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CONTENTS

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Climate policy, regulation and governance: introduction

Simon Goldhill and Georgie Fitzgibbon

Abstract: Regulatory systems and innovative policy solutions are addressing the current and future effects of climate change. The articles presented here range from broad views on climate change governance in agroforestry systems and insights from climate-funded food system projects, to the nationally specific, exploring regulatory contexts in the UK, China, and Mexico. They consider state, private, and civil society actors. Together, they demonstrate the importance of innovative policy solutions to climate regulatory and governance problems.

Keywords: Policy, regulation, governance, agroforestry, food systems, underground space, China, Mexico, civil society.

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Regulatory systems and innovative policy solutions are addressing the current and future effects of climate change. A 2019 policy brief produced by the Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy states that a significant majority of countries have enacted laws and policies to address climate change adaptation. These often identify floods and droughts as major hazards, while impacts such as ocean acidification remain under-addressed. Framework laws and policies often include adaptation plans, information, regulation, and early warning systems, though there is a lack of adaptation investment and economic incentives to encourage adaptation.[1]

The articles presented here range from broad views on climate change governance in agroforestry systems and insights from climate-funded food system projects, to the nationally specific, exploring regulatory contexts in the UK, China, and Mexico. They consider state, private, and civil society actors. Together, they demonstrate the importance of innovative policy solutions to climate regulatory and governance problems.

In the first article, Pamela Katic (2021) presents a systematic review of climate change governance in agroforestry systems. Agroforestry has the potential fundamentally to transform socio-ecological systems in order to address the root causes of climate vulnerability. Although there is increasing interest in agroforestry as a transformative adaptation strategy, its implementation is often discouraged by the requirement to involve multiple stakeholders, sectors, and governance agents with potentially different interests. The author draws on a systematic review of sixty-four peer-reviewed papers on climate change governance in agroforestry systems to (1) outline the current state of the literature, (2) characterise how governance is conceptualised, (3) investigate governance challenges, and (4) provide insights into effective governance. The review finds that most relevant papers have been published in the past three years, and most of these papers are found in interdisciplinary journals. The main governance challenges include coordinating polycentricity, overcoming power imbalances and sharing, translating, and integrating different types of knowledge. However, few empirical studies of agroforestry governance have been completed. A richer conceptual framework of governance is required to improve our ability to navigate the role of sustainable land management practices such as agroforestry in successful climate change adaptation and mitigation.

Next Abrar Chaudhury and Saher Hasnain (2021) explore food projects funded by the Green Climate Fund (GCF). Climate change poses unprecedented and complex challenges to global food systems. Critical vulnerabilities, continuing inequalities, and unsustainability have demonstrated that food systems need significant intervention in order to deliver safe, just, and healthy food for all, against the backdrop of a changing climate. Innovative interventions and effective financing are needed across

[1] Nachmany *et al.* (2019).

the food system to achieve these grand ambitions. While there is recognition of a systems approach in the face of complex issues such as climate change, interventions and financing mechanisms have historically focused narrowly on production or specific sectors within food and related systems. Given the diverse array of stresses and shocks, this approach will not achieve the desired paradigm shifts necessary to secure global food systems and meet the Paris Agreement climate targets. Through a comprehensive review of GCF-funded projects, this paper shows that paradigm shifting interventions can benefit from a food systems perspective by moving beyond specific sectors and activities and delivering outcomes across the socio-economic and environmental spheres. Climate change and food system challenges are complex and necessitate system approaches, and financing instruments need to be designed and structured with systemic complexity in mind.

In the first of a series of nationally focused contributions, Kevin Grecksch (2021) introduces the current situation of underground space governance and regulation in the UK. Underground space has been used by humans for thousands of years: for example, to extract mineral resources or water. Against the background of increasing populations, urbanisation, and energy demand, underground space has come back into focus, promising to ease pressure above the surface. However, geological underground models deliver no more than frameworks for possible uses; and we do not know enough about the interrelations between geological characteristics and the impact of potential human requirements of underground space. Moreover, governing underground space can be complicated as it involves conflicting objectives and regulatory frameworks. One key objective, therefore, must be to conceptualise and implement new approaches to underground governance, taking into account its diverse uses and various stakeholders' claims. Grecksch discusses different themes, such as property rights, regulation, planning, groundwater, fracking, and the future of underground space use exemplified by the storage of nuclear waste.

The penultimate article aims to survey and explain China's stance toward climate change and its investment in renewable energy in the past three decades from 1990 to 2020, encompassing Xi Jinping's tenure as leader and the impact of the COVID-19 pandemic. Hongyi Lai (2021) argues that, as for over a decade China has been the predominant carbon emitter in the global economy, it is imperative for us to understand the factors behind its climate change policy in the past decades. Lai argues that (neo-)realism/nationalism and liberalism, two main theories in the field of international relations, offer only partial explanations of China's climate policy. Instead, Lai highlights the importance of understanding China's domestic political economy, leadership considerations and the desire for economic growth, to understand the climate stances of nation-states. Policy suggestions for external parties to interact with China on climate change are proposed. There the importance of involving China in

global action against climate change, as well as the utility of the economy and trade leverage, soft power standing, and the prevention of extreme weather are discussed.

Finally, Susan Baker, Bárbara Ayala-Orozco, and Eduardo García-Frapolli (2021) examine the role of civil society organisations (CSOs), including non-governmental environmental organisations, in climate governance. The authors utilise a case study approach with regard to the coastal zone of Quintana Roo, Mexico. Focus groups with key stakeholders and in-depth face-to-face and online interviews were employed to examine key-actor perceptions of climate change risk and their involvement in climate governance, across different scales. Participation by CSOs is shaped by a variety of factors, including constitutional arrangements, regulatory regimes, administrative traditions and structures, and a wider set of beliefs about moral responsibility and the exercise of civic duty. CSO participation across multilevel governance scales provides an array of inputs to help address climate vulnerabilities in the coastal zone of Quintana Roo. Especially under conditions of weak administrative capacity and corrupt government, certain enabling institutional conditions are needed. This creates complex contexts in which CSOs emerge, networks develop, alliances are formed, and barriers to effective participation endure.

This issue forms part of the British Academy's COP26 series, which aims to raise awareness of the importance of the humanities and the social sciences in understanding the complex human and social dimensions to environmental challenges and their solutions. The authors are drawn from a range of British Academy programmes, including the *Postdoctoral Fellowships*, the *Sustainable Development Programme,* which funds researchers working on the UN's Sustainable Development Goals, *BA/Leverhulme Small Research Grants*, which support primary research across the humanities and social sciences, and *Knowledge Frontiers*, which aims to enable different communities of knowledge and practice to illustrate the unique added value of international and interdisciplinary collaboration.

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Climate change governance in agroforestry systems: a systematic review

Pamela Katic

Abstract: Agroforestry has the potential to fundamentally transform socio-ecological systems to address the root causes of climate vulnerability. Although there is increasing interest in agroforestry as a transformative adaptation strategy, its implementation is often discouraged by the need to involve multiple stakeholders, sectors, and governance levels with potentially different interests. We draw on a systematic review of sixty-four peer-reviewed papers on climate change governance in agroforestry systems to (1) outline the current state of the literature, (2) characterise how governance is conceptualised, (3) investigate governance challenges, and (4) provide insights into effective governance. The review finds that most relevant papers have been published in the past three years, and most of these papers are found in interdisciplinary journals. The main governance challenges include coordinating polycentricity, overcoming power imbalances, and sharing, translating, and integrating different types of knowledge. However, few empirical studies of agroforestry governance have been completed. A richer conceptual framework of governance is required to improve our ability to navigate the role of sustainable land management practices such as agroforestry in successful climate change adaptation and mitigation.

Keywords: Governance, agroforestry, climate change, socio-ecological systems, systematic review.

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1. Introduction

Agroforestry, broadly defined as an agricultural land use where crops, livestock, and fish production are managed in association with trees to enhance ecosystem services, has been widely promoted as one of the most efficient sustainable land management practices in terms of its simultaneous contribution to address desertification, land degradation and drought, declining biodiversity, and accelerated climate change. The concept of agroforestry was from its very beginning aligned with 'restoration' and linking farmers' knowledge, objectives, and expectations to desirable environmental change. Where earlier definitions of agroforestry focused on the technology of plot-level integration of trees at field and farm level, subsequent interpretations of agroforestry as an element of multifunctional landscapes, have focussed on the agriculture/forest interface at landscape and livelihoods scales. Finally, in the late 2000s–early 2010s, the lack of recognition of the active interface of agriculture and forestry became the basis for defining agroforestry as a domain for coherent policies for all land uses, to achieve the higher-level Sustainable Development Goals (van Noordwijk & Coe 2019).

Issued at the conclusion of the 4th World Congress of Agroforestry in 2019, the 'Montpellier Declaration: Make our Planet Treed Again!' highlights the multiple benefits of agroforestry, including its role in maintaining or enhancing yields while mitigating carbon emissions, adapting to the increasingly frequent droughts and floods linked to climate change, restoring degraded soils, and maximising the overall productivity of landscapes for humanity and nature (International Institute for Sustainable Development 2019). Advancing agroforestry in the policy and scientific agenda is particularly beneficial as these practices significantly depart from conventional coping strategies and incremental adaptation to climate change, which may not always be effective at helping people or ecosystems to reduce their vulnerabilities to climatic changes. Instead, agroforestry fundamentally alters the entire system's ecological and/or social properties and functions, thus reducing the root causes of vulnerabilities to climate change (Fedele *et al.* 2019).

A new appreciation of the relevance of agroforestry and related practices for the climate change agenda is emerging as part of the recent IPCC (Intergovernmental Panel on Climate Change) land-use report (Smith *et al.* 2019). The 2019 update of the IPCC guidelines for national greenhouse gas inventories for the first time explicitly includes default data (for Tier 2 accounting) for a range of agroforestry land uses (Cardinael *et al.* 2018, Ogle *et al.* 2019). National Adaptation Plans increasingly make explicit reference to agroforestry (Meybeck *et al.* 2020). While trees on farms around the world have been steadily increasing, adoption of agroforestry is mostly limited to a minority of innovative land-users and practitioners (Sanz *et al.* 2017). A 'transformative change' is needed to speed up the adoption of agroforestry systems.

From 1990 to 2018, almost ten times more funding for climate change research went to the natural and technical sciences than to the social sciences and humanities (Overland & Sovacool 2020). But we will not solve problems related to land, trees, and forests contributing to our global crises if we do not understand and address the governance challenges (Maryudi *et al.* 2018). Governance research is essential to understanding how to bring about transformational change in policies, institutions, and behaviours (Rahman *et al.* 2018). For forests and trees, governance is relevant across scales (from global policies and challenges to local land use practices) and is inherently multi-actor and multilevel. However, governance structures often do not encourage cross-sectoral and cross-scale planning and cause instability over time. The inability to accommodate traditional governance mechanisms and access rights recognised by indigenous people and local communities can further limit agroforestry from catalysing transformative adaptation (Scherr *et al.* 2012). As agroforestry redefines entire systems and alters both social and ecological processes, it becomes critical to identify the changes required in governance structures to facilitate this type of adaptation (Fedele *et al.* 2019).

While there have been recent syntheses focused on the climate-related benefits of agroforestry (Brown *et al.* 2018), there has not been a comprehensive literature review and synthesis focused on climate change governance of agroforestry systems. We aim to address this gap in the literature by applying a systematic review methodology with five objectives: (1) outline the current state of the literature, (2) characterise how governance is conceptualised, (3) investigate governance challenges, and (4) provide insights into effective governance. The paper begins with an overview of the methods, followed by the results and discussion, and, finally, presents the main conclusions that can be drawn from the research.

2. Methodology

We employ a systematic review of literature related to climate change governance and agroforestry, where we sample, analyse, and synthesise literature to answer targeted research questions. We follow a four-step process as follows: (1) determine research questions to guide the review; (2) develop a search protocol (that is, targeted databases and search terms) to explore literature databases; (3) screen the results of the literature search based on a predetermined set of criteria; and (4) conduct an analysis and synthesis of the remaining literature.

The questions guiding our research relate directly to the objectives (Table 1). Governments, the private sector, and civil society need to have a better, contextually grounded, understanding of options for achieving effective and inclusive governance of forests and trees and promote biodiversity-enhancing agricultural systems, such as

Table 1. Objectives and related research questions.

Objective	*Research question(s)*
To outline the state of the literature on climate change governance in agroforestry settings	What are the main characteristics of relevant publications (e.g., geographic focus)? In what journals are the papers published?
To characterise the current conceptualisation of climate change governance within the literature	Is climate change governance defined? If so, what definitions are used? If not, how is climate change governance being constructed?
To investigate the challenges of climate change governance and provide insights into what is considered effective governance within agroforestry settings	What governance challenges emerge from, or are apparent in the literature? What characteristics and factors emerging from the literature are thought to constitute effective governance?

agroforestry, that can contribute to climate change mitigation without compromising yields. For governance to support this by aligning incentive structures, reimagining accountability systems and levelling the playing field, a governance research agenda must be based on an initial understanding of the paradigms used and the research insights that support transformational change.

While we recognise that grey literature, particularly in the form of reports published by multinational or research organisations related to climate change and agroforestry issues, may be relevant to the purposes of this review, we chose to focus only on published literature to keep the review task manageable (in the face of an overwhelming volume of academic literature) and to validate the quality of the articles reviewed through a peer-review process. Future studies may consider including grey literature to address individual study limitations through contextualisation and triangulation, while treating different categories of evidence separately. We chose Scopus as the targeted database because it contains a broad range of journals related to agroforestry management and climate governance. This database is appropriate since: (1) the relevant literature spans multiple disciplines (for example, ecology, geography, sociology, planning) and (2) there are no journals or databases focused specifically on agroforestry or climate governance. These two conditions necessitate drawing from a range of journals and databases to capture an adequate scope of relevant papers.

The targeted databases were queried using two sets of keywords relating to: (1) definitions and terms used to describe agroforestry systems, (2) terms that explicitly contained the concepts of climate change governance or climate governance (Table 2). We acknowledge that these search terms would omit relevant publications that do not explicitly use the term ‘governance’. However, we assume that explicit use of the term ‘governance’ is important, since we aim to explore governance conceptualisations, challenges, and effectiveness.

Table 2. Search terms by category.

Category	*Terms*
Agroforestry systems	(“agr*forest*” OR “agr*silv*” OR “agr*hort*” OR “evergreen agriculture” OR “improved fallow*” OR “shade tree*” OR “rotational tree fallow*” OR (parkland* AND agr*) OR “tree garden*” OR “forest garden” OR “alley crop*” OR “alley system*” OR “alley farm*” OR intercropping OR “shifting cultivation” OR shelterbelt* OR “natural vegetation strip*” OR “wind break*” OR “sloping agricultural land technology” OR “hedgerows” OR “hedge cropping” OR silv*past* OR “fodder tree*” OR “integrated animal and wood production” OR “trees on pasture” OR “integrated production of animals, crops and wood” OR “tree-crop-livestock” OR “apiculture with trees” OR entomoforestry OR “aqua-silvo-fisher*” OR “tree* on farms” OR “orchard” OR “on-farm tree*” OR “wooded pastures produce” OR “fertili*er trees” OR “shade species” OR “shade-grown” OR “alternative agriculture” OR “tree-based system*” OR “tree fallow*” OR “planted fallow*” OR woodlot* OR “boundary planting” OR “mixed trees and crops” OR “conservation agriculture with trees” OR “farmer managed natural regeneration” OR homegarden OR “fodder shrub*” OR “nitrogen fixing trees” OR “commun* forest* management” OR ((“mix* crop*” OR “multi* crop*” OR legum* OR indigenous OR exotic OR introduc* OR domesticat* OR farm* OR medicinal OR nut* OR fruit* OR timber* OR nitrogen fix*) NEAR tree) OR ((“mix* crop*” OR “multi* crop*” OR legum* OR indigenous OR exotic OR introduc* OR domesticat* OR farm* OR medicinal OR nut* OR fruit* OR timber* OR nitrogen fix*) NEAR shrub) OR “tree crop interaction*” OR ((multifunction* OR multipurpos* OR “multi functional*” OR “multi purpos*” OR multistrata OR “multi strata”) NEAR tree*) OR ((multifunction* OR multipurpos* OR “multi functional*” OR “multi purpos*” OR multistrata OR “multi strata”) NEAR shrub*) OR ((multifunction* OR multipurpos* OR “multi functional*” OR “multi purpos*” OR multistrata OR “multi strata”) NEAR farm*) OR ((multifunction* OR multipurpos* OR “multi functional*” OR “multi purpos*” OR multistrata OR “multi strata”) NEAR agr*) OR “woody perennial*” OR “non timber forest product*” OR NTFP* OR “food forest*” OR woodlot* OR ((tree* OR management) NEAR shad*) OR “overstor* tree*” OR “understor* tree*” OR “understor* crop*” OR ((firewood OR “fire wood” OR fuelwood OR “fuel wood”) NEAR tree*) OR ((firewood OR “fire wood” OR fuelwood OR “fuel wood”) NEAR shrub*) OR ((firewood OR “fire wood” OR fuelwood OR “fuel wood”) NEAR bush*) OR “boundary plant*” OR “liv* fence*” OR “riparian buffer strip*” OR “riparian forest buffer*” OR “buffer zone*” OR ((plant* OR farm* OR barrier* OR “buffer strip*”) NEAR tree* NEAR contour) OR ((plant* OR farm* OR barrier* OR “buffer strip*”) NEAR shrub* NEAR contour) OR “swidden agricult*” OR silv*arable* OR “cut and carry” OR “tree belt*”)
Climate change governance	(“climat* governance” OR “climat* chang* governance”)

The search protocol returned 312 papers. These papers were then screened employing the following criteria: (1) papers must be peer-reviewed; (2) papers must be written in English; and (3) papers must be published during or after 1999, since our focus is on contemporary literature. While it is recognised that several agroforestry studies are performed by not-for-profit, private, and government organisations, and that grey literature is a relevant tool for understanding information, this review's focus on peer-reviewed academic literature enables a discussion on the research direction emerging within the academic field. The articles were then filtered at two different stages of detail, each filter excluding studies that were irrelevant to the research objective. The first filter consisted of a review of each abstract, which demonstrated a clear effort on the assessment of climate-related governance in agricultural and/or forested landscapes, after which we obtained 192 scientific papers. The second filter consisted of a thorough analysis of the full publication. Governance components under scrutiny needed to be clearly stated and an agroforestry operation had to discussed. Sixty-four papers remained after screening.

Following the final selection of papers, information was manually extracted from articles. Qualitative synthesis of extracted features was then used to analyse patterns, interpretations, and gap analysis. Coded features were distributed across the three objectives of the study: (1) the state of the literature, (2) the conceptualisation of climate change governance, and (3) the challenges and effectiveness of climate change governance within agroforestry settings (Table 3).

Table 3. Features extracted from peer-reviewed scientific journals during systematic literature review.

Research objective	*Extracted feature*	*Specific categorisations*
The state of the literature	Year of publication	Year
	Journal of publication	Name of journal
	Academic discipline	Field(s) of study relevant to the citing journal
	Location of study	The country (or region) where the study was conducted
	Agroforestry system type	Details of agroforestry system mentioned
	Study type	Modelling, review, theoretical, methodological, empirical
The conceptualisation of climate change governance	Definition	Definition used or implied of governance
The challenges and effectiveness of governance	Challenges of governance	Identification and categorisation of challenges to governance effectiveness
	Effectiveness of governance	Identification and categorisation of factors contributing to governance effectiveness

3. Results and discussion

This section covers the main findings of the review and discusses their implications. The section is organised according to the objectives (Table 1).

3.1. The state of the literature

The majority of papers included in the sample were published since 2013, with 2019 and 2020 accounting for more than half of the sample (Figure 1). The literature is also found in a diverse set of journals. There were two individual journals (*Forest Policy and Economics* and *Sustainability* (Switzerland)) that each contained more than two papers within the sample. In addition to these two journals, there were eight journals that each published two papers in the sample and thirty-six journals that each published one. While the majority of the papers were from social science (28 per cent) or environmental science (35 per cent) journals, the journals' foci ranged widely and included economic and agricultural science journals.

Approximately 41 per cent of papers were review papers. However, 22 per cent were review papers that drew on case studies to demonstrate their findings (that is, they included case studies but did not report on specific methods for gathering data and examining the case studies). Approximately 44 per cent were empirical papers and

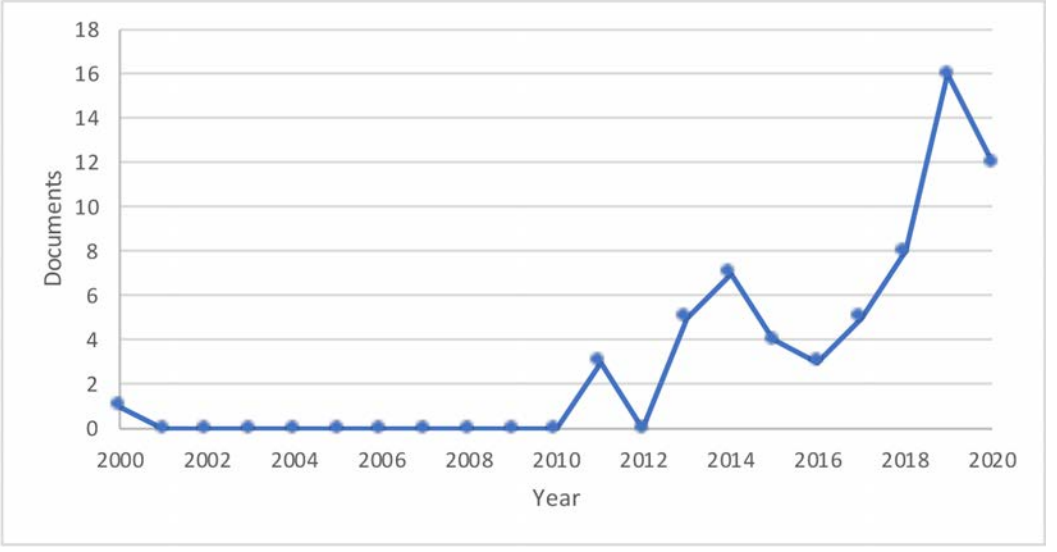

Figure 1. Documents by year.

15 per cent were conceptual papers. The geographic range for empirical and review papers using case studies was varied. However, there were considerably more papers focused on Indonesia (n = 7) than on other countries.

3.2. The conceptualisation of climate change governance

It is important to note that, except for Kunz *et al.* (2019), who define climate change governance as the 'purposeful mechanisms and measures aimed at steering social systems towards preventing, mitigating, or adapting to the risks posed by climate change', none of the literature sampled provided a definition. The sampled literature, rather, exhibits two main implicit conceptualisations of governance: (1) governance as context; and (2) governance as praxis. Each has different implications for how climate change can be addressed.

With regard to 'context', governance is considered part of the setting in which the climate responsive management of the agriculture–forest interactions takes place (e.g., Sahide *et al.* 2020). Thus, governance is seen largely as a structural phenomenon, consisting of rules, regulations, regimes, and the institutional arrangements that enable and constrain management (Jodoin 2020, Singh *et al.* 2020). There are clear lines drawn between governance and management in this perspective, and sometimes the two are cast as having an antagonistic relationship. For example, this literature often asserts that effective sustainable land management practices like agroforestry require converging governance structures that keep agriculture, forestry, and climate change separate (Soto Golcher & Visseren-Hamakers 2018). However, using a 'governance as context' perspective may limit needed attention to the processes required to mainstream or contextualise different management approaches in agroforestry landscapes.

Governance as praxis moves beyond a contextual focus to include attention to process. Governance, under this construct, still contains structural components (for example, rules, regulations, arrangements); however, it is also active and reflexive with a greater attention to the people or actors who are involved in governing and recognising the importance of all governance levels, thus pointing to a polycentric nature of governance (Ruseva *et al.* 2020). The lines between governance and management are somewhat blurred, and the two are considered to contribute synergistically to desired outcomes. For example, the ability to mainstream biodiversity in productive sectors under climate change is viewed as contingent upon determining effective agroforestry governance networks and actor interactions related to information exchange, finance flows, and regulation (Zinngrebe *et al.* 2020).

If the paper described institutions and decision-making rules without engaging with populations around their decision processes on natural resource management,

then the paper was categorised as analysing governance as context. Otherwise, it was categorised as employing the concept of governance as praxis. The latter was the most common construct with 43 per cent of papers invoking it. Governance as context was apparent in 36 per cent of papers. The remainder of the papers either did not invoke either construct (that is, governance as praxis or context) or did not provide enough information to make an adequate judgement.

3.3. The challenges of climate change governance within agroforestry settings

There were three main challenges identified through the systematic review: (1) coordinating polycentricity; (2) overcoming power imbalances; and (3) sharing, translating, and integrating different types of knowledge. These three challenges were each found in approximately 70 per cent of papers. There were three other challenges identified: (1) dealing with uncertainty about future climate or social conditions; (2) negotiating trade-offs among different sectors or resource users; and (3) debunking persistent problem frames. These challenges were less predominant in the literature and were only found in between 20 and 50 per cent of papers. The most predominant challenges are discussed further below.

The first challenge that emerged from the systematic review deals with fostering partnerships and polycentric governance structures. Transformative climate change adaptation by fundamentally changing the characteristics and properties of land use through agroforestry may be discouraged by the need to involve multiple stakeholders, sectors, and governance levels with potentially different interests (Fedele *et al.* 2019). For example, in the context of REDD+ programmes in Indonesia, REDD+ institutions that have been built at the national level have not yet been realised at the sub-national level, resulting in differences in achievement. In addition, conflicting policies among the forestry, plantation, and mining sectors mean that agroforestry projects supported by REDD+ often compete with other major land-based developments (Ekawati *et al.* 2019). On the role of the private sector, Carodenuto (2018) has shown how these stakeholders have entered into partnerships with the government to help the state create supply chain transparency. As a result, 'business would simultaneously play the role of regulator and regulated, which may shift incentives to dilute or generously interpret how certain aspects of zero deforestation definitions are applied in the field'. The challenge of governance becomes fostering partnerships and polycentric structures (for example, commodity chains, mixed management committees, etc.) that connect multiple spatial and jurisdictional scales while dismantling perverse incentives and strengthening business and government accountability (Delabre *et al.* 2020). Climate change adds urgency to the need to coordinate multiple centres of decision-making, but also an extra dimension to the challenge. The challenge

becomes scaling up and recognising the planetary issue of forests and climate change, while simultaneously scaling down to empower social actors (for example, farmers organisations) at scales relevant to them.

In addition to dealing with polycentricity, climate governance in agroforestry settings must also—according to the sampled literature—overcome power imbalances (Ojha 2019). For example, Delabre *et al.* (2020: 1–2) note how conventional approaches to governing forests and promoting agroforestry are 'locked-in by discursive, institutional and material expressions of power premised upon an historical colonial legacy that enables private investments in forest lands and the exploitation of forest resources around the world'. Governance may indeed succeed in changing some of the formal and visible institutional forms, but subtle power relations and socio-political differentiations within local communities and the political arena tend to persist (Wong *et al.* 2019). If not part of a wider political project or empowerment, 'technical "participatory" practices may interact with existing inequalities, norms and power dynamics and risk further disempowerment of marginalized peoples' (Delabre *et al.* 2020: 7). The challenge of governance becomes underpinning a multilevel and multidimensional forest governance system by participation and deliberative processes, with decentralisation and community empowerment being part of larger deliberative and democratic systems.

An additional governance challenge identified within the sampled literature is sharing, translating, and integrating different types of knowledge in governance structures. As Zinngrebe *et al.* (2020: 1419) point out, 'in agroforestry systems, mono-directional knowledge flows from technical experts to project managers and farmers can be a barrier to innovation as collective exploration processes are needed to find solutions responding to contexts and local perceptions'. A nuanced understanding of local-level dynamics and complexities involves engaging knowledge from forest dwellers in the co-production of assessments and decisions about their implications (Delabre *et al.* 2020, Schroeder & Gonzàlez 2019). However, forestry in some governance systems is a 'realm in which scientific and local knowledge systems meet on unequal footing' (Carton 2020: 1364). These pre-existing foci create barriers to using plural lenses and recognising diverse indigenous, scientific, and experiential knowledge. The challenge of governance becomes developing suitable processes for engaging with diverse sources and types of knowledge.

3.4. The effectiveness of governance

The literature we reviewed recognised six factors contributing to governance effectiveness in making progress towards addressing the main challenges highlighted above: (1) science–policy integration, (2) context fit, (3) supportive agroforestry

governance networks, (4) reciprocal exchanges of information (both between actors and between political levels), (5) strong and accountable business and government leadership, and (6) diverse and inclusive co-creating mechanisms that account for heterogeneity at community level. These notions of effectiveness were usually seen as cross-cutting in relation to the challenges identified. The most predominant factor was policy and science integration, which was apparent in approximately 80 per cent of the papers, followed by context fit, which was apparent in 70 per cent. The other four factors were all similarly predominant and apparent in approximately 30–60 per cent of papers. Only the two most predominant notions of effectiveness will be discussed in detail below.

The fragmentation of governance processes (vertically and horizontally) for agroforestry was a strong barrier for mainstreaming biodiversity into productive sectors. With the prospect of new finance opportunities from sustainable value chains or international finance instruments, such as REDD+, possible incentives for agroforestry will depend on the coordination of climate and biodiversity policies, as well as the integration of institutional settings within existing governance structures while reducing administrative hurdles (Zinngrebe *et al.* 2020). In the case of governance systems dominated by one regime, as is the case in climate change, integration might have greater potential outside the intergovernmental regime through soft law approaches (Soto Golcher & Visseren-Hamakers, 2018).

Science–policy integration usually refers to the use of scientific knowledge when making policy. A key ingredient of successful science–policy integration appears to be a focus on interdisciplinary or transdisciplinary science, which facilitates access to diverse forms of knowledge. As Delabre *et al.* (2020: 7) articulate, 'this unity between science, indigenous knowledge, gendered understandings of forest politics and other alternative voices in proactive (counter)action provides opportunities for weakening the perpetuation of dominant myths (of sustainable forest governance) by allowing for a variety of values, knowledges and cultures to inform forest policy'.

We refer to context fit as the ability of governance to account for the socio-ecological characteristics, processes, and dynamics of the agroforestry systems being influenced by governance. Within the literature, context fit usually involves developing and enforcing progressive laws and regulatory frameworks suited to context (Delabre *et al.* 2020) and recognising traditional indigenous ontologies of territoriality (Schroeder & Gonzàlez 2019). However, the ability of governance to achieve context fit is often constrained by pre-existing institutional capacity and social conditions, such as existing jurisdictions or sector-based management. Further empirical work is needed on the role of agroforestry governance networks in linking and balancing different types of context knowledge, and how these relate to governance effectiveness under conditions of change (Hasnaoui & Krott 2019).

4. Conclusions

The literature on climate change governance across agroforestry systems has flourished over the last couple of years. This literature has been found in a number of interdisciplinary journals. Governance is conceptualised mostly as praxis, but also commonly as context. Coordinating polycentricity, overcoming power imbalances, and sharing, translating, and integrating different types of knowledge are the most commonly found governance challenges within the literature, while the need for science–policy integration and context fit are the most commonly cited elements of effective governance.

Currently, few papers treat governance of agroforestry systems—as transformative adaptations to climate change—as theory (that is, a set of propositions and hypotheses to be empirically tested), and there is no unique or distinct definition of governance in this context. This points to a need to develop a richer conceptual framework of governance that accounts for the direct social and ecological linkages and feedbacks between restructured livelihood activities and multi-scale environmental and socio-economic realms. Ongoing conceptual development in the areas of institutional adaptation, agroforestry governance networks, and social–ecological fit may be sources of innovation to foster meaningful and beneficial governance in this context.

This article has shown that the imperative to catalyse more effective and adaptive forms of governance is increasingly evident. Governance is an important component of our ability to navigate transformative adaptation to rapid social and environmental change, and developing a more in depth and appropriate understanding of governance of agroforestry systems is crucial to promoting sustainability as we negotiate current and future change.

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Financing food system transformation: insights from global climate projects

Abrar Chaudhury and Saher Hasnain

Abstract: Climate change poses unprecedented and complex challenges to global food systems. Critical vulnerabilities, continuing inequalities, and unsustainability have demonstrated that food systems need significant intervention in order to deliver safe, just, and healthy food for all, against the backdrop of a changing climate. Innovative interventions and effective financing are needed across the food system to achieve these grand ambitions. While there is recognition of a systems approach in the face of complex issues such as climate change, interventions and financing mechanisms have historically focused narrowly on production or specific sectors within food and related systems. Given the diverse array of stresses and shocks, this approach will not achieve the desired paradigm shifts necessary to secure global food systems and meet the Paris Agreement climate targets. Through a comprehensive review of projects funded through the Green Climate Fund (GCF), this paper shows that paradigm shifting interventions can benefit from a food systems perspective by moving beyond specific sectors and activities and delivering outcomes across the socio-economic and environmental spheres. Climate change and food system challenges are complex and necessitate system approaches, and financing instruments need to be designed and structured with systemic complexity in mind.

Keywords: Food system, climate finance, Green Climate Fund, climate change, systems approach.

Notes on the authors: see end of the article.

Introduction

Climate change poses a huge threat to our global food system. For developing countries, it is an existential crisis as they not only have to feed their growing vulnerable populations but also rely on the sector for livelihoods and generating economic development. The COVID-19 pandemic is exacerbating many vulnerabilities and inequalities in the global food system. Climate disasters, for example, continue while COVID-19 spreads globally. Support for climate-vulnerable farmers in developing countries has improved (World Bank 2021), but lockdown and trade restrictions have hampered access to labour and markets. COVID-19 restrictions impeded the movement of labour, changed consumption demands, closed off processing facilities leading to restrictive distribution and trade policies, with financial pressures across supply systems (UNCTAD 2020). These indicate that vulnerabilities exist along supply chains and in the food system beyond the activity of production. The increasing complexity and fragility of supply chains to climatic and other shocks have necessitated an overarching perspective of the whole system.

Food systems consist of all activities associated with food production, such as producing, processing, retailing, transporting, consuming, and disposing (CIAT 2017, Woodhill *et al.* 2020). The range of food system activities are estimated to be responsible for 26 per cent of global GHG (greenhouse gas) emissions every year, of which crop production itself makes up only 27 per cent (Poore & Nemecek 2018). While food system thinking and research have been conducted over many decades,[1] their findings are often not integrated into food and climate-related issues. In addition, most transformation approaches in developing economies, thus far, have tended to focus primarily on smallholders and food production (IFAD 2013, CFS 2016, Woodhill *et al.* 2020). While attention on production and small-scale farmers is important, they are part of a bigger picture that is undergoing significant transformation, influenced by demographic change, resource degradation, and climate change. Opportunities for stakeholders within the production sector need to be considered in this wider context, particularly given the increasingly unhealthy, unsustainable, and inequitable outcomes of our food systems.

Extreme climate events continue to destroy farmer livelihoods and food security across the world and, in combination with the pandemic, there is a serious risk of hunger and famine for years to come (Mbow *et al.* 2019). Lockdowns have led to the closure of local markets on which smallholder farmers and small food producers are

[1] Notable examples are the works by United Nations Environment Programme's (UNEP) International Resources Panel on the impacts of food system activities on the natural environment (2016) and studies by the University of London's Centre for Food Policy (Lang & Barling 2012, Parsons *et al.* 2019).

so reliant. Tonnes of food remain unharvested on fields if migrant labourers cannot travel, and surplus livestock is being buried (Marchant-Forde & Boyle 2020, Stephens *et al.* 2020, FAO, 2021). Informal economies on which smallholders and small producers depend for survival suffer. Small producers going out of business might also pave the way for bigger businesses, further consolidating and concentrating power in agriculture and broader food systems through integrated supply chains (Kwak 2020). These actors and their associated activities are all interconnected. 'Core' food system activities are influenced by drivers within social, political, economic, environmental, and natural realms (Van Berkum *et al.* 2018, Ingram & Zurek 2018), and supported by processes such as regulations, standards, communications, and logistics. These activities profoundly affect food and nutrition security, environmental sustainability, and social and economic well-being (HLPE 2017). Conceptualising the food system in this manner helps identify the connections and relationships between the wide range of activities and explore the multiple dimensions and systems that food interacts with (for example, environment, socio-economic, and health), the actors carrying out the activities (for example, producing, distributing, and storing), and the drivers that affect them (for example, urbanisation, technology, and climate change). Such an approach enables identification of interventions and the analysis of their unintended and indirect consequences.

In this article we analyse projects funded by the Green Climate Fund (GCF) to understand the role of climate finance in the context of food system activities. GCF is an operating entity of the financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC) and serves the 2015 Paris Agreement, supporting the goal of keeping average global temperature rise well below 2°C. GCF partners with intermediaries (known as Accredited Entities) work alongside developing countries to conceive project ideas and submit funding proposals to the GCF. As the largest dedicated public sector climate fund for developing countries, GCF offers an ideal setting for studying the role of finance in helping developing countries transition to a low-emission and climate-resilient food system. Applying a food system approach to the GCF portfolio is timely as its funding for climate themes, including food, is committed to increase greatly in coming years from its current US$10 billion portfolio. Identifying the necessary frames, measures, and standards at this stage of the process will help guide food system transformation with incoming investments, especially the transformational aspects of finance in food and how funding for projects and programmes can transform the entire sector beyond a single project.

Climate finance offers an important opportunity through funding low-carbon and climate-resilient actions in the food system of developing countries (Millan *et al.* 2019). The food sector's vulnerability to climate and market shocks has traditionally kept funding mechanisms at bay (UNEP 2016). However, by developing innovative

concessional and blended climate financing products, funding institutions are now attracting project developers to the food sector and broader adaptation activities. Despite progress, access to long-term and reliable climate finance remains a challenge, even for small-scale agriculture, despite emphasis on economic development and poverty alleviation activities (FAO 2012, Chiriac *et al.* 2020). Available funding often takes a narrow project and programmatic approach to food systems, focusing on particular aspects and activities, notably production (Diaz-Bonilla 2018, Conevska *et al.* 2019). For example, production-oriented funding projects may support improved farming practices for procuring high-yield seeds or investments in water harvesting techniques, without explicitly accounting for the broader outcomes. However, financing alone cannot solve the food challenge, and particular financing mechanisms may actually increase farmer vulnerability through input-focused loans at times of crop failure. Research indicates that financial resources have to be supported by the appropriate knowledge to apply interventions effectively (Chaudhury *et al.* 2017) and without appropriate risk-mitigating support such as insurance and grants, farmers will not necessarily adopt the most profitable measures to improve livelihoods (Hazell *et al.* 1986, Chaudhury *et al.* 2016). A system-based approach is needed to understand farmer needs in the context of the food system to generate robust strategies.

For example, the products of climate-resilient methods may still be processed and transported by high-emission means, thereby reducing the downstream environmental, food security, and socio-economic benefits of the whole process. The lack of a systems approach in finance suggests that funders and policymakers can underestimate or miss the catalytic nature of finance in the transition to a low-emission and climate-resilient food system (Nakhooda *et al.* 2014, Palmer 2016, Nghiem *et al.* 2018). While many countries identify sustainable agriculture in their global and national commitments and plans, few set goals beyond production in certain parts of the food system, such as sustainable consumption, processing, transportation and logistics, and food waste (UNFCCC 2021). Opportunities for reducing the food systems emissions profile and increasing its climate resilience beyond production remain untapped and poorly defined. Countries lack tangible incentives and mechanisms to address climate problems without measurable commitments related to the food system. As the food system is highly complex and dynamic, with different drivers, outcomes, and stakeholder perspectives, it is important to explore how financing solutions can be applied in a systematic manner.

This article addresses an important gap between the aspiration of current climate financing mechanisms on food system transformation and the how food projects are actually funded. This is accomplished by exploring GCF's areas of focus in projects that seek improvements in food system outcomes and how food system thinking is conceptualised. The paper will demonstrate that significant gains in emissions reduction,

livelihood improvement, number of lives impacted, and food and nutrition security are possible if climate financing mechanisms like the GCF take a food system approach.

This article is organised as follows: an overview of the food system approach is followed by the methods employed, and the analysis of the GCF-funded food projects. The paper concludes with a discussion on the results and significance to current debates in food systems, transformational change, and climate financing.

The food systems approach

Global emissions are currently at 50 billion tonnes of GHG per year in CO_2 equivalents. Emissions reduction is often considered primarily in the realm of energy use and transport. However, the global food system is responsible for nearly 26 per cent of global GHG emissions, and pathways to emission reduction are not clear. Within the food system, livestock and fisheries account for 31 per cent of food system emissions, crop production accounts for 27 per cent, land use for 24 per cent, and supply chains for 18 per cent (Poore & Nemecek 2018). A further 24% of the total emissions from global food systems come from food wasted and lost through supply chains and by consumers (Poore & Nemecek 2018). This demonstrates that the various activities within the food system all consume natural resources and energy.

Beyond emissions, livelihoods are a critical concern. The food system currently employs large numbers of people in developing countries. This includes employment in agriculture, processing, storage, distribution, transport, logistics, retailing, and other services (Townsend *et al.* 2017). For example, while farming accounts for about 65 per cent of total employment in low-income countries (Castaneda *et al.* 2016), the food and beverage sector accounts for 40 per cent of employment in manufacturing in Malawi and Tanzania. Even in developed countries, a significant portion of employment takes place in the food system. For example, in Great Britain, 13 per cent of the population was employed in food system activities in 2019, which includes agriculture and fishing, food and drink manufacturing, wholesaling, retailing, and catering (National Statistics 2019). World Bank analysis reveals that by 2025, the food system will be responsible for more than 70 per cent of all employment in Ethiopia, Malawi, Mozambique, Tanzania, Uganda, and Zambia (Townsend *et al.* 2017). Discussions of livelihoods and living income therefore become essential, particularly since a significant proportion of food system actors (for example, small-scale farmers) do not earn enough for decent housing, education, food, and healthcare (Gneiting & Sonenshine 2018). However, improvements in food system activities may not necessarily translate into improvements in livelihoods. For example, controlled-environment agriculture techniques may reduce labour-intensive jobs that many people rely on. Therefore,

most GCF food projects take a co-development approach to food and livelihood to avoid perverse trade-offs. Food system interventions through GCF projects can achieve co-benefits in the environmental and socio-economic spheres by improving the livelihoods of the millions of people employed within it.

The challenges facing global food systems are multidimensional, complex, intractable, and contested. Climate change, food security, environmental degradation, and the dynamics between humans and animal health are examples of wicked problems (Lazarus 2008, Etzion *et al.* 2017). Reductionist approaches to such problems might result in the exclusion of certain necessary stakeholders, interdependencies overlooked, and targeting symptoms instead of the problem itself. Systems thinking is a way of approaching and addressing such problems. Taking a systems approach provides structures for dealing with the connections between problems. Systems thinking necessitates a different approach to complex problems, by exploring not just what is known about each, but also interrogating and reflecting on the processes of knowledge, biases, barriers, and connections. Reflection, iteration, boundary judgements, and interdisciplinary collaborations are therefore key in systems thinking. These processes can help ensure that multiple differing perspectives are included, the situation is viewed in the longer term, and consideration given to the systemic consequences of interventions (Meadows 2008). Systems thinking encourages the shift from narrow and targeted analyses to those that incorporate all perspectives and unintended consequences, and work with the dynamic relationships embedded in complex systems.

Systems thinking must be applied to food challenges because of the need for structured, inclusive, iterative, and systematic approaches. Mapping the 'big picture' of food commodities or challenges allows for the exploration of the many challenges and opportunities available in a methodological and structured way (Ingram 2011). Figure 1 shows the food system framing developed by the Foresight4Food Initiative that integrates key systems concepts from Ingram and Zurek (2018) and 'Making Markets work for the Poor' (Springfield Centre 2015).

A food system includes the connected and interdependent set of institutions, organisations, and enterprises, cultural rules and norms, activities and relationships that govern, develop, and deliver the inputs to food production activities and handle, process, transport, store, and retail the products to consumers and eventually to waste managers. The industry and business actors, for instance, interact and play an important role in linking smallholder farmers to the food system through input supply, procurement, markets, and financial support. A food system has multiple outcomes across the socio-economic and environmental spheres, with frequent trade-offs being made across desired goals. A food system approach helps identify these goals and outcomes and shapes the strategies needed to achieve gains across all spheres and maximise synergies. This framing is useful for examining the interrelationships

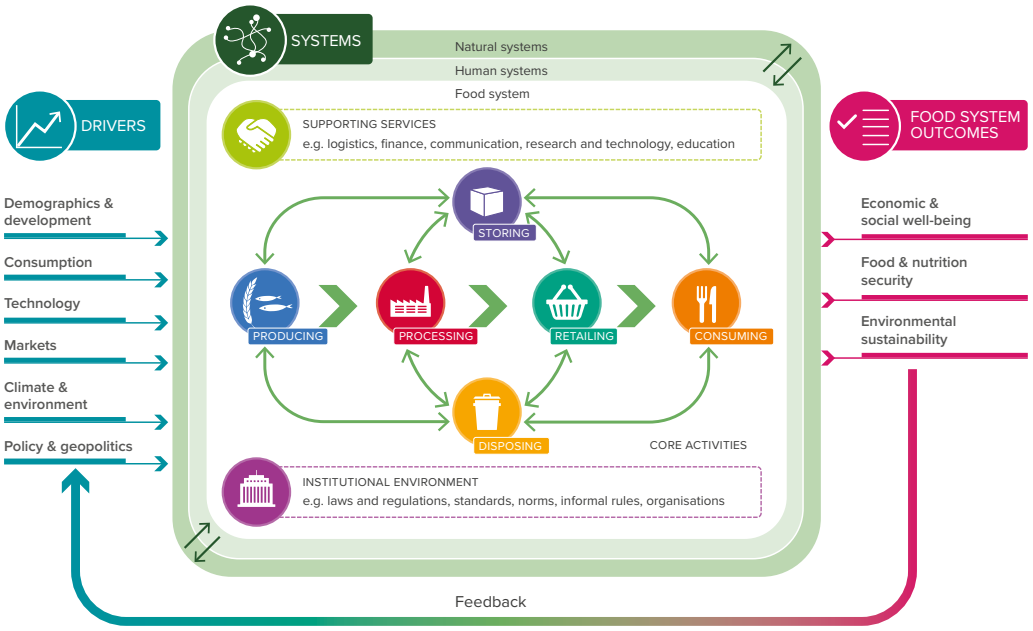

Figure 1. Foresight4Food food systems model describing food system activities, drivers, and feedback loops (Woodhill *et al.* 2020).

between food system activities, outcomes, and the supporting services and activities that enable the system's functioning.

The approach has gained traction in recent years, with the UN Food Systems Summit 2021 acknowledging the fragmentation and lack of clarity in how the concept is realised and operationalised. Important examples of food system approaches in research and practice have been developed by the Global Environmental Change and Food Systems (GECAFs) project (Ingram 2011), Metrics, Models and Foresight for European SUStainable Food And Nutrition, or SUSFANs (Zurek *et al.* 2018), TRANSMANGO (Brunori *et al.* 2015), University of London's Centre for Food Policy, the UK Mapping of Food Systems (Hasnain *et al.* 2020), Resilience of the UK Food System in a Global Context project (GFS 2020), and RAND Europe's food system map for the UK's Food Standards Agency (FSA) (Smith *et al.* 2019). Such maps are part of a systematic inquiry of the distinctions, systems, relationships, and perspectives of the system of concern (Cabrera *et al.* 2008).

The goals of GCF-funded projects are organised around driving a paradigm shift related to the Sustainable Development Goals (SDGs) and meeting the commitments of the parties under the 2015 Paris Agreement. The GCF initial investment framework defines paradigm shift potential as the 'the degree to which the proposed activity can catalyse impact beyond a one-off project or programme investment' (GCF 2020: 3). The assessment dimensions within this framework focus on scale, replicability, and

sustainability of the funding. However, due to the programmatic nature of many such projects, the interventions are tightly focused on limited activities of the food system, and the paradigm criteria are applied in a limited way. This becomes a stumbling block towards not only developing a resilient food system, but also making progress towards all the SDGs and the Paris Agreement for transformational change.

The analytical framework

This paper proposes an analytical framework, as shown in Table 1, based on three key principles arising from the food systems approach discussed before to evaluate the systems and finance capability of the GCF projects:

1. Activities of the food system result in 'outcomes' that can be categorised into economic and social well-being, food and nutrition security, and environmental sustainability. These are part of the paper's analytical framework to explore the breadth of the GCF projects' anticipated paradigm shift.
2. Food system activities are present at the core of the food system. Carried out by a diverse array of actors, a food system can consist of various interacting food system activities.
    a. Production activities include, but are not limited to, farming, livestock rearing, aquaculture, fishing, foraging, and hunting. For the purposes of this classification, this category includes pre-production activities, such as developing agricultural chemicals, fertilisers, and farm machinery.
    b. Aggregation consists of bringing produce and products from different sources together for improving supply chain regularity: for example, the coordination of produce from multiple suppliers for large retailers and wholesale service providers (Dillemuth & Hodgson 2016).
    c. Processing (and/or manufacturing) includes basic or primary processing, such as washing and trimming, and value-addition activities, such as confectionary production (Hasnain *et al.* 2020).
    d. Distribution moves products between the various sites and facilities in the food system.
    e. Retailing consists of activities related to the sale of products to consumers, in sites such as, but not limited to, supermarkets.
    f. Consumption consist of activities for offering a balanced and nutritious diet
    g. Food disposal activities consist of the disposal and processing of degraded, inedible, and wasted food sent to food waste destinations, such as landfills (WRAP 2020).

Table 1. Analytical framework on three key principles arising from the food systems approach to evaluate the systems and finance capability of GCF projects.

Food system outcomes	*Food system activities*	*Supporting mechanisms and institutions*
1. Economic and social well-being	1. Production	1. Industry and business
2. Food and nutrition security	2. Storage and aggregation	2. Infrastructure
3. Environmental sustainability	3. Processing	3. Policy and regulations
	4. Distribution	
	5. Retail	
	6. Consumption	
	7. Disposal	

3. These food system activities and actors are influenced by a range of supporting governance mechanisms and institutions. For the purposes of this paper, these are categorised into industry and business (for example, SMEs (small and medium-sized enterprises), multinationals, civil society, public actors), infrastructure (physical and institutional), and policy and regulations including public sector engagement.

Methods

The research for this paper combined a quantitative analysis of projects funded by GCF under the results area of 'health, food, and water security' with a qualitative analysis (King *et al.* 1994, Silverman 2005) of semi-structured interviews with experts and entities involved in developing and implementing GCF projects in a mixed methods approach (Johnson *et al.* 2007). Health, food, and water security is part of the climate adaptation theme and one of the eight result areas prioritised by GCF for funding projects under climate mitigation and adaptation It is often challenging to separate out the climate-related aspects of impacts on health, well-being, and water and food security. However, the interconnected nature of the challenge means that the GCF has a range of potential entry points to focus on for transformational outcomes of food systems. We selected projects that explicitly focused on food as one of their main objectives.

We collated the project data from the GCF website[2] that lists all projects approved under eight climate action areas, categorised under the themes of climate change mitigation and adaptation. Of the 177 projects approved by the GCF board[3] for funding,

[2] https://www.greenclimate.fund

[3] Approved projects up to the 29th Board Meeting.

seventy-five projects fall under the health, food, and water security action area, representing a total project funding of US$827 million out of the US$8.9 billion committed for all projects. The action area represents 42 per cent of all approved projects, but only 9 per cent of the total funding committed. Of the seventy-five projects, we selected fifty-six projects that explicitly identified food (or other aspects of the food system) in their project objectives, and food action area represented at least 10 per cent of the total project value. Of the fifty-six projects, nine are implemented by direct national entities, two by direct regional entities, and forty five by international entities.

We reviewed the approved funding proposal of each selected project, which are publicly available on the GCF website. Within each funding proposal, we read the programme description and the investment criteria to identify and code the specific outcomes, activities, and mechanism of the project within the food system (Saldaña 2021). We mapped each project's objectives and activities to the three key principles arising from the food systems approach described in the analytical framework: namely, (1) food system outcomes, (2) food system activities, and (3) institutions and governance mechanisms.

Results and analysis

We present the results from the review of the GCF-funded projects under the food results area, based on the three key principles of food system discussed in Table 1. We follow this with an analysis of the project structures and implementation approach of the projects to understand the challenges and opportunities for adopting a systems approach to funding.

Food system analysis

Food system outcomes

Our analysis of the GCF food projects reveals that all fifty-six projects have explicitly considered the key outcomes of achieving food and nutrition security, improving socio-economic status, and safeguarding environmental resources under the sustainability category. Given the GCF's core criteria for transformational change, this is expected. The GCF has set explicit guidelines for all adaptation projects to identify the number of lives impacted. For projects to qualify under the food result area, these must show clear objectives for enhancing food security, although the nutrition impact is not always stated in all projects. Finally, projects have to clearly demonstrate a

strong climate rationale for their interventions in the funding proposals and how the projects will deal with these challenges to succeed in securing funding. Our analysis is limited to projects that have been successfully funded based on the intended outcomes and not the actual outcomes delivered, as all projects are currently in approval or implementation phases. These projects need to demonstrate a strong climate rationale and meet the investment requirements to qualify for funding. Analysing the actual outcomes of the projects on their completion will be necessary to understand the transformational impact of GCF funding. Information on projects that fall short on the climate rationale and investment criteria is not available. According to the GCF team, unfunded projects continue in the project cycle until all objections raised in the evaluation process are addressed or the project developers stop pursuing the funding proposals. Despite this limitation, given the GCF process, we can assume that approved and funded projects incorporate food system outcomes. This focus on achieving food system outcomes strengthens the awareness and desire of GCF in addressing transformational change across many activities at the heart of food systems and across society, economy, health and well-being, and the environment. It demonstrates a strong understanding by GCF that these are interlinked problems requiring systemic solutions and transformation in how our food systems operate. However, this systemic approach has yet to translate consistently across the project portfolio in how food system interventions are designed. We discuss these aspects in more detail in the following sections.

Food system activities

As we move from the broader food system outcomes to a granular analysis of the food system activities, the projects display varying degrees of alignment with the activities. As discussed in the earlier section, food system covers several interrelated activities from food production to consumption, with each activity sensitive to the impacts of climate change but also significantly contributing to GHG emissions.

Our analysis of the GCF projects highlights that the GCF funding is heavily skewed towards production. We observe that the majority of funding projects are designed to improve the resilience of farmers to produce more against the backdrop of a changing climate. Figures 2 and 3 demonstrate that, while all surveyed projects address food production, very few projects consider/include processing (30 per cent), distribution (16 per cent), consumption (5 per cent) or disposal (10 per cent) activities of the food system. None of these projects considered retailing activities explicitly. Only two projects address six activity areas of the food system as shown in Figure 4. These are important activities for building a robust and resilient food system and present an opportunity for leveraging climate finance to unlock investments in the

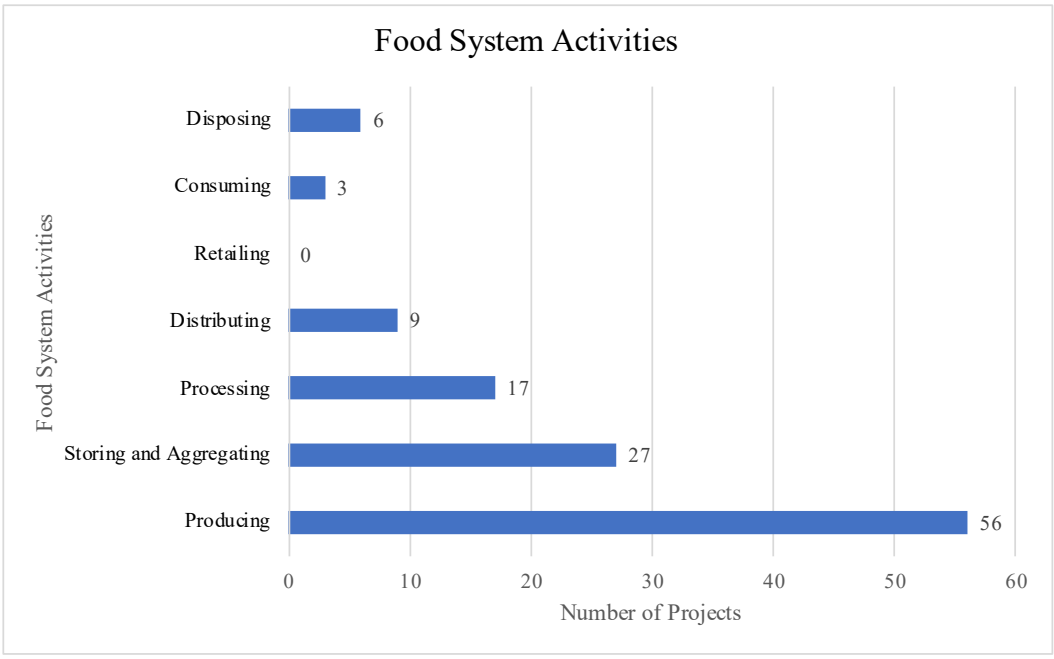

Figure 2. Food system activities in fifty-six GCF-funded projects.

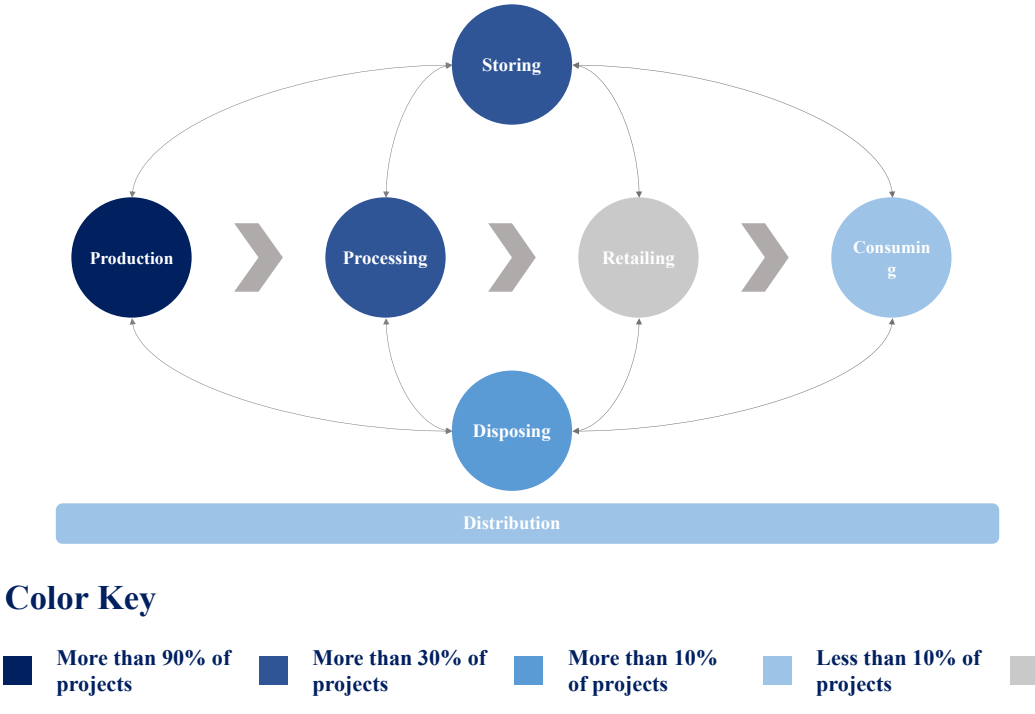

Figure 3. Number of GCF projects in the food system theme.

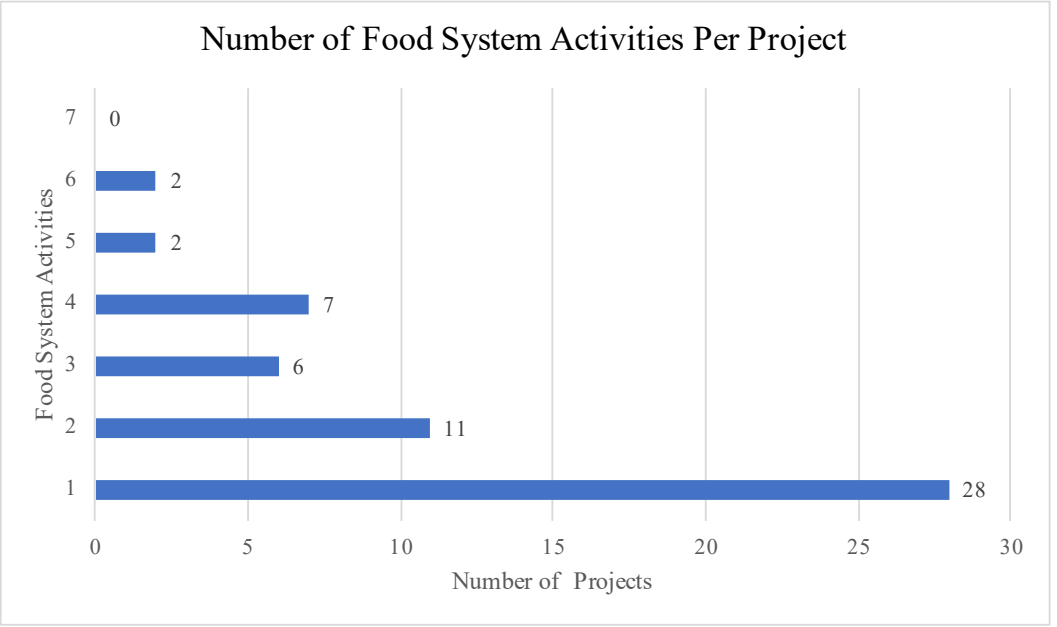

Figure 4. Number of food system activities explicitly addressed in GCF projects.

supply chain. One reason for this production-centric approach is that GCF's investment criteria demand that projects demonstrate a strong climate rationale and the number of lives impacted for the interventions. But GCF leaves it to the project developers to design the interventions based on local needs. Many projects take a localised approach of offering benefits to local communities to meet the GCF requirements, but do not consider the wider opportunities and implications beyond the local communities to the food system activities. This naturally draws the attention of the project developers to the production activity within the food system as it has the potential for the highest number of lives impacted. The number of impacted lives falls along the value chain, as it requires fewer personnel in those areas, and hence is not very attractive for inclusion. A recent report by Worldwide Fund for Nature (WWF)— 'Driven to Waste: Global Food Loss on Farms'— highlights that an estimated 2.5 billion tonnes or 40 per cent of all the food grown goes uneaten around the world each year (WWF 2021). Without taking a systems-wide view for food projects, much of the benefit accrued to the farmers in increased production is lost in other parts of the food system if associated activities in the system are not included. This is important not only for the lost opportunity for addressing the transformational impacts of the proposed activities across the whole system, and given that 18 per cent of GHG emissions is coming from supply chains (Poore & Nemecek 2018), critical action is missed.

Box 1. GCF / ADB project in Cambodia: example of Comprehensive Food System Approach

The GCF and Asian Development Bank funded project in Cambodia demonstrates the full range of food system activities for reducing climate change vulnerability and GHG emissions in agricultural value chains in Cambodia.

This project targets the needs of the most vulnerable populations, including women and rural communities. The project will invest in climate-smart agribusiness value chain infrastructure, capacity strengthening in climate-friendly agriculture, and enabling environment for sound agribusiness policy. It aims to create economic, social, and environmental co-benefits, through increase in yields; improving water use efficiency and energy savings; reduction in post-harvest losses; investing in climate-proof infrastructure to provide more sustainable access to markets; improve household air quality and benefiting productivity while reducing GHG emissions; building capacity of men and women on the use of climate information services and climate-smart agriculture practices along the whole value chain.

The project is aligned with the country's national priorities in climate change adaptation and mitigation and will build on best practices and lessons learned within the country.

There are certainly benefits in improving the productivity of vulnerable farms. However, research also shows that natural capital such as farming land is finite and beyond a certain threshold, it will take more and more resources to produce as soil quality depletes, thus hitting a ceiling on production (Brown 2012). For example, the World Resources Institute estimates a 'land' gap of 593 Mha (described as the difference between projected land area needed for meeting global demand by 2050 and agricultural land area in 2010) if agricultural expansion into forests and savannas is to be avoided (Searchinger *et al.* 2019). In scenarios where production gains are not made, and consumption patterns are not moderated, agricultural land could expand by about 3.3 billion hectares (Searchinger *et al.* 2019). Focusing on the food system activities helps sustain benefits beyond production and meet the paradigm criteria of GCF in practice. The example in Box 1 is of a GCF-funded project that takes a food system activity approach to connect farmers across the value chain and strengthen their resilience to climate change and create new income opportunities.

Institutions and governance mechanisms

In this final level of analysis, we focus on the three linkages of the projects to infrastructure, policy and regulations, and business and industries for uptake and scaling of the projects beyond the project life cycle. Figure 4 shows that nine tenths of the projects make explicit links between food, climate policies, regulations, and relevant policy actors. This high linkage is a result of GCF project guidelines mandating proposals to demonstrate these links under its investment framework, with a specific section dedicated in the proposal template. Infrastructure linkages were also

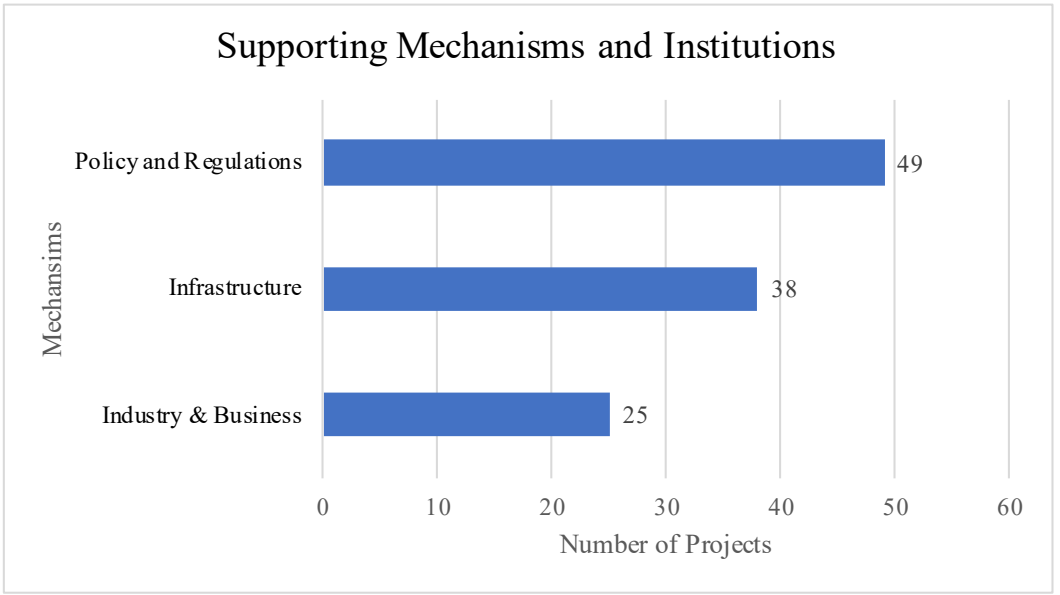

Figure 5. Supporting institutions and governance mechanisms in GCF-funded projects.

prominent as two thirds of projects factored infrastructure investments to support vulnerable communities in areas that generally lacked basic climate and agriculture infrastructure. For example, projects invested in meteorological equipment for accurate weather data or rain harvesting tanks for farmers in drought-prone areas. Investments in such infrastructure were also possible in the projects as over three quarters of GCF projects range upward of US$10 million and allow capacity for such investments. One important linkage in developing a resilient food system that was lacking in over half of the projects is with industry and business. Industry and business play a crucial role in uptake of the food systems activities beyond farmers. They bring in key investments and are natural partners for building new markets, products, and activities. Historically, however, particularly small and medium-tier businesses lack the financial capital and access to capital needed to make steps towards sustainable transformation. Innovations and transformations in this area therefore require innovative financing and improved linkages across the food system institutional infrastructure. Most projects fell short of identifying such linkages and hence were missing significant support in the food system to make it resilient and sustaining. By focusing on production, projects do not create downstream benefits for the farmers from the value addition in the food by businesses and other actors. Few projects that did focus on all three mechanisms offered a resilient pathway for farmers to benefit from the broader food system activities, and also created a sustaining link with the institutions and governance mechanisms for sustained action.

Project funding structure and implementation approach

The GCF classifies the 'health, food, and water security', result under the adaptation theme. Under this theme the impact measure for the projects is on the number of lives impacted. While adaptation efforts are vital to building resilience of the food system and the vulnerable communities dependent on it, it overlooks the significant emissions of GHG by the food system. As discussed earlier, the global food system is responsible for nearly 26 per cent of global GHG emissions. This is a missed opportunity towards a low-carbon and climate-resilient food system. The project developers already have the attention of GCF and by encouraging them towards a cross-cutting approach—that is, projects and programmes that provide actions that may both reduce the amount of GHG and allow vulnerable communities and populations to adapt to climate change—GCF can play a critical role in the transition to a low-carbon and climate-resilient food system.

Our analysis also reveals that GCF funds the majority of the food projects through grants. Grants offer much-needed funding in geographies and interventions that normally lack public and private support. However, the sustainability of the project is questionable once the grants have been consumed. Private and other actors generally have low incentive to participate as they do not find suitable scaling and market opportunities in these projects. By encouraging project developers to take a food system approach, GCF can offer opportunities for actors along the food system to participate in the projects and make these sustaining beyond the grant duration.

We also observed that nearly 80 per cent of the funded food projects are developed and implemented by international organisations. A key reason for this is that international organisations have well-connected networks, experience, and resources at their disposal to design novel projects that meet the GCF guidelines. Much of the knowledge on project design and implementation remains with these international organisations without much coordination with local actors (Chaudhury 2020). This limits the capacity of local organisations to develop robust system-wide projects and take ownership for their challenges. Country ownership is one of the key tenets of GCF funding, yet progress remains slow as seen in only nine projects out of the fifty-six in food developed by national organisations.

Conclusion and way forward

The major disciplinary and institutional shift to food systems indicates an understanding that our thinking around food and nutrition security, environmental sustainability, and socio-economic outcomes needs to change. This is most effectively

illustrated by the 2021 UN Food Systems Summit (UNFSS) on delivering progress on the SDGs through tangible changes in the food system. Bringing together a diverse range of people involved in the food systems, the Summit demonstrates the necessity and urgency of delivering transformational change for a just, secure, and sustainable food future.

This analysis on GCF projects and the current literature on food systems and climate finance reveals that, despite a conceptual and institutional shift to food systems thinking, climate financing mechanisms are not fully implementing a systems-oriented approach. The food systems approach allows for a comprehensive engagement with the complex set of activities, diverse range of actors, and drivers affecting these actors across spatial scales. Funding mechanisms are still unduly limited to food production, with a few notable exceptions. This gap means that there is great untapped potential in improving a range of food system outcomes in the spheres of environment, socio-economics, and food and nutrition security.

To move forward, it is critical to recognise the current limitations of programmatic, short-term, and siloed funding mechanisms. While the thinking around resilient, systematic, and paradigm-shifting change is being incorporated into climate finance, as this analysis demonstrates, interventions are fragmented and seldom address a systems perspective. This means that the gains made in specific areas of the food system are being limited by the fact that complementary interventions are not made elsewhere. It is therefore recommended that climate financing projects take a long-term, food systems perspective in planning and implementing interventions. Given the lack of data and information that often exists in such fields, this necessitates equipping financiers, project developers, and funding reviewers with the data and risk tools needed to evaluate appropriately, projects developed through a systems thinking lens. Incorporating systems learning throughout funding mechanisms will ensure an even shift in financing and project-funding mindsets.

Collaboration and match-making tools that allow project developers to create necessary stakeholder engagements needed for a systems perspective can facilitate transition to more systems-oriented climate financing that is grounded in local and national contexts. Working alongside bodies like the CGIAR Research Program on Climate Change, Agriculture And Food Security (CCAFS) in their efforts to catalyse and diversify climate financing, while using the momentum built from the UNFSS will ensure that innovative financing solutions are systems oriented from the beginning of the process, instead of being an afterthought. Finally, the analysis demonstrates the strength of interdisciplinary project development. Interdisciplinarity in delivering interventions focused on achieving the SDGs must be supported across the financing and implementation process. This approach is important and timely as institutions at different scales are exploring opportunities for national governments and other actors,

to move beyond food production to building a low-carbon and climate-resilient food system future through different and innovative intervention pathways.

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Out of sight – out of regulation? Underground space governance in the UK

Kevin Grecksch

Abstract: Underground space has been used by humans for thousands of years: for example, to extract mineral resources or water. Against the background of increasing populations, urbanisation, and energy demand, underground space has come back into focus, promising to ease pressure above the surface. However, geological underground models deliver only frameworks for possible uses and we do not know much about the context between geological characteristics and human uses, demands, and changes of underground space. Moreover, governing underground space can be complicated as it involves conflicting objectives and regulatory frameworks. One key objective, therefore, must be to conceptualise and implement new approaches to underground governance, taking into account its diverse uses and various stakeholders' claims. This article introduces the current situation of underground space governance and regulation in the UK, discussing different themes, such as property rights, regulation, planning, groundwater, fracking, and the future of underground space use exemplified by the storage of nuclear waste.

Keywords: Underground, governance, regulation, UK, sustainability, property rights.

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Introduction

When politicians, political 'sherpas', negotiators, NGOs (non-goverenmental organisations), and industry lobbyists gathered in late 2021 to discuss the future of climate change mitigation and adaptation at the annual United Nations Climate Change Conference COP26 (Conference of the Parties), they were talking about CO_2 emission reduction targets, fossil fuels, and water security among many other issues. However, they were talking less or not at all about where, for instance, fossil fuels or large amounts of water originate. Without using or exploiting underground space and resources, the world we live in would not be possible. Without iron ore there would be no iron, without coal or gas there would have been no large-scale industrialisation, without oil no plastics, without silicon no smartphone, without underground train systems no fast transport across the world's largest metropoles. And in many areas of the world, without access to groundwater, life and settlements would not be possible. Underground space also plays a huge and important role in our cultural lives. The wall paintings of Lascaux are in a cave; humans settled underground; and still today, for instance, people in Coober Pedy, Australia live partially in caves known for their constant temperature. In many cultures we bury our ancestors underground or in catacombs; underground is almost synonymous with criminal activity (Tondo 2019); people hide underground during wars either to protect themselves or to escape from the enemy; and hell is of course a place underground.

The purpose of this article is to introduce the topic and to ask about the current situation of underground space governance and regulation in the UK using key themes and aspects related to underground space, such as property rights, regulation, fracking, and nuclear waste disposal. The question therefore is: how can an improved and sustainable governance of underground spaces in the UK be ensured? The article will therefore reflect on theoretical foundations and observations with regard to underground space use based on a literature and document review about the current legal and regulatory situation regarding underground space governance in the UK. This article is an introduction to a diverse issue and it is impossible to discuss all aspects of underground space use in detail here. The literature, as we will see, is dominated by civil engineers, architects, and urban planners and it focuses predominantly on urban underground space. Social science views or humanities' perspectives on the underground have been scarce so far (Lee *et al.* 2016, Macfarlane 2019). The basis for this article is academic journals, policy documents, laws and regulations, and grey literature. This will include describing and defining underground governance and identifying themes and patterns. The literature and document review concentrates on the UK, but covers aspects and observations from other jurisdictions as well: for example, countries or cities known for their advanced approach on the issue, such as

the Netherlands or Helsinki in Finland. The starting point for the literature review was a special issue of the journal *Tunnelling and Underground Space Technology* in 2016 (Bobylev & Sterling 2016). Further literature and documents were searched via a snowball search using cross-references and Web of Science and Scopus search engines. Articles were selected on the basis that they deal with underground space use, planning, or governance.

Although humanity has been using underground spaces for thousands of years (von der Tann *et al.* 2020)—for example, for extracting mineral resources or water—the systematic use of underground space, especially in urban areas, is a developing field and laws are not keeping pace with the demand for and opportunities of urban underground space (Bobylev & Sterling 2016). Construction, transport, groundwater, geothermal energy, geomaterials, storage, deposition, or mining are possible uses of underground space. Admiraal & Cornaro (2016) call it 'the final urban frontier waiting to be exploited by those who place the first stake and thereby claim their space'. An extreme case of this can be seen in London, where so-called iceberg houses are extended extensively underground (Baldwin *et al.* 2019, Batty 2018, Batty *et al.* 2018, Burrows 2018). The underground has become an economic and political arena.[1]

While geological underground models deliver only frameworks for possible uses, we do not know much about the interactions between geological characteristics and human uses, demands, and changes. Furthermore, the governance of underground space can be complicated as it involves conflicting uses and legal regulations. Whereas in the UK, coal, gas, minerals, silver, and gold belong to the Crown, groundwater is owned by the landowner, yet its use is limited to reasonable use or has been governed by abstraction licences since 1963. The *cuis est solum, eius est usque ad coelom et ad infernos* (whoever owns the soil, it is theirs all the way to heaven and all the way to the depths below) maxim has, according to Gray and Gray (2009): 'often been invoked in support of some notion of the sacrosanct nature of property rights'. Yet, in contemporary property law this has been substantially qualified. This might be evident for airspace above a property, yet as space beneath a property is out of sight, the regulation and responsibilities of landowners are a patchwork of various practices.

With the exception of nationally significant infrastructure projects, such as power stations, transport schemes, and national parks, planning in the UK falls under the responsibility of local government and is hence fragmented. Strategic regional planning was abolished in 2011 and the sole reference to the underground in the Department for Communities and Local Government (DCLG) 'National Planning Policy Framework' (DCLG 2019) is to encourage underground gas and carbon storage.

[1] For example, the SNL Metals + Mining database, which lists the profiles of 35,000 mines worldwide is under strict copyright and used as a commercial database for potential investors.

Public water supply is the responsibility of the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA) for England, or Natural Resources Wales (NRW), the Scottish Environmental Agency (SEA), and the Northern Ireland Environment Agency (NIEA), and also governed by water companies. Fossil fuels and mineral resources are under the auspices of the Department for Business, Energy and Industrial Strategy (DBEIS). This plethora of authorities could potentially lead to overlaps of governance functions and what and whose objectives should inform the governance of underground space. And, with so many different activities going on underground regulated by different authorities, agencies, and regulators, the bigger picture of underground use should not be forgotten. As above ground, things interact with each other and we should ask the question: how do we actually want to govern and regulate underground space in the future? Hence, a 'spatial dialogue' (Admiraal & Cornaro 2016) is required involving all stakeholders using an interdisciplinary approach (Besner 2016).

Population growth and climate change put stress on public water supply, which includes groundwater aquifers. While low river flows or decreasing reservoir levels are easily visible, the opposite holds true for decreasing groundwater aquifer levels. If further stress is put onto groundwater resources due to an intensified use of the underground for the extraction of shale gas, through hydrological fracturing ('fracking') or CCS technology (carbon capture and storage), this could add further stress on groundwater resources as both new technologies need large quantities of water and increase the risk of drinking water contamination. Therefore, a sustainable governance, understood as binding political decisions to the benefit of future generations that include state and non-state actors through steering mechanisms, cooperation, and coordination (Grecksch 2014), of underground space is needed.

It is striking that, although underground space is used daily by millions or that we are using products that rely on materials extracted from underground, we think so little about it, that we almost take it for granted. When climate change and its causes and effects are discussed, we easily mention words like fossil fuels, water security, etc, but we always omit 'underground', although the link is not in front of us but directly below our feet. Melo Zurita *et al.* (2017) subsume this phenomenon under 'surface bias' in their discussion about the Subterranean Anthropocene. Thus, it should enter the vocabulary of policymakers and those discussing the future responses to climatic changes at the annual COP negotiations.

The Anthropocene (Steffen *et al.* 2016), the new proposed geological epoch, which is defined by human impact on the Earth's geology and ecosystems, is more or less embodied by underground space; it is the future underground (Melo Zurita *et al.* 2017). A geological epoch differentiates itself from its predecessor by significant changes in the rock layers. Hence, the changes humans made and are making to

underground space through extraction, usage, storage, etc will define this new epoch and what we leave behind.

What makes underground such an interesting space?

As mentioned before, humans have been using underground space for thousands of years. Industrialisation and colonisation are deeply linked with the exploitation of underground space for resources. However, with increasing populations and urbanisation around the world, the use of underground space has come into focus again. This is especially the case for cities where space and its efficient use are crucial, yet scarce and expensive. Moreover, the increased use of underground space could help cities to solve pressing issues such as overpopulation (Broere 2016). For example, we already find much infrastructure, utilities, and storage underground. Trains, urban and inter-urban, run underground through cities; broadband cables, electricity, water and wastewater pipes are hidden underground; and a lot of car parks are underground. In fact, without vital infrastructure and transport underground the modern city as we know it would not be possible. Outside of cities, in the countryside, underground space has come to prominence with large infrastructure projects such as the proposed high-speed railway HS2 in the UK, which includes the building of tunnels (Topham 2020). The second big issue in the UK's countryside is hydraulic fracturing, commonly known as fracking. Hailed as an energy source of the future by the UK government, it stirred up local protests at test drilling sites (Cartwright 2019). At the moment fracking has come to standstill in the UK after a series of earthquakes at test drilling sites (Ambrose 2019) and the government has put a moratorium on fracking (DBEIS & Oil and Gas Authority 2019). A later section of this article will take a closer look at and review the debate in the UK in more detail.

Carbon capture and storage (CCS) is a technology favoured by the UK government in its Clean Growth Strategy (HM Government, 2017). In brief, CCS is a process whereby CO_2 is separated from industrial and other energy-related sources, transported to a storage location and isolated long-term, usually underground. CCS technologies could reduce the lifecycle greenhouse gas emissions of fossil fuel power plants; however, CCS has not yet been applied at scale to a large, operational commercial fossil fuel power plant (IPCC, 2014). CO_2 leakage could be a potential issue; however, a growing body of experiments and literature (e.g., Roberts & Stalker 2020) addresses this issue.

Other developments with regards to underground space, which are worth mentioning briefly, relate to seabed rights for offshore windfarms. The Crown Estate, which manages the seabed around England, Wales, and Northern Ireland, in 2021 selected six new offshore wind projects (Crown Estate 2021). This affects underground

space insofar as wind turbines have to be securely anchored into the seabed and pipelines laid to the shore. With regards to the subterranean biome, Sánchez-Fernández *et al.* (2021) emphasise that the subterranean ecosystem should not be forgotten in climate change agendas. And, recently the world's most precious metal, gold, has come into focus in Northern Ireland again (Carroll & Carrell 2020). However, local residents fear dust, air pollution, and water contamination resulting from the prospective gold mine and have submitted more than 40,000 representations to the public enquiry, most of them objections.

Hence, the demand for underground space is rising again, not least because of advances in tunnelling and excavation technology decreasing the construction costs of underground structures (Li *et al.* 2016). The same authors identify underground resources as a space for construction, groundwater, geothermal energy, and geomaterials. Bartel and Janssen (2016: 113) differentiate between *storage* (natural gas, oil, and storage of H_2 and compressed air); *deposition* (CCS; underground waste disposal including storage of radioactive waste, brine injection), *productive activities* (mining; the use of geothermal energy as geothermal heat pumps/shallow geothermal systems, hydrothermal geothermal systems, petrothermal systems/hot–dry rock technology; storage of heating and cooling energy; utilization of mineral springs and groundwater), and *underground structures* (tunnels, technical structures; underground pumped hydroelectric power plants). Apart from these, there are also interesting double-use examples of underground space: for example, road tunnels that can be used to retain flood water (Qihu 2016). The possibilities of underground use seem endless, and human engineering has already come up with a plethora of underground structures and uses. In Helsinki, we find a public swimming pool underground (Roth 2018, Vähäaho 2016) as well as a wastewater treatment plant (Vähäaho 2016). Furthermore, there are underground shopping centres, archives, restaurants, night clubs, etc. Data centres could be located underground, in areas not prone to flooding, saving space, and the excess heat produced by servers could be used to heat houses nearby (Admiraal & Cornaro 2016). In west London, there are plans to excavate gravel from underground creating a vast subterranean cavern while at the same time creating a public park on top (Wainwright 2017).

A special issue of the journal *Tunnelling and Underground Space Technology* in 2016 took stock of urban underground space use in the academic literature from 2006 to 2016 and found that Chinese researchers have the biggest interest in urban underground use, followed by those in the United States, Japan, and the UK. Regarding subject areas, Engineering, Earth and Planetary Sciences, and Environmental Sciences take the top three places followed by Social Sciences (Bobylev & Sterling 2016: 1). It is the Social Sciences perspectives that are of most interest in this article and this includes legislation and regulation. Bobylev and Sterling (2016: 3) conclude, for

example, that laws are not keeping pace with the demand for and opportunities of urban underground space.

Underground space in law and regulation

Admiraal and Cornaro (2016: 215) write: 'As such underground space can be typified as the final urban frontier waiting to be exploited by those who place the first stake and thereby claim their space.' This may evoke the spirit of the Wild West; however, underground space is already heavily regulated. Yet, it is the plethora of different laws and regulations that may lead to conflicting interests and potential environmental damages: for example, to groundwater. However, let us start at the beginning and ask who actually owns underground space.

Without going into too much detail about property rights and property law, since this is not the core topic of this article, let us briefly define property law and property rights. Part of Private Law, Property Law is concerned with relationships over things often involving ownership of things and the rights that flow from that ownership (Fisher *et al.* 2019). Property rights are a social institution limiting, for example, the rights of access to a resource. Blackstone, in his *Commentaries on the Laws of England* said:

> There is nothing which so generally strikes the imagination, and engages the affections of mankind, as the right of property; or the sole and despotic dominion which one man claims over the external things of the world, in total exclusion of the right of any other individual in the universe. (Blackstone *et al.* 1844: sec. 2)

A statement that has lost little in meaning as the writer John Lanchester comments on empty, yet expansive, flats in London: 'a device for getting capital out of your home country, where it might be stolen or expropriated, to the UK, where the only true and universal object of worship is property rights' (Lanchester 2017). This is more so in the US where Goldstein and Hudak (2017) found a growing concern among the US right-wing about the need to defend individual private property rights against rules aimed at protecting the environment, whereas they found no such concern in the EU or among the US left.

Liberal Western democracies are unthinkable without property rights, and it is either a legal or an economics perspective, or both, that dominates the discussion about property rights (Grecksch & Holzhausen 2017). For instance, in the case of fracking, which will be discussed later, we can see how multinational corporations face a property regime which relates to national levels; however, in the age of a global economy, nationally defined property rights must be redefined or dismantled.

Multinational corporations therefore ask for the transformation of property rights into corporate rights and subsequently access to land and access to its resources (Teeple 1997). Braithwaite and Drahos (2000) also describe that globalisation's recent phase, that is, the 1990s, was to extend the security of property to non-citizens, especially transnational corporations.

> The sovereignty cost to nations of a global property regime is not simply a matter of economic adaptability. Property rights are not just economic tools, they are the product of broader social, cultural and philosophical traditions, and ideas. The rights of UK citizens to wander about in their countryside tell us as much about the social and political history of that country as they do about externality problems. Local property arrangements are the products of moral and cultural traditions, which are living traditions and which people do not necessarily want changed. The crucial issue is not the loss of traditions that carry and implement the moral values a society holds important. When governments exercise legislative power over property arrangements, they have to do so in ways that are consistent with the trust granted to them by the community they represent. This is a fundamental tenet of literal democratic traditions. (Braithwaite & Drahos 2000: 84)

We will see the relevance of this later in the section on fracking and how property can evoke more than a legal and economics perspective as, for example, demonstrated by Grecksch and Holzhausen (2017) for the case of narratives.

Riddall (2003), in his introduction to *Land Law*, states that in English law there is no such thing as absolute ownership of land. Instead, all land is held from the Crown by tenure. For instance, unmined gold, silver, and uranium belong to the Crown, as well as oil, gas, and coal (Morgan 2013). Its extraction, however, is possible through licensing. Gravells (2010) observes that the cases support in principle that the owner of land owns any natural or man-made structure below the surface of the land. While Roman law has the *superficies solo cedit* principle, meaning that whoever owns the land also owns what is placed on the land (Admiraal & Cornaro 2016), the common law maxim of *cuis est solum, eius est usque ad coelom et ad infernos* (whoever owns the soil, it is theirs all the way to heaven and all the way to the depths below) has often been invoked in support of some notion of the sacrosanct nature of property right despite it being 'in many ways discordant with the conceptual apparatus of the common law … today it serves a limited function reinforcing an owners exercise of all the rights required for reasonable enjoyment of his property' (Gray & Gray 2009: 14).[2] Gray and Gray (2009) continue to say that the maxim has limited definitional value and has virtually become worthless in contemporary law. For example, it would lead

[2] Sprankling (2008) delivers an interesting and elaborate discussion for the situation in the United States challenging the traditional view of the maxim.

to major problems in terms of air rights (Admiraal & Cornaro 2016) but also with regard to underground space it has been qualified, most recently in the UK, where the Infrastructure Act of 2015 created a new land access regime to use deep-level land below 300 metres (see the section on 'Underground and fracking' below). This enables fracking, as we shall see later, since fracking includes not only vertical drilling but also horizontal fracturing of the rock layers underground; hence the name.

In 1991, the International Tunnelling Association (ITA) conducted a survey among its member countries on legal and administrative issue in underground space use (Barker 1991). Regarding the limits of surface property ownership, four main conditions were identified. First, the surface owner owns to the limit of the earth. Second, the surface owner owns as far as a reasonable interest. Third, the surface owner owns only to a limited depth beneath the land (as little as 6 metres). Fourth, private landownership is almost non-existent and, hence, the underground is also publicly owned (Barker, 1991: 195–6). There are also restrictions on natural and mineral resource exploitation. They depend on the type of resource and often on whether the mineral has economic value. Hence, the survey found that resources can belong to the State which can issue concessions; resources can belong to the surface owner; resources may be developed by anyone who discovers them; mineral rights can be separate from surface ownership; or the State can reserve a share of the resource value (Barker 1991: 196).

The biggest challenge for underground regulation is conflicting uses: that is, transport vs. utilities vs. energy production vs. groundwater. These issues have conflicting priorities and different authorities with differing policies (Admiraal & Cornaro 2016: 217). Hence the authors name three aspects when considering the governance and legal challenges of underground space use: landownership, liability, and building codes (Admiraal & Cornaro: 2016: 218). With regard to landownership, they outline three approaches. First, effective landownership can be limited to a specific depth beneath the surface. Japan and Singapore have taken this route and limit space beyond the limit and deem it to be owned by the State and it may be used for public purposes (Admiraal & Cornaro 2016: 218, Kishii 2016, Zhou & Zhao 2016). The second approach is to acquire land based on a legal mandate through compulsory purchase, eminent domain, resumption, or expropriation. This usually requires compensation. The authors cite the UK Crossrail Hybrid Act 2008 as an example. Crossrail is a major transport infrastructure project crossing London from east to west. The Act determined that 'the Secretary of State had the right to acquire any land mentioned in the Act for up to five years after its passing with a further possible extension with five years' (Admiraal & Cornaro, 2016: 218). The third approach is an easement, a private agreement between two parties to access land (Admiraal & Cornaro, 2016: 218).

Water and underground

The human relationship with water has been a history of use and abuse (Grecksch 2019). Water and underground share a special relationship, as water infrastructure is mostly hidden underground (supply and wastewater pipelines, storage) and we find water in the form of groundwater stored in aquifers at various depths below the surface. Issues arise mostly for groundwater, although leakage of water supply pipelines is an issue haunting England's water companies (Plimmer 2020). First of all, an increasing population is demanding more and more water, putting pressure on water resources. Second, groundwater is mostly invisible and hence the true amount of water in an aquifer can at best be estimated based on weather cycles, precipitation patterns, streamflow, or previous abstraction data. Some hydrologists hence compare it to 'dark matter' because of its invisibility (Fogg 2015). Third, technologies like fracking and CCS require huge amounts of water for their operation. As do other major infrastructure projects:

> Major infrastructure programmes can also pose a threat to chalk streams and other delicate river environments. In the Chilterns, HS2 is likely to require over 10 million litres of water a day for its tunnelling operations. The Environment Agency told us that it will not give approval to any parts of HS2's plans until they have identified and set out any potential groundwater impacts and agreed acceptable mitigation actions. (House of Commons & Public Accounts Committee 2020: 14)

While the 17th-century True Leveller and Digger Gerrard Winstanley proclaimed that resources of the Earth are to be used in common by all (cited in Malcolm & Clarke, 2018), Malcolm and Clarke (2018) state that it is not an option to have no property rights for water as water cannot be left unregulated. Gray and Gray (2009: 51) say that it is:

> surprising the English property law remains relatively uncertain or incoherent in its conceptual treatment of the increasingly valuable resource of water. Although the ownership of water promises to become one of the critical questions of the 21st century, English law persists in regarding water as incapable of being owned.

Malcolm and Clarke (2018: 216) echo this notion:

> We are left with this situation in England as a result of the House of Lords decision in *The Mayor, Aldermen and Burgesses of the Borough of Bradford v Pickles*, where it held that, … , no one has any kind of property rights in or to percolating groundwater at common law. However, since 1963, there have been abstraction licences, issued by the Environment Agency for England that de facto trump property rights. Hence, without an abstraction licence that defines where and how many litres of water can be taken, no one is at liberty to take water from anywhere without a licence. (Malcolm & Clarke 2018: 218)

Planning and underground space

As mentioned in the Introduction, with the exception of nationally significant infrastructure projects such as power stations, transport schemes, and national parks, planning in the UK falls under the responsibility of local government and is hence fragmented. This fragmentation can cause tensions between national strategies and policies on the one side and local planning processes on the other side; however, this is nothing new in the UK (Grecksch & Holzhausen 2017: 103–4). Von der Tann *et al.* (2018) deliver a comprehensive overview of planning regulations in the UK for the subsurface. They conclude that:

> The current governance of subsurface space in England is largely sectoral and project centred rather than based on the premise to control all activities in a given volume. … However, each aspect is addressed separately and the interdependencies dealt with in a particular application are restricted to already existing or planned activities in the project vicinity. The effect of the individual regulations on plan making from the outset seems to be limited. (von der Tann *et al.* 2018: 34)

Furthermore, a conference on underground cities remarked that actual underground planning suffers from sectored tunnel vision:

> On the one hand, sectored planning result in the establishment of not connected 'underground islands' or 'underground patches'. On the other hand, permanent liveability of subterranean spaces faces numerous cultural, physiological and technical challenges. Lastly, traditional planning already relegated below the surface the technical facilities and devices that were supposed to be hidden (catacombs, sewers, transport systems, etc.) as well as the activities physiologically 'acceptable' without daylight (stores, logistics, etc.). Such a strategic bias coined underground areas primarily as service areas. (IRCS 2016)

As we will see below, a city or a whole country can develop a strategy or masterplan for underground space, thereby giving it more attention and focus and most of all the attention it deserves in the future development of resource governance, transport policies, and planning policies. The majority of the literature focusses on urban underground space use and planning, as a solution to overcrowding cities where space is scarce and expensive (Admiraal & Cornaro 2016, Bartel & Janssen 2016, Broere 2016, Dick *et al.* 2017, Hunt *et al.* 2016, Li *et al.* 2016, Price *et al.* 2016, Stones & Heng 2016, Volchko *et al.* 2020, von der Tann *et al.* 2020).

The Netherlands is the first country in the world to publish a national planning strategy for the subsurface (Government of the Netherlands 2018). This takes place in a larger framework of the Environment and Planning Act, an ambitious piece of legislation combining fifteen separate environmental acts into one (Volchko *et al.* 2020). The main reason for a national planning strategy for the subsurface is that the

subsurface is important to the country's energy supply. For example, Europe's largest onshore gas field lies beneath the east of the Netherlands. Second, most of the Netherland's drinking water supply is produced from groundwater. Hence, the purpose of the plan is 'to think about long-term underground management now, in order to prevent problems in the future. For instance, we are making increasing use of alternative energy sources, which imply further utilization of our subsurface. And, of course, we will always need drinking water' (Government of the Netherlands 2018: 2). Other key points of the strategy include the exploration of the potential of geothermal energy, a 'no' to shale gas extraction, and CCS will only be possible offshore (Government of the Netherlands 2018: 2). According to the strategy, the guiding principle is sustainable, safe, and efficient use of the subsurface, balancing exploitation and protection. This will be ensured by deliberation and decision-making, which is based on involving all tiers of government, stakeholders, and NGOs (Government of the Netherlands 2018: 4). The development of the national strategy for the subsurface had already involved a variety of stakeholders with interest in the subsurface (Government of the Netherlands 2018: 18; see also Nouzari *et al.* 2019).

Helsinki is also at the forefront of underground regulation and governance. The city produced an Underground Master Plan which came into force in 2010. However, the planning process goes back to 1980 (Vähäaho 2016, 2018). The city hosts a whole variety of structures underground that go beyond the usual suspects like the metro, parking, utility tunnels, and road tunnels. The most prominent example is the Itäkeskus Swimming Pool, but the most interesting underground feature in Helsinki is the requirement of Finnish property owners to include emergency shelters in buildings of at least 1,200 m^2 (Vähäaho 2018: 16). Usually these spaces are designed to perform a different function during non-emergency times. Thus, the aforementioned swimming pool is constructed in a way that it can shelter 3,800 people in an emergency (Vähäaho 2018: 17). The Underground Master Plan of Helsinki shows both existing and future underground spaces and tunnels, as well as existing vital access links to the underground. It also includes rock resources reserved for the construction of as yet unnamed underground facilities, with the aim of identifying good locations for functions suitable for locating underground, and which would also reduce the pressures on the city centre's rock resources. As with the national strategy for the subsurface in the Netherlands, the Underground Masterplan was developed in a collaboration between public and private stakeholders (Vähäaho 2016).

Underground and fracking

As of November 2019, there has been a moratorium on fracking in England (DBEIS & Oil and Gas Authority 2019).[3] This does not mean the definitive end for fracking in England, but it is an important step for those who criticise the technology (Ambrose 2019). The moratorium was introduced after a report by the Oil & Gas Authority (2019) found that it was impossible to predict the probability or magnitude of earthquakes caused by shale gas extraction. Moreover, another report by the UK National Audit Office (NAO 2019) concluded that the government's 'plans to establish fracking across the UK was dragging years behind schedule and had cost the taxpayer at least £32m so far without producing any energy in return' (Ambrose 2019). And, even earlier in 2019, the UK High Court ruled the government's fracking guidelines unlawful. Scientific evidence had not been considered, and the design and the process of the public consultation were ruled to be unlawful (Harvey 2019).

Fracking in England turns out to be a prime example of why better regulation of underground space is necessary. It shows the interconnectedness of underground-related issues: it is seen as either or both bridging and future energy provider; there is evidence that it may contaminate groundwater; it is an example of the tension between central and local government in England regarding planning; it is a legal issue as fracking companies were able to invoke pre-emptive injunctions against protesters, that is, nip potential protests in the bud; and it is generally speaking an environmental protection issue, as protests could be observed across all test drilling sites fearing implications for the local environment, biodiversity, and water contamination.

Fracking (hydraulic fracturing) is a technology to access shale gas. Shale gas is natural gas trapped in low-permeability shales. The gas is held in pore spaces within the rock, or adsorbed onto minerals and organic material in the shale. New technology for gas production from shale formations, horizontal drilling and hydraulic fracturing, evolved first in the USA, and has led to the rapid exploration of shale formations worldwide (BGS 2020). The UK possesses considerable reserves of shale gas (Stuart 2012) and previous governments favoured the technology, arguing that it promises to help make the transition to a zero-carbon economy and support the UK's energy self-sufficiency (Clark 2018). In 2013, the former Chancellor of the Exchequer, George Osborne, proposed '"the most generous tax regime in the world" for shale gas,

[3] Decisions on fracking applications are a devolved matter. Scotland's government decided that fracking is incompatible with its climate policy and will not issue any licences (Scottish Government 2019). The Welsh Government came to a similar conclusion and will not support any applications for fracking (Welsh Government 2018). In Northern Ireland there is planning presumption against fracking (BBC News 2019).

saying he wanted "Britain to be a leader of the shale gas revolution"' (Bounds & Parker 2019).

Fracking has potential impacts on groundwater. This is important since groundwater is a vital source of freshwater in the UK and provides around 27 per cent of public water supply on average; in south-east England it is nearly 90 per cent of public supply (BGS 2020). Other uses of groundwater include bottled water, agriculture and irrigation, and food and drink production. And, groundwater is also vital for maintaining river flows especially during dry periods and so is essential for maintaining ecosystem health (BGS 2020). Stuart (2012), in his report for the British Geological Survey, summarises that:

> Groundwater may be potentially contaminated by extraction of shale gas both from the constituents of shale gas itself, from the formulation and deep injection of water containing a cocktail of additives used for hydraulic fracturing and from flowback water which may have a high content of saline formation water. (Stuart 2012: 19)

Moreover, fracking requires large volumes of water, putting pressure on groundwater resources with impacts on other uses and ecosystems. The author also lists 'unknowns' with regard to fracking, all three of them water related: shale gas fields could be overlain by aquifers; groundwater could be vulnerable to surface pollution and flowback water; and groundwater could be vulnerable to pollution from fracking operations and shale gas. He also mentions that examples of surface water contamination from releases of fracturing water or flowback water have been documented in the United States (Stuart 2012: 20).

Fracking involves not only drilling vertically but also horizontally, making it an issue for property rights. Stokes (2016), mentions the amendment of the Infrastructure Act in her critique of UK fracking governance, as one of the obstacles that needed to be removed to enable shale gas development. She places her compelling critique against the background of 'regulatory domain' versus 'regulatory dexterity'. The former involves analysing regulation in the abstract:

> It entails taking a synoptic view of the regulatory landscape and looking at regulation as a whole, rather than the individual parts of it. Government maps the general regulatory regimes applicable to fracking, providing a simplified illustration of the great expanse of legal provision. Because fracking is treated as analogous to conventional drilling technologies, it is said to fall within the remit of existing regulations on the protection of health and the environment. (Stokes 2016: 962)

In other words, the UK already has robust legislation and regulation for shale gas extraction and additional new rules would stifle the development. She concludes: 'The practice of resorting to existing legislative coverage gives the "regulatory domain" a sturdiness and panacea-like quality, and leaves little scope for reform in areas where

"domain"-like arguments are invoked' (Stokes 2016: 974). Regulatory dexterity, on the other hand, involves the reverse:

> 'dexterity' is prompted by concerns over the lack of specific legislation and the corresponding need for reform. It prioritises the need to act quickly and with precision in adapting to changing technological circumstances. Rather than viewing regulation in the abstract, 'dexterity' has a narrower focus on concrete legal rules. In this case, government singles out rules governing finance, planning permission, and access to land. Within the confines of these rules, shale gas activities are seen not as analogous to, but as dissimilar from, conventional fossil fuel extraction. This opens up the possibility of fracking-specific regulation. (Stokes 2016: 962)

In other words, new regulation is needed for those elements in the regulation that are an obstacle for the development of fracking. Hence the government blamed the existing planning system and the system for access to land as obstacles for the development of the fracking industry (Stokes 2016: 979). Thus, three pieces of fracking-specific legislation were introduced. First, there was a new tax regime to attract fracking developers. The tax on profits from oil and gas extraction, which stood at 62 per cent was effectively reduced to 30 per cent. Second, there were changes to the planning process. The obligation on fracking operators to notify individual owners or tenants to whose land the planning process relates was removed and the planning application fee for fracking was reduced. Third, there were changes to the Infrastructure Act, creating a new land access regime (Stokes 2016: 981). The UK Infrastructure Act (2015) introduced deep-level land below 300 metres with an automatic right of access for petroleum and geothermal energy. Stokes (2016: 984) also notices that 'issues such as public participation in decisions relating to fracking and the human rights implications of shale gas extraction are conspicuously absent from government debate'.

Social aspects and the perception of fracking in the UK have been well researched (Bradshaw & Waite 2017, Cotton *et al.* 2019, Lloveras *et al.* 2021, Partridge *et al.* 2019, Roberts *et al.* 2021, Short & Szolucha 2017, Williams & Sovacool 2019). Williams and Sovacool (2019: 15) conclude that 'there is a perhaps surprising degree of contestation over shale gas, all the more so given that the UK has such a long history with natural gas and a history of extractive industries going back centuries'. They ask whether there is something new and sinister with shale gas, or whether this contestation associated with an emblematic shift in context. Partridge *et al.* (2019) conducted deliberation workshops in the UK and the US to evaluate conceptions of the underground with regard to shale gas extraction. They conclude that participants identified ecosystem links and described the underground as directly connected to life on the surface and related to human and other animal well-being (Partridge *et al.* 2019: 17). Short & Szolucha (2017), who worked with communities in Lancashire

during the fracking application stage, speak of a collective trauma for the community, damaging or destroying the basic tenets of social life. Bradshaw & Waite (2017) cite surveys that measure the perception and awareness of shale gas extraction. They state that awareness has grown and that there has been a gradual decline in support and an increase in the level of opposition. Seventy-six per cent of the public are aware of fracking according to 'Wave 21', the most recent survey carried out by the Department for Business, Energy and Industrial Strategy (DBEIS 2017). Forty-nine per cent of the respondents neither supported nor opposed shale gas; 2 per cent did not know. This is likely to partly reflect a lack of knowledge about fracking. Thirty per cent of respondents are opposed to fracking; 19 per cent support it (DBEIS 2017: 7). Asked for reasons why people opposed fracking, respondents mentioned the loss or destruction of the natural environment (56 per cent); the risk of contamination to the water supply (32 per cent); that it is generally not a safe process (32 per cent); the risk of earthquakes (29 per cent); and that there is too much risk or uncertainty to support it at present (29 per cent). Reasons for supporting fracking are the need to use all available energy sources (35 per cent); reducing dependence on other countries for UK's energy supply (31 per cent); fracking being good for local jobs and investment (30 per cent); reducing dependency on other fossil fuels (28 per cent); and that it may result in cheaper energy bills (27 per cent) (DBEIS 2017: 7). Public opinion and public participation matter. The Climate Assembly UK, which is discussed further in the next section, is proof of the need for wide-scale public involvement in the future development of the country, especially with regard to matters of the environment. This extends to underground space as well. Public participation is a key constituent of environmental governance and hence a sustainable underground space use and its governance should reflect this.

Thus, following Stokes's (2016) observation that public participation was largely absent from the fracking discussion, it may be no wonder that, despite previous UK government's support for the technology, fracking has sparked a series of protests at the drilling sites across England (Cartwright 2019). The focus was often on a site in Lancashire near Preston. The Preston New Road site and the earth tremors caused by the drilling also led to the moratorium on fracking in England. The drilling site was operated by Cuadrilla Resources, a UK-based oil and gas exploration company.[4] In July 2017, three protesters managed to climb on lorries that were approaching the fracking site, rendering them unable to move any further. The men were sentenced to

[4] It is interesting to note that *cuadrilla* is a term originating in Spanish bullfighting. The *cuadrilla* is the entourage of the *matador*, the bullfighter, who help him to gore the bull eventually killing the animal. Since fracking requires vertical drilling into the earth one could make an analogy of 'goring' the earth until it dies. And in colloquial Spanish a *cuadrilla* is a name for a gang of thieves.

imprisonment of up to 16 months. This marked the first instance of imprisonment for environmental protest since the Kinder Scout mass trespass in 1932 (Curling 2019). UK fracking operators were also granted so-called pre-emptive injunctions, that is, an injunction in anticipation of breaching a legal right. INEOS, another fracking operator, was granted such an injunction, which is placed on unnamed individuals, even before the company received permission to drill (Curling 2019). Breaches of the injunction could be punished by a prison sentence of up to two years and/or a fine of up to £5,000. After a first challenge of the injunction failed before the High Court, the Court of Appeal ruled much of the injunction granted to INEOS unlawful in May 2019 (Curling 2019).

All of this seems historical against the moratorium on fracking in England since the end of 2019. However, the above showed how a controversial technology was fast-tracked by means of benign and industry-friendly legislation and regulation under the exclusion of public perceptions and consultation, causing protests. A hint of irony remains, though. The government's own former shale gas commissioner resigned from her post in frustration about 'ridiculous' regulations (Booth & Topham 2019). In an interview with BBC Radio 4, she said: 'if you applied the same standards to anything else, you wouldn't build another school or a hospital, you probably wouldn't have any buses or lorries on the roads' (Booth & Topham 2019).

Underground space and the future: nuclear waste

I would like to end this exploration through different aspects and themes of underground space use with a journey to the underground. In 2019, I had the opportunity to visit an underground research laboratory in France. The laboratory is situated near the small village of Bure in the Département de la Meuse in the east of France. Far away from bigger cities, Nancy as the nearest big city is over an hour's drive away, close to Bure is the Meuse/Haute Marne Underground Research Laboratory. The purpose of the facility is to evaluate the potential as storage for high-level and medium-level radioactive waste. Low-level radioactive waste is stored above ground in France, covered by concrete and secured and monitored for 300 years. In the near future, the laboratory will also be open for experiments in the field of CCS.[5] The site will remain a research laboratory, while the actual storage of radioactive waste will be very close by. The site was chosen because there are hardly any natural resources

[5] Even within the geology community, there is competition about underground space: oil versus gas, gas versus geothermal, etc. And it is also about research money. If funds go into geothermal research, then there is less for oil research and so on.

nearby.[6] The site is approximately 500 metres deep. The rock formation is claystone (Oxfordian) and it costs between 25 and 30 million Euros per year to run the facility. It is a fascinating maze of tunnels filled with dusty, dry air. There is heavy and light machinery everywhere. Different sizes of tunnel diameters and tunnel shielding technologies are tested, but the most obvious things are over 10,000 measuring points. At the time of the visit, most of the research was on gas build-up in tunnels and fractures, both effects of tunnel ventilation. A fellow visitor explained to me that for a long time and currently gases have been the biggest problem for radioactive waste storage and CCS. In the future it will be about microbiology, clay after all is organic matter.

At the end of one tunnel shaft was what looked like a black hole from a distance. Looking at it closer, it turned out to be a steel-lined tube with a diameter of just 80 cm that reached 80 m into the rock. Equipped with measuring points, tests are carried out for corrosion and hydrogen, which the steel emits as it corrodes. Corrosion in small quantities is not problematic; however, in larger quantities it destabilises the system physically and chemically. This steel-lined tube, in fact many of them, will be used to store high-level radioactive waste. Only 3 per cent of radioactive waste is high level, yet it carries 97 per cent of the radiation. Before high-level radioactive waste can be stored underground, it needs to cool down on the surface. The process of transporting the waste underground and storing it will be fully automatic. The monitoring period after storage is an unimaginable 500 years. The nuclear waste storage facility will run for 120 years and at the end the site will be closed with a giant bentonite plug. However, a change in French law introduced the law of reversibility in 2016. All machines and robots need to be able to retrieve the waste during the 120 years of operation. Yet, during the visit, I was told that it was more about retrievability than reversibility, because it is not really reversible, as the process of retrieval takes much longer than the process of storage. ANDRA (Agence nationale pour la gestion des déchets radioactifs), the agency responsible for running the facility, also has a group that works on the issue of how to communicate the site to future generations so as not to open Pandora's box (Sebeok 1986). At the moment the idea is to place several layers of red stones scattered across the surface area of the storage facility. Hence, should future generations start digging and ignore the first 'warning', a second layer appears. But who knows if red will be recognised as a warning colour in 500 years or what language we will be using. Even today the colour red has different cultural meanings across the world. Wedding dresses in many Asian countries are red, because it symbolises good fortune, success, and fertility. And, many native English speakers would have trouble understanding and reading the English spoken 500 years ago.

[6] It should also be mentioned that the site is in an area with a very low population density and a high percentage of unemployment.

The visit to the underground research laboratory was fascinating and insightful. Yet, what seems like an elaborate technological undertaking is of course one of the most controversial issues in countries which operate nuclear power stations. Faced with the closure of nuclear power plants for political reasons, because they have reached the end of their lifecycle, or because they do not comply with security standards, a wave of high-level radioactive waste is coming towards countries like France, Germany, and the UK. Objects like nuclear waste need to be kept safe. One challenge, however, is to provide institutions that cater for the longevity that the storage of nuclear waste requires: 'Carbon sequestration and storage as well as nuclear waste, in general, require continued management within stable institutional safeguards and communication systems over centuries, if not longer' (Hanusch & Biermann 2020: 20). At the moment, however, the authors claim there are no concepts for long-time organisations and how they could function over time.

Altman (2019) calls the process of one generation leaving behind toxic legacies for its successors 'time-bombing'. Nuclear technology introduced a new kind of legacy, one read into the body and carried there through time, she writes. Evens (2020) discusses the intricate relationship of nuclear reactors and water. In the past, protests at the proposed German deep-storage site for high-level radioactive waste in Gorleben have caused widespread protests as the site is already used for interim storage. The arrival of casks with radioactive waste usually drew thousands of protesters and an equal number of police officers. The geological exploration of the underground storage was suspended in 2012 and was ended in 2013 (BGR 2020). The UK is looking for a Geological Disposal Facility and the siting process is open. It is expected to take fifteen to twenty years. Community participation is a key aspect, according to the Nuclear Decommissioning Agency (NDA); however, the process is also sweetened by financial promises: 'we will … invest up to £1 million per year in communities once a Community Partnership is formed; also, invest up to £2.5 million per year in communities where deep borehole investigations take place' (Nuclear Decommissioning Agency 2020a). It is expected that the first radioactive waste could be stored at the chosen site by 2040 (Nuclear Decommissioning Agency 2020b). A report produced by Climate Assembly UK (2020), a large-scale public participation project, highlights some assembly members' voices on the issue, ranging from asking whether it is moral to store nuclear waste outside of the country (400), to 'we need to work a lot harder on nuclear waste management to ensure safe and secure storage to manage the public perception for what is an efficient technology' (402) or that some assembly members 'would rather have a small amount of nuclear waste in the north sea than a load of carbon dioxide' (468), the latter hinting at a comparison to CCS technology.

Conclusion

A lot of underground spaces are often out of sight, while other underground spaces, especially those for transport, are in plain sight and used by millions every day. Yet from those 'hidden' underground spaces come the materials that make our modern life possible. Rare earths for smartphones and computers, oil and gas to provide electricity, petrol, and plastic, the artefact of our times. And, of course, groundwater for public water supply. Hence, because materials and resources extracted from the underground feature in so many products, we should pay more attention to underground space and how we use and govern it, making sure to avoid the mistakes we made and are still making governing materials and resources above ground.

Three key messages follow from this article. First, underground space is an already heavily regulated space. However, regulation is fragmented and does not look at underground space as a whole or govern it as an entity. Instead, regulation orientates itself on resources or matter: for instance, oil, groundwater, or planning regulations for private houses. The example of the Netherlands showed, however, that it is possible to develop a national subsurface strategy and the UK could follow suit.

Second, the example of fracking showed how not to do it: that is, regulating and governing a specific area of underground space use. Independent of what one thinks about fracking, the approach by the government, fast-tracking permissions, and making industry-friendly regulation yet lacking the necessary public consultation, was almost meant to fail. The government and advocates of CCS technology should learn from these mistakes. The Climate Assembly UK could be a good starting point, as it reflects a diversity of views on issues of future importance, such as climate change and energy supply. It could be the basis for any conversation about future technologies in the UK and public perceptions, no matter whether it includes the use of underground space or not.

Third, there is an interdependence and an interplay between the themes identified —property rights, regulation, groundwater, fracking, nuclear waste storage—requiring a coordinated, interdisciplinary, and integral approach. At the moment the field, especially urban underground space, is dominated by engineers, architects, and urban planners. However, a ' UK underground dialogue' is necessary that includes a larger and more diverse range of researchers, stakeholders, and the public. As mentioned a couple of times in this article, the exploration and use of underground space are nothing new in human history; however, the renewed interest is a chance to design and use underground space based on the ideas of sustainability. For example, shifting large infrastructure facilities such as wastewater treatment works or refusal collection and storage underground could free up necessary space above ground, space that could be used for social housing or parks.

The underground is humanity's archive, a treasure trove for archaeologists. In future years, centuries, and millennia, when archaeologists want to find out about the living conditions, culture, and artefacts we used, they will dig underground. Hence, casting back from the future to the present, we could ask ourselves what is it that we want them to find.

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The evolution of China's climate change policy: international and domestic political economy and a strategy for working with China

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Abstract: For over a decade China has been the predominant carbon emitter in the global economy. It is thus imperative for us to understand the factors behind its climate change policy in the past decades. In the article, the author surveys the evolution of China's climate change policy during 1990–2021 and applies theories from international relations and international political economy to explain it. It is found that (neo-)realism/nationalism and liberalism, two main theories in the field, offer only a partial explanation of China's climate policy. The most effective theory is domestic sources. In particular, leadership power consolidation and a concern with economic growth seem to dictate China's climate policy. The findings point to the analytical utility of domestic political economy in accounting for the climate stances of nation-states. Policy suggestions for external parties to interact with China on climate change are proposed. There the importance of involving China in global action against climate change, as well as the utility of the economy and trade leverage, soft power standing, and the prevention of extreme weather are discussed.

Keywords: Climate change, public policy, China, domestic politics, international relations, international political economy.

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Since 2006 China has surpassed the United States to be the largest carbon-emitting economy in the world. In the following years, China's share in global carbon emission continued to soar from 21 to 27.4 per cent in 2018, whereas that of the United States had been declining steadily from 19.93 to 14.9 per cent, and that of the European Union consisting of twenty-seven member states (EU-27) decreased from 12.4 to 8.4 per cent (Our World in Data 2021). Thus, by 2018, China's carbon emissions (27.8 per cent) far exceeded the combined total of the US and the EU-27 (23.3 per cent), the second and third largest carbon emitters. China's share in the world total carbon emissions is poised to further increase in the coming years. Given China's lion share in global carbon emissions and the pressing need to address climate change, it is thus imperative for us to understand the contour of the change in its climate policy and the underlying factors and to involve China in the global action on climate change.

Targeting policymakers, policy analysts, and political scientists, this article aims to shed light on the political and economic factors underlying the evolution of China's climate change policy during 1990–2021. A comprehension of these factors would not only be useful for them to fashion sound responses but will also enable other scholars and the public concerned with climate change to further their understanding of China's climate policy.

To denote China's climate change policy over the decades, the author will categorise a stance that rejects the urgency for a reduction in carbon emissions to address the imperious consequences of global warming as 'defensive'. The term, which conveys a pro-status-quo stand on climate change, also denotes China's position to defend the entitlement of a nation (in the Chinese case and perspective, a developing nation) to develop their economy despite the fact that this will lead to higher carbon emissions at the national and per capita level. Similarly, a position that entails resistance to international calls for action to reduce carbon emissions will be characterised as 'resistant'. In addition, China's apparent retreat from a position favourable toward collective efforts to address climate change will be coined 'regressive'. On the other hand, when China embraces a programme or pronounces a high-profile goal aiming at peaking or cutting carbon emissions, this will be characterised as a 'progressive' or 'proactive' stance on climate change, respectively. Obviously, these labels can be applied to other carbon emitters. For example, until recent years the climate policy of the United States can be viewed as 'defensive' (in this context, the US defends its entitlement to economic growth despite its status of an advanced economy), whereas that under the Biden administration can be regarded as 'progressive'. However, given the primary focus of this article on China, the characterisation of climate policy of other nations over recent decades is beyond the scope of this article. Given the limit on the length of an article and given the voluminous debate on the responsibilities of developed and developing nations for climate change and for carbon emission, the

author has no intention to arbitrate on this debate. The key focus of this article is to explain the variation in China's stance on climate change over the past decades. It is simply assumed in this article that limitation and reduction in carbon emissions by any nation, developed and developing alike (characterised as 'progressive' or 'proactive' stance on climate change), will help combat climate change and will be hugely beneficial to our planet.

Overall, before 2009 especially 2006, China's climate policy remained rather defensive. Specifically, during 1990–2005 China largely ignored the pressing nature of climate issues and, instead, argued for the urgency of economic development. From 2006 to 2008 China started to soften its resistance to climate issues and acknowledged the negative effects of climate change. This adjustment continued during 2009–11, when China refused to accept internationally binding commitments while announcing its voluntary efforts to reduce carbon intensity. Similarly, climate policy under Xi has experienced ebbs and flows. Xi marked his arrival on the global stage of climate negotiations by putting up an overtly assertive and defensive posture during 2012–14. He dramatically reversed this stance in the subsequent period of 2015–19 by claiming a moral high ground of international leadership. Nevertheless, during 2020–1 the unfolding of heavy industrial and carbon-intensive projects seemed to suggest Xi's retreat from this proactive position on climate issues, despite his public unfolding of a progressive goal.

This article aims to offer an empirical review of the changes in China's climate change policy since 1990. It offers an original and theoretically based interpretation of the change in China's climate policy. Main theories in international relations (IR) and international political economy (IPE), as well as the domestic political economy theory, are applied to explain China's stance over the last three decades. Overall, (neo-) realism/nationalism and liberalism, two main theories in the field, offer only a partial explanation of China's stand. The most effective theory is domestic sources.

This article is organised in the following way. In the first section, the existing literature on China's climate change policy is briefly outlined and reviewed. This is followed by an assessment of the main theories in IR and IPE and their relevance to the case of China's climate change policy. In the subsequent section, China's climate change policy from 1990 to the present will be examined and its main stance and shifts will be identified. The three main theories are applied and their explanatory power for the change in China's position is assessed.

In the final section, building on the preceding analysis of the grave challenges from climate change in China in 2020 and on the findings of this study, this article also suggests a pragmatic strategy for engaging China in the global climate talks and rewarding it appropriately for its positive contribution. This policy-related discussion is relevant, as this article is submitted to a series of special editions of the *Journal of*

the British Academy on topics broadly related to climate change. These special editions are related to the Academy's wider work in the area and the debates leading up to and out of the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow hosted by the UK in October and November 2021, as well as the Fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15) in Kunming, China in October 2021. The author argues that climate change remains one of the few bright spots where China and the rest of the world could work together constructively for the fate of mankind. It is in China's interest to sustain its proactive stance to fight climate change. It is also in the global and especially British and European interests to encourage China's endeavours on climate change.

The existing literature on China's climate change policy

The existing literature on China's climate change policies investigates the following issues: economic and technological studies of China's energy consumption and carbon emissions and reduction, as well as the evolution and underlying causes of China's climate change policy. These two streams of studies will be reviewed, with heavy attention to the second stream, as it relates closely to the topic of this article.[1]

Economic and technological studies of energy use and carbon emissions and reduction

The first stream of literature consists of two inquiries. The first inquiry focuses on the factors that shape energy consumption, demand, and carbon emissions in China. One typical approach is econometric analyses of carbon emissions and energy consumption in China over the past decades, or across its localities such as provinces or major cities (Dhakal 2009, Yu 2012). Using Kaya decomposition approaches, researchers have suggested that underlying drivers of China's carbon emissions are determined by the carbon and energy intensity of its economic growth (Ma *et al.* 2019). Relevant factors also include industrialisation, urbanisation, energy mix, and final consumption rate (Dong *et al.* 2018, Ma *et al.* 2019). Scholars explore the linkage between carbon emissions and economic development (Zhang & Cheng 2009). They also disagree and debate over the effects of China's climate change policy on peaking of carbon emissions in 2030 (Elzen *et al.* 2016, Zhang *et al.* 2016). Other studies also

[1] This article makes use of estimates on China's carbon emissions compared to other major economies, such as those by environmental scientists and economists, such as Myllyvirta (2019) and Spracklen (2016), or those by institutions or internet platforms, such as World Resources Institute (2014, 2017) or Our World in Data. They are not covered in the literature review as they are not concerned with China's climate policy.

examine China's energy demand and sources as well as their prospects (Lai & Warner 2015a, 2015b, Thomson & Boey 2015). These studies offer a diagnosis of the patterns of energy production and demand and of carbon emissions, as well as the underlying economic causes. It serves to illustrate the technological possibilities and constraints in China's responses to climate change.

The second inquiry is on the technological and economic measures China has taken or could take to reduce carbon emissions. It surveys and proposes the state's initiatives to reduce carbon intensity and restrain carbon emissions (Wang *et al*. 2012, Woetzel *et al.* 2020) and assesses the effectiveness of these policies (Chen, Y. 2012, Wang *et al.* 2012). Nevertheless, rather than exploring the political causes of China's climate policies, the focus of these studies is on the technicality and effectiveness of these policies, which is obviously important once China has made commitments to address climate change.

Evolution and causes of China's climate change policy

The studies closest to this article are those examining and explaining China's climate change policy. They purport to review the changes in China's climate change policy in the past two decades and reveal the factors that accounted for the evolution of the policy. While the studies on this topic are relatively limited in number, most of the authors were scholars in social sciences, such as political science and law. Heggelund (2007) examined the relative weight of domestic and external factors. He suggested that China's climate change policy was shaped by the following factors in order of importance: energy demand to sustain China's rapid growth, vulnerability to climate change, material benefits from participating in clean development mechanism (CDM) projects, international pressure, and global climate change. In another study published about the same time, Lewis (2007) argued that domestic bureaucratic advocacy and international pressures combined to produce adjustment in China's formerly obstinate climate stance. An example of international pressure was a shift away from the defensive position on climate change by some forest-rich developing countries such as Brazil to claim aid from developed nations. A third study argued that the change in China's climate policy could best be explained by the advocacy coalition framework (ACF). This argument emphasised the role of scientists and scholars outside the bureaucracy who were advising the government, and their beliefs, and technical information in shaping China's climate policy during 1988–2013 (Stensdal 2014). A fourth study also published around 2007–8 pointed to the high relevance of enlightened pragmatism and domestic politics in moulding and changing China's climate change policy. It was argued that Beijing would be persuaded not by moral obligation, but by concerns with public health, domestic instability arising from climate change

consequences, and decreasing costs in the wake of improved technology and global image (Wiener 2008). One of the most in-depth studies in this stream was Chen G.'s (2012) book on China's climate change evolution. Echoing the above studies and supplying in-depth analyses, he postulated that a more diversified climate policy process featuring the involvement of bureaucratic players, non-governmental organisations (NGOs), and international pressure, as well as concerns with energy security, had resulted in an adjustment in China's climate policy from resistance to acceptance of international obligation. In his words, 'in response to rising international pressures and domestic energy security issues, and attracted by lucrative carbon businesses and a clean energy market, the regime shows some sort of better-than-expected flexibility and shrewdness in coping with the newly emerged challenges' (Chen G. 2012: xii). One of the latest studies of China's climate policy focused on central–local governmental interaction. Zhang *et al.* (2019) concluded that the recentralisation of climate policy-making by Xi Jinping, the Chinese top leader, created short-term benefits as well as long-run uncertainty and risks for climate policy implementation in China.

Taken together, this stream of literature tends to incorporate both domestic and international factors in explaining the change in China's climate change policy. The domestic factors include energy security manifest in the stable energy supply needed for sustained economic growth; bureaucratic players, especially those speaking out for a proactive stance in climate policy and central–local interaction; scientists and academic advisers to the government; and vulnerability and public health issues in climate change. The most prominent international factors included the international pressure for climate action, especially from the developed world and NGOs, followed by the shift in the stand toward the developed world by some large developing nations such as Brazil or a group of developing nations. The other international factors included the economic benefits of participating in projects related to climate change, such as CDM, and the global perception of China as acting responsibly or irresponsibly on climate change. These studies tended to conclude that the relative strengths of domestic and international factors created pulls and pushes, resulting in China's eventual climate policy. Meanwhile, domestic factors tended to take precedence over international ones. Nevertheless, it is worth noting that the input from NGOs and scientific advisers alone, as emphasised by Lewis (2007), Stensdal (2014), and Chen G. (2012), seems to increase over the years. As such, it will not suffice to explain the ebbs and flows of China's commitment to address climate change. In addition, the central–local dynamics adds nuance to China's implementation of climate policy, instead of dictating it, given China's unitary and centralised structure of the party-state.

This study will expand on the insights from this stream of the literature while pushing for a more theoretical interpretation of China's climate change stances from the 1990s to the present time. Specifically, this study will make the following contributions to the

existing literature. First, it updates the analysis of China's climate policy to that under Xi's leadership (that is, from 2012 to 2021), thereby extending the analytical interpretation of China's climate action to the most recent twelve years when China has been a predominant carbon emitter. In contrast, most academic studies covered China's climate policy mostly up to 2008. Second, this study will advance the theoretical interpretation of China's evolving climate policy during 1990–2021 by applying three main theories in international political economy and assessing their validity and relative explanatory power. That is what the existing literature has largely failed to do. In addition, it presents a domestic political and economic explanation drawn from analysis of the linkage of China's foreign policy with internal sources from the 1950s to the 2000s (Lai 2010). The explanatory power of this domestic sources theory will be tested in the context of the evolution of China's climate policy. Sources of information come from news reports, policy reports, and academic studies. In particular, this study makes frequent use of established and detailed accounts of China's climate policy by journalists such as Hollingsworth (2017) and scholars such as Chen G. (2012) and Heggelund (2007), policy analyses on China's climate stance, and estimates on China's energy profile, carbon emissions, and renewable energy.

IR and IPE theories and the author's explanation

Before the author proceeds to the presentation and analysis of China's climate change stance, it is helpful to review the main theories in international relations (IR) and international political economy (IPE). They could provide a relevant theoretical tool for our understanding of China's evolving posture on climate change. The following three schools seem the most relevant to the stands on climate change adopted by nation-states: namely (neo-)realism/nationalism, liberalism, and domestic political economy (DPE). Each school offers a different interpretation of the logic of nation-states' behaviour in global affairs.

(Neo-)realism/nationalism

(Neo)-realism/nationalism is a short-hand reference to realism, neo-realism, and nationalism. This school has been the mainstream theory and arguably the dominant one in IR and IPE for decades. This school maintains that nation-states are the central players in IR and IPE, despite globalisation and intensified economic and social links between nation-states. It submits that nation-states are the most powerful connector between power and wealth, and that they exert the greatest impact on power and are the ultimate guarantor of national wealth (O'Brien & Williams, 2016: 8–9). This

school perceives relations between nations as filled with constant rivals and measured by relative gains. Scholars of this school agree that national interests should be a good standard in formulating national foreign policy, including climate policy. They also concur that the power of the nations is the most immediate and effective basis for advancing and protecting national interests and that the state, instead of markets, should dictate foreign policy (Gilpin 1987: 31–3).

There is a subtle distinction between neo-realism and realism/nationalism. The latter holds that the yearning for power (control or leverage over other states) arises from human nature. It posits that nation-states would strive for power within international affairs. On the other hand, neo-realism believes that the lack of an effective world government in the international system (coined world anarchy) causes nation-states to seek power to protect themselves. In particular, offensive realism, a sub-school of neo-realism, perceives a chaotic and highly insecure international system and argues that the best means to the survival of nation-states is to obtain the most power possible (Mearsheimer, 2001: 21–2).

Translating into climate change policy, (neo-)realism/nationalism will predict an inherent struggle between nations, each striving to take a stance on the issue best suited to its national interests. In particular, neo-realists postulate that nations are primarily concerned with relative gains and see that benefits from climate action will take up to a century to materialise (Purdon 2017). According to (neo-)realist logic, each nation may thus avoid shouldering a big responsibility for carbon reduction, would rather see other nations taking on a greater duty, and would avoid adjusting their policy and fighting against climate change due to the perceived prolonged pain of economic slowdown. This school would thus predict that China would not act on climate change as it does not immediately affect its survival and that it will prioritise its wealth and power over action on the climate issue. Worse, China could act as a freerider, passing the buck to the other nations, or will use its power to pressure less powerful nations to act against carbon emissions.

Liberalism

The other prominent school of theories in IR/IPE is liberalism. It believes that individuals and states are rational and have sound reasoning toward cooperation. It highlights the growing importance of free trade and capital mobility, as well as an increasing role of firms, NGOs, international organisations, and even activists in global affairs (Gilpin, 1987: 26–8, O'Brien & Williams, 2016: 20). According to two of the leading advocates of this school, inter-state interaction is moving away from the highly competitive and potentially deadly and mutually destructive realm of military rivalry toward less deadly and more cooperative and beneficial realms of economic,

social, and environmental areas of concerns. Interdependence among states is rising. It is in the interests of nation-states to work out international regimes to tackle issues of common concern and to contain destructive competition and conflict (Keohane 1984, Keohane & Nye 2012).

Climate change has been regarded by liberals as an issue affecting the future of human civilisation. No nations would be spared from the catastrophic outcomes of global warming, such as calamitous weather and a rising sea level. Working together with other nations to address this pressing global problem is in the interests of all nations. According to Keohane (1984: 244), even without the leadership of a hegemon such as the United States, international regimes and institutions can foster international cooperation by providing a convenient platform to bring nations together, supplying necessary information and reducing information costs, facilitating agreements, decentralising their enforcement, creating linkage across issues, and reducing transaction costs. Liberal scholars would thus predict that out of their self-interest nations would participate actively in the global action to tackle climate change and would eagerly seek ways to reduce carbon emissions. Keohane (1984: 252–3, 258) proposed what I coin a liberal yet pragmatic argument on international cooperation. He argued that a small number of developed nations shared common interests over a range of issues and that they could work together to address a host of major global issues. This claim seemed to apply to most of the developed nations, especially the European Union, and with some exceptions to the United States on climate change. Echoing Keohane's argument, Victor (2006) even suggested that flexibility in policy choice and international treatments and unconventional wisdom might be needed in forging substantial international efforts on the climate issue. He proposed that a forum of leaders of twenty key nations on climate change would overcome the issue of diverse interests among nearly 200 nations and areas on the issue and could take the lead in global climate action.

Domestic political economy (*innenpolitik*)

The third theory relevant for the national stance on climate change is domestic political economy. This school holds that domestic political and economic coalitions, the articulation of their interests in the policymaking process, and leadership are the key factors that shape the climate change of nations. In the first book-length investigation of the domestic sources of China's foreign policy, the author (Lai 2010) proposed that domestic political and economic regime, political security, vision and skills of leaders, and the decision-making process help drive foreign policy. Foreign policy is formulated to serve the interests of the regime, the ruling coalition, and the top leader. This approach is applied to China's inauguration of the Belt and Road Initiative (BRI).

It has been argued that the BRI aimed to help the heavy industrial sectors dominated by state firms to find outlets for their surplus product, to speed up growth in the western region which possessed these sizable sectors, and to ensure a steady supply of energy to power China's economic growth (Lai 2021). China's climate policy may be conditioned by two domestic factors. The security of the top leader affects China's external posture. When a leader is busy with consolidating his power, he may be reluctant to make international concessions, as doing so would be perceived as weak and would undermine political support at home. In addition, since 1978, the ruling party in China (that is, the Chinese Communist Party) has viewed economic growth as a key basis for its political legitimacy and has thus given it heavy political attention (Lai 2010).

Other theories

Marxist scholars have offered a critical yet rather comprehensive perspective on capitalism and the environment. They attribute environmental degradation and climate change to the capitalist restless pursuit of profits and over-accumulation (Gills 2010). The Chinese state is also seen by historical materialist scholars as following the path of capitalism by promoting exports, attracting foreign investment, and tolerating capitalist extraction from workers through less-than-ideal working conditions as well as inequalities (Hardy 2017). Nevertheless, this approach will not predict the ups and downs of China's climate policy. It is thus not adopted in this analysis.

According to constructivist theory (Wendt 1999), national identity is critical in understanding the perceived national interests and actions of a nation-state in the world. From 1990 to 2021, China identified itself with developing and emerging economies, such as India, South Africa, and Brazil, and had been emphasising its rights to economic development and growth in carbon emissions in international climate negotiations. Although this identity has remained unchanged, China's climate policy has undergone considerable changes. Thus constructivism seems to have limited utility in accounting for the vicissitudes of China's climate stance and will not be included as a theory to be tested below.

In the following section, the author will review the evolution of China's climate change policy since 1990. It is found that the domestic political economy provides the best explanation of the apparent change in China's stance on climate change, even though other factors might have been relevant to some extent.

Explaining the evolution of China's climate change policy during 1990–2011

The existing literature, especially that on the evolution of China's climate policy, covers mostly the period up to 2008. This study will cover the period of 1990–2021. In the following two sections, China's climate policy during 1990–2011 and that in the era of Xi Jinping from 2012 to 2021 will be examined, respectively. In both sections, the author will describe the main contents of China's climate policy in each of the six periods of 1990–2021 (these periods will be outlined shortly). He will then examine the main variables helping to explain the features of China's climate policy of each period and, if relevant, the change from those in the previous period. The main features of China's climate policy are summarised in the second and third rows in Table 1.

Six main periods in China's climate policy from 1990 to 2021 can be identified by the main features of China's climate policy. During 1990–2005 (Period 1) China's position could be viewed as strictly defensive and resistant toward the climate change argument and the prescribed reduction in carbon emissions. In the ensuing period of 2006–8 (Period 2), China started to be responsive to climate issues. It publicised its international commitments in restraining carbon emissions in 2009–11 (Period 3). However, China's stance was still viewed as insufficient by the climate change advocates in the developed world, especially the EU, and thus tension between both sides simmered. Their clash culminated in the wake of the 2009 Copenhagen summit, to be detailed below. From late 2012 onwards, China's climate policy has entered the era of Xi Jinping. In the following period of 2012–14 (Period 4), China appeared uncompromising in global climate talks in defending the rights of developing nations to develop. This defensive stand was dramatically reversed between 2015 and 2019 (Period 5) when China signed and upheld the Paris agreement. At the latest period starting from 2020 (Period 6), China seemed to pull back from its proactive stance by embracing carbon-intensive developmental projects at home.

In analysing these six periods, the author will draw upon the aforementioned in-depth and well-grounded studies on the evolution of China's climate policy during the 1990s and the 2000s. The author is aware of the complexity of China's climate policy as uttered by Chen G. (2012: x) as follows:'To understand China's climate change policy is not easy, as the country itself is a paradoxical factor in the global climate political economy.' Nevertheless, this exercise is worthwhile, as it enables us to gain a valuable glimpse into the evolution of China's stance regarding climate change, as well as the key variables that condition China's endeavour.

In applying the nationalist, liberal, and *innenpolitik* perspectives to the main causes of the ebbs and flows of China's climate stance, the following factors are highlighted in each period of China's climate policy. The first factor is the degree of nationalism

in China's stance on the climate issue. When China argued for development rights, this stand fitted the (neo-)realist/nationalist perspective on international affairs. It will be seen as validating the (neo-)realist/nationalist explanation. The second factor is the global pressure on China to act on the climate issue. This factor was revealed to be relevant in several existing studies (Lewis 2007, Chen G. 2012). To a large extent, this factor is in line with the liberal argument reviewed above in two ways. First, the liberal school argues that international cooperation is possible over global issues. Second, as the liberal pragmatic view uttered by Keohane (1984) and Victor (2006) indicates, a feasible way to address pressing global issues is to have a small number of influential nations work together and forge coordinated action. China would thus be a critical member of this small but influential climate coalition. The third and fourth factors relate to the *innenpolitik* perspective. To be specific, the third factor is domestic leadership, which indicates whether the top leader has consolidated his power or not. This variable is derived from the author's finding (Lai 2010): When a new leader is busy with consolidating his power, usually in the initial years of his assumption of the post, he would appear nationalistic to shore up political and popular support. However, after he has consolidated his power, he would be more willing to be cooperative in international negotiations. The fourth variable is the domestic concern with economic growth (ranging from extremely high to moderate), depending on the growth rate in China. As expounded in the existing study (Lai 2010, 2021: 324), economic growth constitutes the primary basis for China's leader to claim political legitimacy. A sluggish growth rate would usually cause the leadership to be gravely concerned with economic growth, whereas a double-digit annual growth rate would reduce their concern to a moderate level.

If any of these factors (say, international pressure) is correlated with a change in China's posture on the climate issue, the concerned theory (in this case, the liberal school) would then be deemed as effective in explaining China's climate policy in this concerned period. In Table 1, three sets of variables used to explain China's climate change policy are summarised. Those variables that are best at explaining the policy are highlighted in bold, and those variables that are partially correlated with China's climate stance are indicated in italic bold.

1990–2005: utterly defensive

In the 1990s, China set up inter-ministerial coordinating bodies to manage its climate policy. In 1990, the National Climate Change Coordination Leading Small Group (CCCLSG; *guojia qihou bianhua duice xietiao lingdao xiaozu*) was established as the highest-level climate policy-making body to coordinate climate policy and efforts among ministries. The CCCLSG was presided over by the National Development and

Reform Commission (NDRC). Before 1998, the China Meteorological Administration (CMA) was entrusted with coordinating climate change policy and representing China on the Intergovernmental Panel on Climate Change (IPCC). Since 1998, the NDRC has assumed a prominent role in China's climate policy. A Climate Change Office was set up within the NDRC in 1998 to provide secretarial assistance to the CCCLSG (Heggelund 2007: 168). After the administrative restructuring in 2003, the Energy Bureau in the NDRC took charge of China's energy policy (ibid: 172). The other major bureaucratic players in China's climate policy included (1) the Ministry of Foreign Affairs (MFA) which seemed to have taken a foreign policy stance on climate change similar to the NDRC, and (2) the Ministry of Science and Technology (MOST) with responsibility for research and technological transfer regarding climate policy (ibid: 173). Both ministries were members of the CCCLSG.

As early as 1990, China's ministries started to formulate a stance toward environmental issues including climate change that was later known as 'common but differentiated responsibilities' (CBDR). In 1990, at a meeting the Foreign Ministry, the State Planning Commission (SPC), the predecessor of the NDRC, the National Environmental Protection Agency (NEPA), and State Science and Technology Commission (SSTC) formulated the following guidelines for international environmental negotiations: economic development should be integrated instead of sacrificed for the environment; developed nations were historically responsible for the damage to the environmental and greenhouse gas emissions, and therefore should provide resources for implementation of international treaties and should provide developing nations with relevant technology at a below-market price; no country should meddle with the decision by other countries to use natural resources (Economy 1998: 271–2, as cited in Chen G. 2012: 5–6). Later, the spirit of these guidelines, known as the CBDR, was included in the United Nations Framework Convention on Climate Change (UNFCCC) of Earth Summit in Rio de Janeiro, 1992. For years it was the cornerstone of the stance by developing nations toward climate change. The Kyoto Protocol passed in December 1997 obliged developed nations to cut their greenhouse gases but exempted developing nations from this burden. The protocol provided handsome rewards for developing nations, especially China with funds to improve its environmental protection during development through the CDM funds and projects, which will be elaborated below. China's pioneering role in germinating the CBDR and in defending the rights to development for the developing countries earned it legitimacy and reputation within the developing world (Chen G. 2012: 6–8).

In addition to CBDR and in line with its 1990 guidelines, China declared its refusal to accept mandatory carbon reduction and third-party monitoring. During the negotiation of the Kyoto Protocol in 1997, China suggested not committing to

Table 1. Evolution of China's Climate Change Policy, 1990–2021

Variables	*1990–2005*	*2006–2008*	*2009–2011*	*2012–2014*	*2015–2019*	*2020–2021*
Main Stance (DV)	Highly Defensive and Resistant.	Defensive and Modestly Progressive. First energy-intensity reduction target.	Moderately Progressive. First commitment to reducing carbon intensity.	Assertively Defensive and Uncompromising.	Proactive and Progressive. Intention to peak carbon emissions in 2030.	Regressive Actions and Progressive Pledges (Overall Regressive).
Stance: Additional Contents (DV)	Placing development above climate.	Adjusting; more responsive to climate issues.	Progressive after being blamed in Copenhagen.	Regressive.	Signed and defended the Paris agreement. Obvious progress toward renewables, reduction in carbon intensity, and growth in carbon sink.	Highest growth in carbon emissions in a decade recorded in first quarter of 2021. Pledge to be carbon neutral by 2060.
A Nationalist Argument on Climate Issues (IV)	**Extreme nationalist.** Defending rights to development.	**Nationalist.** Maintained'common but differentiated' principle, though noticing climate effects.	***Nationalist.*** Defending rights to development while making first climate commitment.	**Nationalist.** Asserting development rights. Sided with developing nations to oppose the West.	Moving away from a nationalist stance. Arguing for global action on climate issues.	Declaring China's commitment while reversing some of it in launches of development projects.
Carbon Emissions Status and Global Pressure (IV; liberal explanation)	Fast-growing, still behind the US. Half of the US in 1990. ***The US pointed to developing nations such as China when rejecting the Kyoto Protocol.***	Became the largest emitter. **Increasing demand from the West for China's action.**	The largest emitter. **Intense pressure from the West on China.**	The largest emitter. Intense pressure from the West on China.	The predominantly largest emitter. Nearly twice as much as the US emissions in 2017. **Intense global pressure on China.**	The predominantly largest emitter. Intense global pressure on China. Some international concerns.
Domestic Leadership (IV; domestic politics)	Under Jiang until 2002; **Hu took charge after 2003.**	**Under Hu whose power was more stable.**	**Under Hu whose power was more stable.**	**Xi just became a new top leader.**	**Xi consolidated his power and sought global leadership.**	Xi is the supreme leader.
Growth concerns (IV, domestic economy)	**Very high.**	**Moderate.**	Moderately high.	High.	Very high.	**Extremely high.**

Notes: The variables comprise a dependent variable (DV) and independent variables (IVs). The IVs that are correlated with the DVs the closest and seem to best explain the DV in each period are highlighted in bold, and one that can partly explain the DV is in italic bolds.

carbon reduction until it reached a 'medium level of development' around US$5,000 (ibid: 178). Nevertheless, it had actively been involved in CDM projects. In 2004, a Designated National Authority (DNA) was established within the NDRC for the management of the CDM projects. By the end of 2006, 255 projects had been approved (ibid: 179–82). China did utilise CDM to access technology to help develop its domestic renewable technology and catch up with the advanced economies (Lewis 2012). However, as illustrated by Thomson and Boey (2015), China's energy has been drawn predominantly from coal, a primary energy source that produces most carbon emissions, and this will remain the case in the foreseeable decades. Thus, overall, China's attitude toward the Kyoto Protocol could be characterised as support for it without having committed to mandatory cuts in carbon emissions, while trying to benefit from the climate change funds and access to renewable energy technology.

As just discussed, during this period, China adopted a highly defensive posture toward climate issues. During this period, China's carbon emissions were rapidly expanding, though still behind those of the United States. In 1990, China emitted an equivalent of half of the amount of carbon dioxide by the US. During this period, the main demand for China to act on climate change came mainly from the United States, especially when the latter was reluctant to sign on to the Kyoto Protocol. Turning to domestic factors, China's frontline top leader Jiang Zemin wholeheartedly embraced the emphasis on GDP growth laid down by Deng Xiaoping in his governance of the nation since 1992. Deng was the paramount leader in China from 1978 to 1994.[2] Anything which seemed to impede China's growth, such as climate commitments, would be perceived as politically unacceptable. Jiang remained the top frontline leader until 2002. During 2002–5, Hu Jintao succeeded Jiang to be China's frontline top leader. Needing to consolidate his power within the party-state during these years, Hu had largely inherited the single-minded focus on GDP-based economic growth without deviation. In this period, China was the international spokesman for the nationalist position on climate change. It vigorously defended the rights of developing nations to economic growth, urged the developed world to shoulder the bulk of responsibilities over carbon reduction, rejected the demand for it to cut back carbon emissions, and championed the CBDR principle.

[2] Deng died in 1997. However, during 1994–7, his final years, Deng's poor health prevented him from supervising China's policies. Jiang was thus in charge.

2006–8: defensive and modestly progressive

The turning point for China's change in its CBDR came around 2006 and 2007. In 2006, China published its 11th five-year plan (FYP) covering the period 2006–10. For the first time in history, its FYP included a target regarding energy consumption which would reduce carbon intensity and the growth in carbon emissions. This FYP mandated a 20 per cent reduction in energy intensity: namely, energy consumption per unit of GDP in five years. The target might be included for multiple reasons. First, it was in line with the 'scientific outlook on development', a concept on economic development proposed by President Hu Jintao. This notion of development departed from the previous simplistic emphasis on GDP growth and heeded the environment, as well as the welfare and well-being of the population. Second, China's carbon emissions had been growing rather rapidly in the previous decade, registering 6 per cent a year during 1994–2005. In particular, China's carbon emissions from the combustion of fossil fuel grew at an alarming 15.6 per cent a year during 2002–5 (Zhang *et al.* 2009: 151). Despite China's refusal to admit it, the increase in China's carbon emissions far surpassed the other two largest carbon emitters: namely, the United States and India in Annex I in the Kyoto Protocol (ibid: 154–5). Third, by introducing this mandatory target in energy intensity reduction China aimed to rein in the escalating energy demand and rising energy price and ensure energy security while easing global concerns with its soaring carbon emissions.

China received negative international attention as the largest carbon emitter. In April 2007 the International Energy Agency (IEA) revealed that China could become the world's largest emitter of greenhouse gases as early as 2007 (Chen G. 2012: 9). A month later, the IPCC, the United Nations body leading climate change action, met in Bangkok. Its working group delivered a report recommending a range of tools to contain global temperature rise, including charging polluters up to US$100 for each ton of CO_2 by 2030. China was regarded by some nations as a major obstacle to the approval of this report (Chen G. 2012: 9). Although being the largest carbon emitter and eager to sustain its rapid growth in the coming decade, China did not want to be an outcast in the global climate talks and be the prime target of sanctions or draconian anti-warming measures advocated by the developed nations.

China's strategy to fend off international criticisms and the potential risks of derailing its domestic growth had been two-pronged. On the one hand, it tried to resist international criticisms and formally uphold CBDR. On the other hand, it stepped up its action to reduce the growth in its carbon emissions by announcing voluntary targets to improve carbon intensity. In 2007, China published the National Climate Change Programme (《中国应对气候变化国家方案》). In this document, the NDRC acknowledged the adverse implications of global climate change as well as the

difficulties for China to accept the mandatory carbon reduction target, given its heavy reliance on coal as an energy source and its need to develop its economy (Chen G. 2012: 10). In the same year, the National Leading Small Group to Address Climate Change was established. It was headed by Premier Wen Jiabao and his deputies included a Vice Premier and a State Councilor. China also reiterated its energy intensity reduction target in its 11th FYP.

During this period, China's climate stance was defensive. It had largely adhered to the nationalist argument on climate issues by upholding the CBDR. However, China also started to bear the brunt of the international pressure for action, as it eclipsed the United States to be the largest carbon emitter during this period. China's willingness to acknowledge the side effects of climate change had a clear domestic linkage. President Hu had consolidated his power. In the wake of the SARS outbreak, he proposed a scientific outlook on development and moved the nation away from the simple-minded focus on GDP-based economic development. Meanwhile, China was enjoying phenomenal economic growth. As a result, President Hu and Premier Wen were not overly concerned with the dampening effect of climate action on China's growth. Being more or less politically secure, nor were they concerned that accommodating international demand for carbon reduction would critically undermine their leadership posts.

2009–11: moderately progressive

The year 2009 seems another replay of 2007 when China took voluntary action to slow down the growth in its carbon emissions. However, later that year it was caught in international controversy, which overshadowed its pledge of action. In September 2009, President Hu delivered a speech at the United Nations. He announced several unprecedented pledges by China regarding containing the growth of carbon emission: (1) to reduce per unit of GDP CO_2 emissions by 40–5 per cent in 2020 compared to 2005; (2) to increase non-fossil fuels in primary energy consumption to 15 per cent by 2020; (3) to increase forest coverage by 40 million hectares by 2020 from 2005 to absorb carbon emission; (4) to develop a green and low-carbon economy and technologies (*New York Times* 2009).

However, the widely perceived failure to pass a legally binding international accord to combat climate change at the Copenhagen summit in December 2009 placed China in a highly negative international limelight. China and other major developing economies such as India, Brazil, and South Africa, on the other hand, rigorously defended their rights to economic development (*Guardian* 2009, *Independent* 2009). Leaders of developed nations such as a senior official from an EU nation and Ed Miliband, the climate secretary of the UK, blamed China for rejecting a legally

binding target to reduce its rising carbon emissions, thereby derailing the Copenhagen climate summit.

In 2011, China had adopted two responses in the wake of the fiasco at the Copenhagen summit. The first response was the inclusion of three targets concerning energy usage and carbon emissions in its 12th FYP. Unfolded in March 2011 and governing the period 2011–15, the 12th FYP mandated a 16 per cent reduction in energy intensity, raised the share of non-fossil fuel energy in total energy use to 11.6 per cent, and required a 17 per cent reduction in carbon intensity, that is, carbon emissions per unit of GDP. The second and especially the third targets were included in the FYP for the first time, reflecting the urgency for China to showcase its determination to cope with climate change.

The other response was a conditional softening of its long-standing refusal of an internationally binding carbon reduction commitment. In December 2011, at a climate summit in Durban, South Africa, China expressed its willingness to accept a legally binding agreement on carbon emissions reduction as long as developing countries including China were treated differently from rich countries (Hollingsworth 2017). Even though the resistance from China and India toward the pressure from the developed world on carbon reduction prevented any major agreement from being reached then, the parties at the meeting agreed to strive for such an agreement in 2015. This change in the stand was noticeable. Back in 2007, Lu Xuedu, deputy director-general of China's Office of Global Environmental Affairs, declared China's refusal to binding commitments, citing its lack of capability to reduce carbon emissions. This position was visibly maintained by China until 2009 (Hollingsworth 2017).

During this period, China continued to soften its defensive stance on climate issues. It partially embraced the nationalist posture by rejecting international binding commitments, supporting its development rights, and reaffirming CBDR, especially at the internationally watched Copenhagen summit in 2009. However, under intense international pressure, especially backlash from Western Europe, China announced its first international commitment to a reduction in its carbon intensity and to enhance carbon sinks through forestation. A critical cause seems to be the security of the top frontline leader in China. As Hu started his second term as China's frontline top leader, his political status was secure. He could thus afford to accommodate international demand for reasonable action to address climate issues. Furthermore, during this period, through fiscal stimulus, China sustained its high economic growth in the wake of the global financial crisis of 2008. Thus, while Hu was concerned with economic growth, his concern was not as high as Jiang's during the first period, or in the later period under Xi.

Understanding climate change policy under Xi Jinping (2012–present)

2012–14: assertively defensive and uncompromising

The early years of Xi's leadership were marked by an assertive stance to defend China's long-standing position of siding with the developing world and resisting the pressure from the developed world to reduce carbon emissions substantially. China was not afraid to play hard-ball tactics. In December 2012, one month after Xi was inaugurated as the new paramount leader in China, Xie Zhenhua, the top Chinese official on climate policy, spoke to countries in Doha, Qatar, where they met and agreed to extend the expiring the Kyoto Protocol. He coined the developing countries as 'victims of climate change' and declared that developed countries should do more than developing ones. The next year, China and the United States disagreed over whether developed countries should do more in climate action when nations met in Warsaw, Poland. In discussions regarding compensation for countries suffering the most from global warming, the G77 countries and China organised a walkout of 132 developing countries. At the end of the Warsaw meeting, countries agreed to publish their emission reduction contributions in 2015 (Hollingsworth 2017).

Despite the high international demand for China's climate action, Xi's China embraced an assertive, defensive, and uncompromising position on climate issues. The nationalist element was highly visible in China's position. Its characterisation of the developing nations as 'victims of climate change' and its leadership in the boycott of climate talks at Warsaw marked an unapologetic act of nationalism. During this period, China's concern with decelerated domestic growth was high, though probably not as intense as during 1990–2005. The most relevant factor seems to be that Xi had just become the new top leader in China. Newly assuming his post, Xi needed to consolidate his power. For this purpose, he fanned nationalist sentiments in China by championing China's new strength on the world stage. As a result, he did not want to be perceived as too weak and too accommodating to Western demands for climate action.

2015–19: proactive and progressive

In 2015, in formulating the first FYP under his leadership, namely, the 13th FYP covering 2016–20, Xi kept the three important climate-change-related indicators introduced by his predecessor: namely, the reduction in energy intensity, the reduction in carbon intensity, and an increase in the share of clean energy in overall energy consumption. He also continued to further experiments with the green economy. The 13th FYP set a target of reducing China's carbon dioxide intensity by 18 per cent and of reducing its energy intensity by 15 per cent during the five years. These targets

showcased China's efforts to meet its international commitments to peak its carbon emissions in 2030 under the Paris Agreement on Climate Change. The 13th FYP included a nationwide total energy cap for all energy sources at less than the equivalent of five billion tonnes of coal over the next five years. This cap could be easily achieved thanks to the drastic slowdown in the growth in China's energy usage slowed from 6.4 per cent from 2005 to 2012 to 2.3 per cent annually from 2012 to 2015. The share of clean energy in total energy use in the 13th FYP was set to increase from 12 per cent under the 12th FYP to 15 per cent by 2020. In December 2016, the 13th Five-Year Renewable Energy Development Plan specified $373.1 billion (RMB 2.5 trillion) in total investment for a new installed capacity of renewable energy by 2020, including $74.6 billion (RMB 500 billion) for hydropower, $104.5 billion (RMB 700 billion) in wind, $149.3 billion (RMB 1 trillion) in solar, and additional investments in biomass, power generation, biogas, and geothermal energy utilisation (Koleski 2017: 18). The 13th FYP reaffirmed its backing for the Made in China 2025 initiative, and the latter identified new energy vehicles as one of the ten key sectors the state should support (ibid: 9).

On 30 June 2015, China submitted its Intended Nationally Determined Contribution (INDC), including the target to peak CO_2 emissions by 2030 at the latest, lower the carbon intensity of GDP by 60–5 per cent below 2005 levels by 2030, increase the share of non-fossil energy carriers of the total primary energy supply to around 20 per cent by that time, and increase its forest stock volume by 4.5 billion cubic metres, compared to 2005 levels. In December 2016, China joined the Paris agreement, a global agreement to step up action and investment to combat climate change. It maintained its commitment and criticised the Trump administration's withdrawal from the pact in 2017 (Hollingsworth 2017).

Around 2017, China's INDC was rated 'medium', between sufficient and inadequate, by Climate Action Tracker (climateactiontracker.org), the same rating for the INDC as the US, India, Brazil, and EU. In contrast, Australia, Canada, Indonesia, Japan, Russia, South Korea, South Africa, and Saudi Arabia were rated 'inadequate'. In 2020, this website rated China's climate targets as insufficient, and highly insufficient by 2030, as its rationale and emission trajectory will leave the world's temperature to rise by 3–4 degrees Celsius (Climate Action Tracker 2020).

According to a Chinese governmental source, by 2019, China's climate change action had achieved the following results. Its carbon intensity declined by 48.1 per cent compared to that in 2005, well ahead of its international pledge of a reduction by 40–5 per cent. Besides, non-fossil fuel accounted for 15.3 per cent of energy consumption, up by 7.9 percentage points from 2005, meeting its 15 per cent target scheduled for 2020. In 2018, renewable energy was responsible for 26.7 per cent of the nation's power generation, with 16.9 per cent coming from hydropower, and 9.85 per cent from

wind, solar, and biomass (Gov.cn, 17 November 2019). Besides, during the 2005–18 period the forest area in China grew by 45.1 million hectares, and its forest stock expanded by 5.1 billion cubic metres, topping the world (Xinhua Net 2020).

In particular, China has made the biggest investment in renewable energy and has built up the largest renewable energy capacity in the world in recent years. This is arguably China's most noticeable action in global climate change. A report on the development of global renewable energy in 2019 captured China's prominence in this sector in the following terms, 'China and other developing and emerging economies accounted for a higher share of total renewable energy investment than developed countries for the fifth consecutive year, and China again had the highest total investment despite a decrease for the second year in a row' (REN21, 2020: 30). In 2019, China invested a whopping US$90.1 billion in renewable power and fuel capacity, accounting for nearly 32 per cent of the global total. China's dominance in this department remained in 2019, despite its investment falling by 6.0 per cent from 2018, compared to a meagre increase in global investment by 1 per cent during the same period (REN21, 2020: 166, 169). China topped four out of the eight areas of renewable energy capacity being invested. These four areas are solar photovoltaics, wind power, hydropower, and solar water heating capacity. The remaining four areas were dominated by four individual nations (REN21, 2020: 36).

During this period, China's stand on climate issues could be characterised as the most progressive since 1990, despite criticisms. Xi apparently and publicly abandoned the nationalist argument on climate change. He called for and openly embraced global cooperation to combat climate change. His change of heart might have had to do with the continued international pressure, which China had been feeling since the period 2006–8. His active stance also deviated from an apparent domestic concern with noticeably decelerating economic growth in 2018–19 in the wake of the trade war with the United States, the last two years of this period. So the best predictor of this change in China's policy seems to be the security of national leadership. By 2015, Xi had consolidated his power at home. He had the ambition to project China's status as a global leader over issues of global concerns, especially over high-profile issues such as climate change.

2020–21: regressive actions amidst progressive moves (overall regressive)

In this section, three new developments regarding China's stance on climate change will be briefly discussed. The first development was that China is seen as refraining from taking determined actions in climate change due to economic considerations. An analyst raised an alarm over the weakening of Xi's commitments to climate change

action in his possible attempts to resuscitate an economy severely damaged by the COVID-19 outbreak. Signs of concerns included the cutting of spending on solar and wind power, a surge in funding on coal-fired power plants, as well as expanding unnecessary infrastructure such as high-speed rail, subways, and airports. Furthermore, China seems to be injecting a huge sum of investment into heavy industries that had long suffered from oversupplies of products, such as steel, aluminum, plate glass, and cars (Smith 2020). This concern was echoed by a Reuters report, which cited an analyst from a Chinese official think-tank and took note of the rush toward big projects in certain provinces in China, including the nation's key coal-producing base, that is, Shanxi (Xu & Stanway, 2020). Analysis suggested that in the first quarter of 2021, China's carbon dioxide (CO_2) emissions were 5 per cent higher than in 2019, a pre-COVID-19 level, and that China's carbon emissions soared by 15 per cent year-on-year, reaching their fastest pace in more than a decade. Energy demand appeared to sustain its surge in the second quarter of 2021 (CarbonBrief 2021a).

Among the potential causes listed in Table 1, the variable that can best explain China's retraction from its progressive climate course is domestic economic concerns. The COVID-19 outbreak has derailed China's decent economic growth and might have even caused a downturn in the first half of 2020, one of the lowest growth rates for decades in China. This temporary economic recession raised an alarm for the Chinese leadership. To sustain his legitimacy and fend off political, economic, and social problems, Xi reverted to the conventional tools of starting investment-intensive and even energy-intensive projects to stimulate the economy. Thus domestic political economy has driven China's deviation from its climate commitment.

The second development is devastation in China from extreme weather associated with climate change. In 2020, unprecedented floods in numerous river basins wreaked havoc on multiple regions in China. During June–mid-July, the rainfall in the middle and lower Yangtze basin reached the highest amount on record since 1961. It caused heavy flooding in central and eastern China, affecting Hubei, Hunan, Anhui, and Jiangxi Provinces. Besides, in mid-July record high levels of water swelled thirty-three rivers, and the water level in 433 rivers surged above the flood control line. By July, nearly 55 million residents in twenty-seven out of thirty-one provinces in China were impacted by floods. Floods forced the relocation of 3.8 million people, caused the deaths or disappearance of 158 people, and inflicted damage of $20.7 billion. For days, even the Yellow River in northern China experienced floods. In August 2020, Typhoon Bavi became the second typhoon to land in China's northeastern Liaoning Province since 1949, causing massive disruption. In Shenyang, the capital of Liaoning Province, 108 trains were halted out of safety concerns. In the province, water in fifty-one reservoirs swelled above the flood limit, and over 100,500 people had to be evacuated (Li & Wu, 2020). There are indications that the huge floods along the

Yangtze and the typhoon caused a significant drop in crop output in central China and the northeast, China's biggest granaries. One academic study published in *Environmental Research Letters* in 2018 suggested that, if the temperature rose by 2 degrees, the historical 1-in-100 year high river level would occur once every twenty-five to thirty-five years in China. It is thus imperative for China to adhere to the objective of the 2015 Paris climate agreement by restricting warming to below 2 degrees Celsius (Pike 2020).

The third development is several proactive moves adopted by China toward carbon reduction. In September 2020, at a virtual summit meeting of the United Nations General Assembly, Xi announced China's goal to become carbon neutral before 2060. While this objective was undoubtedly ambitious, analysts suggest that moving away from coal power would remain a formidable task given that coal powers nearly two thirds of China's electricity, that 200 new coal power plants are being planned or built in China, and that 3.5 million workers in the coal-mining and power sector need to be properly resettled (Mallapaty 2020). In May 2021, China's government announced the establishment of an 'emissions peaking and carbon neutrality leading small group' (EPCNLSG), headed by the first Vice Premier Han Zhen. This LSG signalled China's determination to fulfil Xi's pledge. In June 2021, the Ministry of Environment and Ecology urged environmental authorities to tighten their approval of high-energy and high-emissions projects (CarbonBrief 2021b). While these two measures are welcome news, their effectiveness in curbing the strong growth in carbon emissions remains to be seen.

The first two aforementioned points suggest the same conclusion: it is in China's benefit as well as the interests of the rest of the world to maintain its commitments to fight climate change and to move toward a low-carbon economy, even in the wake of COVID-19 economic downturns. Failure to do so would roll back the gains in the previous years enabled by China's bold reduction in carbon intensity and its increase in carbon sinks through forestation. More importantly, China would feel the immediate and immense costs from its inaction or retreat from its climate commitments. The huge floods and Typhoon Bavi in China in 2020 served as a stern reminder of future devastation from extreme weather in China in the business-as-usual scenarios.

Conclusion of analysis: the domestic explanation best explains the Chinese climate policy

As we have seen, starting from a resistant stance during the long first period of 1990–2005, in the following decades China's climate change policy has become progressive and flexible. China has started to heed the harmful effects of climate

change since 2006 and make global commitments to reduce carbon intensity and limit the growth in carbon emissions since 2009. Nevertheless, as detailed above, China's climate policy has experienced ups and downs. It also appeared to backtrack from its climate commitments twice under Xi, most noticeably during 2012–14 and to a lesser extent, during 2020–1.

As the previous analysis suggests and as summarised in Table 1, three sets of variables seem to explain to varying degrees the variation in China's climate change policy. The first variable is the nationalist claim in China's climate policy over the six periods. This claim usually maintains that China has the right to economic development and that China should be free from mandatory international monitoring. This variable seems to correlate well with China's climate policy in the first four periods. To be precise, the third period of 2009–11 among these four periods constitutes an outlier, when the explanatory power of the nationalist explanation seems partial, as China displayed a mixed position. On the one hand, China defended the nationalist position about rights to development and the CBDR principle. On the other hand, it started to make the first international commitments to climate action during 2009–11. The nationalist explanation does not fully explain China's stand and behaviour in the last two periods. During 2015–19, China adopted an international stand and argued for global action on the climate issue. During 2020–1, it maintained this position publicly, even though its domestic economic practice deviated from it.

The second variable is international demand, especially pressure from the developed world, chiefly Western Europe, that China should take decisive action and make a significant contribution to address climate change. This variable is derived from the liberal explanation. This variable seems to correlate with China's policy in four periods, namely, 1990–2005, 2006–8, 2009–11, and 2015–19. In the first period, international demand for China to act on climate change was modest, and the pressure mainly came from the United States which rejected the Kyoto Protocol. Partly thanks to weak international pressure, China could afford to take a resistant attitude in international climate talks. In the other three periods, international pressure on China had been intense, especially in the latter two periods. International pressure compelled China to step up its commitments first to reduce energy intensity during 2006–8, to cut carbon intensity during 2009–11, and to announce its target in 2015 to peak its carbon emissions in 2030. However, international pressure did not work its magic in the two periods, namely 2012–14 and 2020–1, where China seemed to substantially backtrack from its climate commitments.

The third set of variables that seem to correlate well with China's climate stance are those of the domestic political economy, especially the security of China's top leader and his concerns with economic growth. When the leader has not consolidated his power and feels insecure (A), or when he is greatly concerned with an apparent

slowdown in the economic activities (B), China is likely to step back from its commitments to climate action. Type-A cases included Jiang who tried to establish himself as an able post-Deng leader during 1990–7, Hu who tried to consolidate his status as post-Jiang leader during 2003–5, and Xi who tried to consolidate his power during 2012–14 after he took over the reins from Hu. Type-B cases included the period 1990–7 when Jiang needed rapid economic growth to showcase his credentials as the post-Deng leader, the subsequent period of 1998–2001 when China tried to cope with the growth-decelerating effects of the Asian financial crisis, and the most recent period of 2020–1 when China tried to revive an economy hard hit by the COVID-19 pandemic. When the leader has consolidated his power, like Hu during 2006–8 and 2009–11 and Xi during 2015–19, or when high growth erased economic concerns, like Hu during 2006–8, China could take a relatively progressive stance on climate change (Table 1).

Overall, the domestic explanation seems able to account for China's climate policy in all six periods. In contrast, (neo-)realism/nationalism and liberalism could each explain China's climate stance in three out of six periods, and each could partially explain that in an additional period. This study sheds light on the critical factors, especially domestic political and economic considerations that shape China's climate policy, arguably the most consequential policy for the future of our planet. It thus showcases the intellectual appeal of a domestic explanation in helping us to comprehend the environmental and economic policy of a major power such as China. In addition, this study illuminates the strengths and especially limitations of the two mainstream theories (that is, the (neo-)realist/nationalist and liberal theories) in interpreting the climate policy of a major nation. The findings of this study could enhance our understanding of international politics and IPE of climate policy and could expand our intellectual toolkits in approaching climate policy by seriously heeding the domestic explanation. This insight will be indispensable for our intellectual input in combating climate change.

A viable approach toward China in climate change

The findings of this study reveal that in interacting with China regarding climate change it is important to address its domestic political and economic concerns. In the era of COVID-19 two issues seem to have become more salient for China's leaders. The first is to stimulate and sustain economic growth. This point was discussed earlier. The other is China's damaged external relations in the wake of the COVID-19 outbreak. The public and leaders in many nations, especially those in the developed world, widely perceived China's response to the novel coronavirus outbreak at the early stage as secretive and weak and regarded it as a critical cause for the rapid spread of the virus around the globe in the early months (PEW 2020). In addition to the

COVID-19 rampage, international attention and controversies have surfaced in the recent few years regarding China's practice toward political freedom and human rights. As a result, the public impression of China in numerous advanced economies, most of them major trade partners and sources of foreign investment for China, has turned sour. A public opinion survey of seventeen advanced economies in the Asia-Pacific and Western Europe in 2021 suggested that an average 88 per cent of the public viewed China negatively as they believed China did not respect the freedoms of its people. In addition, the majority (about two thirds) of the public in all but one of these economies preferred economic ties with the United States over those with China (PEW 2021). It is no exaggeration that China confronted the most strained ties with numerous nations in recent decades, especially in North America, Western Europe, Oceania, East Asia, South Asia, Eastern Europe, and Latin America. China's fractured political ties with these regions have resulted in China's diplomatic isolation unseen for decades.

To a large extent, China's sluggish economic growth is linked with its strained external ties, especially with its major trade partners. In order of importance, China's major trade partners include East Asia, Western Europe, North America, Southeast Asia, and South Asia. Many of these nations have already taken measures to reduce their reliance on trade, as well as investment and technological linkages with China. The subdued public enthusiasm in economic exchanges with China will only prompt these economies to take further cautionary measures in moving some of their trading or outsourcing activities away from China, thereby hurting China's economic growth.

Wierner (2008) urged enlightened pragmatism and domestic politics in engaging with China over climate action. Indeed, it is in China's political and economic interests to repair its strained external ties. Taking his recommendation for enlightened pragmatism this author proposes the following pragmatic approach of encouraging China to step forward toward climate action. The international community can and should make it clear to China that one of the most vital areas where it can rebuild its strained ties with the aforementioned regions is to take decisive actions in climate change. An improvement in China's ties with these regions will help China to partly regain its international standing which it had enjoyed for years before the COVID-19 outbreak. Furthermore, improved external ties and subsequent unhampered flow of trade and investment will give a strong external impetus to China's economic growth. In particular, China's firm commitment to climate action and the unambiguous demonstration of its actions are critical dimensions in its ties with the developed nations, particularly in Western Europe, East Asia, North America (including the United States in the wake of the presidential election), and Oceania. China's climate commitment is also of high importance for developing nations, many of which would suffer the most from the adverse effects of climate change. It would enable the global community including

China to reduce or even evade impending calamitous events, such as severe heat, droughts, floods, storms, famines, massive and disruptive migration, and conflict. A firm climate commitment would enable China to gradually regain soft power and standing in the developing world. Driving home this point in global talks with China over climate change might trigger a favourable response from China at best, or dissuade China from taking too many regressive steps from its commitments to fight climate change at worst. The international community can and should respond favourably to China when it has heeded this advice and has indeed taken positive steps. While grievances between China and the rest of the world might not be easily brushed aside, both could and should work together on climate change to ensure a bright future for their respective populations and our planet.

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The role of civil society organisations in climate change governance: lessons from Quintana Roo, Mexico

Susan Baker, Bárbara Ayala-Orozco and Eduardo García-Frapolli

Abstract: To examine the role of civil society organisations (CSOs), including non-governmental environmental organisations, in climate governance, a case study approach in the coastal zone of Quintana Roo, Mexico is utilised. Focus groups with key stakeholders, in-depth face-to-face, and online interviews were employed to examine key actor perceptions of climate change risk and their involvement in climate governance, across scale. Participation by CSOs is shaped by a variety of factors, including constitutional arrangements, regulatory regimes, administrative traditions and structures, and a wider set of beliefs about moral responsibility and the exercise of civic duty. CSO participation across multilevel governance scales provides an array of inputs to help address climate vulnerabilities in the coastal zone of Quintana Roo. Especially under conditions of weak administrative capacity and corrupt government, certain enabling institutional conditions are needed. This creates complex contexts in which CSOs emerge, networks develop, alliances are formed, and barriers to effective participation endure.

Keywords: Non-governmental organisations, environmental NGOs, multilevel governance, participation, climate vulnerabilities, coastal zones.

Notes on the authors: see end of the article.

Introduction

A consensus has emerged, in both climate governance regimes and in the scientific literature, that climate change adaptation should involve multiple actors from the public and private sectors and from across civil society (IPCC 2014). This view forms part of a shift from seeing public policy as a modernist, technical, and state-directed activity (Peters & Pierre 1998) to understanding public policy as taking place through complex networks and negotiations, downwards through multilevel governance scales, from the federal, State, and local levels, and outwards to civil society and economic actors. This shift in the making of public policy is expected to result in locally appropriate actions and thus increase policy effectiveness (Rootes *et al*. 2012). This broader participation by non-state actors also has the potential to enhance the democratic legitimacy of environmental governance (Bäckstrand 2006a).

There is growing recognition that both public and private actors are embedded in existing webs of rules, resources, and hierarchies, which shape their actions and policy outcomes (Kooiman 2003). How roles and responsibilities are shared across the public and private spheres, and through the multiple levels of governance, depends not only on administrative traditions (Peters & Pierre 1998), legal regulations, and existing administrative structures, but also on the wider collection of normative settings built on shared assumptions and a deeper level of taken-for-granted beliefs and codes of conduct, structures, and actor relations (Klein & Juhola 2018). Operating within these embedded contexts, power relations, and institutional structures can undermine both the democratic nature of policymaking and the effectiveness of policy by reproducing path-dependent governance processes with business-as-usual outcomes (Newig & Fritsch 2009). Furthermore, changes in governance patterns, which see private organisations play both formal and informal public policy roles, raises the issue of how the public interest is pursued in these circumstances.

There is increased recognition that the governance of climate change is taking a hybrid form, one that combines public and private authority in governance (Baker *et al.* 2020). While the substantive participation of private actors in climate governance has been researched (Bäckstrand 2006b), whether 'hybrid' forms enhance governmentality—that is, the practices through which matters are governed so to improve environmental outcomes—remains limited. Yet, as Purcell reminds us, the political field—as reflected in governance arrangements—is now irreducibly plural (Purcell 2009).

In addition, forms of multi-actor governance are also created through a multitude of civil society coalitions, alliances, and networks, engagements that are often as much about locally focused actions, as they are about directly shaping formal policy (Newell

et al. 2012). However, the focus of the literature has been on institutionalised hybrid authority, through co-management, public–private partnerships, and social–private partnerships (Lemos & Agrawal 2006). In this article, we widen the focus to examine hybrid forms of governance in which a complex array of state-led, regulatory governance operates with self-organised interests to engage in forms of steering that are not necessarily formalised. Furthermore, there is an underlying assumption in the literature that the arena in which the dynamics of hybrid governance plays out lies within the liberal democratic order, within Western, welfare states. Distancing ourselves from the Weberian, state-centric narratives, grounded in the European experiences of state formation (Baker *et al.* 2020), enables the article to examine the experience of hybrid governance in other state contexts. The case of Quintana Roo provides an opportunity to examine governance in the context of a weak state presence, where the system of public administration is only emerging as municipality formation takes place, and in the context of state corruption and lack of transparency.

This article examines the role of civil society organisations (CSOs) in climate governance, focusing on the case of Quintana Roo, Mexico. Mexico has been identified as particularly vulnerable to the impacts of climate change, with the coastal region of the Caribbean Sea, where Quintana Roo is located, seen as most vulnerable to its combined impacts (Rubin & Rossing 2012). These impacts include an increase in the sea surface temperature, a situation that favours the occurrence of more frequent and intense hurricanes (IPCC 2007). Natural ecosystems may be endangered by a changing climate, including the ecologically important Mesoamerican Reef (UNDP 2020). This problem is exacerbated by urbanisation, irregular settlement growth, and heavy deforestation. The State of Quintana Roo is one of the fastest growing sub-regions and the largest tourist destination in Latin America. The continuous expansion of the tourism sector along the coastline and the associated rapid population growth has brought a marked degradation of coastal ecosystems (Pedrozo-Acuña *et al*. 2015). The tourism industry is very sensitive to sea level rises, yet the coral reefs protecting the Mexican Caribbean coastline have degraded because of tourism-related land use changes (Nature Conservancy 2018). The construction of hotels on fragile coastal lands has resulted in increased sediment run-off, to which coral reefs are particularly sensitive, and there has also been extensive deforestation, and loss of mangroves despite their having legal protection under Mexican law. Some of this destruction is illicit and clandestine (Murray 2007). Another major problem affecting the coastal region is untreated sewage outflow into the marine ecosystem, and high levels of water consumption from tourism and population growth. In addition, changes in temperature and precipitation add further pressure to an agricultural system that is experiencing intense drought, but which lacks infrastructure and financial support. Water availability may also be reduced by climate change, and in Quintana Roo water and sewage

service demands cannot currently be met by existing infrastructure and natural water availability. Thus, water is transferred from distant watersheds and untreated sewage is disposed of into the sea. In this context, the rapid population and urban growth occurring in the State, particularly in the coastal zone, further increase vulnerability to climate change (Sosa-Rodriguez 2014). The capacity of the system of public administration in the State to address these climate risks and vulnerabilities is weak, including in terms of financial resources and expertise, and in relation to governance, including policy implementation, where efforts to address climate change have the potential to be seen as disruptive to the current economic development and growth trajectory (Baker *et al.* 2020).

It is within this context that the State of Quintana Roo sees a highly developed and dense network of CSOs operate. This article examines the role of CSOs in climate governance in the State. It begins by examining the literature on the role of CSOs in climate governance, then details the methods used. This is followed by a general discussion on climate vulnerabilities in Mexico and more specifically in the case of Quintana Roo, and how these are being addressed in public policy. Having turned to the case of Quintana Roo, the administrative context is detailed, and findings on the role of CSOs in climate change governance are presented, thematically grouped. The Conclusion draws together the threads of analysis to indicate the significance of the findings for our understanding of the role of CSOs in climate governance. The article puts forward an analysis that combines consideration of institutional setting, on the one hand, and, on the other, the actor-related processes that operate to shape climate governance.

Civil society organisations and climate change governance

CSOs are voluntary associations that explicitly seek to shape the rules that govern different aspects of social life and that are institutionally separate from state actors (Bernauer & Gampfer 2013: 1). Non-governmental organisations (NGOs), and non-profit business-related organisations, such as chambers of commerce or trade associations, are also organisational forms of civil society (Vormedal 2008). Here, we focus on CSO participation, which refers to input from the public into the process of governance of matters that relate to the public sphere (Brooker *et al*. 2019). Indeed, so pervasive has been the shift to participatory practices that governments are increasingly relying on a network of decision-making relationships that link government and civil society across many scales. This new form of governance is in widespread use in natural resource management, including forest and watershed management, conservation, and planning (Lane & Morrison 2006).

Arguments about the importance of civil society participation can be grouped into two broad categories. First, there are instrumental claims, which hold that CSO participation in public governance provides knowledge to enhance problem-solving capacity, which in turn leads to more effective and efficient policy implementation (Baker & Chapin 2018). This role is of particular importance in countries with weak capacity in their systems of public administration. Here the role of CSOs in problem identification, scientific data collection, and policy research can come to the fore. This also facilitates the inclusion of local or tacit knowledge in public policymaking.

A second group of arguments are normative in appeal, based on claims that participation supports democratic values by fostering a more inclusive and deliberative form of public policy decision-making. This in turn can enhance public support for policy and reduce policy conflict. For instance, non-state actors can give voice to under-represented groups, thereby legitimising and validating policy decisions and improving the democratic quality of a polity (Bäckstrand & Kuyper 2017). These normative dimensions are frequently a component of broader discussions on developing community and deepening democracy (Baker & Chapin 2018). Nevertheless, some have questioned the strength of CSO grassroots linkages, especially those that have strong ties to international doners (Banks *et al.* 2015).

Engagement can also promote governance transparency, thus mitigating the risk of governments catering primarily to influential domestic interest groups (Dombrowski 2010). By pushing for monitoring and stakeholder consultation mechanisms, CSOs can also help foster the creation of formal accountability mechanisms in the system of governance, particularly within public administration (for a fuller discussion, see Bernauer & Gampfer 2013). In developing countries, governance gaps tend to be wide, given that systems of public administration have fewer resources to address sustainable development challenges. However, in engaging civil society in gap coverage, specific risks need to be recognised, such as the creation of dependencies and the crowding out of public policies (Chan *et al.* 2019). Although a CSO may have the status of a statutory organisation, which stipulates that they must be consulted on relevant policy developments and may therefore be in receipt of state funding, the fact that CSO interventions are often driven by short-term project-focused funding means that gaps may reappear once interventions are over, making long-term strategic engagement difficult. It is also important not to ignore the possibility that CSOs may use their skills and funding to pressure local governments and further their own policy preferences, which may not always align with local needs (Cook *et al.* 2017). There is increasing recognition among governance scholars that non-government actors are exerting greater levels of influence over governance systems and contributing in novel ways to governance processes, but that in doing so they may be actively pursuing their own policy agendas (Gouldson 2009).

The fair consideration of different interests is particularly important in the face of climate change, given its differential effects on societal groups (Thomas *et al*. 2018). Furthermore, climate change is the typical example of a complex multi-scalar environmental problem, where mitigation and adaptation require a diversity of actors across the state–society divide (Lemos & Agrawal 2006). In the area of climate change, non-state actors are taking an enhanced governance role across international down to local scales (Kuyper *et al*. 2018). CSOs participate with the state as actors in international climate change negotiations (Lane & Morrison 2006, United Nations 1992), being recognised as an essential component of good governance (Banks *et al.* 2015). CSOs also participate as key agents in the implementation, monitoring, and evaluation of climate change policy (Haris *et al*. 2020). However, as climate change has become accepted by policy institutions and by state and non-state actors, in many cases the role of CSOs has shifted from being critical agents that provide bottom-up pressure on the government, demanding problem recognition and policy implementation, to state-partners developing and implementing strategies, threatening their legitimacy (Gough & Shackley 2001).

There is a growing focus in the literature on the interdependence between civil society and the state, and the developing institutional relations that are emerging across governance scales. The state can govern 'through' civil society, but this also reminds us that civil society is constantly translating, interpreting, and resisting government policy. Such considerations call us to move beyond the simple binary of the powerful (but clumsy) state pitted against powerless (but flexible and innovative) civil society (Lane & Morrison 2006). This suggests that, although CSOs are becoming important actors in shaping and framing climate change problems and solutions (Davidson & de Loe 2016, Newell *et al*. 2012), their role and significance may be more complex than this. In short, CSOs need to be examined to ascertain if they have generated agency, gained access, are exercising authority and whether this is resulting in the alteration of climate change risks.

Yet, amidst these claims it is also important to recognise that the social and political history and context of individual polities are largely responsible for shaping institutional arrangements. These dimensions have deep historical roots (Putnam 2000). Thus, whether a society relies upon on market, non-profit, or state provision for social and other key services and the provision of public goods is heavily constrained by historical development and evolving societal patterns (Lane & Morrison 2006). Indeed, institutional analysis has suggested that the size of civil society varies according to the level of government expenditure, and according to the disposition of the state to either cooperate with or control civil society (Lane & Morrison 2006). This recognition calls for context-specific research. Chan *et al.* (2019) warn that, when studying the novelty of observed phenomena, the stubbornness of old practices can

easily be underestimated. It is therefore vital to study not only the increasing number of non-state actions but also how consequential they are, whether they substitute unsustainable activities, and whether their scope is broad enough to generate systemic change (Chan *et al*. 2019). Specific knowledge will also be key to critically appraising geographically imbalanced outcomes of non-state actions. The case of Quintana Roo provides an opportunity to examine the role of CSOs in climate governance in a context of high coastal vulnerability and weak state presence. It also presents a case where a thick network of CSOs has emerged.

Methods

To explore the role of CSOs in climate change governance in the state of Quintana Roo, Mexico, a case study approach was employed (Gerring 2007). Qualitative fieldwork involved stakeholder focus groups, in-depth face-to-face and online interviews, direct observation, and document analysis to examine key actor perceptions, attitudes, and interests. The study took place along the coastal corridor of the State of Quintana Roo (Figure 1) throughout 2017–18.

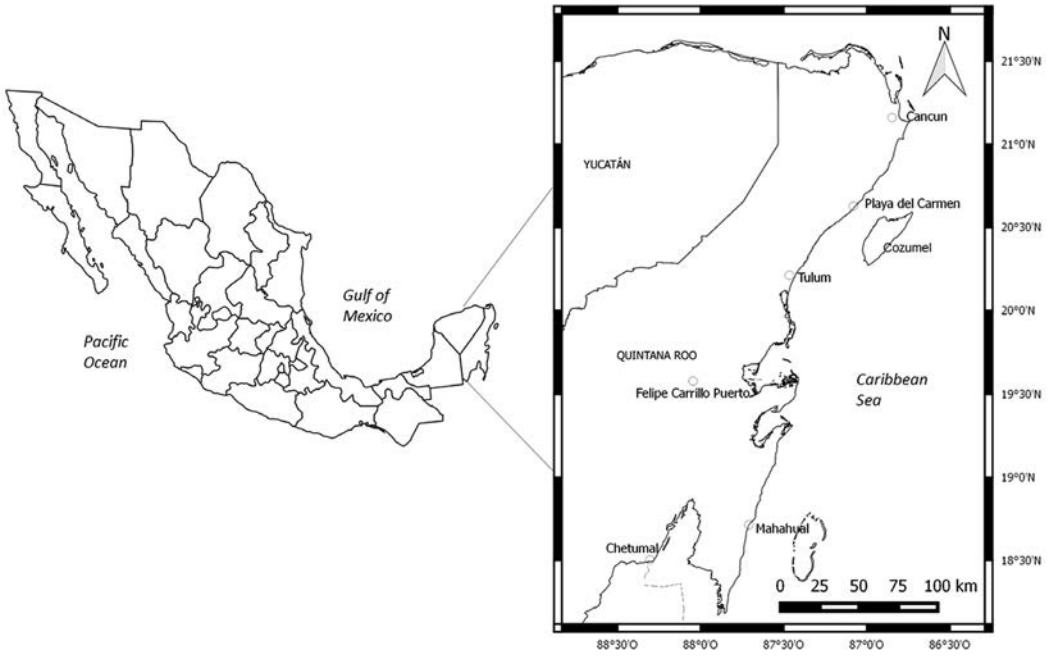

Figure 1. Map of Quintana Roo showing the location of the study sites.

In addition, during 2020 a series of online interviews with key actors from CSOs were held. At the beginning of the study, the authors received ethical approval from their respective universities. Four stakeholder focus groups were held in Tulum, attended by twenty-four participants in all; and one was held in Bacalar, attended by seven participants. The focus groups were held in March 2017 and drew representatives from local and regional government, research institutions, representatives from the water, forestry, and ecotourism sectors, and from CSOs. In May 2017, three semi-structured interviews were conducted in Cancún and Playa del Carmen with key environmental organisations operating in the region. In July 2020, ten online semi-structured interviews with key CSOs were conducted using the video conferencing application *Meet by Google*. Interviews explored the different organisations' actions, motivations, role in public policy formulation, implementation, and monitoring. All the interviews were recorded and transcribed with the consent of participants. Transcripts were analysed through Atlas.ti 8 for Windows (Scientific Software Development GmbH), using the qualitative content analysis method (Schreier 2012) based on a deductive coding strategy (Mayring 2020, Hsieh & Shannon 2005). These interviews were conducted in Spanish and subsequently translated by the authors. In addition, documents from CSO web pages provided background information, together with direct observations, for the internal validity of results through data triangulation. The research was also informed by the scientific literature.

Governance of climate change in Mexico

Mexico joined the UN Framework Convention on Climate Change (UNFCCC) in 1992. However, during the 1990s, addressing climate change was not given priority by the Mexican government. It was not until 2005 that Mexico established the Intersecretarial Commission on Climate Change (CICC, Spanish acronym), tasked with mainstreaming climate change in economic development policy. Hosting the 16th Conference of the Parties (CoP16) of the UNFCC in Cancún in 2010 had a significant effect. Mexico is widely credited with helping to rescue faltering international efforts at the time to address climate change, although the lack of corresponding action addressing climate change domestically was noted.

A national climate change law, *The General Law on Climate Change* (LGCC, Spanish acronym), was passed in 2012.[1] The LGCC was the first of its type for low- and middle-income countries and one of the most comprehensive in the world at that

[1] Gaceta Parlamentaria, año XV, número 3489-IV, jueves 12 de abril de 2012, available online at: http://gaceta.diputados.gob.mx/Gaceta/61/2012/abr/20120412-IV.html#DictamenaD1

time, setting high targets for mitigation and aiming to coordinate the work of federal, State, and municipal governments and the actions of civil society and the private sector (INECC 2019). The LGCC contains many provisions relating to mitigation, including a mandate to reduce emissions of carbon dioxide by 50% below 2000 levels by 2050. Furthermore, it stipulates that 35% of the country's electricity should come from renewable sources by 2024 and requires mandatory emissions reporting by the country's largest polluters. Mexico became the first developing country to present its unilateral commitments to greenhouse gas emissions, even though it was not obligated to reduce its emissions under international agreements.

Mexico has created an appropriate regulatory and institutional framework for developing regional and local climate change adaptation plans. Several local adaptation programmes have also been initiated nationwide (Sosa-Rodriguez 2014). However, administrative traditions have not proved conducive to the emergence of governance approaches that can effectively address the problems of climate change. Plans to address climate change through enhancing relationships between the state, market, and civil society have faltered, despite the central role that this relationship plays in the government's strategic planning.

Despite regulatory, institutional, and planning responses, climate change policy in Mexico is restricted by the premise that implementation should not impose a burden on national economic growth and that the country's competitiveness in international markets should not be hampered (Gobierno de la República 2013). There are also considerable path dependencies that hinder transition, particularly in the energy sector where monopolies, perverse subsidies, and inefficiency in energy use act to disincentivise the transition to clean energy (Ibarrarán Viniegra *et al*. 2011, Sosa-Núñez 2015). In fact, a recent energy law passed in May 2020 priorities the use of fossil fuel power plants at the expense of renewable energies and puts Mexico on a path that is even more inconsistent with the steps needed to achieve the Paris Agreement's 1.5°C limit (Climate Action Tracker 2020). The failure to act effectively to ensure forest conservation has also hampered efforts to address climate change (Rantala *et al*. 2014).

Policy weaknesses are also noticeable, including in the climate strategies, which lack concrete lines of action and instruments or mechanisms to carry out the proposed objectives (Ibarrarán Viniegra *et al*. 2011, von Lüpke & Well 2020). It has also been argued that, like most countries in the region, while Mexico has produced national climate action plans and at least one emissions inventory, these instruments have been used exclusively for reporting purposes, and have not been translated into specific planning or monitoring actions (EuropeAid 2009). Thus, it is not surprising to find that, from 1990 to 2017, emissions in Mexico saw an increase of 64.7 per cent, with an annual growth rate of 3.2 per cent resulting from higher energy use (Climate Action Tracker 2020).

Governance of climate change in Quintana Roo

Quintana Roo is one of the three States participating in the Yucatan Peninsula regional climate change initiative. In 2016, the States of Campeche, Yucatan, and Quintana Roo signed the Sustainability Agreement for the Yucatan Peninsula, which has specific activities and goals for climate change mitigation and adaptation (IIED 2019). Actions are also supported at the State level, as addressing climate change is, in part, a devolved competence within Mexico's federal structure. In Mexico, States oversee the elaboration and implementation of regional development plans, drafting policies on the use of natural resources, implementing ecological controls, and managing State natural protected areas (NPAs). The State legislature can create its own laws on environment, urban development, and civil protection, but they align with federal legislation.

In 2013, work started in Quintana Roo on the formulation of a State climate change law, *Ley de Acción de Cambio Climático del Estado de Quintana Roo*, which requires a State action plan (PEACCQROO), and created a Climate Change State Commission.[2] The State Development Plan 2011–2016 focused on the need to identify climate change vulnerabilities and formulate adaptation measures. It also highlighted the value of adopting a regional focus, covering the Yucatan Peninsula, and the importance of involving all sectors and stakeholders.[3] The current *State Development Plan 2016–2022* begins to address the need for economic diversification, and how to promote more ordered growth in keeping with environmental sustainability (UN Environment 2017).

Like Mexico, Quintana Roo has weak governance structures and limited implementation capacity. This weakness constitutes one of the main challenges for addressing climate change and implementing the many policies that have been formulated (Fosci 2013). While Constitutional reform in 1999 gave municipalities greater autonomy, the State remains unable to implement significant actions without federal support, which is not always forthcoming (Rantala *et al*. 2014). States and municipalities remain highly dependent on federal transfers. In addition, responsibility is highly fragmented, with the federal government having control over marine areas and a narrow strip of coastal land, while the State in Quintana Roo holds control over land more than twenty metres from the sea and is the principal actor in developing and enforcing ecological land-use plans. Furthermore, the State controls the municipal tax rates and must approve all municipal development plans. This means that lower levels of government can easily be controlled by actors operating at higher levels.

[2] http://www.opb.gov.mx/ opb2011/

[3] http://www.qroo.gob.mx/ qroo/planquintanaroo/

While an effective climate change strategy involves coordination with most departments, sectors, and across multilevel governance scales, the structure of governance in Mexico acts against this coordination. Local governments often lack decision-making powers over key policy issues relevant to addressing climate change, such as transportation, energy, and infrastructure. In addition, departments in charge of climate change often have limited budgets and lack political influence within the government structure (Satterthwaite & Dodman 2009). Corruption within the system of public administration in Mexico, across all levels, also risks illegal division and sale of land, and bribery in planning.

Weaknesses in the State and in governance in Quintana Roo provide both the need for and the opportunity for CSO engagement. Recent years have seen the thickening of civil society in the State, and the number of NGOs and business interest associations has grown dramatically (Baker *et al*. 2020). Furthermore, a small, but growing, local entrepreneurial class has emerged, and the State also boasts several academic institutions, including the University of Quintana Roo and El Colegio de la Frontera Sur (ECOSUR) in Chetumal. The State also has experience of utilising participatory planning processes, given that, for example, river basin councils, and the development plans all involved participation as a federal prerequisite. In addition to the participatory processes developed locally, there are close personal relationships that encourage cooperation between different government sectors and with civil society and the private sector.

The role of civil society organisations in climate change governance in Quintana Roo

According to different databases provided by CSOs, in Quintana Roo there are approximately fifty organisations working on different aspects of conservation, environmental management, and governance. The diversity of organisations is wide, from small ones working on very local issues, to large international NGOs such as The Nature Conservancy. Without covering all the areas in which these CSOs work, these organisations carry out activities on issues of conservation, natural resource management, development, fisheries, forestry, tourism, and education and outreach, in diverse ecosystems such as marine, coastal, terrestrial, aquifer, among others.

Working on climate change

According to the interviews conducted, while many CSOs do not deal directly with the implementation of climate change adaptation or mitigation actions, most groups

address climate change, '*in a more tangential way*' (Interviewee IC). A few CSOs mentioned that climate change is one of their main lines of action, although all acknowledged that they directly or indirectly work with climate change because of the high vulnerability of the region. One highly organised group, with a long-standing engagement in the State, admits: '*on climate change, this project that we submitted … would be our first*' (Interviewee IC). However, there are specific international groups operating in the State that address climate change as a core part of their operations:

> [We have] *a very defined strategy for confronting climate change. In the case of Mexico and the Mexican Caribbean in particular, we are working with coastal resilience, how to build the resilience of communities, both human communities and biological communities.* (Interviewee ID)

For instance, for several years this particular ENGO (environmental NGO) has been implementing a programme called Coastal Resilience that promotes the restoration and conservation of natural coastal systems, such as dunes, mangroves, and reefs, to protect against the impacts of climate change. Another CSO is directly taking action to address climate change issues through the eradication of invasive species on islands, such as Cozumel, with the intention of subsequently restoring these ecosystems and thus mitigating the effects of climate change. Another CSO promotes regulatory responses and, acting in collaboration with the Interamerican Association for Environmental Defence (AIDA), was able to enhance the legal protection provided for the Yum Balam Protected Area in Quintana Roo by filing an *amicus curiae* brief before the Supreme Court of Justice. The coastal ecosystems that make up the Yum Balam Protected Area, in addition to their environmental value, also have an important role in addressing climate change. In addition, some of the organisations interviewed have been extensively involved in designing and constructing policy for reducing emissions from deforestation and forest degradation (REDD+), plus the enhancement of carbon stocks at national and subnational levels. REDD+ plays a role within global efforts to mitigate climate change from the forestry sector, as it seeks to slow down, stop, and reverse the loss of forest cover and increase in carbon emissions.

Recognition of the problem of climate change for the coastal community is growing, with one group acknowledging that '*in Cozumel it is already very dramatic because there are already many people, there are already more than eighty thousand people living at sea level*' (Interviewee IE). Similarly, another group demonstrates its knowledge of the cascading vulnerabilities of the Yucatan, with climate change expected to bring:

> *Changes in rainfall, if there is no rainfall, then you are going to have an aquifer with saline intrusion; if there is more rainfall you are going to have flooding as just happened with Cristobal* [a recent tropical storm that hit the area in June 2020]*; if you have a rise*

> *in sea level, erosion of beaches, and that has an impact on tourist infrastructure, which in the case of Quintana Roo is the main economic sector—but on the other hand climate change is also affecting the mangroves which are the fish nurseries and this is also affecting fishing. In short, there are a series of conditions which show you that the Yucatan Peninsula is vulnerable. … Right now, we are working on a proposal to implement adaptation actions based on ecosystems or natural solutions, precisely to address these vulnerabilities in terrestrial, coastal, and marine ecosystems.* (Interviewee IJ)

The coastal zone is seen as particularly vulnerable to climate change because of the ecological destruction that has accompanied the area's rapid ad hoc development, that lacks strategic and integrated planning, and which has reduced the capacity of the system to absorb climate change shocks:

> *We continue to build in the coastal zone with bad practices, we continue to deteriorate the natural protection that we already have—mangroves, dunes, and reefs—and then the storms come stronger and stronger … climate change increases the degradation of the systems that is already happening and increases the impact and flooding …* (Interviewee ID)

Similarly, another group stresses that:

> *You can't separate climate change here from the impact of tourism; the biggest risk for the whole area is bad tourist development. I can mention hotel areas where there are no drains, and the hotels continue to discharge their …* [waste] *waters to the sea*. (Interviewee IF)

This link between coastal development and climate vulnerability makes addressing climate change more complex, because it means that the task also has to address systemic matters. This is acknowledged by several groups, and is clearly reflected in the statement '*in reality adaptation to climate change is something that has to be transversal to all activities, all sectors particularly our regions*' (Interviewee IA). At the same time, the fact that the main form of economic development, tourism, is acutely dependent upon the maintenance of critical ecosystem services in the region, in turn creates opportunities for action, a matter that we return to below.

The fact that the coastal area is highly vulnerable to climate change also means that groups working on different aspects of coastal management are indirectly dealing with climate change matters:

> *… in the Riviera Maya, precisely Akumal, is one of the sites of greatest erosion on the coast of Quintana Roo … and I imagine that this affects, or is reflected in, the different scenarios of climate change, above all in the rise in sea level. … Akumal has a very narrow strip of beach, so all the hotel infrastructure, condominiums, and homes are subject to the direct interaction of waves, storm surges, swells, normal coastal changes or processes, loss and gain of sediments, and ultimately climate change.* (Interviewee IH)

Indeed, there is a sense in which the issue of climate change, although only dealt with indirectly in projects or activities to date, is in fact a core, underlying, challenge to which all their work is addressed. For example, a group, working on cultural heritage, tell us that their work in fact forms part of climate change mitigation actions, even if it is not directly specified in this way:

> *We work from the local and regional social fabric, and we approach and connect from that voice, so we have a presence in reflections on climate change ...* [as] *… we are generating from the appropriation or re-appropriation of the cultural and natural value of heritage, the possibility of sustainability of rural communities … of transformation towards sustainable practices, conservation agriculture and … safeguards for self-consumption of mainly native maize seeds.* (Interviewee IG)

Nevertheless, the same group expresses concern that directly focusing attention on climate change may risk taking actions too far away from community needs:

> *... we avoid addressing large complex concepts that generate a nebula in … the attention to needs* [within] *communities. ... So, we work directly with climate change mitigation strategies; however, we are very transparent in evolving our language from the language of the communities themselves.* (Interviewee IG)

Groups also pointed out that there are different ways to deal with the problem of climate change, over and above addressing it in a substantive manner, either directly or indirectly. It is also about giving voice to people and enhancing their capacity to act in the face of climate threats. One development organisation plainly states that '*we know that participatory and collaborative models are indispensable for the sustainability of transformations*' (Interviewee IG). This is more so given concerns about the slow or even absent pace of government response, even if the manifestations of climate change are visible as urgent.

Activities undertaken

Data gathering is a typical activity of a CSO, designed to support policymaking directly, but also indirectly by underpinning arguments in support of more government regulation and involvement. Several of the CSOs are engaged in monitoring and data collection, which they share directly with public authorities, playing an important role in capacity building and knowledge sharing in relation to the emergence of risks and impacts generated by climate change. For example, one group explains their motivation is to '*… contribute with information that influences decision-making*' (Interviewee IH). Another example is provided by an ENGO:

> [We] *made a projection of how the hurricanes are going to change over the next hundred years. It is a very complex and complete study and we arrived not only at the physical assessment of how much the flooding and the swell in the reefs are reduced, but also at the economic value.* (Interviewee ID)

Many of those working for CSOs come from a natural science background, and scientific data gathering and sharing lend them authority in the governance system. One group explained that '[We are] *an NGO or CSO that publishes a lot because we are based on science, we have more than 130* [scientific] *articles*' (Interviewee II). Another group, directly working on the impact of the rise in sea level arising from climate change, explains:

> *We made the diagnoses, we have a group of mathematicians within the organisation, compact and very good at modelling … so, just as they are involved in data management for conservation, we are also involved in the issue of sea level rise modelling in the Caribbean.* (Interviewee IE)

Many times, this scientific work is carried out in collaboration with academia, including Mexican universities as well universities from abroad. Another group explains that their role '… *is to provide data, we generate hard data, scientific data, we have databases available, our philosophy is free access to information …*' (Interviewee IA). Knowledge sharing and allowing free access to data are partly driven by the recognition that federal agencies, although they have the mandate to undertake inspections and monitoring, lack sufficient funds and capacity to undertake these tasks:

> *The State institutions that deal with environmental problems are completely weakened, they have neither financial nor human capacities to be able to operate, all of them, that is, our environmental apparatus is fatal, in a very bad state.* (Interviewee IJ)

Furthermore, in recent years, the position of these agencies has deteriorated even further, particularly under federal government austerity programmes '*They're overstretched, they're taking more and more of their budget*' (Interviewee IB), and as detailed in one interview:

> *Bearing in mind the federal level, for instance, the Minister for the Environment has had a cut on their budget for almost 40 per cent for the last three years, so it means that they have less people to hire and they have less expertise. … So, it means that* [while] *they need to request the technical opinions according to law … they don't have money to hire the expertise for reviewing the statement.* (Interviewee IL)

Nature protection is particularly hard hit, '*I work directly with CONANP* [Comisión Nacional de Áreas Naturales Protegidas]*, which is without resources even to be able to do control and surveillance*' (Interviewee IJ). In this context, organisations also help to strengthen the capacity of State institutions and support federal authorities fulfil their monitoring obligations:

> *We have contributed to establishing some monitoring schemes for the aquifer, in this specific case we have two studies in Tulum, we were able to acquire a parametric probe, which we use to see water quality.* (Interviewee IH)

As well as support for implementation and monitoring, groups also work to support new policy developments. One group is working on an action programme for endangered species, and many of the organisations work to bring better regulation of environmental issues. The use of scientific data as leverage for regulation is notable. Groups also believe that, through their scientific data gathering and monitoring of information, they have built up good relationships with federal authorities. Thus, the scientific work conducted by a CSO not only lends legitimacy to their engagement in governance but can also give them a seat at the policy table.

Civil society organisation engagement across governance scales

Community involvement

Several of the CSOs interviewed have developed strong ties at local, community, level. These ties can form through engagement in educational activities, which includes a component of awareness raising, which in turn forms part of a wider agenda of civil society development. A developed civil society goes hand in hand with the capacity to participate in public policy decision-making, thereby allowing a community to have a say in decision-making that shapes their lives. One group is particularly clear about this role, saying '*We are a civil society organisation—our mission is to promote the participation of all stakeholders to achieve sustainable or sustained marine conservation and fisheries*' (Interviewee II).

This is more than just an interest in supporting participation through bringing together stakeholders on an ad hoc basis. Democratisation of governance, especially through access to information, is also a major motivating factor. One CSO, for example, argued that one of their objectives in starting a local Smart Water project was to address the '*issue of governance and democratisation of information, that as a citizen you can know what quality of water is coming to you when you open the tap*' (Interviewee IC).

For some groups, the democratisation of governance is grounded on a moral commitment to promote environmental justice. This is reflected in their desire to give voice to the marginalised and those who are not normally considered in public policy-making. This work brings CSOs directly into the public policy arena and into the orbit of public authorities and public administrators, across multiple levels of governance.

Institutionalisation of engagement across multilevel governance

All CSO organisations we interviewed had built up a range of relationships with public authorities, across multilevel governance structures, operating from the federation, to the State, and down to the local, municipal, levels. Relationships range from having informal contacts, often at a personal level, through to membership of official bodies and boards. However, organisations differed in their opinion as to why they thought that this engagement was necessary, some seeing themselves as undertaking work that ought, in an ideal case, to be undertaken by the State, and others seeing their role as bringing additional, often instrumental value to policymaking and implementation, such as through providing information, policy options, and scientific data.

Speaking about nature protection, one group believes that '*CONANP should be totally responsible for everything we are doing*' (Interviewee IB), and similarly another holds that '*we are covering gaps that should probably be covered by the government, but we are in difficult situations and that is why*' (Interviewee IA). A similar sentiment was expressed by another group: '*So I think that there are things that the NGOs end up doing that the government should do mor*e' (Interviewee IC). Some see themselves as co-engaged, through a sense of shared responsibility with the legally designated authorities:

> *Well, I am convinced … that we cannot do all the work alone. I am convinced that the work of conservation and the use of resources must be multi-sectoral; it is a collaborative process where all sectors must do their part …* (Interviewee IJ)

Others see that their role, rather than accompanying the state in the fulfilment of their legal obligations, or filling in for an absent state, is to act as a catalyst and a facilitator, bringing together private and public interests to galvanise action. A recurring theme is that CSOs act as the generators and managers of strategic alliances:

> *One of our most important components is the creation of strategic alliances. ... Flowing with different actors, we are facilitators of networks, of alliances, of bringing actors together and facilitating those processes.* (Interviewee IJ)

CSOs are also seen as having a critical role to play in giving voice to different viewpoints, with a bearing on policymaking, an argument often made in the literature, as discussed above:

> *I think that there are things that the NGOs end up doing that the government should do more, but there are others that the government should not do, because in the end we are an independent viewpoint and another sector of society, so we will always have a niche for participation and opinion … so I think there is a role that can never be replaced by, the role that civil society organisations play.* (Interviewee IC)

Links with federal government proved strong: in particular, those forged with federal authorities charged with the management of environmental affairs, including water. One group provided an example of a typical portfolio of relationships held by a CSO:

> *We have a collaboration, at the federal level—it is a lot with CONANP … also with … SEGOB* [Secretaría de Gobernación]*, with SECTUR* [Secretaría de Turismo]*, with FONDEN* [Fondo de Desastres Naturales]*, SEMARNAT* [Secretaría de Medio Ambiente y Recursos Naturales]. *Then at the State level we also work very closely with the environmental sector of Quintana Roo, both at the level of the Secretary of the Environment and at the level of the technicians, both on climate change … we have a collaboration agreement signed with them, and now also with SEDETUR* [Secretariat of Tourism of Quintana Roo]. *At the municipal level … the response has not been very good and then … they change every three years—at the municipality, if there is a need, we inform, but we do not seek that relationship*. (Interviewee ID)

Whether an organisation works at federal level or below is thus shaped by how the division of competences across Mexico's multilevel constitutional structure is organised:

> *We only work with federal authorities, we work at sea all the time, so we only have to deal with Marina, CONAPESCA* [Comisión Nacional de Acuacultura y Pesca] *and CONANP, who would be responsible for doing what we are doing* (Interviewee IB)

In contrast, other organisations explain that they predominately work at State level, and this ranges across involvement in State councils and advisory boards. For example, an organisation is on the social development commission of the State government, where it has built up '*a fluid, transparent relationship*' (Interviewee IG). Another group explains it simply when it says '*We are on practically all the advisory boards that deal with island territories*' (Interviewee IE). However, some groups found that the State level was difficult to penetrate. One group explains that the formality involved, and the requirement for official invitations, inhibit participation and cooperation. In contrast, the local, community level is seen as more accessible (Interviewee II).

Groups also work at the municipal level, although this can mean their engagement overlaps across governance scales. Development of strong links with the municipal level of government is made both necessary and possible by virtue of the weak capacity of local government:

> *We always operate in coordination, or at least on the basis of a very informed intervention, at the municipal level—where we understand that there is a lack of training throughout the structure of municipal governments and they are very weak, that is, they are very weak at the budgetary level, but also at the level of capacities for management and governance, they have very few tools, they still manage a lot because of political patronage.* (Interviewee IG)

Groups also found that personal relationships are critical, particular at the local level. Connections with environmental policy champions were particularly important in driving policy forwards. However, groups are keenly aware that such champions operate in a wider political context, which may restrict their capacity to act. Here, it is clear that the political opportunity structure does impact upon the capacity of environmental champions to act. At a more general level, groups can also express frustration, especially about the slow pace of change:

> *I work with CONANP, with CONAPESCA, with INAPESCA* [Instituto Nacional de Pesca y Acuacultura]—*nothing has changed, they don't solve anything quickly. … I was talking to people from INAPESCA, he says, 'it's that there's no money', well, it's the same thing I've heard for thirty years, they never have money, never, why should this time be any different.* (Interviewee II)

Thus, despite the extent of relationships, judged by range and numbers, that have built up between CSOs and public authorities, there is also scepticism about this engagement. A representative from one group describes that, while they participate in some public bodies, especially advisory councils, and technical and consultative councils:

> *You can see that there is an infinite number of councils … 'this is a time taker'. … We have had terrible experiences … we have no memory, we say the same thing over and over again, we sell the same biscuit … the government never has a solution.* (Interviewee II)

Another interviewee expresses frustration about the government's planning efforts due to lack of real action:

> *I think that we should stop making plans, that is to say, we should stop making workshops and plans, and we need more will, but clearly from the private sector, and if it's not voluntary will, there should be more enforcement.* (Interviewee IA)

Instead, the organisation expressed a strong preference for avoiding this form of engagement, choosing to work '*in small local committees*' (Interviewee II). Here, they can see a real option for change.

Risks of engagement

Engagement is also not without risk, especially when groups face intimidation and harassment. Mobilisation of civil society, with its focus on collective action for the common good, brings groups into conflict with prevailing powers in Mexico. The main reason, according to virtually all interviewees, is corruption:

> *In the States, and then in the municipalities, it's very complicated, really the level of corruption, I believe that this is the central issue in Mexico—again in the example of Tulum, we feel frustration and sadness and anger to see the people who work in the municipality, their interests, the corruption, it is a very, very strong issue.* (Interviewee IC)

Corruption directly affects the capacity of groups to address the particular vulnerabilities of the region in the face of climate change, given that addressing coastal risks is central to climate change adaptation and mitigation and given the reductions in natural defences caused by tourism development:

> *There is a lot of corruption, corruption in the region is very serious, it's very important in the sense that it has a lot of power, we are facing very big powers, right now there is a construction site of a hotel that was built in a turtle nesting area, in the dune, in the mangrove and it has an order from a judge to stop the activities, the activities were not stopped, they continue … if we continue to destroy the reef, the dune, the mangrove and everything, can we have plans to adapt to climate change?* (Interviewee IA)

Part of a CSO's effort, therefore, is to work to counteract the impact of this corruption on environmental governance, and more generally to promote order in public life. Here CSOs see themselves as playing a vital role in ensuring that policy is made in the best interests of society and the environment, and that CSOs act as a countervailing force in the face of bribery. In this fraught context, establishing horizontal relationships, within and between CSOs becomes important for building networks of support and solidarity:

> *We have very good relations with important organisations and actors or individuals who have also done environmentalist work for many years … we have joined in and supported, so to speak, demonstrations in the media, as well as legal proceedings, denunciations, all that sort of things that could help … we participate with a consortium of more than sixty organisations in the Mesoamerican Reef System.* (Interviewee IH)

This view is not least because groups see their role as one of supporting the growth of civil society and the democratisation of the public sphere. NGOs are also well linked internationally, a link that puts them at a distinctive advantage when it comes to leveraging funds in support for activities, especially targeted projects at the local level. However, donor dependency can bring risks, especially in relation to donor-driven agenda setting. Speaking about '*the dark side of the environmental movement*', one group explains their concerns about becoming:

> *… very dominated by foreign agendas, that's very worrying and one lives it … what they call it in English 'donor driven': I'm going to give you a fund, but you're going to dance to my tambourine*. (Interviewee IE)

But groups also face other donor-related difficulties, including that donors often only provide support at project level, funding that is frequently short term. Funding can sometime be of a more local origin, with groups working directly with local economic actors in support of local activities. The hotel sector was pointed to by many groups as both a critical source of environmental problems and as a funder of remedial action, as one group describes:

> *You have a very large potential in the Yucatan Peninsula, big businessmen, the hotel sector, which could be putting in resources that go directly to the field. … We are creating a regional fund for the Yucatan Peninsula, to be able to converge with these investments or to align public and private investments.* (Interviewee IJ)

Donor dependency poses fewer risks when organisations work with local actors. As mentioned earlier, climate change presents a direct threat to the coastal tourism industry and thus the interests of CSOs and the tourism industry are closely aligned. As a result, collaboration on coastal protection measures with private economic interests is growing. For example, one group mentions:

> *We already know how to do it* [but the question is] *who pays for it, right—well let's go to the hoteliers that are interested … in protecting their beaches from coastal erosion, which is the new phenomenon of loss … well, you contribute locally, right? the hoteliers or tour operators put in boats, the other hotelier puts in petrol …* (Interviewee ID)

One group provides another rationale for this collaboration between CSOs and economic actors:

> [there is a] *tendency to seek to make the state … responsible for a certain guarantee of rights … today of the one hundred largest economies in the world fifty are companies, then, obviously the distribution of decision-making to shape or polish, to give shape to society, is not necessarily in the hands of states or the configuration of inter-state cooperation instances, but it also has to do with other sectors of society that are having a lot of power.* (Interviewee IG)

This turns our attention to the need to draw out the significance of these findings for our understanding of the role of CSO in climate governance.

Conclusion: the role of CSOs in climate governance

Quintana Roo in Mexico presents a case where CSOs actively engage, both formally and informally, with public authorities to address climate vulnerabilities. While not all groups deal with climate change directly, recognition of the pervasive and encompassing nature of the climate challenge means that attention also has to be paid to those

organisations that deal with other, related, issues, such as environmental and development issues, including specific species and habitats. This wider view gives a better picture of the role of CSOs in climate governance.

In the case of Quintana Roo, CSOs were found to provide scientific and technical expertise to underpin implementation and monitoring of existing policy, but also acted as advocates of new legislation, particularly for protected areas. In this sense, CSOs play a complementary or supplemental rather than substitutive role, where government still functions as a regulatory actor—and indeed are expected and encouraged to do so by CSOs. Furthermore, CSOs were also shown to act as boundary organisations, serving on the interface between communities of experts and public policy decision-makers (Cash *et al.* 2003). More specifically, they have functioned as epistemic communities, forming critical bridges that serve as conduits for information flow (Haas 1992). Over time, CSOs have built solid and trusting relationships with local communities, with governmental agencies, and with federal, State, and municipal governments, playing an essential role in the capacity building of an array of key actors. In part, this acceptance has been based on the value of the contribution that CSOs have made, often to specific issues, and in support of the public management of climate vulnerabilities. Their engagement has also lent input legitimacy to government processes, while, in turn, strengthening the credibility of CSOs as legitimate actors operating within the climate governance system. This participation is in part driven by the failure of central government to ensure that the constitutional arrangements that give power and responsibility downwards in the system of multilevel governance to State and municipal actors is matched by the provision of corresponding resources to enable them to exercise their duties. In this context, CSOs have had to fill in for an absent state (either federal or devolved), helping to close the 'capacity gap', which is particularly evident as one moves down the system of multilevel governance, a gap that prevents tiers of governments from effective management of climate change (Cook *et al.* 2017).

The research also revealed that structures do affect what CSOs can achieve. Especially under conditions of weak administrative capacity and corrupt government, certain enabling institutional conditions are needed, such as a willingness on the part of authorities to open up their administrative systems to participatory processes, the existence of actor networks, the establishment of personal links and contacts, and the presence of environmental policy champions. Globally, it is not uncommon for CSOs to have to work under conditions of state corruption and to be hampered by lack of access to sufficient resources. By examining how CSOs operate under these conditions, this article contributes to a deeper understanding of the enabling factors that promote successful CSO engagement.

Yet, in the context of government corruption and the lack of transparency and accountability in the management of public affairs, CSOs remain wary of getting too close to government. Furthermore, there are considerable ideological barriers to the involvement of CSOs in climate governance, especially when the model of economic development that is promoted both creates climate vulnerabilities and coalesces vested interests around its continued expansion. The coastal zone of Quintana Roo is particularly vulnerable to climate change because of the ecological destruction that has accompanied the area's rapid development, which has reduced the capacity of the ecological system to absorb climate change shock. The direct link between coastal development and climate vulnerability makes addressing climate change more complex, because it brings attention to the need for a new economic approach. At the same time, it also sees the emergence of business interest associations seeking to address climate vulnerabilities caused by tourism development and act to support the natural resource base upon which tourism, and their livelihoods, depend. This creates complex contexts in which CSOs emerge, networks develop, alliances are formed, and barriers to effective engagement begin to erode. The collaboration forged between actors operating across civil society and the business sector has enabled the formation of a buffer against climate change and supported actions in pursuit of more sustainable futures.

We have used 'hybrid governance' as a conceptual lens in this article to explore climate governance. This has enabled us to examine the dynamics involved in, and consequences of, private actor mobilisation in collaboration with state agency. While the literature on hybrid governance has been largely restricted to a focus on hybrid arrangements that involve formal partnerships, this article has paid attention to informal relationships, which emerge at local scale through practice. This shift of focus to governance arrangements existing outside of formal institutionalisation has revealed new insights into the capacity of the system to respond to climate change. Whether or not the process of what Purcell (2009) calls the 'welding together' of disparate interests improves governmentality remains in question. Hybrid formations do improve outcomes, as demonstrated in this article. Yet, as Purcell remind us, 'the idea that economic growth trumps other concerns remains the dominant common sense' (2009: 315) even in the face of the evident threat of climate change. Whether CSO actions can become a dominant, counterbalancing force is, as yet, undetermined.

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