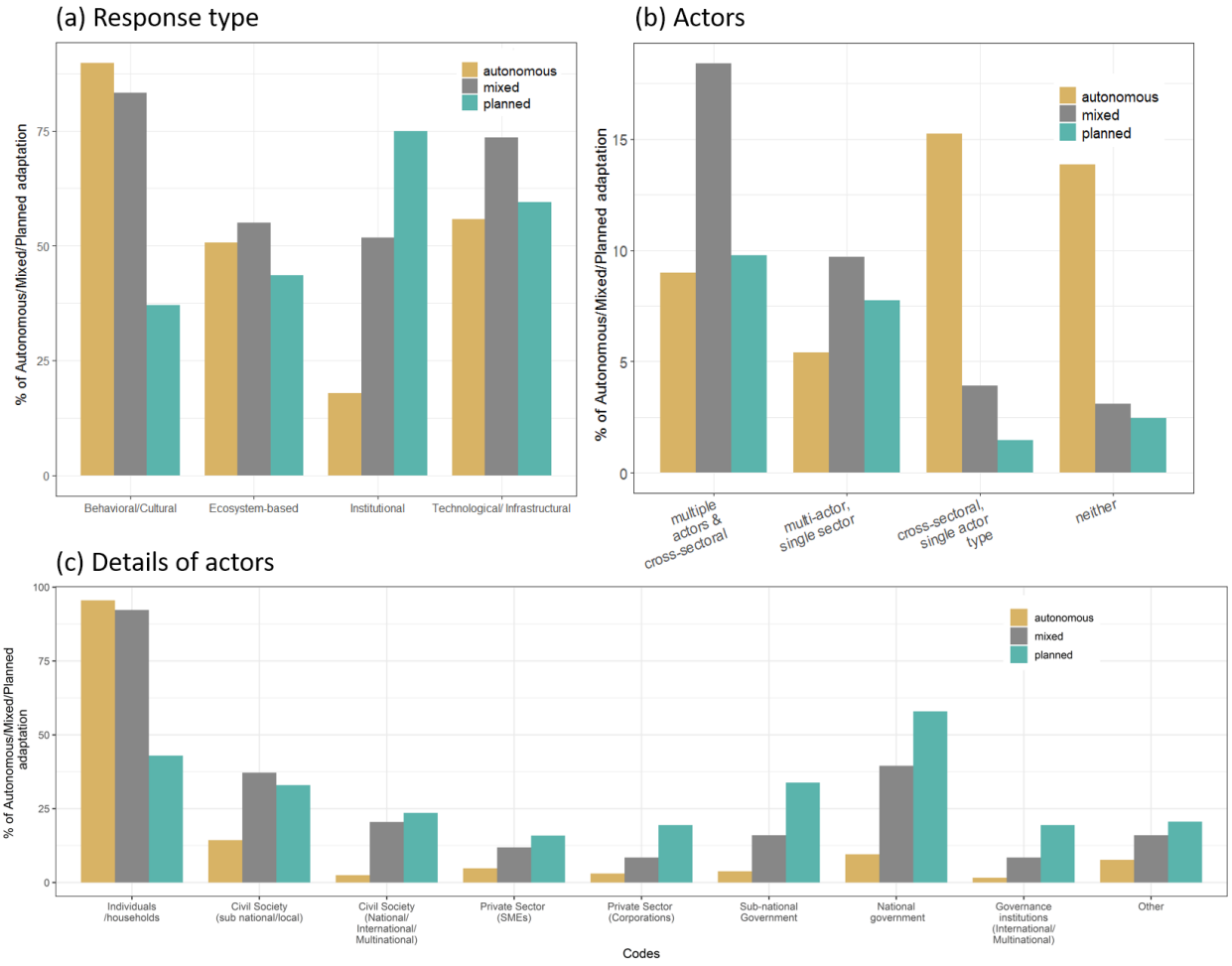
We also conducted two ordered logistic regressions in order to evaluate the depth (model 2) and scope (model 3) of autonomous/mixed/planned. In this case, our outcome variables are ordered: low, medium, or high [depth or scope]. As controls, the same independent variables used in model 1 are also included (except for policy tools). And lastly, we conducted a simple binary logistic regression in order to evaluate the inclusion of underrepresented groups in autonomous/mixed/ planned adaptations. An ordered logistic regression functions very similarly to a multinomial logistic regression, but it includes the cumulative probability of the ordered categories. The outcome variable is the inclusion of any underrepresented group (e.g. one or more), represented by a binary variable- 1 for inclusion of an underrepresented group and 0 for non-inclusion. Again, the sectors, regions, actors, and response type are included as controls Regressions were implemented using the R packages *nnet* for multinomial logistic and *MASS* for ordered logistic (Ripley 2021, Ripley and Venables 2022).

SECTION 2. SUPPLEMENTARY INFORMATION ON RESULTS

2.1 Prevalence and process of autonomous, mixed, and planned adaptation



Supplementary Figure S1. Distribution of articles reporting autonomous, mixed, and planned adaptation across regions and sectors. Mustard bars represent percentages of total articles in that sector (and for that region) that are coded as autonomous, grey bars represent mixed, and green bars represent planned adaptation. For instance, out of the total number of articles in the food sector globally (991), 52% reported on autonomous (516/991), 38% on mixed (372/991) and 10% on planned (103/991). More information on the number of articles in each sector and region is provided in the data sheet in Appendix B. Overall this figure shows that articles reporting on mixed adaptations form a significant proportion of adaptation articles across various regions and sectors.



Supplementary Figure S2. Percentage of articles reporting on autonomous, mixed, and planned adaptations across (a) response types, (b) number of actors and sectors involved in the response types and, (c) details of actors. Y-axis represents percentage of autonomous/planned/mixed adaptation articles across each cross-category. E.g., in panel (a) 90% of the 691 articles reporting autonomous adaptations include behavioral/cultural responses (620/691), whereas about 75% of the 340 articles reporting on planned adaptations include institutional responses (255/340). Detailed explanation of each of the terms is provided in Supplementary Table S2. Please note that percentages do not add to 100% as multiple options (for response type, actor type or sector) were possible per article, for example, a single article reporting on autonomous adaptation could include both behavioral and technological responses or a single article reporting on autonomous adaptation could be coded as both food and poverty sectors. Overall, this figure shows that articles reporting on mixed adaptation include many different response types, are often cross-sectoral and involve multiple actors. On the other hand, a large majority of articles reporting autonomous adaptations involve behavioral responses (90% of articles coded as autonomous) and individual/household actors (96% of articles coded as autonomous), while articles on planned adaptations are dominated by institutional responses (75% of articles coded as planned) and national governmental actors (58% of articles coded as planned).

2.2 Regression analyses

SUPPLEMENTARY TABLE S3. Multinomial logistic regression predicting autonomous or planned adaptation (versus mixed adaptation) (Model 1). Significance codes of + < 0.05, * <0.01, ** <0.001, and *** 0 are given to the right.

Category	**Codes**	**Autonomous**		**Planned**	
		Coeff	Relative OR	Coeff	Relative OR
Region	Africa	0.593*	1.810	0.220	1.247
	Asia	0.479*	1.615	-0.135	0.874
	Oceania	-0.317	0.729	-0.779	0.459
	CS America	0.083	1.086	0.432	1.540
	Europe	0.108	1.114	-0.189	0.828
	N America	0.496	1.641	0.431	1.539
	Islands	0.146	1.157	0.596	1.815
Sector	Cities	-0.080	0.923	0.272	1.313
	Food	0.233	1.263	-0.622**	0.537
	Health	-0.291	0.747	-0.253	0.777
	Oceans	0.708*	2.030	-0.318	0.728
	Poverty	0.172	1.188	-0.037	0.964
	Terrestrial	-0.144	0.866	-0.184	0.832
	Water	-0.337	0.714	-0.337	0.714
Response type	Behavioral	0.424	1.527	-1.295***	0.274
	Ecosystem-	-0.064	0.466	0.152	1.347

	based				
	Institutional	-0.763***	0.938	0.298	1.164
	Technological/ Infrastructural	-0.644***	0.525	-0.482*	0.618
Actors	International	-0.872	0.418	0.985**	2.678
	National Government	-1.049***	0.350	0.489*	1.631
	Subnational Government	-0.115	0.891	0.260	1.297
	Local Government	-0.905***	0.405	0.495*	1.641
	Private sector (Corporation)	-0.060	0.941	0.231	1.260
	Private Sector (SMEs)	-0.250	0.779	-0.091	0.913
	Civil Societies (international/ multinational)	-1.421***	0.242	-0.027	0.973
	Civil Societies (subnational/local)	-0.451*	0.637	-0.258	0.772
	Individual/ Households	0.063	1.065	-1.974***	0.139
Tools for implementation	Regulations	-1.433**	0.239	0.890**	2.436
	Plans	-0.859	0.424	1.008***	2.739
	Economic instruments	-1.470***	0.230	-0.076	0.927

	Information sharing	-1.425***	0.240	0.220	1.246
	Capacity Building	-0.806*	0.447	-0.148	0.863
	Networks	-0.604*	0.546	-0.241	0.786
Intercept		1.080*	2.954	1.264**	3.540

Significance codes: ***$p < 0.001$; **$p < 0.01$; * $p < 0.05$. Aikake's Information Criteria (AIC) = 2020.9. OR = Odds ratio, the exponentiated regression coefficient.

SUPPLEMENTARY TABLE S4: Multinomial logistic regression predicting mixed or planned adaptation (versus autonomous adaptation) (Model 1). Significance codes of + < 0.05, * <0.01, ** <0.001, and *** 0 are given to the right.

Category	**Codes**	**Mixed**		**Planned**	
		Coeff	Relative OR	Coeff	Relative OR
Region	Africa	-0.593*	0.552	-0.373	0.689
	Asia	-0.479*	0.619	-0.614*	0.541
	Oceania	0.317	1.373	-0.462	0.630
	CS America	-0.083	0.921	0.349	1.417
	Europe	-0.108	0.897	-0.297	0.743
	N America	-0.495	0.609	-0.064	0.938
	Islands	-0.146	0.864	0.450	1.568
Sector	Cities	0.080	1.083	0.352	1.422
	Food	-0.233	0.792	-0.855**	0.425
	Health	0.291	1.338	0.038	1.039
	Oceans	-0.708*	0.493	-1.026*	0.359

	Poverty	-0.172	0.842	-0.209	0.811
	Terrestrial	0.144	1.154	-0.040	0.961
	Water	0.337	1.400	0.000	1.000
Response type	Behavioral	-0.423	0.655	-1.718***	0.179
	Ecosystem-based	0.064	1.066	0.216	1.241
	Institutional	0.763***	2.145	1.061***	2.891
	Technological/ Infrastructural	0.644***	1.904	0.162	1.176
Actors	International	0.872	2.392	1.857***	6.405
	National Government	1.049***	2.854	1.538***	4.655
	Subnational Government	0.115	1.122	0.375	1.455
	Local Government	0.905***	2.472	1.400***	4.055
	Private sector (Corporation)	0.061	1.062	0.292	1.339
	Private Sector (SMEs)	0.250	1.284	0.159	1.172
	Civil Societies (international/ multinational)	1.421***	4.140	1.394***	4.029
	Civil Societies (subnational/local)	0.451*	1.570	0.193	1.213
	Individual/ Households	-0.063	0.939	-2.037***	0.130
Tools for implementation	Regulations	1.433**	4.190	2.323***	10.205
	Plans	0.858	2.359	1.866***	6.461
	Economic instruments	1.470***	4.349	1.394***	4.032
	Information sharing	1.425***	4.156	1.644***	5.176

	Capacity Building	0.806*	2.239	0.658	1.932
	Networks	0.604*	1.830	0.363	1.438
Intercept		-1.080	0.339	0.184	1.202

Significance codes: ***$p < 0.001$; **$p < 0.01$; * $p < 0.05$. Aikake's Information Criteria (AIC) = 2020.3. OR = Odds ratio, the exponentiated regression coefficient.

SUPPLEMENTARY S5. Coefficients as predicted by ordered logistic regression models for depth (Model 2) and scope of adaptation (Model 3), and binary logistic regression model for equity consideration (i.e., at least one underrepresented group was included in adaptation implementation) (Model 4). The ordered regression analysis also showed that planned adaptations are the most likely to be higher depth and scope, followed by mixed and lastly autonomous. One of the main interpretations from the table is that we notice systematic differences in whether equity was considered, with planned adaptations (-0.612***) being significantly less likely to include marginalized groups in their implementation, than mixed or autonomous adaptations. Significance codes of + < 0.05, * <0.01, ** <0.001, and *** 0 is given to the right.

		Model 2 Depth	**Model 3 Scope**	**Model 4 Equity**
model		ordered logistic	ordered logistic	binary logistic
outcome variable		if depth of the adaptation response was coded as high, medium, or low	if scope of the adaptation response was coded as high, medium, or low	if any (at least one) underrepresented group was included in the implementing the adaptation response (1) v. not at all (0)
Target variable: Adaptation Type	Autonomous (reference category)	0.000	0.000	0.000
	Mixed	0.459 **	0.508**	-0.123
	Planned	0.817***	1.038***	-0.455*
Controls	sectors	yes	yes	yes
	regions	yes	yes	yes

	actors	yes	yes	yes
	response types	yes	yes	yes
Intercept(s)				0.002 **
	Low/Medium	1.717***	1.438***	
	Medium/High	4.845***	3.975***	
AIC		1733	2100	1821
n		1419	1440	1588