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On Adaptiveness

Changing Earth System Governance

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1.1 Introduction

The year 2020 was advocated to be the 'super year for sustainability', in which the United Nations (UN) sought to launch a 'decade of action' for implementing the Sustainable Development Goals (SDGs) within the Agenda 2030 (UN, 2020). Supplementing the SDGs, the Paris Agreement on Climate Change, Sendai Framework for Disaster Risk Reduction, and the New Urban Agenda were all adopted in 2015 and 2016. In order to achieve these goals and thus more sustainable development, global efforts need to be strengthened, to accelerate, and to gain more transformative dynamics (UN, 2020). However, reports have regularly documented that global environmental changes and their impacts have been enormous, while the speed and scale of necessary progress for managing the global challenges have remained insufficient (IPBES, 2019; IPCC, 2018, 2019a, 2019b).

By 2020, the level of global warming was at 1.1°C above pre-industrial levels (IPCC, 2018), and began to seriously impact the world's natural and human systems (IPCC, 2018, 2019a, 2019b). Humankind has thus far failed to achieve the Paris Agreement goal of limiting warming to 2°C (UNEP, 2019). Rapid and transformative actions are increasingly called for to reduce greenhouse gases emissions by 2030 and achieve net-zero emissions by 2050. Such actions not only include processes such as decarbonisation, implementation of bioenergy and carbon capture and storage (BECCS), but also behavioural changes (IPCC, 2018). Nature and its vital resources and services used by humans, including biodiversity and ecosystem functions and services, are deteriorating worldwide (IPBES, 2019). These reports document that we are not on course to achieve the SDGs by 2030 and that governance responses have neither been adequate nor adaptive vis-à-vis the dynamics of the challenges at hand.

As this book was finalised, COVID-19 was pronounced a global pandemic by the World Health Organisation (WHO, 2020) in March 2020. The virus and its consequences wrought havoc on global health, disrupted education systems, and brought tourism and aviation industries to a halt (UN, 2020). The COVID-19 virus spread globally virtually overnight with the number of people affected and dying increasing exponentially on a daily basis. Governments immediately ordered people to work from, study, and stay at home; wash their hands more regularly; and practise social distancing. From January to April 2020, global aviation was largely grounded, countries' borders closed, jobs lost overnight, and companies declared bankrupt. National economies suffered as the virus spurred economic recession. In response, economic stimulus packages were rolled out in countries around the world. Within a few months, government and institutional responses, as well as public behaviour, were forced to adapt and change practices at extraordinary speeds. Such quick and widespread responses were unprecedented, especially when compared to the pace and scale of the responses to reduce carbon emissions and manage climate change. Driven by the problem at hand and informed by science, governance and institutional responses to the COVID-19 pandemic demonstrate what adaptive governance responses can look like.

Similarly, rapid and transformational actions become ever more urgent to achieve a just, resilient, and ecologically sustainable global society. In particular, governance approaches are called upon that respond to address the respective problem dynamics and are effective to align social, economic, and ecological developments towards the sustainability goals. These governance approaches for rapid and transformational actions have to address changing and uncertain conditions and need to be responsive, flexible, and, in that sense, adaptive.

The Earth System Governance (ESG) Project as a global alliance of social science researchers in the area of governance and global environmental change evaluates current governance practices and explores novel proposals in the search for more effective governance mechanisms to address major changes and transitions in the biogeochemical systems of the planet (Biermann, 2019). In doing so, the ESG Project conceptualised earth system governance as 'the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development' (Biermann et al., 2009: 4). In its Science Plan of 2009, the project developed a core research focus around five analytical themes (5As) – namely, architecture, agency, adaptiveness, accountability, and allocation and access (Figure 1.1) (Biermann et al., 2009). To continue the process, the ESG Project prepared a new
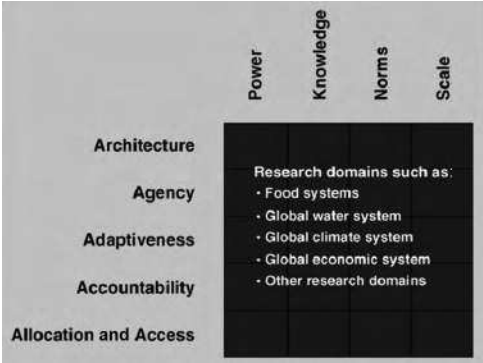
Figure 1.1 Adaptiveness in the 5As within the ESG Project Science Plan 2009.
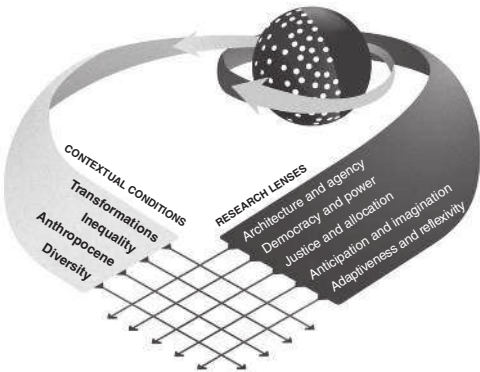Source: Biermann et al. (2009: 28)

Figure 1.2 Adaptiveness and reflexivity as research lenses in the new ESG Project Science Plan 2018.
Source: ESG (2018: 19)

Science and Implementation Plan in 2018, which combined adaptiveness with reflexivity as a core theme for future research in the field organised around five research lenses and four contextual conditions (Figure 1.2) (ESG, 2018).

The Harvesting Initiative within the ESG Project aims to review the results of a decade of research on these themes and compiles key research findings in books or journal contributions (ESG, 2020). This initiative has resulted in a number of publications, special issues, and edited volumes on agency (Betsill et al., 2019); agency and empowerment (van der Heijden et al., 2019); and architecture (Biermann & Kim, 2020). This book is an outcome of this Harvesting Initiative, focusing on the analytical theme of adaptiveness.

Throughout the book, we follow the initial understanding of adaptiveness as 'an umbrella term for a set of related concepts – vulnerability, resilience, adaptation, robustness, adaptive capacity, social learning and so on – to describe changes

made by social groups in response to, or in anticipation of, challenges created through environmental change' (Biermann et al., 2009: 45). Understanding adaptiveness as an umbrella for these key concepts, harvesting related research thus could draw on the related outcomes from the related fields of study. However, in this book we seek to draw connections between the respective fields among themselves and towards adaptiveness and adaptive governance in earth system governance. Thus, it is our goal to not only repeat what has been discussed in the respective fields, but also to synthesise and relate the findings to each other and to the challenges of adaptive governance. In doing so, we avoid positing one concept against another in the interest of carving out overarching insights and lessons. However, the challenge arises where to draw the boundaries of the umbrella and to scrutinise the multiple connections and relationships within or under the umbrella, including those that are implicit or not explicitly referring to adaptiveness per se. This book thus followed a pragmatic approach combining a bird's-eye perspective to see the whole picture largely with the means of a systematic literature review with a bottom-up perspective from selective discussions and empirical case studies.

Since the 2009 Science Plan postulated this notion of adaptiveness in the attempt to bring together different research strands, our interest in this book was to analyse how far it has been taken up and brought to fruition in the scholarly community and beyond. Thus, the overarching research question addressed in this book is: *How has adaptiveness, as an umbrella concept, been developed and applied in the context of earth system governance in the first decade after its inception, and what insights and practical solutions has it yielded?* Following the ESG 2009 Science Plan, this broad question will be approached by addressing four specific questions:

1. What are the politics of adaptiveness?
2. Which governance processes foster adaptiveness?
3. What attributes of governance systems enhance capacities to adapt?
4. How, when, and why does adaptiveness influence earth system governance?

Thus, this book brings together the threads of a debate that has been gaining societal relevance and academic traction throughout the last decade. This work is a collaboration written by eminent authors in the related fields and documents experiences from different world regions as well as different levels of decision-making. The 10 chapters discuss recent trends in the literature on adaptiveness and the utilisation of adaptiveness concepts and draw on case studies examining challenges and solutions requiring aspects of adaptiveness.

The structure for this chapter is as follows. Based on the introduction to the motivation and rationale for the whole book in Section 1.1, Section 1.2 examines

the concept of adaptiveness by summarising the latest debates, the links to related concepts and its interlinkages with other analytical issues. The following Section 1.3 reflects on research methods to explore themes of adaptiveness. Section 1.4 presents the book structure as well as key findings from the individual book chapters. Finally, Section 1.5 discusses synthesis findings from this volume, how they relate to the 2009 Science Plan questions on adaptiveness, and the role of adaptiveness in the future of earth system governance. In this section, we put forward the findings from the chapters on the four ESG 2009 Science Plan questions listed in Section 1.1.

1.2 Adaptiveness: Related Concepts and Interlinkages

Within the context of earth system governance, adaptiveness is a catch-all term to describe changes generally made by actor groups or institutions in anticipation of or responding to risks, disruptions, or challenges resulting from environmental change. It thus relates to concepts of adaptive management, adaptive governance, vulnerability, resilience, robustness, adaptive capacity, and social learning. These concepts represent larger research traditions that overlap in parts and all address dynamics in socio-ecological systems. However, they are not identical and have partly complementary and partly divergent research foci. Acknowledging these differences, the overarching notion of adaptiveness seeks to bring together the commonalities and connections between the concepts as outlined in the following.

1.2.1 Adaptive Management and Adaptive Governance

Adaptive management is one of the most utilised concepts in the research related to adaptiveness in the sense of the 2009 ESG Science Plan. It is considered a management approach for responding to ecosystem change (Folke, 2006). It aims at maintaining and managing dynamic and at the same time resilient systems that can withstand stresses of climate change, habitat fragmentation, and other anthropogenic effects without losing its capabilities to provide essential ecosystem services (Chazdon, 2008). Active adaptive management and governance of resilience (Lebel et al., 2006) are essentially tasked with sustaining desired ecosystem states and transforming degraded ecosystems into fundamentally new and more desirable configurations (Folke, 2006). Through feedback learning and structured scenarios, actors can tackle uncertainty and unpredictability intrinsic to all socio-ecological systems (Berkes et al., 2000; Folke et al., 2002). Adaptive management, adaptive co-management, and anticipatory governance share numerous similarities with adaptive governance

(Huitema et al., 2009; Hurlbert & Gupta, 2018) that brings them together metaphorically and practically underneath the umbrella of adaptiveness.

Adaptive governance has emerged as a framework to proactively and flexibly deal with increasingly uncertain, systemic, complex problems (Dietz et al., 2003). Such governance approaches connect individuals, organisations, agencies, and institutions at multiple levels (Folke et al., 2005), and are often facilitated by key leaders and shadow networks (Olsson et al., 2006). Adaptive governance encompasses a range of interactions between actors, networks, organisations, and institutions emerging in pursuit of a desired state for social-ecological systems (SES) (Chaffin et al., 2014). They seek to align the ecosystem dynamics with governance responses, trying to match scales, complexity, and intensity between governance and SES-related problems (Termeer et al., 2010).

1.2.2 Resilience

The concept of resilience has evolved considerably since Holling's (1973) seminal paper. Resilience is proposed as 'the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedback' (Walker et al., 2004: 5). Like adaptiveness, the concept builds on the insight into non-linear dynamics, thresholds, uncertainty, and surprise. It analyses how periods of gradual change interact with periods of rapid change, and the interaction of dynamics across temporal and spatial scales (Folke, 2006). Resilience, adaptability, and transformability are three related attributes of SES that largely determine their future trajectories (Walker et al., 2004). Adaptability refers to the capacity of actors in the system to influence resilience, while transformability is the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable (Walker et al., 2004). With its origin in ecology, the field of study has evolved to address core social science topics of governance, power, and learning (Olsson et al., 2014). Resilience has multiple levels of meaning: as a metaphor related to sustainability, as a property of dynamic models, and as a measurable quantity that can be assessed in field studies of SES (Carpenter et al., 2001). There is a vast breadth of literature proposing various resilience frameworks and attempts to operationalise the concept into specific applications, such as the food system (e.g. Hodbod & Eakin, 2015), urban planning (Davoudi et al., 2012; Lloyd et al., 2013), and disaster management (Chang & Shinozuka, 2004; Cutter et al., 2008; Djalante et al., 2013).

1.2.3 Vulnerability

Vulnerability is defined by the Intergovernmental Panel on Climate Change (IPCC) as 'the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt' (IPCC, 2014: 1775). Its key components include exposure, sensitivity, and adaptive capacity (IPCC, 2014). Miller et al. (2010) discuss whether resilience and vulnerability are complementary or conflicting concepts. They argue that resilience and vulnerability represent two related yet different approaches to understanding how systems and actors respond to change, to shocks and surprises, as well as to slow creeping changes. Vulnerability research poses many challenges including how to develop robust and credible measurements, how to incorporate diverse methods that include perceptions of risk and vulnerability, and how to incorporate governance research on the mechanisms that mediate vulnerability and promote adaptive action and resilience (Adger, 2006). General conditions of vulnerability are characterised by multiple contexts, multiple dimensions, temporal variability, multiple scales, and scale interdependency (Hufschmidt, 2011). In discussing social vulnerability, Cutter et al. (2012) proposed three main tenets for vulnerability research: (1) the identification of conditions that make people or places vulnerable to extreme natural events (i.e. an exposure model), (2) the assumption that vulnerability is a social condition (i.e. a measure of societal resistance or resilience in regard to hazards), and (3) the integration of potential exposures and societal resilience with a specific focus on particular places or regions. There is a vast number of frameworks available to assess the vulnerability of coupled human–environment systems (Turner et al., 2003) to climate change (Füssel, 2007), to natural hazards (Birkmann, 2006), or to livelihoods (Yaro, 2004).

1.2.4 Adaptive Capacity

As a component of vulnerability (Kelly & Adger, 2000; Smit et al., 2000), the IPCC defines adaptive capacity as 'the characteristics of communities, countries and regions that influence their propensity or ability to adapt' (IPCC, 2001: 882). The adaptive capacity of SES is related to the existence of social, economic, or political mechanisms for coping with (climatic) change. Even though the debate is ongoing about how to conceptualise adaptive capacity, there is broad understanding of its multidimensional character, determined by complex inter-relationships of numerous factors at different scales, and based on institutional collective responses as well as the availability of and access to resources (Cinner et al., 2018; Vincent, 2007).

Central elements of adaptive capacity are common at different scales, although the structure of each index is scale-specific (Gupta et al., 2010; Vincent, 2007). Collective action and social capital have been identified as pertinent elements of adaptive capacity in relation to the performance of institutions that cope with the risks of changes in climate (Adger, 2003). What seems to be a strongly related message for adaptiveness research is that adaptive capacity requires a diversity of responses to cope with complex systems, high dynamics, and substantial uncertainty in human-dominated environments (Elmqvist et al., 2003).

1.2.5 Robustness

Studies on robustness are commonly discussed in terms of 'network robustness' (e.g. Klau & Weiskircher, 2005) or 'modelling robustness' (e.g. Hinrichsen & Pritchard, 2011; Kuorikoski et al., 2010). Robustness can be seen as an antonym to (static) vulnerability. It is related to general resilience, which includes coping with the unknown (Scholz et al., 2012). Robustness and resilience are necessary for maintaining the adaptive capacity and work through preserving a balance among heterogeneity, modularity, and redundancy, and tightening feedback loops to provide incentives for sound stewardship (Levin & Lubchenco, 2008).

1.2.6 Social Learning

Literature on social learning has emerged rapidly in recent years, mainly originating from the field of psychology (e.g. Bandura, 1977; Mischel, 1973). Social learning is a broad concept encompassing multifaceted, more specific types and levels of learning and knowledge in relation to SES (Reed et al., 2010). These include collective or group learning and social memory, mental models and knowledge-system integration, visioning and scenario building, leadership, agents and actor groups, social networks, institutional and organisational inertia and change, adaptive capacity, transformability, and systems of adaptive governance that allow for the management of essential ecosystem services (Folke, 2006). Of particular relevance is the question of how far knowledge and learning relate to practical behaviour of actors and societies. The process of social learning involves change at and beyond the individual level to change within broader social units by way of social integrations within social networks (Reed et al., 2010). Thus, 'communities of practice' (Wenger, 2010) became a popular research focus. Through successive rounds of learning and problem-solving, these learning networks can incorporate new knowledge and related new or altered practices to deal with problems at increasingly larger scales, ideally arriving at adaptive co-management arrangements (Berkes, 2009). Through problem-sharing perspectives

and working with different kinds of knowledge and competencies, multiple actors or stakeholder parties co-construct a social learning process in an emerging community of practice (Bouwen & Taillieu, 2004).

A core question in social learning studies is which organisational or societal level is concerned. Within organisations such as municipalities or corporations, organisational learning can take different forms drawing on organisational sociology (Siebenhüner & Arnold, 2007). On a national level, social learning processes have been found to relate largely to political cultures among other factors (Social Learning Group, 2001). In global environmental governance, organisations are observed to engage in one of three forms of learning: reflexive learning, adaptive learning, and no learning depending on specific learning mechanisms, change agents in leadership functions, and external triggers such as pressures from governments or non-governmental actors (Siebenhüner, 2008). Reflexive social learning informed by policy and programme evaluation constitutes an increasingly important basis for 'interactive governance' (Sanderson, 2002).

Social learning processes are crucial for building adaptiveness, since they help to cope with informational uncertainty, reduce normative uncertainty, build consensus on criteria for monitoring and evaluation, empower stakeholders to take adaptive actions, reduce conflicts and identify synergies between adaptations, and improve fairness of decisions and actions (Lebel et al., 2010). Informal networks are considered to play a crucial role in such learning processes (Pahl-Wostl, 2009). Transformative change building on fundamental social learning processes towards adaptive management have even been described as 'learning to manage by managing to learn' (Pahl-Wostl, 2007: 49).

1.3 Reflection on Research Methods

Both ESG Project Science Plans of 2009 and 2018 discuss the use and development of adequate methods for addressing the challenges and issues of earth system governance research. While Biermann et al. (2009) discuss various social science methods and stress, in particular the role and benefit of interdisciplinary research methods at the interface of the social and natural sciences, the 2018 Science Plan goes one step further. Beyond the suggestion of a set of new, innovative methods for analysing matters of earth system governance, it outlines the ontological and epistemological foundations of the research agenda and argues for a wide diversity of the ways of knowing and representing the world (ESG, 2018). Additionally, it extends the methodological portfolio and explicitly includes transdisciplinary research methods 'noting the need for engagement with broader societal actors outside of academia who also hold key knowledge and perspectives on what is both feasible and desirable as solutions to societal problems' (ESG, 2018: 84).

Among the ESG analytical problems, the theme of adaptiveness poses some particular methodological challenges. Most of the phenomena subsumed under adaptiveness are intangible and not directly measurable. Vulnerability, resilience, and robustness, for example, are inherent to a (socio-ecological) system and become only apparent when their limits are tested in times of pressure, stress, or crisis. Hence, studies around these phenomena are often placed within such settings of increased stress, describing systems responses to perturbations (see e.g. McGreavy et al., 2016). As another strategy, governance researchers try to approach resilience, for example, through the institutional and governance principles that attempt to shape the resilience of SES. In this vein, analysts take advantage of the inter-relatedness of those different concepts by relating, for instance, the adaptive capacities or arrangements for adaptive governance to the resilience of the underlying SES (e.g. Gunderson & Light, 2006). However, such a research strategy may also appear problematic because it rests on often implicit normative assumptions about those governance models, remains under-specified as to how governance modes and system properties are linked, and hence, may paint an overall simplistic picture (Biesbroek et al., 2017). In this light, the ESG Project's explicit inclusion of interdisciplinary approaches linking social and natural systems, as well as of the critical realist approaches 'to study and seek to understand generative causal mechanisms that produce events, processes and phenomena' (ESG, 2018: 78) appears particularly relevant for the study of adaptiveness.

Beyond these more general methodological issues, the study of adaptation faces some more practical methodological challenges, which could be tackled by a diversity of methodological approaches. Here, we provide a few examples.

Case studies are among the most popular research methods for studying questions of earth system governance, as the contributions of this volume highlight. In the social sciences, case studies are employed for a variety of purposes, including the detailed assessment of a phenomenon under study, the development of explanations for social outcomes and the broader generalisation of those, or the application of more general concepts in specific cases (George & Bennett, 2005).

While case studies are hardly an innovative or overlooked method, they offer great potential for the in-depth study of multifaceted issues, such as adaptiveness, as they allow for the consideration of context and place the research object within its wider social, environmental, and cultural context to trace processes in their historical evolution and to re-draw causal chains linking to specific outcomes. One great advantage here is their versatility to be combined with a magnitude of different methods and analysis techniques. Counterfactual analysis, for example, may provide one fruitful avenue to tackle the intangibility of various phenomena of adaptiveness. A counterfactual is a 'subjunctive conditional in which the