Transformation as praxis: responding to climate change uncertainties in marginal environments in South Asia

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This paper provides some of the conceptual and methodological underpinnings being developed in the ongoing TAPESTRY project which is part of the Transformations to Sustainability (T2S) Programme. We debate how the notion of transformation may be conceptualized from 'below' in marginal environments that are especially marked by high levels of climate-related uncertainties. We propose the notion of transformation as praxis — where the focus is on bottom-up change, identities, wellbeing and the recovery of agency by marginalized people and explore how 'patches' and the 'marginal' offer critical conceptual templates to examine whether and how systemic transformative changes are being assembled and effected on the ground by hybrid and transformative alliances. The article concludes by discussing potential challenges of such engagements, alongside pursuing a normative and political approach to T2S.

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Introduction

Climate change is a key threat to the sustainability of societies and their environments [1,2]. Yet, knowledge about the scale and impact of these changes remains deeply uncertain. This is particularly true at the local level, where uncertainties manifest themselves both in highly variable ecological systems and in interaction with other drivers of change [3•], thereby exacerbating the existing vulnerabilities of marginalised communities. Climate uncertainties are particularly acute in marginal environments (drylands, deltas and coastal ecosystems) where extreme events such as droughts, floods and cyclones intersect with the uneven impacts of capitalist expansion and threaten people's well-being as well as their sense of place and identity.

Climate-related uncertainty refers to the inability to predict the scale, intensity and impact of climate change on human and natural environments [4]. Uncertainties in climate change projections remain particularly high and, combined with economic and political drivers of change, make local-level effects difficult to predict [5]. There is a growing acknowledgement that climate science is better at dealing with uncertainties that arise due to macro trends, such as temperature extremes and sea level rise, than understanding the effects at the local level. This is due to downscaling challenges [6] which often create 'the envelope of uncertainty' [7] that intersects with social, political, economic, cultural and scientific domains, leading to a cascade of uncertainties [8•].

Uncertainty can be: aleatoric, referring to natural fluctuations, high degrees of variability and disequilibrium dynamics having unknown effects [9]; epistemic, dealing with indeterminate knowledge about changes and their impacts [5]; or linked to larger political economic conditions, including unanticipated outcomes of socio-political interventions and how they are experienced by diverse groups [10,11]. While uncertainty can exacerbate anxieties about the future [12,13], our starting point is that uncertainty can also provide an opportunity to create systemic transformative changes in so called marginal environments.

We demonstrate historically how distinctions have been created between 'marginal environments' (subjected to unpredictable natural events) and the 'environmental normal' regions, referring to the relatively productive, stable and predictable zones [14•]. We argue that such

negative portrayals are not only misleading but, critically, do not capture local residents' understandings of their environments and livelihoods, therefore calling for alternative framings of such 'marginal' environments as well as the lives and livelihoods that they sustain. The 'marginal environments' that we are studying are disaster-prone and characterized by ecological uncertainties arising from floods, wetland loss/degradation and droughts as well as rapid socio-economic change, often leading to growing inequality and vulnerability of marginalized people. While local communities may have historically developed practices and memories to deal with uncertainties arising due to environmental variability and seasonality [15], these might not be sufficient to respond to the radical uncertainties generated by current climate change impacts [16] and further exacerbated by socio-economic trajectories. In response, state driven interventions have tended to resort to bureaucratic, techno-centric/top down approaches geared towards 'controlling uncertainty' [17,18•,10] yet these often falter or can harm certain groups, in particular the poor [19]. Given these challenges, action is required that goes beyond incremental change and instead warrants systemic transformative change [20,21].

In this paper, we focus on linkages between uncertainty and transformation in marginal environments. Building on some of the conceptual and methodological underpinnings being developed in the TAPESTRY project, which is part of the Transformations to Sustainability (T2S) Programme,[6] we focus on how transformation may be discussed and conceptualized from 'below' in marginal environments that are marked by high levels of climate change induced uncertainties. We suggest that 'local' (patches) and the idea of transformation as praxis are critical conceptual templates to help map and explain how systemic transformative changes can be assembled and effected on the ground through a range of interactions between social actors, socio-economic and political processes and co-produced knowledges. We then turn to some of the methodological underpinnings of this approach before concluding by examining some of the potential challenges of such engagements, alongside pursuing a normative and political approach to T2S.

What is transformation?

The idea of transformation in response to climate change is rooted in multiple disciplines and means different things to different scholarships. This makes it challenging to come to a consensus on what 'transformation' actually entails [22]. Contemporary mainstream approaches in both adaptation and mitigation have tended to be only incremental in nature or even maladaptive [21,23]. Despite the many divergences in the transformation literature, a general consensus is that transformation goes beyond marginal change, is non-linear and challenges the status quo of

existing development structures [24,21,25,26]. It requires innovation and a profound shift in the way we think and act, including our values, consumption patterns and conceptions of well-being, which are closely associated with understandings of culture, place and identity. A key issue is to frame the ideas of transformation not only in terms of responding to threats, but also as moments of opportunity and policy windows [18•].

We thus ask how and whether uncertainty can be an opportunity to reframe how we view marginal environments and bring about transformative change co-produced with local communities and other actors (see also Ref. [27•]). Following Few *et al.* [28•], we distinguish between transformational adaptation, which tends to address immediate causes of vulnerability, from transformative adaptation, which can be an opportunity to address root causes and in effect 'to reconfigure the meaning and trajectory of development' [24]. This means questioning dominant economic and development discourses that require the reconfiguration of knowledge and value systems, and the reorganisation of institutions and frameworks [28•]. Our focus is also on *deliberate* as opposed to *emergent* or *outcome* transformation. Deliberate efforts seek to alter development pathways away from those that cause current vulnerabilities [26], unravelling development alternatives that tackle climate change uncertainties and address marginality and vulnerability. We are mindful that no historical precedent of a deliberate transformation of this nature exists [29] and that uncertainty can also be politicised and can serve as a fig leaf for the status quo. Thus, we follow Blythe *et al.* [30•] who warn against the dark sides of transformation and the 'latent risks' in the shift from merely pursuing descriptive outcomes (emergent) to prescriptive (deliberate) approaches. That is, in merely shifting the response burden to the most vulnerable, transformation discourses can be used to justify business as usual by ignoring social differentiation, overlooking conflict or opposition to change and paying insufficient attention to power and politics.

These risks count for both macro and micro scales, including bottom-up initiatives. We take a normative stance and position the needs and interests of marginalised communities in marginal environments upfront, recognising that these communities will be socially differentiated due to caste, gender, class, *Adivasi* (tribal), ethnicity, religion, knowledge, the capacity to act and power relations (both between individuals and within communities and between individuals and communities and the state). Social and intergenerational differences may also lead to different understandings of transformation across individuals and social segments. Building on earlier T2S projects, our normative position involves a kind of 'transgressive learning' that 'intentionally generates critical thinking and collective agency and praxis that directly and explicitly challenges those aspects of society

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that have become normalized' [31•]. This means focussing specifically on issues of epistemic, environmental, social and gender injustices as well as domination and privilege upfront.

Patches and praxis

TAPESTRY focuses on how transformation may arise from 'below' in marginal environments through hybrid alliances between natural resource dependent communities, NGOs (non-governmental organisations), scientists and (sympathetic) state agencies. Such alliances and their initiatives serve as 'seeds' or 'socio-ecological bright spots' that can improve environmental conditions and human well-being [32]. We ask whether they can also provide scope to reimagine nature/society relations in environments affected by climate-change related uncertainties. We call these 'patches of transformation' — sites and exemplars amidst largely unsustainable processes where hybrid alliances, and their innovative initiatives, reimagine sustainable development and inspire transformative societal changes that can be scaled up and out. While acknowledging that such emergent processes may be resisted by incumbent players and may not always challenge underlying inequalities associated with class, ethnicity, gender or caste [33], we believe that hybrid and co-produced initiatives provide a fertile ground for more embedded, inductive and bottom-up processes of transformation. Each patch is unique; some fade, others grow or merge to form a tapestry.

Patches are sites where specific processes (alliances, initiatives) are challenging dominant trajectories of development, and where relations of power and knowledge are being reconfigured in more heterogeneous and deliberative ways to challenge dominant framings of nature-society relations and create spaces in which new practices emerge. Thus, collaborative and deliberative projects which seek to reframe dominant practices and tackle questions of power and privilege upfront in the context of sustainability may be understood as patches. Rather than develop fixed criteria upfront, we map processes of making and unmaking as they unfold. Towards the end of the project, we may provide some exemplars and process-based criteria regarding how these patches and their related alliances and strategies can be scaled up and out.

The discursive struggles over place and space are as important as the physical nature of the sites themselves. Such practices take place between hybrid actors (e.g. local communities, scientists, NGOs) and involve questioning, reframing and reconfiguring constellations of power, knowledge and identities. Drawing on Haraway's [34] idea of Chthulucene – 'the making of kin' – this involves forging new networks, tentacles and webs that lead to new alliances across classes and categories of people, species, knowledge groups as well as relations of power and dominance.

In each of our patches, initiatives around livelihoods, biodiversity, pollution abatement or sustainable resource use are challenging dominant narratives of climate related uncertainty in marginal environments (see below). These discourses and practices may start in small and experimental ways, and we will examine ways in which they can be scaled up and out from the patches. Thus, our notion of patches focuses not just on the innovation per se but more importantly on the strategies of the disempowered in marginal spaces who are part of hybrid alliances.

TAPESTRY is concerned with two aspects of transformation: how transformation happens in these 'patches' through co-production and alliances and how these initiatives can be scaled up and out — in sum the praxis of transformation. We define *praxis* as a reflexive process involving both a critique of the existing social arrangements/status quo and the search for alternatives [35,36]. We build on a rich tradition of theories of social change, emphasising the interplay of agency and social reproduction [37–39,40•,41] as well as the multiple ways of valuing, knowing and doing [42]. Importantly, praxis may be explored as the capability to change [43–45]. Successive judgements across scales and in many dimensions will interlink to make up transformation, affecting its likelihood and quality.

As a concept, praxis challenges the duality between theory and implementation (theory and practice) or knowing and doing [42] and underlines that change occurs through an ongoing dialectic between knowledge and practice. There is a certain normativity to our idea of praxis as this is more about 'changing than merely interpreting the world' [46]. In other words, building on actor-oriented approaches, change is not just predetermined by structural forces and is not always historically determined. Praxis is a key dimension in structuration theory which looks at the interplay of structure and agency and how the social order is produced, reproduced or subverted [47]. Structuration theory however does not explicitly address questions of radical social change, disruptive power and transgressions of 'normalised' social order [48]. Following Freire [40•] we take an emancipatory understanding of praxis as it is linked to self-conscious social actions [40•], linked to certain values (justice, equity, capability expansion) and the ongoing dialectic between knowledge and practice. This is also linked closely to the idea of 'deliberate' transformation or informed action which seeks to facilitate socially just processes through an explicitly normative positioning of praxis as value-oriented and bottom-up change.[7]

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[7] Our approach is different from collective action theories which tend to look at action in an instrumental way in terms of achieving common goals without looking at the tensions and contractions in the outcomes as well as thorny issues of social differentiation, power and politics.

Transformation as praxis is an embedded, reflexive and engaged process of change aimed towards transformation of the self and the wider social and political/institutional arrangements and is an attempt to reconfigure the dominant development trajectory. Thus, for any meaningful transformation to occur, we need to engage with change at the individual and collective (i.e. patches) as well as institutional levels. To study and be part of these processes provide important opportunities for transformative science.

Key to transformative praxis is a better understanding of how agency can be strengthened to bring about deep-seated structural alterations in the patches and consequently inform wider societal changes. Human agency is central to responses to environmental change and crises [49] and constitutes the personal sphere through which transformations can be motivated [50]. Thus, it is important to engage with how and whether practices of co-producing socio-ecological knowledge (on agriculture, livestock, livelihoods and ecosystem conservation) can enhance the agency of people living in marginal areas to transform existing socio-political structures of power and recognition and assess whether such initiatives can serve to counter entrenched injustices and political exclusion in current systems of knowledge-making, governance and valuation [51].

The processes of scaling up and out will link transformations across the personal, inter-personal and wider society [50]. They include a diversity of actors (local communities, state agencies, civil society and academics) to forge *transformative alliances* that challenge dominant power structures. In this way, we expand on O'Brien and Sygna's [50] concept of 'spheres of transformation' (namely practical, political and personal) through our notion of transformative alliances, as it brings all three spheres into play.

Uncertainty, meaning making and the reframing of marginal environments in the patches

We are studying and co-producing transformation in selective patches in marginal areas of India and Bangladesh. Both countries have ecologically dynamic environments at risk from climate shocks and stressors while witnessing accelerated capitalist growth trajectories that exacerbate social and political inequities, with high environmental costs affecting the poor. They also face a range of climatic challenges, including rising average temperature, high rainfall variability, changes in river flow regimes, sea-level rise and flooding which intersect with other drivers of change such as industrial development, resource grabs and wider politics [3•]. Our patches are **Mumbai**, a mega-urban coastal region in western India largely reclaimed from the sea. In urban Mumbai, coastal ecosystems, mangroves and wetlands have been systematically appropriated by the state and private actors for

commercial and infrastructure development purposes, negatively affecting the livelihoods, wellbeing and identities of the Koli fishers who are the original inhabitants of the region. Together with civil society groups – Bombay 61 and the Conservation Action Trust – we are working with fishers on issues concerning mangrove restoration and appropriation by powerful actors as well as sustainable waste management of the creeks through innovative methods. **Kutch** is a dryland located in the state of Gujarat where herders have been systematically marginalised and climate and other changes (e.g. rapid industrialisation along the coast) have made their livelihoods even more precarious. The Kharai (swimming) camel is a unique indigenous breed but its habitat is under threat due to industrialisation on the coast which is destroying the mangrove eco-system. We are working with Sahjeevan and the Camel Breeder's Association (KUUMS) on initiatives that seek to help pastoralists reclaim their pastoral identities and lifestyles as well as develop livelihoods that are climate resilient and flexible. **The Sundarbans** delta in India and Bangladesh is home to the largest mangrove forest area in the world, recognized by UNESCO as a world heritage site due to its ecological and cultural significance. It is also considered to be a climate change 'hotspot' due to frequent natural disasters (e.g. cyclones, storm surge flooding, land erosion) and climatic stressors (sea level rise, disappearing islands). In the Sundarbans, alliances between NGOs, scientists and local people have been challenging state-dominated development trajectories that have tended to neglect the dynamic nature of the delta and are also exploring new farming and fishing methods that can help strengthen and diversify livelihood options in the delta.

Through these initiatives in the patches, we are seeking to reconceptualise what have been hitherto considered as marginal environments by reimagining them instead as vibrant spaces of transformative change. Why is this important? Environmental historians have demonstrated how large swathes of South Asia, through the course of the long nineteenth century under British colonial rule, were classified under the broad rubrics of 'marginal environments' on the one hand, and the 'environmental normal' on the other [14•]. This colonial administrative perception arose from the belief that marginal environments were hostage to extreme natural events such as droughts, floods, earthquakes and violent river behaviour, while the 'environmental normal' regions referred to the relatively stable, predictable and productive zones of the British empire. This 'marginality' trope also reinforced other stereotypes such as remoteness from the main centres of wealth and being peopled by impoverished communities of pastoralists, herders, nomads, subsistence cultivators, artisanal fishers and forest tribes. Historically, as well as in current times, the contrasts between the 'marginal' and the 'normal' shape different types of administrative interventions and state capacities and also

create sociological and economic distinctions. According to Damodaran and D'Souza [14•] the marginal was about subsistence communities that were characterised by mobility, vulnerability and regular environmental distress, while the normal was comprised of commercial farming communities, revenue paying peasantry and environments defined by their legibility as sites for commodity production.

Inhabitants of these marginal environments, moreover, have been subjected to the bias of the 'normal'. Pastoralists, for example, have been subject to policies for forced sedentarisation and fishers on Mumbai's coast have had their claims on the city's marshes and edge ecologies ignored or criminalized. Similarly, in the Sundarbans, cultivators have often been portrayed as only living in desperate poverty and therefore in need of a planned exit strategy.

Our research however, building on local residents' own understandings of their localities, is seeking to reframe such conceptions of 'marginal environments'. For example, some pastoralist groups and activists are reframing drylands from being 'wastelands' to savannah landscapes that can successfully sustain pastoralist livelihoods and recognise the synergistic human-environment relationships. Similarly, some of Mumbai's Kolis are themselves engaged in struggles to reframe their community lands from 'slums' to coastal zone areas deserving of protection (CRZ III zone areas) and to properly demarcate the boundaries of their communal land in urban planning maps. Thus, transformative alliances require new stories and imaginings to guide and make sense of new complexities and uncertainties [34]. There is immense possibility here to examine how individuals and groups of people can re-imagine uncertain marginal environments such as drylands or wetlands to push back against dominant framings and trajectories of development.

TAPESTRY recognizes the messiness and entanglements embedded in co-production, scaling up/out and working towards change. At every point, it is important to be aware of the power laden nature of such processes, the trade-offs between competing interests and demands and also to recognise that emergent processes may or may not always challenge the underlying inequalities and social dynamics that arise due to class, ethnicity, caste, gender, minority and *adivasi* (tribal) dynamics. It is thus important to also engage critically with knowledge intermediaries (namely, frontline bureaucrats, activists, grassroot workers, CBOs, academics and also community leaders) who speak on behalf of local people.

Methodological considerations

Transformation, whether incremental or structural, needs to be looked at and evaluated from a *longue durée* perspective so that the changes can be mapped out both for their short and long-term impacts on socio-ecological systems. The focus on praxis also lends itself to action-oriented research guided by reflexivity, dialogue and negotiation between all the partners where research is also treated as being part of the design for steering and realizing changed outcomes on the ground.

In each patch, the work is taking place in a transdisciplinary collaboration involving both researchers and CBOs. Through art-based and visual methods (photovoice), we are eliciting stories and narratives from below and the margins to counter elite perceptions of lands, resources as well as the lived experiences of the neoliberal processes of accumulation of coastal resources and spaces. Since we are interested in reframing marginal landscapes, we are focusing on the knowledge dynamics and contestations that exist around socio-ecological relations, such as the relations between camel grazing and mangroves or diverse perceptions of the quality of water in creeks, rivers and along the coastlines. Here, we seek to demonstrate the perceptions of local women and men, civil society and officials to qualitatively understand diverse narratives around the dynamics of environmental change over time.

Additionally, archival research in all the patches provides historically situated understandings of uncertainty as well as contrasts between official and local responses. The notion of the temporal, in effect, for the purposes of our project, will require us to grasp the historical nature of change rather than accepting time as a simple seamless movement in space. Consequently, we will be attentive to aspects of temporal continuities in local contexts as much as we will be alert to differences brought on by moments of sharp rupture such as colonialism and the impetus for modernization and industrialisation. In sum, historical frameworks and approaches will be critical to informing our understanding of environmental and social change in the patches. We also draw upon natural science methods (e.g. GIS, remote sensing and participatory mapping) to examine landscape dynamics, patterns and changes over time. This tempo-spatial information and mapping can hopefully validate discredited indigenous ecological knowledges, and help in improving our understanding of people's stories and narratives around human-nature relations and values, for example, camel-mangrove relations in Kutch.

Normative considerations, challenges and conclusions

While conceptual thinking on transformation has seen considerable interest and growth in recent years [22], there remains a dearth of empirical evidence that explores bottom-up processes of transformation, that is, their drivers, challenges and outcomes for sustainability/social and gender justice. The transformation literature remains vague regarding normative positions and how to actualize

transformation, with some notable exceptions (e.g. Refs. [52•,31•]). This paper presents a normative project built on the idea of transformation as praxis. However, it has also outlined some of the barriers, challenges and opportunities for systemic transformation.

Researching 'transformation as praxis' involves addressing multiple understandings and perceptions of vulnerabilities, and uncertainties from diverse actors (e.g. state, researchers, activists, environmentalists, NGOs, urban and rural dwellers), with an aim of seeking epistemic justice for marginalised voices and people [52•]. However, what counts as transformation or not is not straightforward. We observed during fieldwork before the pandemic[8] that it is difficult for local communities (both rural and urban) to respond to abstract questions regarding transformation because of questions of scale, attribution, and temporality. While the local communities are affected by the here and now, transformation is usually associated with changing wider systems that are historically enmeshed in unequal power relations, landscape imaginaries and ecological changes. As Blythe *et al.* [30•] and Taylor [23] have noted, insufficiently addressing broader political economy factors may obscure questions of responsibility and shift it 'downwards' to individuals at the community level. We are aware of such risks, but posit that the patches and the bottom-up approach of 'transformation as praxis' may, in fact, provide an entry point to challenge precisely such incumbent power structures through multiple (collective) strategies, at different scales while giving a voice to vulnerable residents in the patches. Additionally, by working with local partners who are also involved in documenting and challenging government policies through legal processes and advocacy work, our focus is also on macro level changes at the city or regional scale (e.g. issues related to flood risk mitigation in Mumbai and mangrove conservation along the coastline).

It also leads us to questioning 'who is seeing transformation and for whom?'. Thus, there is an additional ethical responsibility on the part of researchers and practitioners to reflect carefully on the processes unfolding and wrestle with these plural meanings, tensions and contradictions. While addressing livelihood security in a context of climate change uncertainties, we also need to be mindful of trade-offs between environmental and social goals and be vigilant to maladaptive pathways that could inadvertently be promoted in the patches. For example, prawn cultivation or aquaculture can provide livelihood security but may not be environmentally sustainable. Our approach is not to provide immediate relief but to

comprehend historical changes in order to suggest more sustainable long term solutions, especially since livelihoods and social goals such as equity and justice cannot be addressed only through technical approaches to risk reduction or livelihoods.

Finally, can doing research in the midst of a pandemic be seen as an opportunity for transformation? The pandemic has laid bare problems of inequalities and unequal access to public goods such as health, water and sanitation. The pandemic has also intersected with ongoing crises of food, pollution, water and climate, thus threatening already fragile livelihoods, especially in marginal environments, compounding uncertainties and vulnerabilities for marginalized people. In our patches, the responses from above have been inadequate, too late, or complete failures. Still, we have seen a burst of mutual aid and solidarity as well as civic action. There are also many examples of resilience at the local level, especially amongst several pastoralists, fishers and farmers who have turned to subsistence production. Historical studies of epidemics have shown how they can lead to new visions about political and societal organization [53]. The post-COVID recovery period should thus build on these lessons and hopefully bring about the systemic shifts badly needed to address locally appropriate and socially just transformations to sustainability.

Conflict of interest statement
Nothing declared.

References and recommended reading
Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest

1. Adger W, Barnett J, Brown K, Marshall N, O'Brien K: **Cultural dimensions of climate change impacts and adaptation**. *Nat Clim Change* 2013, **3**:112-117 http://dx.doi.org/10.1038/nclimate1666.

2. Hulme M: *Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity*. Cambridge: Cambridge University Press; 2009.

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[8] We had begun ethnographic and in-depth fieldwork in all the patches which at the time of writing has been suspended due to the pandemic. While some research is taking place digitally (e.g. through online mediated interviews), we are hoping some fieldwork can resume soon.

3. Mehta L, Srivastava S, Adam HN, Alankar SB, Ghosh U, Kumar VV:
• **Climate change and uncertainty from 'Above' and 'Below': perspectives from India**. *Reg Environ Change* 2019, **19**:1533-1547 http://dx.doi.org/10.1007/s10113-019-01479-7.

4. Curry JA, Webster PJ: **Climate science and the uncertainty monster**. *Bull Am Meteorol Soc* 2011, **92**:1667-1682 http://dx.doi.org/10.1175/2011BAMS3139.1.

5. Barros V, Dahe Q, Field C, Qin DJ, Dokken KL, Ebi MD, Mach GK, Plattner SK, Allen M, Stocker T *et al.*: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*. New York: Cambridge University Press; 2012.

6. Bhave AG, Conway D, Dessai S, Stainforth DA: **Barriers and opportunities for robust decision making approaches to support climate change adaptation in the developing world**. *Clim Risk Manage* 2016, **14**:1-10 http://dx.doi.org/10.1016/j.crm.2016.09.004.

7. Wilby RL, Dessai S: **Robust adaptation to climate change**. *Weather* 2010, **65**:180-185 http://dx.doi.org/10.1002/wea.543.

8. Srivastava S, Mehta L, Bose S: **A 'Natural Disaster' on top of a**
• **pandemic – preparedness in the face of cascading uncertainties**. *IDS Opinion Piece*. Brighton: IDS; 2020 https://www.ids.ac.uk/opinions/a-natural-disaster-on-top-of-a-pandemic-preparedness-in-the-face-of-cascading-uncertainties/.

9. Achutarao K: **Uncertainty from above: can it be reduced?** *Paper Presented at Workshop on Climate Change and Uncertainty from Above and Below, New Delhi, January 2016* 2016 https://www.slideshare.net/Stepscentre/krishna-achutarao-uncertainty-from-above-can-it-be-reduced.

10. Wynne B: **Uncertainty and environmental learning: reconceiving science and policy in the preventive paradigm**. *Glob Environ Change* 1992, **2**:111-127.

11. Mehta L, Leach M, Newell P, Scoones I, Sivaramakrishnan K, Way S-A: *Exploring Understandings of Institutions and Uncertainty: New Directions in Natural Resource Management, IDS Discussion Paper 372*. Brighton: IDS; 1999.

12. Fritze JG, Blashki GA, Burke S, Wiseman J: **Hope, despair and transformation: climate change and the promotion of mental health and wellbeing**. *Int J Mental Health Syst* 2008, **2**:13 http://dx.doi.org/10.1186/1752-4458-2-13.

13. Penrod J: **Refinement of the concept of uncertainty**. *J Adv Nursing* 2001, **34**:238-245 http://dx.doi.org/10.1046/j.1365-2648.2001.01750.x.

14. Damodaran V, D'Souza R: *Commonwealth Forestry and*
• *Environmental History: Empire, Forests and Colonial Environments in Africa, the Caribbean and South Asia and New Zealand*. New Delhi: Primus Books; 2020.

15. Heredia RC, Ratnagar S: *Mobile, and Marginalized Peoples: Perspectives from the Past*. New Delhi: Manohar; 2003.

16. Mukhopadhyay A: *Living with Disasters: Communities and Development in the Indian Sundarbans*. New Delhi: Cambridge University Press; 2016.

17. Van der Sluijs J: **Uncertainty as a monster in the science-policy interface: four coping strategies**. *Water Sci Technol* 2005, **52**:87-92 http://dx.doi.org/10.2166/wst.2005.0155.

18. Scoones I, Stirling A: *The Politics of Uncertainty: Challenges of*
• *Transformation*. London: Routledge; 2020.

19. Leach M, Scoones I, Stirling A: *Dynamic Sustainability's: Technology, Environment, Social Justice*. Oxon: Earthscan; 2010.

20. Westley F, Olsson P, Folke C, Homer-Dixon T, Vredenburg H, Loorbach D, Thompson J, Nilsson M, Lambin E, Sendzimir J: **Tipping toward sustainability: emerging pathways of transformation**. *AMBIO J Hum Enviro* 2011, **40**:762-780 http://dx.doi.org/10.1007/s13280-011-0186-9.

21. O'Brien K: **Global environmental change II from adaptation to deliberate transformation**. *Prog Hum Geogr* 2012, **36**:667-676 http://dx.doi.org/10.1177/0309132511425767.

22. Feola G: **Societal transformation in response to global environmental change: a review of emerging concepts**. *Ambio* 2014, **44**:376-390 http://dx.doi.org/10.1007/s13280-014-0582-z.

23. Taylor M: *The Political Ecology of Climate Change Adaptation*. London: Routledge; 2014.

24. Pelling M: *Adaptation to Climate Change: From Resilience to Transformation*. London: Routledge; 2011.

25. Jackson T: *Prosperity without Growth: Economics for a Finite Planet*. London: Earthscan; 2009.

26. Pelling M, O'Brien K, Matyas D: **Adaptation and transformation**. *Clim Change* 2014, **133**:113-127 http://dx.doi.org/10.1007/s10584-014-1303-0.

27. Nightingale A, Eriksen S, Taylor M, Forsyth T, Pelling M,
• Newsham A, Boyd E, Brown K, Harvey B, Jones I *et al.*: **Beyond technical fixes: climate solutions and the great derangement**. *Clim Dev* 2020, **12**:343-352 http://dx.doi.org/10.1080/17565529.2019.1624495.

28. Few R, Morchain D, Spear D, Mensah A, Bendapudi R:
• **Transformation, adaptation and development: relating concepts to practice**. *Palgrave Commun* 2017, **3**:17092 http://dx.doi.org/10.1057/palcomms.2017.92.

29. Scoones I, Leach M, Newell P: *The Politics of Green Transformations*. Oxon: Routledge; 2015.

30. Blythe J, Silver J, Evans L, Armitage D, Bennett NJ, Moore ML,
• Morrison T, Brown K: **The dark side of transformation: latent risks in contemporary sustainability discourse**. *Antipode* 2018, **50**:1206-1223 http://dx.doi.org/10.1111/anti.12405.

31. Lotz-Sisitka H, Ali M, Mphepo G, Chaves M, Macintyre T,
• Pesanayi T, Wals A, Mukute M, Kronlid D, Tran D: **Co-designing research on transgressive learning in times of climate change**. *Curr Opin Environ Sustain* 2016, **20**:50-55 http://dx.doi.org/10.1016/j.cosust.2016.04.004.

32. Bennett EM, Solan M, Biggs R, McPhearson T, Norstrom A, Olsson P, Pereira L, Peterson G, Raudsepp-Hearne C, Biermann F *et al.*: **Bright spots: seeds of a good anthropocene**. *Front Ecol Environ* 2016, **14**:441-448 http://dx.doi.org/10.1002/fee.1309.

33. Godfrey-Wood R, Naess LO: **Adapting to climate change: transforming development?** *IDS Bull* 2016, **47**:49-62 http://dx.doi.org/10.19088/1968-2016.131.

34. Haraway D: **Anthropocene, capitalocene, plantationocene, chthulucene: making kin**. *Environ Humanit* 2015, **1**:159-165 http://dx.doi.org/10.1215/22011919-3615934.

35. Benson JK: **Organizations: a dialectical view**. *Adm Sci Q* 1977, **22**:1-21 http://dx.doi.org/10.2307/2391741.

36. Myeong-Gu S, Creed WED: **Institutional contradictions, praxis, and institutional change: a dialectical perspective**. *Acad Manage Rev* 2002, **27**:222-247 http://dx.doi.org/10.2307/4134353.

37. Gramsci A: *Selections from the Prison Notebooks of Antonio Gramsci*. New York: International Publishers; 1971.

38. Bourdieu P: *Outline of a Theory of Practice*. Cambridge: Cambridge University Press; 1977.

39. Giddens A: *The Constitution of Society: Outline of the Theory of Structuration*. Berkeley: University of California Press; 1984.

40. Freire P: *Pedagogy of the Oppressed*. London: Bloomsbury
• Publishing; 2000.

41. Shove E: **Beyond the ABC: climate change policy and theories of social change**. *Environ Plann A* 2010, **42**:1273-1285 http://dx.doi.org/10.1068/a42282.

42. Kilminster R: *Praxis and Method*. London: Methuen; 1979.

43. Sen A: *Inequality Re-examined*. Oxford: Clarendon Press; 1992.

44. Sen A, Nussbaum M, Sen A: **Capability and wellbeing**. *The Quality of Life*. Oxford: Clarendon Press; 1993.

45. Sen A: *Development as Freedom*. Oxford: Oxford Paperbacks; 2001.

46. Marx K: *Thesis 11. Theses on Feuerbach*. 1845 https://www.marxists.org/archive/marx/works/1845/theses/theses.htm.

47. Cohen I: *Structuration Theory: Anthony Giddens and the Constitution of Social Life*. London: Macmillan International Higher Education; 1989.

48. Turner J: **The theory of structuration**. *Am J Sociol* 1986, **91**:969-977.

49. Brown K, Westaway E: **Agency, capacity and resilience to environmental change: lessons from human development, well-being, and disasters**. *Annu Rev Environ Resour* 2011, **36**:321-342 http://dx.doi.org/10.1146/annurev-environ-052610-092905.

50. O'Brien K, Sygna L: **Responding to climate change: 'the three spheres of transformation'**. In *Paper Presented at Proceedings of Transformation in a Changing Climate conference*; *University of Oslo, Norway: 2013*.

51. Burke BJ, Heynen N: **Transforming participatory science into socioecological praxis: valuing marginalized environmental knowledges in the face of the neoliberalization of nature and science**. *Environ Soc* 2014, **5**:7-27 http://dx.doi.org/10.3167/ares.2014.050102.

52. Temper L, Del Bene D: **Transforming knowledge creation for**
   • **environmental and epistemic justice**. *Curr Opin Environ Sustain* 2016, **20**:41-49 http://dx.doi.org/10.1016/j.cosust.2016.05.004.

53. Atwood E, Williamson S: **Plague and protest go hand in hand**. *Jstor Daily*. 2020. August 19th 2020, https://daily.jstor.org/plague-and-protest-go-hand-in-hand/.