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TOPOCAL REVIEW

Engaging with uncertainty and ambiguity through participatory ‘Adaptive Pathways’ approaches: scoping the literature

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Abstract

Climate change adaptation planning demands decision-making under conditions of uncertainty and ambiguity. Adaptive Pathways (AP) planning is receiving increased attention as a method to guide adaptation planning in the face of uncertainties. The approach has been most extensively developed and applied in large, well-funded contexts such as the Thames Barrier and Dutch Delta program. However, the development of AP planning has focused much less on the parallel need for engaging with the challenge of ambiguity—that there are diverse, sometimes contending, knowledges, values, and stakes involved. A more nascent body of work has been exploring ways of engaging with both the uncertainties and ambiguities of adaptation through various participatory approaches to AP planning. This paper sought to synthesise insights from this emerging work. Examining the peer-reviewed and grey literature identified eight cases from four countries across five different policy issues that provided details of how they approached diverse participation. Analysis of this small suite of cases provided some key insights for those seeking to use participatory approaches to AP planning to engage with the inherent uncertainties and (arguably necessary) ambiguities of adaptation. The paper concludes with a call for greater publication of details regarding how participatory approaches to methods such as AP planning have been undertaken not just what was undertaken.

1. Introduction

Even as our understanding grows that human activity is changing the climate, uncertainty will remain inherent in adaptation decision-making. These uncertainties are associated with the rate (and magnitude) of climatic changes, the potential for nonlinear changes in the climate and ecosystems, long time horizons, and political and social responses and changing values (Schneider and Lane 2006, Dessai et al 2009, Green and Weatherhead 2014, IPCC et al 2018). As Schneider and Lane (2006:13) emphasise, ‘this should not be interpreted as a sign that scientists cannot assign a high degree of confidence to any of their projected climate change impacts, but rather that the scope of possible consequences is quite wide’. Consequently, adaptation plans based on a singular ‘optimal’ pathway, or a ‘most-likely’ scenario are destined for failure because the future will inevitably be different from those hypothesized (Walker et al 2003, Haasnoot et al 2013). This requires adaptation planning to identify a range of actions that are both robust across multiple plausible futures and that can be adapted in response to indicators of change.

A substantial body of work has been developing and applying a planning method called Adaptive Pathways (AP) planning to help guide decision-making under conditions of uncertainty. It aims to help planners identify robust actions that can support the targeted system to adapt to changing climatic, social, environmental, and economic conditions (Haasnoot et al 2013). Through a form of structured decision-making, AP planning aims to help users explore and plan sequences of actions (pathways) that can respond to changing conditions over time by working through five broad and iterative activities:

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(1) define goals and objectives;
(2) understand the current situation;
(3) analyse possible futures, including analyses of vulnerabilities, opportunities, and assessing the efficacy of actions under different futures to identify system and action thresholds (points at which an action no longer performs satisfactorily in relation to objectives);
(4) develop adaptation pathways that consist of ‘a concatenation of actions, where a new action is activated once its predecessor is no longer able to meet the definition of success’ (Haasnoot et al 2013); and
(5) implement, monitor, evaluate, report, and improve.

This approach to adaptation planning has its antecedents in adaptive planning in environmental management (Holling 1978, McIain and Lee 1996) and the decision and policy sciences (Lempert et al 1996:236). In 2003, UKCIP guidance asked, ‘Can adaptation options be identified that could be increased at a later date, or implemented separately or in combination or in sequence to provide flexible levels of response to risk?’ (Willows et al 2003). This thinking informed development of the ‘route-map’ approach used in the Thames Estuary 2100 project (Reeder and Ranger 2011). In turn, that approach informed development of New York City’s infrastructure adaptation plan (Rosenzweig and Solecki 2010). At the same time, Kwadijk et al (2010) and others at Deltares argued for an approach that defines different ‘thresholds’ or tipping points regarding if and when other adaptation strategies may be needed, which informed the Netherlands National Water Masterplan 2009–2015.

Haasnoot et al (2011) built upon that work to develop the Dynamic Adaptive Policy Pathways (DAPP) approach, which combines adaptive policymaking and AP concept, to includes the route-map or decision-pathways and tipping point methods (Jeukens et al 2015). DAPP currently informs the Dutch Delta program (Jeukens et al 2015: 716). Consequently, AP planning has been mostly developed and applied in large, well-funded infrastructure projects (Lawrence and Haasnoot 2017), with clearly defined decision-makers, reasonably unambiguous goals (Wise et al 2014).

In more ambiguous contexts where decision-makers, goals, means, stakes, values and knowledges are diverse and sometimes contending, there is much less guidance on using the AP approach to adaptation planning. Yet there are several reasons for seeking to understand how and whether AP planning could engage with such ambiguities. Firstly, ambiguity cannot be solved by more information (Leith et al 2014, Cairney 2016: 5). Rather, it might be reduced by dialogue and knowledge sharing between different stakeholders (Refsgaard et al 2013). This means adaptation planning must be participatory (Leach et al 2010, Mimura et al 2014, Dewulf and Termeer 2015, van der Brugge and Roosjen 2015, Chelleri et al 2016, Eisenhauer 2016, Gibbs 2016, Tschakert et al 2016, Bosomworth et al 2017, Wallis et al 2017, Burnham et al 2018). Secondly, framing of the adaptation problem, selection of goals, means to achieve those goals, and evaluation of the outcomes are all driven by whose knowledge, values and stakes are involved (Rein and Schon 1993, Hajer 1995). Therefore, adaptation planning must also consider a diversity of representation and procedural equity (how people might be able to participate) (Paavola and Adger 2006, Scholzberg 2012). Thirdly, participatory approaches are more likely to enhance the adaptive capacity of social learning (Ballard 2005, Pahl-Wostl 2009). All of this points to the need for adaptation planning approaches such as AP planning, to give as much attention to how participatory processes are designed and conducted, as that given to the planning method itself.

While there is a nascent body of work exploring participatory approaches to AP planning to engage with ambiguities, collation of insights from that work has yet to be developed. This paper therefore seeks to synthesise insights from that work to help understand how AP planning might be approached to also support decision-making under conditions ambiguity. By examining both grey and academic literature, the review sought to identify themes within challenges and possibilities associated with participatory AP planning as a means of engaging with this challenge.

2. Methods

Given the above, this review sought cases of participatory AP planning where stakeholders with interests and/or responsibilities for adaptation planning actively participated in the entire planning process, and where details were provided as to how the participatory approach was undertaken. To find such cases, a broadly systematic literature review process was combined with targeted Google searches on individual cases found through the systematic process. The terms ‘adaptive pathways’ AND ‘climate change’, ‘adaptation pathways’ AND ‘climate change’, and ‘adaptive policy pathways’ AND ‘climate change’, were searched using four search engines: Scopus, Web of Science, Science Direct, and Google Scholar. The search protocol defined inclusion and exclusion criteria (table 1).

Making the review practicably feasible also presented several limitations. In an effort to be systematic, we only reviewed documents that explicitly used our search terms. As a result, adaptation processes that might be regarded as involving an adaptation pathway approach but were not referred to as such would not have been captured. In addition, the search terms may
Table 1. Inclusion and exclusion criteria.

| Inclusion criteria                                      | Exclusion criteria                                                                 |
|--------------------------------------------------------|-------------------------------------------------------------------------------------|
| Application of adaptation or adaptive pathways planning| Refers to adaptation pathway, or pathways but does not apply the concept in its approach e.g. reviews or guidebooks |
| Peer-reviewed or grey literature (Mahood et al. 2014)   | Conference abstracts or proceedings, magazine articles, dissertations, working papers, news and blog articles, editorial or notes |
| Broadly undertakes the entire ‘5 step’ process          | Mentions an approach but does not describe methods; focuses on a specific tool or method |
| Enough detail to guide others                          | Little to no detail provided limiting its repetition                                |
| Applied in practice with stakeholders (those with responsibilities and/or interests) from start to end| Hypothetical cases/applications; primarily conceptual in nature; stakeholders are asked to ‘ground-truth’ one part of a broader research process |
| Not focused on an infrastructure (broadly technical) issue | Focused on infrastructure, including water supply systems, broadly structured issues |
| Date range: up to Oct 2018                             | Published after Oct 2018                                                            |
| English                                                | Non-english publications (limitation of the authors)                                |

Table 2. Data organisation and analysis.

| Category                          | Details                                                                 |
|-----------------------------------|-------------------------------------------------------------------------|
| Bibliographic data                | Author, year, title, journal or report name.                            |
| Study context/case                | Eg. Dutch Delta program; montane forests in SE Australia;               |
| Contribution                      | Framework Method Conceptual/Theoretical/Hypothetical Applied case        |
| Policy issue and location         | Policy problem geographic location                                       |
| Participants                      | Practitioners, communities, researchers—combinations or researchers working alone |
| Process used                      | A particular framework (e.g. DAPP), combined DAPP or adapted version of the AP concept/intent |
| Identified challenges, benefits, and limitations | As per the category title |

reflect a geographical lexical trend as well as the English language-only criterion. Nonetheless, significant effort was undertaken to seek out detailed studies of participatory approaches.

Exclusions included documents using the term APs but meaning development pathways, climate resilient pathways, socioeconomic pathways, transition pathways, or pathways to resilience, adaptation, or sustainability, as well as those identifying a single pathway. Also excluded were those invoking the concept of ‘APs’ but that did not involve any form of planning, alongside those adaptation plans clearly developed with stakeholders but with little replicable methodological detail regarding the participatory processes used. So too were studies focused on a single method whether in theoretical or practical application (e.g. scenarios, games, etc). Data from the reviewed documents was organised and analysed using categories in table 2.

3. How and where is participatory AP planning occurring?

Over 600 potentially relevant documents were initially identified across the four databases (table 3). This total was reduced to 238 after each abstract and, where necessary, each document was read by both authors. Cross-referencing databases further reduced returns to 109. The focus on participatory AP planning from beginning to end, reduced returns to a total of 16 useful documents (table 4) and excluded the three most often cited examples: Thames Estuary 2100, NYC, and the Dutch Delta Program (table 4).

While stakeholders participated in these projects, detailed information regarding the participatory methods used (e.g. workshop designs, participant ‘types’, participant responses and questions, etc) and reflections on the efficacies of those methods was unavailable. For example, despite the Dutch Delta program including ‘the participation of governors and civil servants, as well as (representatives from) NGOs, interest groups and companies’ (van Buuren and van Popering-Verkerk 2016), few details were available regarding how they were involved and importantly, how differing perspectives were sought and dealt with. Equally, while Kwakkel et al. (2015) describe involvement of stakeholders in scenario explorations, and similarly Hermans et al. (2017) and Haasnoot et al. (2018) in development of their proposed monitoring and evaluation approach, there was little available detail regarding how stakeholders were engaged and the efficacy of those methods. Similarly, the Thames Estuary plan TE2100 indicated stakeholder consultation involved presentation of a draft plan online, 15 local workshops, multiple public meetings, and over 50 meetings with key organisations (E.A. 2012). However, no information was found detailing how stakeholders were involved in the workshops such as how
or even if, stakeholders participated in defining the problem, identifying potential pathways, etc. The NYC case also provided a broad overview of its stakeholder participation process and a guide that presumably informed their approach. However, besides mentioning the establishment of ‘a taskforce of infrastructure managers’ and a ‘panel of various academic experts’ (Rosenzweig et al., 2011), detailed information regarding participatory processes (e.g. workshops, designs and methods) were absent.

The following subsections discuss some broad findings regarding the literature itself before discussing insights from the selected cases.

3.1. Guides and hypothetical cases

The review found multiple ‘guides’ to AP planning (e.g. Bosomworth et al., 2015, Chapman et al., 2016, Siebentritt and Stafford Smith, 2016, Radhakrishnan et al., 2017, Gilroy and Jeuken, 2018, Lawrence et al., 2018). Lawrence et al. (2018), for example, describe extensive engagement and work to incorporate AP concepts into New Zealand’s National Coastal Guidance. Another group of documents were found to use AP concepts of robust flexibility over multiple plausible futures presented in their own AP planning frameworks (O’Connell et al., 2015, Colloff et al., 2016, Gibbs, 2016). Another 16 documents were found to have explored the applicability of AP planning in a theoretical case or an actual case but with seemingly little to no stakeholder involvement. (E.g. Abel et al., 2016, Buurman and Babovic, 2016, Colloff et al., 2016, Manocha and Babovic, 2016, van der Hoek et al., 2016, Doherty et al., 2017, Kingsborough et al., 2017, Manocha and Babovic, 2017, Prober et al., 2017, Scussolini et al., 2017, Aerts et al., 2018, Cradock-Henry et al., 2018, Gilroy and Jeuken, 2018, Ramm et al., 2018a, 2018b). These too were excluded from the reviewed cases but were used to inform the reflection on AP practice generally.

3.2. Tools within an AP planning process

22 peer-reviewed papers focused on specific methods or tools (e.g. serious games, scenarios, MCDA, etc) (table 5). While excluded from this review because they were not depicted as part of an entire AP planning process, they are tabled here because of their potentially useful contributions to AP planning practice generally. For example, authors such as Fazey et al. (2016) and Fischer (2018), explored the ways in which ‘mapping’ historical pathways can help participants appreciate the implications of their decisions for others and for future possibilities. Several authors explored and tested the use of scenarios, models, or serious games in supporting an AP planning process (e.g. Valkering et al., 2013, Lawrence and Haasnoot, 2017, Moallemi and Malekpour, 2018). Hermans et al. (2017) and Haasnoot et al. (2018) provide guidance for monitoring and evaluation of AP planning. The work by Murphy et al. (2017) is perhaps most pertinent to the question of engaging with ambiguities of adaptation because their approach was based in an argument that understanding how ‘place’ contextualizes future imagined trajectories of social and ecological change is integral to AP planning. Yet while each of these studies

Table 3. Initial search returns.

| Subset | Search terms | Databases |
|--------|--------------|-----------|
| 1      | Adaptation pathways + climate change | Scopus: 127, WoS: 124, Science direct: 243, Google scholar: 200+ |
| 2      | Adaptive pathways + climate change  | Scopus: 15, WoS: 12, Science direct: 78, Google scholar: 200+ |
| 3      | Adaptive policy pathways            | Scopus: 22, WoS: 28, Science direct: 43, Google scholar: 200+ |
| Totals |                           | Scopus: 164, WoS: 164, Science direct: 364, Google scholar: 600+ |

Table 4. Screening steps and returns.

| Databases     | Total returns after abstract read/article scan for potential relevance | Total returns after cross-reference with other database search results | Total returns of cases (that met our criteria) |
|---------------|------------------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------|
| Scopus        | 48                                                                     | 47                                                                  | 6                                             |
| Web of science| 58                                                                     | 13                                                                  | 1                                             |
| Science direct| 52                                                                     | 23                                                                  | 0                                             |
| Google scholar| 80                                                                     | 16                                                                  | 4                                             |
| Google*       | N/A                                                                   | N/A                                                                 | 5                                             |
| TOTAL         | 238                                                                   | 104                                                                 | 16                                            |

* Google was searched for further details on identified applied cases.
might usefully inform various stages of an AP planning process, they were excluded from this review because it was unclear whether they were part of a participatory AP planning process that included stakeholders throughout the entire planning process.

3.3. Identified cases of participatory AP approaches

Despite wide-ranging exploration across different concepts and methods of AP planning, the review found only eight cases of participatory AP planning that sought stakeholder participation across the entire planning process from problem framing to plan production. These eight cases were represented by 16 documents, with several referencing a single AP planning case. For example, Butler et al (2014, 2015, 2016a, 2016c), Butler (2016b), Skewes et al (2016) and Wise et al (2016) are all drawn from a single case of AP planning for livelihoods in Nusa Tenggara Barat Province, Indonesia. Three by Barnett et al (2011, 2014a, 2014b) refer to AP planning for a coastal area in Victoria Australia, and two by Campos et al (2016a, 2016b) relate to a case of AP planning for a coastal area in Portugal. Consequently, these were grouped as three cases, which meant the review found eight cases of participatory AP planning across five policy issues, in eight different locations across four countries.

Three of the eight cases related to Natural Resource Management (NRM) in Australia, two related to coastal/delta issues of sea-level rise and riverine flooding, one regarding rural livelihoods in Indonesia, another regarding remote central Australian communities, and one regarding food security in the Orma region of Ethiopia. Most cases were at a ‘regional’ or large-city scale, with exceptions being Maru et al (2014) working with individual remote communities, and Barnett et al (2014a, 2014b) working with a local coastal township. Table 6 summarises the policy problems and geographic location of these cases.

4. Insights from attempts to engage with ambiguity

The challenge of ambiguity—diverse ways of understanding a topic or issue—in adaptation requires transparent processes of engagement to ensure an
equitable diversity of perspectives and knowledge are involved (Moser and Dilling 2007). Engagement also needs to mediate differences, identify possible areas of agreement, and identify or manage those differences where mediation is currently unachievable (Innes and Booher 2010). This all means that how participatory planning processes are designed to integrate diverse knowledges and ‘ways of being’, is as fundamental as what knowledges and ‘ways of being’ are engaged in that process (Murphy et al 2017). Therefore, this review sought to synthesise insights into how the participatory processes of each case were designed and conducted, including: how stakeholders were engaged in framing the adaptation problem; how they participated in exploring multiple futures; and how they were engaged in identifying actions, thresholds (in systems of interest or the adaptation actions themselves), and ultimately, the adaptation pathways. Analysis of the reviewed cases provided several insights into these factors, including what they suggest about engaging with ambiguity.

4.1. Engaging diverse voices

Overall, most cases relied on workshops to engage stakeholders in their planning process, with some also using focus groups and interviews. Conduct of the workshops varied from the research and policy teams co-designing the process and employing a professional facilitator, through to the research team facilitating the workshops, or a combined research and policy team facilitating the process. Dunlop et al (2016), and Bosomworth et al (2018) both remark on the importance of ‘good’ and bespoke facilitation for different groups as they grapple with different issues during the planning process, but neither explore this much further. Bosomworth et al (2018:16) state that ‘Professional facilitators were needed because we wanted to ensure that if the process wasn’t going to ‘work’ it was due to the process itself, not limited facilitation skills’. Butler et al (2016c:88) suggest that their use of facilitation was designed to minimise potential power asymmetries and tensions.

Each case variously sought to engage a diversity of stakeholders. For example, in the Butler et al case, the research team first conducted a stakeholder analysis to identify and prioritise 30–40 individuals with responsibility for and knowledge of community development and NRM, with prioritisation of female stakeholders. Then, aiming to ‘to mitigate potential power asymmetries’, held a series of three different workshop types (Butler et al 2016c). The first involved a provincial-level workshop with representatives of national and provincial governments, and NGOs, as well as Australian and Indonesian biophysical and social scientists to identify relative vulnerabilities of sub-districts. The second was a suite of workshops with local governments, NGOs, and communities in each sub-district that had been prioritised in the first workshop, to re-assess indicated vulnerabilities and identify actions. A third and final ‘integration workshop’ was used to finalise strategies. Barnett et al (2014a, 2014b) similarly conducted separate pieces of work with ‘experts’ and community members. In their case, background information was first collected through interviews with policy practitioners and community members, and an extensive phone survey with 199 local residents and second-home owners to capture community-identified values at risk. They then conducted a workshop with local decision-makers before a series of focus groups with community members to identify potential actions and social triggers for action.

Alternatively, Campos et al (2016a, 2016b) combined ‘experts’ and community members in two initial information seminars that were open to anyone to ask questions about climate change and the project. A representative group of 30 people, identified by their respective communities and stakeholder groups, were then invited to participate in further scenario and pathways planning workshops. Similarly, Maru et al (2017) collaborated with Indigenous and non-indigenous leaders from government and private organisations who already had good relationships with the remote communities. Prior to the planning workshop, participants received a project and workshop information sheet, and two sets of questions for group exercises at the workshop. In Bosomworth et al (2018), the policy leads used different approaches to inviting diverse stakeholders. One used a combination of advertising through local newspapers and radio for expressions of interest and direct invitations to target stakeholder groups unrepresented in the responses to the EoI. The other lead NRM planner actively targeted a diversity of participants via email invitations.

With the exception of Butler et al, the majority of participants were government/policy representatives. Jacobs et al (2018) worked solely with policy practitioners from a range of functional areas to explore their perspectives on managing NSW National Parks under a changing climate. In several of the other reviewed cases, participants noted that they were not representative of all who may have a stake or concern for the place for which the planning was being undertaken. For example, participants in the Dunlop et al (2016) case ‘were mindful of the diversity of preferences of different stakeholders, [and that] the perspectives available in the workshop were only those of the mixture of individuals at the workshops’. Similarly, the participants in the Bosomworth et al (2018) study suggested that there were a ‘Good blend of ideas but probably too narrow a base of participants. … We are a quite alike group, so maybe no major confrontations or differences of opinions’ (p 24).

Barnett et al (2014a, 2014b), Butler et al (2014), and Bosomworth et al (2018) discussed the relative representativeness of their participants with regard to diverse knowledges, values, or stakes. (Barnett et al 2014a, 2014b: 1107) suggested that ‘young people
(under 30 years old) and Indigenous people were not well represented in the focus group sample’. While Butler et al (2014) stated that ‘the numbers interviewed was also small, preventing more extensive analysis such as the contrasting of different types of leaders’ perceptions of drivers and interventions, or gendered comparisons’. Bosomworth et al (2018: 24) stated that ‘despite concerted efforts, representation of all potential stakeholders, including the Traditional Owners was not achieved, and representation was not always consistent across the workshops’. While the challenges of obtaining representativeness are not unique to AP planning, none of the cases explicitly reflected on the efficacy of the methods used to seek diverse voices (e.g. timing, workshop-based), let alone the influence of those who did participate on the nature of the adaptation pathways identified.

4.2. Framing the problem

Questions of who is involved (and how) are crucial to how the adaptation problem is framed, and thereby the consequent goals and means identified. Approaches to framing the adaptation problem varied across the reviewed cases. Some involved the research team first reviewing scientific reports, academic literature, and available grey literature to describe their understanding of the problem before ‘testing’ this with participants. Others worked to involve participants in framing the adaptation problem before seeking out relevant data and literature. For example, to understand community framing of the adaptation problem, Campos et al.’s (2016a, 2016b) Ilhavo and Vagos case brought expertise into their process in response to questions raised during their action-research process. Barnett et al (2014a, 2014b) reviewed relevant literature and undertook interviews with policy practitioners and community members. In contrast, Butler et al (2016a, 2016c) framed the adaptation problem as one of livelihood by using expert elicitation to develop a typology of rural sub-distRICTs based on the ecosystem goods and services underpinning livelihoods. Participatory workshops in each subdistrict then sought to engage local stakeholders in ‘ground-truthing’ those assessments (Skewes et al 2016).

Somewhat alternatively, Bosomworth et al (2018) suggested they built a shared framing of the problem among participants through several participatory activities, including a collective hand-drawing of a historical timeline for the area, presentations by Traditional Owners and scientists, and group work examining reports, plans, and stories of the landscape to identify key attributes and drivers of the system. Similarly, Maru et al (2014) worked with their participants to frame the adaptation problem, suggesting that workshop discussions almost immediately identified climate-related, event-based risks (fire and flood), which each illustrated contrasting implications of climate change for the participants and the communities they sought to represent.

Only Butler et al (2014) referred to institutional drivers of problem framing, suggesting that ‘perhaps due to their embedded positions within the system, participants did not mention some in-cultured factors such as the fatalistic and passive world view of the poor.’ This reflection and the seeming lack of consideration within the other cases of the institutional (normative, cultural-cognitive) contexts with which adaptation planning must engage, suggests much more work is needed on this issue in participatory approaches to AP planning.

4.3. Scenario development and use

Scenario development and use is another important component of AP planning. Scenarios are used to explore and ‘test’ the robustness and flexibility of current and potential future actions, by identifying theoretical ‘tipping points’ or thresholds in the system of concern, for which indicators are developed and then alternate actions identified. The ambiguities of adaptation driven by diverse, sometimes contending knowledges and values, also have implications for scenario development and use in adaptation planning.

Broadly, the approaches to scenario development and use in the reviewed cases could be categorised in one of two ways. The first, a ‘traditional’ presentation of climate change projections and essentially asking participants to extrapolate out from these based on their values and expertise. The second, a more exploratory development of narrative-based scenarios. Approaches that might be considered ‘traditional’ include Jacobs et al (2018) apparent use of the more traditional approach of presenting climate change projections and working with policy participants to extrapolate the implications for their areas of responsibilities, visualised as causal diagrams. In a similar vein, Barnett et al (2014a, 2014b) developed two hypothetical future flooding scenarios in a workshop with local government representatives, before discussing these in community focus groups regarding triggers for action that were meaningful to them.

In the more co-productive mode of developing narrative-based scenarios with planning participants, Butler et al (2016c) used multiple approaches to scenario planning across their suite of workshops. A ‘high-level’ workshop combined climate and population projection data to assess relative impacts on ecological goods and services and human well-being under a ‘Business as Usual’ scenario. In their community-based workshops they used a combined Participatory Systemic Inquiry approach (Burns 2012) with a suite of questions concerned with identifying parameters of change, establishing guiding principles for change, identifying potential future change, and identifying what could be. This approach enabled participants to develop explorative scenarios (i.e. multiple
plausible futures described in words, numbers and/or images), and then compared their assumptions against ‘expert’ models. From there, participants identified actions.

In the Campos et al (2016a) case, three climate change scenarios were first presented to participants in the form of GIS maps, including indication of tipping-points corresponding to sea level rise and coastal erosion. They state that the scenarios were purposely extreme and normative to promote a critical discussion. Participants then critiqued those scenarios, developing a fourth scenario, and using the suite to create a shared vision.

Bosomworth et al (2018) compared the use of both the traditional extrapolation from climate change projections and the co-construction of narrative scenarios in their two studies. They concluded that ‘where climatic projections data were used, the future scenarios were very much based in replicating and continuing current patterns of work, life, and governance, with limited exploration of their contested nature’. Whereas the co-constructed narrative scenarios led to discussions that some of the dystopian scenarios were not far from the current situation for many and led the group to identify actions that they thought might address drivers of those current situations. They suggested that participants also commented that the co-constructed ‘utopian’ scenarios gave them a sense of hope.

Several of the cases suggested there were challenges in participants understanding and accepting the need to consider multiple plausible futures and different ways of thinking. For example, Bosomworth et al (2018) pointed out that one of their participants dismissed the scenario process as ‘fantasy; I’m trained in working from data’. Similarly, Maru et al (2017) found that ‘moving from conceptualising and characterising systems to defining concrete actions that can lead to real-world improvements through projects remains challenging.’ Dunlop et al (2016) propose that ‘some core concepts such as alternative states, future management regimes and future management triggers have conceptual utility but are challenging to apply and document in practice.’ From these studies it is difficult to draw conclusions on which might be a better approach. In addition, no case reflected on whether the type and facilitation of the scenario development process influenced the challenges they identified.

4.4. Identifying thresholds
Identifying triggers and thresholds is a persistent challenge in AP planning, particularly for those aspects for which information is not always readily available (Siebentritt and Hall 2017), let alone agreed. This challenge was evident across the cases reviewed here. Jacobs et al (2018) used two categories to help participants identify potential thresholds: those related to ‘slow changes in climate that may eventually result in system damage and are amenable to incremental approaches to adaptation’; and those related to ‘abrupt or catastrophic changes in climate that lead to ‘dangerous’ system impacts unacceptable as a consequence of their scale and irreversibility and which call for transformative responses’. However, it was not clear whether this proposed categorisation was found to be helpful by the participants.

Maru et al (2017:42) argued thresholds in both biophysical and human capacities tend to only be discoverable after being crossed, although they also posited that ‘some biophysical thresholds such as soil acidity, and land size viable for farming are being crossed’. Bosomworth et al (2018) also stated that the identification of thresholds was difficult in complex social-ecological systems. However, they argued that identifying proxy ‘critical attributes’ (Walker et al 2006) or key system drivers (Kahane 2012) helped engage with this challenge. Somewhat differently, Barnett et al (2014a, 2014b) worked to identify limits of ‘socially acceptable risks’ and used these social triggers as the bases for discussing participant past experiences of coastal flooding in relation to two scenarios. They posit that identifying such triggers may be more salient to local people and so can help build consensus among diverse stakeholders.

Taken together, these experimental approaches to identifying thresholds in the context of ambiguity suggest areas for further research, particularly that related to socially acceptable limits of risk and identification of critical attributes of social-ecological systems.

4.5. Identifying actions and pathways
The participatory methods used to identify actions and pathways also varied across the cases. Most cases used participatory workshops wherein stakeholders identified potential adaptation actions. However, it varied as to whether the research teams translated information from preceding work into an AP plan that was presented back to participants, or participants worked through a plan development process within a workshop.

In their community focus groups, (Barnett et al 2014a, 2014b: 1107) used two scenarios to discuss meaningful triggers that would ‘signal a level of social and environmental change that departed from the present’ and the kinds of responses participants would expect in the event of such a change. Bosomworth et al (2018) used workshops in which stakeholders working in small groups used narrative scenarios they had previously developed to identify potential adaptation actions and discuss potential thresholds. Participants then identified potential barriers and enablers of the actions, and in turn, actions to address those barriers and enablers (Bosomworth et al 2019).

In the Portuguese case (Campos et al 2016a, 2016b), the research team drafted pathways between two scenario planning workshops. In a subsequent
workshop, printed copies of the draft pathways were given to participants who worked in groups to sketch new pathways on top of those drafts. These were then incorporated into pathways mapping software, and the developing pathways projected up on a screen for the participants to view. A final ‘report was then sent to all participants, which included the final pathways, with a representation of potential coastal adaptation policies and measures’ (Campos et al 2016a).

An apparent commonality across most of the cases was a tendency for the participants and/or the process to focus on actions that address proximate risks or expressions of vulnerability, rather than identify and then plan for addressing the underlying (often socioeconomic) drivers of those vulnerabilities. For example, in the Campos et al case there seems to have been a resistance to the inevitability of change reflected in one of the aspirations to ‘keep the beaches as they are now’. Yet, reflecting on a context of existing disadvantage and vulnerabilities, Maru et al (2014) argue for an ‘urgency of dealing with current, deep disadvantage needed before any “adaptation” planning might occur’ (emphasis added). Alternatively, Bosomworth et al (2019) suggested that by co-developing a multitude of future scenarios, participants began to question current governance arrangements and identified a need to reconfigure those arrangements to explicitly include and be led by Indigenous people and knowledge.

Evidently, a number of these participatory cases did not seek to or were unable to encourage participants to critically engage with the institutional dimensions of adaptation. There appears to have been little reflection within the cases as to whether this was a function of the process they used, or the ‘nature’/training of the people involved.

4.6. Participation takes time and resources
Across the cases it was evident that participatory AP planning aiming to engage with the ambiguous nature of many adaptation problems requires significant investment in preparation, design, and implementation. For example, Dunlop et al (2016:59) suggest that for the planning process itself, ‘it would be cognitively easier, with greater learning opportunity, to spread the analysis over a series of single day workshops separated by periods allowing for reflection and offline refinement and preparation between key stages. However, such a process would require a great level of commitment from participants, especially where significant travel to attend is involved’. Similarly, participants in the Bosomworth et al (2018) case discussed whether a series of four ‘all-day’ workshops would be feasible for all stakeholders.

Alternatively, reflections from other cases suggest much more time may be required in terms of both the planning process and the time required for implementation. For example, (Butler 2016b: A6) argued that although the project was funded for four years, ‘this was insufficient time to generate transformation of musrenbang (akin to local councils) in the five case studies or beyond’. This challenge also occurred in the Thames Estuary 2100 project. Despite its major political support and extensive budget, that project commenced in 2002 and the final TE2100 plan was released in November 2012; 10 years later. Collectively, these insights suggest that any form of participatory AP planning takes time and resources. In particular, it require substantial pre-work in the design of participatory processes that incorporate diverse methods.

4.7. What about implementation?
Finally, despite the proliferation of scholarly papers exploring concepts, methods, and possibilities of AP planning, as Lawrence and Haasnoot (2017) and Siebentritt and Hall (2017) have identified, there are still few examples of implementation of AP-based plans beyond the three predominant examples in NYC, The Netherlands, and London. All eight cases in this review were working towards production of an adaptation plan, with only few having begun various forms of implementation (e.g. Jacobs et al 2018 and Bosomworth et al 2018). Butler et al (2016a) suggest that their pathways plan was not implemented beyond trials of actions because ‘windows of opportunity did not arise, and inadequate engagement with key, but ephemeral political actors’. This reflection hints again at a need for AP planning to understand and engage with its broader institutional and governance contexts to support implementation. Nonetheless, the lack of implementation is not unique to AP based plans and may be in part, because change in complex adaptive systems is not always immediately evident.

5. Discussion
Looking across the reviewed cases revealed several possibilities for participatory AP planning to engage with the challenges of ambiguity in adaptation planning. AP planning is an inherently malleable process that can be adapted for different policy problems. In a practical expression of this, Campos et al (2016a, 2016b) state that because their process was characterized by a sequence of responses to requests for additional types of information, it led to involvement of a multidisciplinary research team (i.e. sociologists, economists, environmental engineers) and growth of the initial planning group to include other researchers, municipal stakeholders, and city residents. All the cases also reported an enabling of a collective understanding of the complex, systemic nature of the adaptation challenge and, depending on the approach used, identification of actions to address immediate drivers of risks and vulnerabilities.

Barnett et al (2014a, 2014b) also argued that the AP planning process ‘prompted new kinds of thinking about adaptation … with decision-makers suggesting...
that adaptation needs to slow down and be more locally-driven and strategic.’ Similarly, Dunlop et al (2016: 60) concluded that AP planning enabled their participants to explore the multi-sector and multi-level nature of the adaptation challenge, including how near-term actions shape future decision contexts. Bosomworth et al (2018: 20) also argue that the participatory approach ‘helped people recognise the socio-political construction of the current situation’. This included that the current situation is already a worst-case scenario for many ecosystems and communities (Bosomworth et al 2018). Campos et al (2016a, 2016b) posit that ‘the participatory experience offered the opportunity to begin a discussion on the technical complexities of coastal interventions, highlighting the multiplicity of options and costs as well as potential secondary effects of different measures’. They also suggest that planners and experts appreciated the rare opportunity to jointly discuss the issues and, farmers felt heard. However, residents and business owners emphasized that collaborative planning was pointless without some implementation and two planners suggested that ‘the workshop discussions failed to appropriately address policy and administrative legal instruments’ (Campos et al 2016a, 2016b). Finally, Maru et al (2014) posited that participatory exploration of APs can be useful to rethink tackling underlying causes of immediate disadvantage and poverty to reduce vulnerabilities to longer-term climate change. This also reflects comments by Siebentritt and Hall (2017) who suggest that APs seem to be quite useful as a metaphor and Lawrence and Haasnoot (2017) who suggest games based on AP concepts can engage multiple stakeholders in appreciating the complexity of interrelated decisions.

Yet while other studies and reviews have suggested AP planning is very useful in contexts where the problem is treated as largely technically tractable, the cases reviewed here suggest that AP planning needs more development or adaptation itself, to help engage with the ambiguities of adaptation. It is unclear from this review to what extent the participatory processes addressed ambiguities and to ‘whose’ satisfaction—how did the processes grapple with tensions and differences between knowledges and values? Butler et al perhaps provide the most comprehensive description and analysis of such a participatory approach, and there is much that can be learned from that suite of papers.

Rather than suggesting one approach may be better than another, the diversity of approaches reflects arguments that the differential roles science/research can or might be positioned to play in any adaptation planning exercise, is influenced by how the problem is structured or framed (Leith et al 2018). Further to this, approaches such as Bosomworth et al (2017) ‘problem-structuring approach’, Scholbjerg’s (2012) ‘climate justice and capabilities framework’ and the ‘Pathways to Sustainability’ concept proposed by Leach et al (2010) all explicitly start with understanding and engaging with different framings, power, etc., in the design and conduct of adaptation planning.

There may well be potential in exploring application of a hybrid approach between these and the AP concepts to enable adaptation planning (and action) that effectively and justly engages with the uncertainties and ambiguities of adaptation.

6. Conclusion

This scoping review found a small but disparate cohort of examples that could provide some insights for those wanting to undertake AP planning in ambiguous contexts; those involving contested values, knowledges, and actions. Several interesting developments and possibilities are emerging from these kinds of applications in regional, place-based (rather than issue-based) adaptation, where multiple policy issues come together. Here, there will likely be much for AP approaches to learn from other disciplines and theories, including political ecology, policy studies, political science, critical governance, etc. As King-\nsborough et al (2017) have argued, ‘there is a need to continue developing, trialling, critiquing and demonstrating how pathways approaches can be utilised in informing and motivating adaptation planning’.

Yet the challenge of ambiguity in adaptation seemingly receives little attention within most approaches to AP planning (and adaptation generally), which still tends toward a top-down, technocratic approach. This is despite AP planning offering potential as a means of stakeholder participation in exploring and navigating this diversity (e.g. Barnett et al 2014a, 2014b, Campos et al 2016a, 2016b, Murphy et al 2017, Bosomworth et al 2018). Realising this potential in a way that effectively engages with issues of climate justice, requires AP planning (and adaptation planning generally) to first understand the nature of the problem for which planning is being undertaken by seeking out and engaging with diverse, sometimes contending, framings of the problem, goals, and means (Leach et al 2010, Hoppe 2011, Scholbjerg 2012, Bosomworth et al 2015, 2018).

Overall, this review suggests that there is a significant need for those undertaking adaptation planning to make readily available the details of their process, including methods and tools, what worked, what did not, and benefits and challenges. This is particularly crucial for issues of justice and equity. This call goes beyond those exploring AP planning. It applies more generally to the application of decision frameworks and tools proposed by the research community. If adaptation scholars wish to support adaptation action, then our work needs to be salient and useable, and part of this requires enhanced and faster feedback to the literature about what was done and how, alongside what worked, what did not, and why.
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