



Policy priorities to enable engaged and transformational adaptation on the coast: Learning from practitioner experiences in England

Sien van der Plank

School of Geography and Environmental Science, University of Southampton, Southampton SO17 1BJ, UK

ARTICLE INFO

Keywords:

Transformational adaptation
Climate change
Coastal management
Local stakeholder participation
England

ABSTRACT

Coastal communities and their environments are facing unprecedented changes, with climate change driving rising global mean sea level, exacerbating extreme sea level events, and increasing hazards. Whilst adaptations to change have been central to coastal life for millennia, climate change brings a speed and intensity of change not previously experienced. Researchers are noting that adaptations are needed that are large scale and systemic with significant changes to lives and livelihoods – Transformational Adaptations – yet there is little evidence of this in practice, and there remains an operationalisation gap between ambitions and actions. This paper uses a qualitative case study method to assess how existing policy may enable and inhibit local stakeholder involvement in transformational adaptation in English coastal flood and erosion risk management. Through twenty interviews with coastal management stakeholders, the capacity for local coastal management stakeholders to initiate transformational adaptation and the perceived involvement of residents are analysed. The results indicate that transformational adaptation remains a distant aspiration in the English coastal management system, with local stakeholders possessing limited capacity to initiate it. The perceived role for residents in adaptation processes is often focused on their being recipients of adaptation interventions, and there are a range of barriers to their further involvement. The paper concludes that despite the theoretical interest in transformational adaptation, there is limited evidence its implementation in English coastal flood and erosion risk management, and there are multiple priority areas for policy development to support capacity for engaged transformational adaptation practices in coastal management contexts.

1. Introduction

Our coasts are facing unprecedented changes, with climate change driving rising global mean sea level and exacerbating extreme sea level events and coastal hazards (Oppenheimer et al., 2019). Coastal communities are particularly exposed to risks of submergence, coastal flooding, and coastal erosion (Wong et al., 2014). Whilst adaptations to change have been central to coastal life for millennia, climate change brings a speed and intensity of change not previously experienced. Researchers are noting that adaptations are needed that are large scale with significant changes to lives and livelihoods – transformational adaptations – yet there is little evidence of this in practice (Suckall et al., 2019). Transformational adaptations offer a chance to overcome adaptation limits (Klein et al., 2014), as is common when traditional coastal management strategies are unable to reduce climate-related risks to acceptable levels.

"Transformational adaptation" remains a widely defined and applied concept, but can be distinguished from incremental adaptation by its

focus on: system wide or cross-system change; future, long-term change and uncertainty; recognizing adaptation outcomes to be open ended and uncontrollable, and; proactive, planned management of change (Lonsdale, Pringle et al., 2015). Most examples of transformational adaptation in practice are inland, with agricultural transformations dominating both practice and research (Vermeulen et al., 2018). There are limited recorded examples of transformational adaptation in coastal environments beyond delta systems (Suckall et al., 2018), such as the Delta Works and Room for the River programmes in the Netherlands (Kates et al., 2012; Kuhl et al., 2021). Transformational and transformative adaptation are often used interchangeably. Here, the focus is on transformational adaptations that are of a greater spatial, temporal and/or visionary scale than incremental adaptations seeking to maintain the status quo, and are differentiated from transformative adaptations in that their focus may not specifically be on development goals within adaptation (Few et al., 2017). Further, across transformational adaptation literature an "operationalisation gap" has been identified to describe the challenge of turning ambitions into actions (Deubelli and

E-mail address: sien.vanderplank@soton.ac.uk.

<https://doi.org/10.1016/j.envsci.2024.103806>

Received 17 January 2024; Received in revised form 31 May 2024; Accepted 3 June 2024

1462-9011/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Mechler, 2021) (p11).

Radical step changes, such as the relocation of settlements or ambitious engineering projects, appear to increase community resilience and reduce vulnerability to coastal hazards. However, transformational adaptations generate both winners and losers; they cannot be assumed to have universal benefits (Suckall et al., 2019). For example, while relocation is often framed as reducing vulnerability of communities, relocation can be to areas exposed to other hazards, or without effective changes to livelihoods and resource access (Nalau and Handmer, 2018). In the English context, the need for transformational coastal change may require 1600–1900 km of shoreline that is currently planned to be held at its present-day location to be realigned further inland, directly impacting 120,000–160,000 residential and non-residential properties by the mid-century (Sayers et al., 2022).

Increasingly, coastal residents are expected to be part of coastal flood and coastal erosion risk management processes, but engaging stakeholders and supporting their participation remains problematic, both in least developed nations (Holler et al., 2020), as well as developed nations such as the United Kingdom (UK) (Nye et al., 2011). Little is known about the types of political power that local stakeholders possess to influence transformational decision-making, nor the existing and potential pathways for household engagement in coastal adaptation. Transformational adaptation offers fundamental challenges to contemporary engagement processes. The critical gap, addressed here, but not considered in prior work, is that achieving transformation depends on it being grounded in local needs and being built on the lived experiences of local residents (Cradock-Henry et al., 2018). This paper uses a qualitative case study method, drawing on semi-structured interviews with local, regional and national English coastal management stakeholders, to identify enablers and barriers to transformational adaptation on the coast, and to local stakeholder involvement in those adaptation processes. Drawing together theory and empirical data, the paper concludes by identifying priority policy areas to support engaged transformational adaptation in England, and builds on existing transformational adaptation frameworks originally developed inland for the coastal context.

2. Methods

In the UK, coastal risk management responsibilities are, to varying extents, subject to legislation, policy, and administration from the devolved nations; the case sites and focus of this work are solely based on the English governance context. The study examined two broad case study areas which have significant coastal flood and/or erosion risk and are experiencing a shift in coastal risk management practice, in the east of England encompassing Norfolk, Lincolnshire and Yorkshire, and in the south of England encompassing Hampshire and Dorset. The use of a case study method allows for insights into coastal flood and erosion policy application within England in specific socio-economic, environmental and policy contexts (Yin, 2014).

The sampling method was purposeful and interviewees were selected per their anticipated richness in contribution to the research aim (Gentles et al., 2015). A stakeholder analysis, whereby stakeholders are selected according to their influence and importance to the specific project or process (Prell et al., 2009), was used to identify potential interviewees. The primary targeted stakeholders for interviewing were those who have some or significant influence or interest in coastal flood and erosion risk management in two areas of England experiencing significant flood and coastal erosion risk, or for whom these risks are an important factor to consider within their responsibilities and interests ($n = 20$, see Table 1). Interviews were conducted between June and September 2022.

The interview protocol focused on interviewees' experiences of contemporary policy and practice coastal adaptation, their perceptions of key and local stakeholder (including resident) responsibilities, and opportunities and barriers to transformational adaptation on the coast (see Supplementary Material 1 for interview protocol). The semi-

Table 1

Overview of interviewees whose primary focus of work is either in the south or east of England, or at a national scale (England). "Coastal management" describes those working in coastal flood and/or erosion risk management roles.

ID code	Organisation (role or focus)	Location	Scale of work	Gender
LA1	Local Authority (coastal management)	South	Local	M
LA2	Local authority (recently retired, previously coastal management)	East	Regional	M
LA3	Local authority (coastal management)	South	Local	F
LA4	Local authority (coastal management)	South	Local	M
LA5	Local authority (coastal management)	East	Local	M
LA6	Local authority (coastal management)	South	Local / regional	M
ENG1	Coastal engineering consultancy (estimator)	South	National	M
ENG2	Engineering consultancy (coastal management)	East	National	M
PL1	Local Authority (planning officer)	South	Local	M
PL2	Local authority (sustainable development officer)	East	Local	M
PB1	Non-departmental public body (coastal management)	East	Regional	M
PB2	Non-departmental public body (coastal management)	East	Regional	F
PB3	Non-departmental public body (coastal management)	East	Regional	M
PB4	Non-departmental public body (adaptation management)	England	National	F
PB5	Non-departmental public body (adaptation management)	England	National	F
AC1	University (physical geographer)	South	National / international	F
AC2	University (human geographer)	East	Local / regional	F
AC3	University (coastal geomorphologist)	South	National / international	M
AC4	University (coastal process scientist)	South	National	F
LOC1	Community flood group (chair)	South	Local	M

structured approach offered flexibility in the opportunity for dialogue and further probing into ideas and experiences particular to that interviewee (Wincup, 2017). This supported the interviewees to both reflect on existing practice and policy for coastal adaptation, as well as consider opportunities and barriers for potential transformational adaptations.

The analysis was driven by an abductive coding process, whereby a set of existing theories were used to drive initial coding, and the resultant outputs judged for their meeting theoretical expectations (Vila-Henninger et al., 2022) (see Supplementary Material 2 for codebook). Themes derived from existing literature for the abductive coding process are summarised in Table 2, and include the adaptation barriers and opportunities typology of Klein et al. (2014), the participatory process criteria of Samaddar et al. (2022), and the level of citizen involvement in adaptation by the framing of Hegger et al. (2017). To examine possible resident roles in transformational adaptation, this analysis considered three roles that a resident can perform in society, namely as: a citizen, affected by processes of engagement and decision-making; as a consumer, affected by their adaptive capacity and motivation to "consume" adaptive options, and; as an elector, affected by the scale of policy-making and access to elected representatives (Hegger et al., 2017).

Table 2

Theoretical (transformational) adaptation framing for analysis by abductive coding. Adaptation opportunities and barriers draw on the Klein et al. (2014) framing; participatory adaptation from Samaddar et al. (2022); resident roles building on work from Hegger et al. (2017).

Adaptation framing	Adaptation opportunities	Adaptation barriers	Participatory adaptations	Resident roles
Categories	Awareness raising	Physical	Early engagement	Consumers
	Capacity building	Biological	Stakeholder representation	Citizens
	Tools	Economic	Clear and agreed objectives	Electors
	Policy	Financial	Continued engagement	
	Learning	Human resource/capacity	Fairness and equality	
	Innovation	Social and cultural	Mutual trust	
		Governance and institutional	Transparency and accountability	
		Knowledge, awareness and technology	Power to influence decisions	
			Capacity building and empowerment	
			Incorporating local knowledge	
			Good facilitation and two-way communication	
			Resource availability and mobilisation	
			Time	

3. Results

There are few examples of transformational adaptation interventions in contemporary policy or practice on the English coastline. Per the definition of transformational adaptation adopted in this paper, no interviewee identified past or ongoing examples for coastal flood and coastal erosion risk management. Whilst the interviews and research aims were initially to focus specifically on engagement practices in ongoing transformational adaptation, with so little of any form of adaptation taking place, the focus expanded to also consider the expectations for resident involvement in transformational processes, and more broadly, the perceived role and involvement of residents in current day coastal flood and erosion practice as an indication of the barriers and opportunities for their involvement in potential transformational adaptation. Henceforth, “(transformational) adaptation” refers to both potential-transformational and current-day incremental adaptation practices.

Interviewees identified a lack of policy framework to support (transformational) adaptation, a lack of even basic adaptations occurring, and, limited use of existing adaptation policy tools such as Shoreline Management Plans¹ (SMPs) or Coastal Change Management

¹ Shoreline Management Plans identify flood and coastal erosion risk management approaches in the short-term (0–20 years), medium-term (20–50 years) and long-term (50–100 years) and are developed by Coastal Groups, whose membership draws mainly from local authorities and the Environment Agency.

Areas² (CCMAs). In terms of ongoing adaptations, multiple interviewees identified and discussed the Bacton Sand Engine (a project in which 1.5 million cubic metres of sand were strategically placed on the North Norfolk coast near Bacton, the first major example of sea driven sand nourishment in England) and the Coastal Transformation Accelerator Programme (two local authorities on England’s east coast are working with communities to identify strategic planning pathways and actions to support coastal erosion adaptation 2023–2027). Working on longer timescales was the most frequently desired transformational shift to adaptation processes. Below, the results are examined through (1) the perceived role of residents, (2) the current and possible involvement of residents, and (3) the capacity of local stakeholders to involve residents in (transformational) adaptation processes.

3.1. The perceived role for residents in transformational adaptation

All interviewees spoke of residents in (transformational) adaptation in the context of their being citizens, but very few considered their consumer and elector roles (Table 3). As citizens, residents were considered across a spectrum of non-participatory and more-participatory approaches, from: recipients who depend on coastal risk management for the maintenance of their way of living, with residents displaying varying opinions on their received adaptations; as citizens who can be engaged and educated in adaptation; as citizens who can support adaptation through providing finance; and as citizens who have the power to drive adaptation. By contrast, considering resident roles as consumers of adaptation, interviewees identified only two main pathways: as consumers of property through their purchasing decision making; and as consumers of coastal defence options, through driving or leading the development of coastal risk management infrastructure. Despite significant reflection from interviewees on the relationship between politics and (transformational) adaptation, there was minimal consideration of how residents are electors, with only PB2 and AC3 directly discussing the influence that residents have through their elected representatives. In summary, where residents are involved in (transformational) adaptation, interviewees perceive that the main role of residents is to be affected and engaged by coastal adaptation decision making.

3.2. The involvement of residents in transformational adaptation

The participatory engagement framework of Samaddar et al. (2022) is applied to explore the current state and potential for resident involvement in (transformational) adaptation (Table 4). For example, participatory engagement requires the inclusion of local communities from the “inception of the project” (Samaddar et al., 2022), and in this case the presence of early engagement in project planning and delivery was demonstrated in various ways by the interviewees. This included: developing a shared vision with communities; including communities from the outset of adaptation planning, such as processes that will lead to management policy change; preparing communities now for long-term adaptation and coastal change, such as by involving those who are not yet exposed but will be; and using CCMAs as a tool to enable such long-term engagement. However, long-term engagement can be hard to initiate when communities only engage in “the issues which [they] are immediately facing” (LA2), and when there is little to no funding to deliver what is eventually agreed. Linked to the principle of early engagement, consensus on clear and practical project goals further support participatory management practices (Samaddar et al., 2022); interviewees stressed the importance of being clear about project objectives, such as to avoid controversy and tension.

² Within the National Planning Policy Framework for the UK, Coastal Change Management Areas (CCMAs) are local planning policies for areas where shorelines are likely to change significantly in the next 100 years.

Table 3 Perceived roles for residents in coastal adaptation decision-making processes. Associated quotes are cited by Interviewee ID codes from Table 1 and are available in Supplementary Material 3.




ROLE	DEFINITION	STUDY EXAMPLES	EXAMPLE QUOTE
 Citizen Citizen	Residents as affected by decision-making and engagement.	<ol style="list-style-type: none"> 1. Dependent recipients of adaptation policy and action (AC1; AC2; PB2; ENG1; PL2; LA1; LA5). 2. Engaged and educated in adaptation (AC2; AC3; LA1; LA2; LA3; PB3). 3. Support adaptation through providing finance (LA4). 4. Power to drive adaptation (ENG2; AC4). 	<p>“And that that is a good example where that, that tireless is having meetings and having studies ... Explaining to people, educating people about this is not a permanent fixture, this is a thing that’s on the move and your road is unsustainable and blah blah blah. Yes we can spend £30 million of building a seawall along the whole frontage but you know you never going to get that money and then your beach will disappear in front of your seawall.” (AC3)</p>
 Consumer Consumer	Residents as consumers of adaptive options.	<ol style="list-style-type: none"> 1. Consumers of property, i.e. purchasing homes (LA4; LA5; AC2; PB2). 2. Consumers of coastal defence infrastructure (PB4; LA6; ENG2). 	<p>“We have found actually that one small community ... they built their own defences. They have got boat houses, but they also have small chalets and things like that. This community is really forward thinking. They understand they can’t be there forever, so they’re already putting things in place and their own adaptation plans to relocate or move out of the area in the longer term.” (PB4)</p>
 Elector Elector	Residents as affected by policy-makers and access to their elected representatives.	<ol style="list-style-type: none"> 1. Lobbying politicians (PB2; AC3). 	<p>“Often we end up at the situation where we say, well, you know, there is no other option but to lobby your MP. This week I can only tell you as a public officer what the situation is and what is what. Support is available for you. If you don’t like the rules or you can do is lobby your MP.” (PB2)</p>

Table 4

Good practice and challenges in involving residents in current adaptation processes, using the participatory framework of Samaddar et al. (2022). Associated quotes are cited by Interviewee ID codes from Table 1 and are available in Supplementary Material 3.

Participatory trait	Evidence of good practice from case sites	Challenges in current engagement practices
Early engagement	<p>Common vision: working with the community to generate a common vision for the coast (AC1; ENG1).</p> <p>Including communities from the beginning: engaging as early as possible (AC2; PB4; LA5).</p> <p>CCMAs: a tool for early engagement of residents and other stakeholders (AC3).</p> <p>Starting difficult conversations early: with communities for long-term retreat and adaptation (AC3; ENG2; PB1; PB3; PB4; PL2).</p>	<p>Resource shortfall: early engagement can generate open-ended scenarios, but there is no funding to realise any of them (LA3).</p> <p>Resident transience: difficult to sustain long-term interest with residents (LA1).</p>
Clear and agreed objectives	<p>Consensus: attempting to build consensus between stakeholder groups and reduce controversy (AC1; LA2; PL2).</p>	<p>Long-term focus: hard to set long-term objectives with residents, who tend to be more reactive to immediate problems (LA2).</p>
Continued engagement	<p>Diverse engagement approaches: there are multiple stages to adaptation engagement, requiring diverse engagement approaches (PB2; LA1).</p> <p>Enables community input: captures public realm knowledge, support consensus development, builds relationships (LA1; LA2; LA4; LA6; AC2; AC4; PL2).</p> <p>Takes time: provides people with the time needed for long-term adaptation (AC3; ENG2; LA1; LA2; LA5; PL2).</p>	<p>Limited resource: for long-term, continued engagement (AC1; LA1).</p>
Resource availability and mobilisation	<p>Availability and security of (financial, materials, people) resource enables effective engagement processes (AC4; PB1; PB4).</p>	<p>Lack of resource hinders effective engagement processes, i.e. by being unable to plan ahead, not having an engagement led approach, reducing amount of engagement possible (LA1; LA2; LA5; PL2; AC1; AC4).</p>
Time	<p>Recognition that effective engagement takes time (LA3; AC2; AC4).</p>	<p>Residents’ ability to be available for engagement affects who gets engaged/involved (AC4; PB1).</p> <p>Wellbeing cost to involvement for residents (LOC1).</p>
Stakeholder representation	<p>Whole household: recognition that everyone in the household needs to be involved (AC4).</p> <p>Involving diverse community demographics and groups (AC2; AC4; PB1; LA2; LA3; LA4).</p> <p>Engaging schools and young people (AC4; LA6).</p> <p>Inclusive definitions of stakeholder, i.e. including</p>	<p>Who is the community: defining the “community” is not an obvious process (LA2).</p> <p>Accessing the most impacted: engagement processes often still fail to access most impacted publics (AC4).</p> <p>Disengagement: majority of public remains disengaged (ENG1).</p>

(continued on next page)

Table 4 (continued)

Participatory trait	Evidence of good practice from case sites	Challenges in current engagement practices
Fairness and equality	those who, although not exposed, will be impacted by adaptation decisions, including those who will be exposed in the future (LA1; LA2; PL2). Reflecting on who is (re) present(ed) in (transformational) adaptation (PL2). Using a diversity of methods to engage residents (LA3; LA4). Recognising the centrality and relevance of stakeholder concerns beyond FCERM (LA2).	Big, ethical decision: It is unclear who has the right to make significant decisions around (transformational) adaptation (AC2; AC3).
Incorporating local knowledge	Local interests: including local interests for the seafront and coast (PB1; LA6). Local knowledge: recognising and acknowledging residents' ideas and experiences (AC2; AC4; LA4).	Challenges of scale, how to engage local knowledge into larger scale and longer-term adaptation planning (PB1).
Good facilitation and two-way communication	Different engagement methods: Examples of using engagement methods that engage diverse publics (LA1; LA3; LA4; LA6; AC2; AC4; PB3). Conversation: incorporating conversations into engagement, i.e. two-way flow of information that include listening to residents (PB1; LA1; LA2). No data.	One-way engagement, i.e. "educating" and informing residents (AC4; ENG1; PB1; LA1; LA4; PL1). Transience of the coastal risk management workforce can be a barrier to and failures of two-way communication, with people moving on just as they have established a working relationship (AC1). Mutual trust is not always evident between residents and other stakeholders (AC1; LA2; LA4; PL1). No data.
Mutual trust	No data.	No data.
Transparency and accountability	Data accessibility: examples of efforts to make data available and accessible (PB4).	No data.
Power to influence decisions	Ensuring that communities having a voice in coastal management decision-making (PB4). Supporting stakeholders to propose ideas and identify their priorities (LA4). Providing options, i.e. more than one, for communities and residents to select from (LA2; LA3; LA4; LA5; PL2).	Barriers (institutional, financial) to providing communities with decision-making power (LA6; PL1). Financial resource can determine decision-making power, i.e. wealthier residents may have more options to influence policy (ENG2; PB2). Lack of options to offer residents in adaptation, i.e. no funding, power or flexibility within the system to offer more than one adaptation (AC4; PB2; LA1; PL1).
Capacity building and empowerment	Honest conversations can build support (PB3).	Limited capacity building: limited number of examples of capacity building efforts for residents and other stakeholders (AC4; PB1; PB5).

Interviewees also identified sustained engagement as key for supporting communities through the long-term nature of adaptation, including preparing people for future change, and maintaining public knowledge on coastal risks and change. Coastal flood and erosion risk

management and (transformational) adaptation take time, and community engagement needs to be sustained if public input is to be embedded throughout the process, to build consensus, and because the adaptation communication journey can be lengthy with multiple stages: "We find that people start to come round to the idea of adapting when they've achieved three key points: And that's baseline, options and benefits." (PB2). However, despite the desire for sustained engagement, resource (financial and human) was identified as a barrier to encompassing continuous engagement in (transformational) adaptation processes. Interviewees agreed that material, financial and human resource are necessary to enable effective engagement processes, but resource for effective participatory engagement was frequently described as non-existent, insufficient, disjointed, and short-term in character. It was also raised that effective engagement processes take time, and that people's varying capacity to afford that time affects their ability to be engaged.

Ensuring fair and equal representation of different community groups in decision making, including marginalized and deprived publics, was recognised and addressed in various ways. Interviewees described how "it's really important that you engage in all ages in the household" (AC4), including young people, a diversity of demographics and groups, people beyond the "vocal minority" (LA1), and being expansive in considering who has a "stake" – i.e. those who may be exposed to risks in the future, and those who may be impacted by adaptation decisions and actions. Reaching these different publics was chiefly suggested to be achieved through using targeted and diverse methods of engagement. Fair and equal representation may also require recognition of public concerns and ensuring two-way communication (Samaddar et al., 2022): this was often expressed as incorporating local interests and knowledge, having a conversation, listening and asking questions. LA2 further highlighted place-specific values that need consideration in (transformational) adaptation planning. Nevertheless, interviewees were sceptical that representative engagement was occurring in practice, with coastal flood and erosion risk management workforce turnaround impeding relationship-building, instances of one-way engagement, and challenges to identify, access and integrate the knowledge of target communities. Interviewees also offered reflections regarding adaptation justice: who has the right to decide which village gets protection and which does not, or to make a transformational change to a place?

Further participatory traits – such as transparency and accountability, mutual trust, and power to influence decisions – are all built on the recognition of communities as partners rather than recipients of (transformational) adaptation. But there was limited discussion by interviewees on public understanding of the decision-making process and of approaches to support their voice, and a number of examples demonstrated the absence of mutual trust between stakeholders. One interviewee highlighted the importance of having "honest discussions with affected communities" (PB3), and multiple highlighted opportunities they sought to pursue to facilitate such conversations. The extent of power "given" to communities in decision-making was generally confined to their choosing from provided options, and even then interviewees lamented the situations in which they felt they did not even have options to offer. Furthermore, the power of communities to have decision-making power in (transformational) adaptation was also identified to be limited by institutional barriers in the planning process to incorporate resident or community perspectives, and even by residents' financial capacity, where those with financial resource are more likely to be able to be an active part of decision-making and adaptation planning.

3.3. The capacity of local stakeholders to initiate transformational adaptation

The interview analysis exposes limited (transformational) adaptation in practice, with scope to increase the involvement of residents in any

existing policy and practical processes. Similarly, the analysis exposed a range of barriers for local stakeholders to develop and enact any form of coastal adaptation policy or practice. Beyond the barriers to residents leading (transformational) adaptation, interviewees identified barriers to other local stakeholders being able to initiate (transformational) adaptation. These barriers encompassed: knowledge and awareness, social and cultural, funding, human resource and capacity, and governance and institutional (see Table 5). By contrast, potential adaptation barriers in the Klein et al. (2014) framing such as biological, physical or

economic barriers, were scarcely considered by interviewees.

Generally, where knowledge and awareness were identified as problematic was with regard to local authorities not having the knowledge or understanding of coastal flood and erosion risk data, or being unable to retain expertise in house. Social and cultural barriers raised by interviewees included: the current negative framing of adaptation and erosion, including by the media; long-term effective coastal erosion risk management stalling future-looking adaptation thinking; lack of societal acceptance in policy to consider relocation as adaptation; lack of coastal adaptation champions; lack of specific consideration of the social-cultural characteristics and vulnerabilities of those who live in exposed coastal areas.

Financial, human resource capacity and governance/institutional barriers were widely discussed and covered in greatest detail by the interviewees. Financial barriers included limited resource available to engage communities, curbing local stakeholder capacity to develop long-term and pre-emptive engagement in complex and emotional adaptive journeys. This was compounded by the general concern of interviewees for resource available to local authorities to carry out all aspects of (transformational) adaptation, including: planning, relocation, expertise, people, communication, engagement, and defences. There was also a perception that “other” hazards receive more funding than the one of the interviewee’s remit, i.e. with PB4 expressing that “there is certainly less resource both in terms of money and people from a coastal perspective than there is from an inland flooding perspective”, and within the coastal zone, LA3 suggesting that “a lot of money to look into coastal adaptation is funded to the erosion side of things and not the flood risk side of things”. The lack of financial security was further identified to be limiting (transformational) adaptation opportunities, such as by constraining the potential for larger scale, integrated projects.

Human resources capacity barriers included: lack of expertise; lack of necessary funding; and, issues retaining expertise. Concerns around the lack of expertise related both to individuals and organisations: individuals are not always trained in the coastal risk management area that they are now working; the school curriculum is not per se educating the next generation sufficiently in adaptation needs, and there are not enough skilled experts to go round all the local coastal authorities seeking to generate adaptation plans; and, local authorities do not have the human resource capacity to design and deliver (transformational) adaptation. Further to this are the related issues of lack of funding for human resource and issues retaining expertise: local authorities are often too small to house necessary expertise, and cannot offer competitive salaries to attract or retain necessary staff. These issues are compounded by a reported focus of funding on delivering and maintaining structural defences, with reduced funding directed toward supporting staff for other roles, including engagement or research.

Governance and institutional barriers that interviewees identified encompassed: the planning system; restrictive policy options; the role of politics; lack of national vision or strategy; and, the lack of a delivery mechanism for policy. The planning system was seen as restrictive, particularly in the context of enabling rollback or larger scale projects, but similarly the existing coastal risk management and adaptation policy options – and particularly those eligible for central government funding – were often described as being limited. Furthermore, interviewees generally perceived politics to be impeding (transformational) adaptation rather than aiding it, such as by being short sighted and government turnover, or by alienating communities from the adaptation process and preventing uncomfortable reports from being shared publicly. There was a reported lack of national interest, vision and strategy for the (transformational) coastal adaptation, as well as a lack of delivery mechanism for any such existing or desired national strategy for adaptation or resilience: “At the moment, transformational adaptation in this country feels for me personally, as a bridge too far... we’ve not got the policy framework in place, we’ve not got the funding mechanisms, we’ve not got the governance, the organisations, to actually to actually look at that.” (PB4)

Table 5

Barriers for local stakeholders to initiate (transformational) adaptation processes. Associated quotes are cited by Interviewee ID codes from Table 1 and are available in Supplementary Material 3.

Barriers for local stakeholders	Examples (Klein et al. 2014)	Examples in this study (interviewees)
Physical	Climate, geographical features, soil conditions, land use and change	None
Biological	Temperature, precipitation, salinity, acidity, and intensity and frequency of extreme events including storms, drought, and wind	None
Economic	Existing livelihoods, economic structures, and economic mobility	None
Knowledge, awareness and technology	Lack of awareness or access to information or technology	<ul style="list-style-type: none"> • Lack of expertise (LA1), • Limited institutional knowledge (ENG1; LA2; AC3).
Social and cultural	Social norms, identity, place attachment, beliefs, worldviews, values, awareness, education, social justice, and social support.	<ul style="list-style-type: none"> • Negative framing of adaptation and erosion (AC4; LA5), • Lack of future-looking adaptation (ENG1), • Limited societal acceptance for relocation (PB2), • No coastal adaptation champions (LA3), • Limited consideration of social-cultural vulnerabilities of those who live in exposed coastal areas (PL2).
Financial	Lack of financial resources	Lack of funding for: <ul style="list-style-type: none"> • Public engagement (AC2; LA3), • Local authorities (AC4; LA1; LA2; LA3), • Specific hazards (PB4; LA3), • (Transformational) Adaptation as opposed to coastal flood and erosion risk management (ENG1; ENG2; LA2; LA3; PL2).
Human resource/capacity	Individual, organizational, and societal capabilities to set and achieve adaptation objectives over time including training, education, and skill development.	<ul style="list-style-type: none"> • Lack of expertise (AC1; AC3; AC4; ENG1), • Lack of necessary funding (LA3; PB2), • Issues around retaining expertise (AC2; AC3; LA1).
Governance and institutional	Institutions and Policy: existing laws, regulations, procedural requirements, governance scope, effectiveness, institutional arrangements, adaptive capacity, and absorption capacity.	<ul style="list-style-type: none"> • Restrictive planning system (ENG1; PB2; LA3; PL1; LA2), • Restrictive policy options (AC4; PB4; LA2), • Political hindrances (AC3; PB3), • Lack of national vision or strategy (AC1; PB1; PB2; PB4; LA2; LA3), • Lack of a delivery mechanism for policy (AC2; LA3; LA5).

In summary, the results indicate that there is limited capacity for local stakeholders to proactively initiate (transformational) adaptation processes, and that there are still significant barriers to involving residents (see Fig. 1).

4. Discussion

Contemporary flood risk management and coastal risk management processes in the UK and elsewhere are only recently starting to recognise the importance of effective, well-designed public engagement programmes and public participation (Begg, 2018; Challies et al., 2016; EA, 2018; Ueberham and Kabisch, 2016). Yet the transformational adaptation processes that will become more widespread to prepare for and respond to climate change on the coast are (Lonsdale et al., 2015; Mach and Siders, 2021), by their very nature, going to occur at larger time and spatial scales than traditional hazard risk management processes (Fedele et al., 2019; Holland, 2017; Suckall et al., 2019). Transformational adaptation may, therefore, both be even more dependent upon participatory and engaged adaptation approaches as well as challenge existing policies and processes to do so.

4.1. Wait and react, or pre-empt

In the face of rapidly changing coastlines, communities and decision-makers across scales are faced with a choice: wait and react at a later stage, or explore opportunities for adaptation now that address future change and structural problems driving risk (Chung Tiam Fook, 2017). Chung Tiam Fook (2017) examined transformative adaptation as an opportunity for forwarding alternative social and policy structures, facilitating community-focused adaptation as opposed to business-as-usual actions in preparation or response to climate change. But the results of these case studies in England suggest that local stakeholders such as residents, communities and/or local authorities have limited power to make that choice to proactively initiate (transformational) adaptation processes. However, the analysis also exposed evidence that stakeholders are considering social change as a fundamental part of coastal adaptation. Interviewees expressed concerns beyond coastal management being relevant to coastal adaptation, of generating a holistic vision for the future coast, and of building on local knowledge and interests (Table 4). This indicates a working practice that is future orientated and actively seeking to listen and be informed by local stakeholders. In the context of infrastructure developments or energy industries, the opportunity for long-term engagement may be limited by the uncertain geography of future placement of such projects (Walsh et al., 2017). Researchers have a responsibility in this context also; by embracing interdisciplinary, co-production methods that create knowledge *with* communities, local organisations feel more legitimised to share their perspective on future coasts (Ziervogel et al., 2022). With long-term coastal change data and strategies such as SMPs, coastal adaptation processes in England do not suffer this impediment to structured, long-term engagement; there is no physical limit to why

there cannot be long-term engagement in place, and it appears instead that capacity and institutional barriers in coastal engagement processes explain why so much adaptation engagement remains (1) constrained to be wait and react in nature, and (2) lacking long-term, co-produced adaptation pathways.

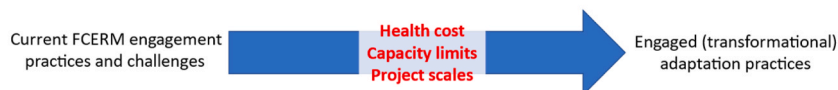
4.2. Procedural justice in transformational adaptation

Hellin et al. (2022) were concerned about the social questions of agricultural transformation that go beyond the underpinning technological innovation, building on the premise that social, institutional and governance factors are the key drivers to transformation, and concluding that a transformative agenda is one focussed on justice across generations (intergenerational equity), stakeholders (recognition equity), decision-making (procedural equity), and resources (distributional equity). Holland (2017) pushes the concept further still, framing transformational adaptation as being akin to transformative adaptation in that it addresses the root causes of vulnerability, and argues that procedural justice in this process resembles vulnerability populations having the “political power to shape adaptation decisions” that are being made in the context of limited resources and other policy priorities (p.18). In the interview data presented here, it was found both that there is limited scope within current policy for local involvement in any form of adaptation and that there is almost no ongoing transformation, supporting earlier desk-based worked of Scolobig et al. (2023) that similarly observed little evidence of transformative adaptation in practice. For example, regarding participation in coastal adaptation in England, interviewees generally perceived residents as citizens *affected* by decision-making with little influence on that process (see Table 3). Nevertheless, there were multiple examples of residents being directly involved in decision-making (such as LOC1, chair of a community flood group) and adaptation (residents funding their own flood defences) that directly negate the common perception that residents are not powerful players in adaptation processes. Residents may be further supported to engage in adaptation processes by recognising their knowledge and contributions as valuable *because* they are distinct from scientific evidence, accepting alternative logics as rational even when different to that of accepted elite perspectives, and allowing discourse with residents and/or communities to go beyond assumed project boundaries (Turnhout et al., 2020). Linked to this, local stakeholder engagement in adaptation can be improved by focusing not (only) on persuasive communication campaigns – “adapt by taking this action” – but also inviting stakeholders into local and personal decision making through deliberative communication – “consider this future and reflect on the adaptation pathways” (Johnson, 2012).

4.3. Policy opportunities to increase capacity for engaged transformational adaptation processes

Achieving transformation depends on it being grounded in local needs and being built on the lived experiences of local residents

(1) Barriers to **engaged** (transformational) adaptation in practice



(2) Barriers to **any** transformational adaptation in practice

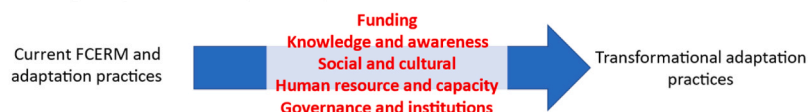


Fig. 1. Summary of barriers to (engaged) (transformational) adaptation practices.

(Cradock-Henry, Fountain and Buelow, 2018). Hochrainer-Stigler et al. (2023) posit that, despite the need for systemic risk research to address the operationalisation gap in transformational adaptation, these fundamental system changes need not only be top-down change, but can also be driven by cumulative local level changes. In this assessment of engagement practices of coastal practitioners in England, there was still significant scope across scales to increase and improve the involvement processes for residents in adaptation. Residents were generally perceived by interviewees as citizens with varying potential to participate in adaptive processes; their potential elector or consumer roles were rarely considered. Despite national policy statements around household responsibility (Environment Agency, 2020, 2022), there is currently limited evidence of that being enacted in practice (van der Plank et al., 2022). Thus, as with preceding work (Deubelli and Mechler, 2021), these results suggest that there is an operationalisation gap for transformational adaptation in the English coastal context: the vision is there, the structural framework to deliver is lacking.

Whilst the operationalisation gap can seem like an intangible challenge to address, Scolobig et al. (2023) offer an itemization of the core elements of public-sector adaptation. According to their framing, four system characteristics are necessary to support transformational adaptation: a transformational vision, planning, institutions, and interventions. In the English coastal context, this framing exposes four priority policy areas to enable transformation and embed people within that process (Fig. 2). First, the need for inclusion of diverse stakeholder in adaptation planning. Interviewees described this as being currently hindered by lack the capacity and resource, and not having the tools to appropriately engage diverse groups and facilitate long-term engagement. Second, the need for aspirational visions for the coast. Interviewees saw transformational adaptation as offering a narrative for positive adaptation, but they seek more flexibility within policy to explore innovative, place specific, and creative adaptation approaches. Third, the need for integration across institutions. Pathways are currently lacking to communicate adaptation needs and situations across sectors and scales of governance; there remains scope to increase coordination and cooperation. Fourth, the importance of evidence driven interventions. Data availability and quality, regular monitoring, and good modelling are embraced as critical to adaptation, and past and existing innovation programmes were welcomed as learning opportunities. Whilst transformative adaptive pathways remain more abstract than observed, both in this and past work (Chung Tiam Fook, 2017; Deubelli and Mechler, 2021; Scolobig et al., 2023), this work highlights

both the aspiration for bigger scale approaches to climate change adaptation, and the scope to incorporate diverse stakeholders within current and aspirational processes.

Furthermore, there is reason to be hopeful for a bottom-up drive for change, with policy priorities as perceived by local stakeholders mapping almost directly onto the four equity requirements posed by Hellin et al. (2022): placing people at the heart of adaptation planning and ensuring adaptation planning is integrated across institutions (recognitional and procedural equity), being future orientated in adaptation (intergenerational equity), and desiring evidence driven interventions (distributional equity). Thus, despite there being multiple examples in this work of how the existing policy framework in English coastal management and adaptation is currently limited in its support for transformative change and involvement of local stakeholders, there is optimism among those local stakeholders that there are nevertheless pathways to (1) support transformative change under current policy, and (2) improve policy to facilitate engaged transformative change.

5. Conclusion

There is a growing body of work exploring the definition, scope, and application of transformational adaptation (Fedele et al., 2019; Holland, 2017; Mach and Siders, 2021; Suckall et al., 2019; Vermeulen et al., 2018), but scant literature has assessed this in the context of coastal management practice, nor taken into account how transformational processes may affect the ability of local stakeholders to be involved. This work therefore applied existing participatory practice and transformational adaptation frameworks to the coastal context in England, to identify the extent to which local stakeholders are involved in adaptation and how their involvement can be sustained or improved in transformative processes. The results drew only from English coastal sites, and chiefly from interviews with those working on the management of storms, floods, and erosion. In the context of transformational adaptation, whereby adaptation transcends sectoral or topical boundaries, future studies should also consider social, industrial, and other areas of change and adaptation. Furthermore, the interviews were primarily conducted with coastal policy stakeholder and practitioners, with minimal representation of the resident voice at stake. This limits the results to being a practitioner perspective of resident engagement in coastal management, and fails to capture the experience of those being engaged. Whilst the initial aim was to study engagement in the context of transformational adaptation, the interviewees described that there was

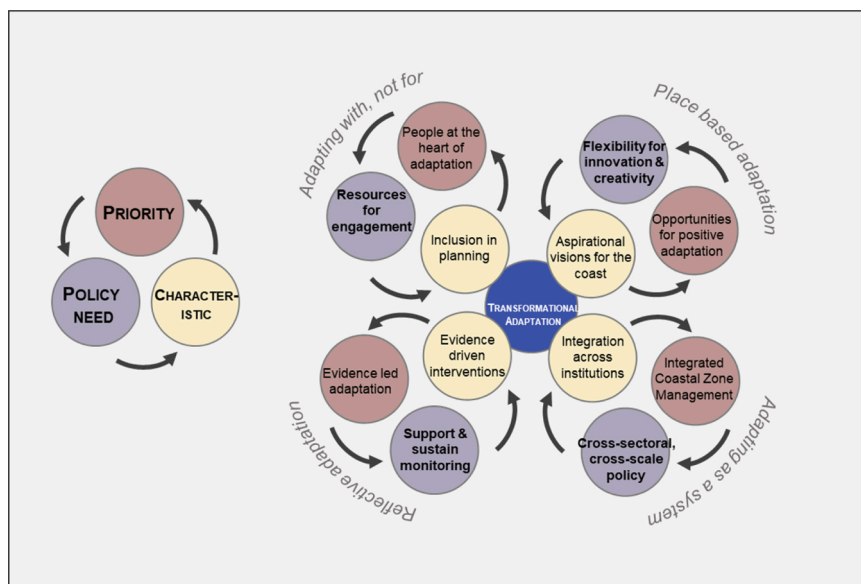


Fig. 2. Four priority policy areas to develop transformational adaptation capacities in England (drawing on the work of Scolobig et al. 2023).

neither transformational nor even incremental adaptation ongoing in their areas of work, and thus the work provided joint conclusions on how to develop engaged (and) transformational adaptation policy. Existing transformational literature laments the lack of practical studies or practical translation of transformational adaptation (Deubelli and Mechler, 2021; Sayers et al., 2022); perhaps there are examples of transformational adaptations underway in agriculture (Vermeulen et al., 2018), where much of the literature focuses on, but in the English coastal context there is still little to study at the present time. If the transformational adaptation campaign wishes to further their theoretical and practical cause, they need to find pathways for change. Such pathways could be through policy, as put forward in this work in the framing of transformational opportunities through overcoming contemporary barriers in policy to support a transformational vision, planning, institutions and interventions (Scolobig et al., 2023). The potential to ground transformational adaptation in the lived reality of local residents was not refuted by those participating in this work; but there is still scope to develop how coastal policy makers and practitioners define and implement involvement.

CRedit authorship contribution statement

Sien van der Plank: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Acknowledgements

The author gratefully acknowledges the insights from Profs Emma Tompkins and Pauline Leonard, and to all interviewees and “Transformational Coasts” podcast producers and interviewees for their contributions. The data underlying this paper was collected as part of an ESRC South Coast Doctoral Training Programme Fellowship funded through UKRI ESRC ES/W006189/1.

Supplementary Material 1

Semi-structured interview protocol.

Supplementary Material 2

Codebook for qualitative analysis.

Supplementary Material 3

Quotes from interviewees exemplifying codes and results (where consent was given for publication).

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.envsci.2024.103806](https://doi.org/10.1016/j.envsci.2024.103806).

References

- Begg, C., 2018. Power, responsibility and justice: a review of local stakeholder participation in European flood risk management. *Local Environ.* 23, 383–397. <https://doi.org/10.1080/13549839.2017.1422119>.
- Challies, E., Newig, J., Thaler, T., Kochskämper, E., Levin-Keitel, M., 2016. Participatory and collaborative governance for sustainable flood risk management: an emerging research agenda. *Environ. Sci. Policy* 55, 275–280. <https://doi.org/10.1016/j.envsci.2015.09.012>.
- Chung Tiam Fook, T., 2017. Transformational processes for community-focused adaptation and social change: a synthesis. *Clim. Dev.* 9, 5–21. <https://doi.org/10.1080/17565529.2015.1086294>.
- Cradock-Henry, N., Fountain, J., Buelow, F., 2018. Transformations for Resilient Rural Futures: the Case of Kaikōura, Aotearoa-New Zealand. *Sustainability* 10, 1952. <https://doi.org/10.3390/su10061952>.
- van der Plank, S., Brown, S., Tompkins, E.L., Nicholls, R.J., 2022. A typology of responsibility for coastal flood risk adaptation. *Front. Mar. Sci.* 9 <https://doi.org/10.3389/fmars.2022.954950>.
- Deubelli, T.M., Mechler, R., 2021. Perspectives on transformational change in climate risk management and adaptation. *Environ. Res. Lett.* 16, 053002 <https://doi.org/10.1088/1748-9326/abd42d>.
- EA, 2018. *Accounting for Adaptive Capacity in FCERM Options Appraisal*. Environment Agency, Bristol.
- Environment Agency, 2020. *National Flood and Coastal Erosion Risk Management Strategy for England*. Environment Agency, Bristol.
- Environment Agency, 2022. *Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026*.
- Fedele, G., Donatti, C.I., Harvey, C.A., Hannah, L., Hole, D.G., 2019. Transformative adaptation to climate change for sustainable social-ecological systems. *Environ. Sci. Policy* 101, 116–125. <https://doi.org/10.1016/j.envsci.2019.07.001>.
- Few, R., Morchain, D., Spear, D., Mensah, A., Bendapudi, R., 2017. Transformation, adaptation and development: relating concepts to practice. *Palgrave Commun.* 3, 17092 <https://doi.org/10.1057/palcomms.2017.92>.
- Gentles, S., Charles, C., Ploeg, J., McKibbin, K., 2015. *Sampling in Qualitative Research: Insights from an Overview of the Methods Literature*. *Qual. Rep.* 20, 1772–1789.
- Hegger, D.L.T., Mees, H.L.P., Driessen, P.P.J., Runhaar, H.A.C., 2017. The Roles of Residents in Climate Adaptation: A systematic review in the case of the Netherlands. *Environ. Policy Gov.* 27, 336–350. <https://doi.org/10.1002/eet.1766>.
- Hellin, J., Amarnath, G., Challinor, A., Fisher, E., Givertz, E., Guo, Z., Hodur, J., Loboguerrero, A.M., Pacillo, G., Rose, S., Schutz, T., Valencia, L., You, L., 2022. Transformative adaptation and implications for transdisciplinary climate change research. *Environ. Res.: Clim.* 1, 023001 <https://doi.org/10.1088/2752-5295/ac8b9d>.
- Hochrainer-Stigler, S., Deubelli-Hwang, T.M., Mechler, R., Dieckmann, U., Laurien, F., Handmer, J., 2023. Closing the ‘operationalisation gap’: Insights from systemic risk research to inform transformational adaptation and risk management. *Clim. Risk Manag.* 41, 100531 <https://doi.org/10.1016/j.crm.2023.100531>.
- Holland, B., 2017. Procedural justice in local climate adaptation: political capabilities and transformational change. *Environ. Polit.* 1–22. <https://doi.org/10.1080/09644016.2017.1287625>.
- Holler, J., Bernier, Q., Roberts, J.T., Robinson, S.-a., 2020. Transformational Adaptation in Least Developed Countries: Does Expanded Stakeholder Participation Make a Difference? *Sustainability* 12, 1657.
- Johnson, B.B., 2012. Climate change communication: a provocative inquiry into motives, meanings, and means. *Risk Anal.* 32, 973–991. <https://doi.org/10.1111/j.1539-6924.2011.01731.x>.
- Kates, R.W., Travis, W.R., Wilbanks, T.J., 2012. Transformational adaptation when incremental adaptations to climate change are insufficient. *Proc. Natl. Acad. Sci.* 109, 7156–7161. <https://doi.org/10.1073/pnas.1115521109>.
- Klein, R.J.T., Midgley, G.G.F., Preston, B.L., Alam, M., Berkhout, F.G.H., Dow, K., Shaw, M.R., 2014. *Adaptation Opportunities, Constraints, and Limits*. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 899–943.
- Kuhl, L., Rahman, M.F., McCraine, S., Krause, D., Hossain, M.F., Bahadur, A.V., Huq, S., 2021. Transformational Adaptation in the Context of Coastal Cities. *Annu. Rev. Environ. Resour.* 46, 449–479. <https://doi.org/10.1146/annurev-environ-012420-045211>.
- Lonsdale, K., Pringle, P., Turner, B., 2015. *UK Climate Impacts Programme. Transformational adaptation: what it is, why it matters and what is needed*. University of Oxford, Oxford, UK.
- Mach, K.J., Siders, A.R., 2021. Reframing strategic, managed retreat for transformative climate adaptation. *Science* 372, 1294–1299. <https://doi.org/10.1126/science.abh1894>.
- Nalau, J., Handmer, J., 2018. Improving Development Outcomes and Reducing Disaster Risk through Planned Community Relocation. *Sustainability* 10, 3545. <https://doi.org/10.3390/su10103545>.
- Nye, M., Tapsell, S., Twigger-Ross, C., 2011. New social directions in UK flood risk management: moving towards flood risk citizenship?: Flood risk citizenship. *J. Flood Risk Manag.* 4, 288–297. <https://doi.org/10.1111/j.1753-318X.2011.01114.x>.
- Oppenheimer, M., Glavovic, B., Hinkel, J., van de Wal, R., Magnan, A., Abd-Elgawad, A., Cai, A., Cifuentes-Jara, M., DeConto, R., Ghosh, T., Hay, J., Isla, F., Marzeion, B.,

- Meyssignac, B., Sebesvari, Z., 2019. Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities, in: (C)Pörtner, H., Roberts, D., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E., Mintenbeck, K., Mintenbeck, A., Nicolai, M., Okem, A., Petzold, J., Rama, B., Wyr, N. (Eds.) (C), IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Intergovernmental Panel on Climate Change, Principality of Monaco.
- Prell, C., Hubacek, K., Reed, M., 2009. Stakeholder analysis and social network analysis in natural resource management. *Soc. Nat. Resour.* 22, 501–518. <https://doi.org/10.1080/08941920802199202>.
- Samaddar, S., Si, H., Jiang, X.Y., Choi, J., Tatano, H., 2022. How participatory is participatory flood risk mapping? Voices from the Flood Prone Dharavi Slum in Mumbai. *Int. J. Disaster Risk Sci.* 13, 230–248. <https://doi.org/10.1007/s13753-022-00406-5>.
- Sayers, P., Moss, C., Carr, S., Payo, A., 2022. Responding to climate change around England's coast - The scale of the transformational challenge. *Ocean Coast. Manag.* 225, 106187 <https://doi.org/10.1016/j.ocecoaman.2022.106187>.
- Scolobig, A., Linnerooth-Bayer, J., Pelling, M., Martin, J.G.C., Deubelli, T.M., Liu, W., Oen, A., 2023. Transformative adaptation through nature-based solutions: a comparative case study analysis in China, Italy, and Germany. *Reg. Environ. Change* 23, 69. <https://doi.org/10.1007/s10113-023-02066-7>.
- Suckall, N., Tompkins, E.L., Vincent, K., 2019. A framework to analyse the implications of coastal transformation on inclusive development. *Environ. Sci. Policy* 96, 64–69. <https://doi.org/10.1016/j.envsci.2019.03.003>.
- Suckall, N., Tompkins, E.L., Nicholls, R.J., Kebede, A.S., Lázár, A.N., Hutton, C., Vincent, K., Allan, A., Chapman, A., Rahman, R., Ghosh, T., Mensah, A., 2018. A framework for identifying and selecting long term adaptation policy directions for deltas. *Sci. Total Environ.* 633, 946–957. <https://doi.org/10.1016/j.scitotenv.2018.03.234>.
- Turnhout, E., Metz, T., Wyborn, C., Klenk, N., Louder, E., 2020. The politics of co-production: participation, power, and transformation. *Curr. Opin. Environ. Sustain.* 42, 15–21. <https://doi.org/10.1016/j.cosust.2019.11.009>.
- Ueberham, M., Kabisch, S., 2016. Resilience, risk communication and responsibility in the context of flood prevention - The relation between public protection and private mitigation in flood-prone settlements. *Hydrol. und Wasserbewirtsch.* 135–145.
- Vermeulen, S.J., Dinesh, D., Howden, S.M., Cramer, L., Thornton, P.K., 2018. Transformation in practice: a review of empirical cases of transformational adaptation in agriculture under climate change. *Front. Sustain. Food Syst.* 2 <https://doi.org/10.3389/fsufs.2018.00065>.
- Vila-Henninger, L., Dupuy, C., Van Ingelgom, V., Caprioli, M., Teuber, F., Pennetreau, D., Bussi, M., Le Gall, C., 2022. Abductive coding: theory building and qualitative (Re) analysis, 00491241211067508 *Sociol. Methods Res.* 0. <https://doi.org/10.1177/00491241211067508>.
- Walsh, B., van der Plank, S., Behrens, P., 2017. The effect of community consultation on perceptions of a proposed mine: A case study from southeast Australia. *Resour. Policy* 51, 163–171. <https://doi.org/10.1016/j.resourpol.2016.12.006>.
- Wincup, E., 2017. *Criminological Research: Understanding Qualitative Methods*, 2nd edition ed. SAGE Publications, Thousand Oaks, CA.
- Wong, P.P., Losada, I.J., Gattuso, J.P., Hinkel, J., Khattabi, A., McInnes, K.L., Saito, Y., Sallenger, A., 2014. Coastal Systems and Low-Lying Areas. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge; New York, pp. 361–409.
- Yin, R.K., 2014. *Case Study Research Design and Methods*, 5th ed. Sage Publications, California.
- Ziervogel, G., Enqvist, J., Metelerkamp, L., van Breda, J., 2022. Supporting transformative climate adaptation: community-level capacity building and knowledge co-creation in South Africa. *Clim. Policy* 22, 607–622. <https://doi.org/10.1080/14693062.2020.1863180>.