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Stakeholders' views on natural flood management: Implications for the nature-based solutions paradigm shift?

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Abstract

An exemplar of nature-based solutions (NBS) is natural flood management (NFM), for which interest is growing worldwide. As with many NBS, implementing NFM requires the participation of support of multiple stakeholders. However, we lack understanding about the views and expectations of the many stakeholders who might be expected to enable or implement it. Understanding such views may offer insights regarding whether and how the dominant flood risk management protection paradigm is really being challenged. Using the first survey (N =118) across a range of water and environmental management stakeholders in the United Kingdom (UK), this research explores whether there is support for a paradigm shift to "work with nature" as intended with NBS. We find evidence that some stakeholders view NFM as a "no-brainer"; a judgement based on perceived cost-effectiveness, social and environmental benefits and the failure of the protection paradigm exposed in recent floods. Others, typically farmers and landowners, have more cautious views about change.

All our respondents generally agree that responsibility to enable, implement, and fund NFM should be shared across society, but disagreements remain about the detail and the basis for any enabling payments. We argue that the shared perception of roles and responsibilities provides a foundation for further work to facilitate NFM, explicitly considering principles and specific contractual details. In the UK, the possibilities of post-Brexit agri-environment policy make such a debate particularly pertinent. It is also likely to be productive in many other cases and places, since the paradigm shift entailed by ideal visions of NBS often entails new relationships between stakeholders and new activities 'on the ground'.

Introduction

Scholars of environmental management and governance increasingly emphasise the need to work with nature to support societal well-being, rather than defending or separating the 'human' from the 'natural' (Iacob et al., 2014; Potschin et al., 2016; Lane, 2017; Nesshöver et al., 2017). The promotion of such 'Nature-Based Solutions' (NBS) can be seen in research agendas (e.g. for the European Union, DG Environment (2015)), conservation advocacy (e.g. by the International Union for the Conservation of Nature[1]), government policies (e.g. as reflected in the UK's 25 Year Environment Plan, HM Government (2018)), and in financial investments internationally (Coles et al., 2019).

There are varying definitions of NBS, but the most ambitious interpretations entail a radical reappraisal of who, how and for what end we manage the environment (Seddon et al., 2020), often linked to debates about managing the land for public goods (e.g. Calliari et al., 2019). Paavola and Primmer (2019) argue that recalibrating land management for public goods provision, calls for attention to incentives, rights and responsibilities and a new governance framework that supports catchment-scale collaboration and networking within and across scales. NBS can thus be seen to entail a paradigm shift in the approach to environmental management by those directly involved in, and affected by it. A paradigm shift, understood as a transition by which a dominant paradigm is superseded by a new incommensurable paradigm that is based on different conceptual framings (Kuhn, 1996), entails those involved to both think and act differently.

It is notoriously difficult to achieve a paradigm shifts, since pre-existing ways of thinking, working and governing tend to prove remarkably 'sticky' (Waylen et al., 2015). Implementing NBS requires collaborating with and adapting to multiple stakeholders (Ferreira et al., 2020). Yet liaising with new networks of stakeholders generally entails more time, complexity and contestation than interventions delivered by a single agent (Waylen et al., 2017). This is compounded where concepts challenge familiar stakeholder conceptions or knowledge backgrounds. There is evidence that changes in discourse can reveal early signs of conceptual changes that prefigure or form the beginning of a paradigm shift (Pahl-Wostl et al., 2011).

A prominent example of NBS is Natural Flood Management (NFM). NFM involves "techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters" (SEPA, 2015, page 6). Interventions include installing in-stream woody debris and re-meandering and connecting floodplains (cbec and EA, 2017). Past approaches to flood risk management (FRM) have generally viewed floodplains as something to 'protect' (Baldassarre et al., 2013) and floods become something to defend against with engineered structures (O'Connor, 2020). However, more recent approaches of Sustainable Flood Management do not always seek to resist or prevent floods, but rather to minimise and mitigate their impacts on society and infrastructure (Everard and Moggridge, 2012).

Working with, and for society, is an important part of the rationale for all NBS. For NFM, it is also essential, since implementing many of its interventions requires the consent and cooperation of multiple stakeholders, including, landowners, statutory agencies, and local authorities as well as broad acceptance from the general public. NFM is explicitly supported by many scientists and in policy, including in the European Union and UK (e.g. EC, 2014; Barlow et al., 2014; Dadson et al., 2017; Lane, 2017). There are some high-profile initiatives such as *Room for the River* in The Netherlands (Klijn et al., 2018) and *Engineering with Nature* in the USA (Bridges et al., 2018). Nevertheless, there has been slow progress in delivering NFM. To some extent this is common to other NBS concepts (Seddon et al., 2020), particularly those involving large-scale landscape

[1] See, https://www.iucn.org/theme/nature-based-solutions

interventions and multiple stakeholders, i.e. with challenges centred around collaborative governance and funding (Benson et al., 2013) and rhetorical support for NBS is often not matched by resources and tailored policy instruments. For example, in July 2020, the UK government announced a £5.2 billion long-term plan to tackle flooding, of which only £200 million was earmarked for local initiatives including NBS (HM Government, 2020).

In the UK, there have been NFM pilots, but it is far from being commonly implemented at scale. Some argue this is because it has been inserted into the existing FRM paradigm, in which technical solutions remain the priority with little stakeholder participation (Cook et al., 2016). Some insights about the challenges of adopting NFM come from assessments of these pilots (on the Holnicote Estate, National Trust (2015) and the Yorkshire Integrated Catchment Solutions Programme (iCASP) Richardson et al., (In press)), and studies of farmer, land manager, and FRM practitioner attitudes in the UK and USA (Holstead et al., 2014; Nazmul et al., 2017, Milman et al., 2018; Wells et al., 2019). They indicate that tradition and custom is a barrier for many landowners, that attitudes to government flood assistance and land management regulation is determinative of landholder support, and that uncertainties regarding effectiveness, benefits and responsibility are concerns for FRM practitioners. Furthermore, the views of other stakeholder groups may not uniformly or completely support NFM (Waylen et al. 2017; Wells et al. 2019). What is missing is a direct survey across a range of stakeholder groups.

All this points to the question on whether there is support for a paradigm shift "to work with nature" as intended with NBS. Our research questions are: (1) What is the current understanding of NFM, and what are the expectations for its wider adoption? (2) What are the challenges and opportunities to NFM? (3) Do responses from different stakeholders diverge and what are the implications of such divergent views? In addressing these questions, this study augments the growing body of literature on the views of environmental practitioners in the development of innovative environmental management tools beyond NFM (Martin-Ortega et al., 2019; Sandbrook et al., 2019).

Methodology

2.1 Survey design

An online survey was designed to improve understanding of a combination of issues that had arisen in the authors' prior work on NFM and in the literature on NFM and NBS. These themes were explored adapting to NFM the survey design of Waylen and Martin-Ortega (2018). The survey was piloted by an academic and a rivers trust practitioner.

The survey (see Supplementary Information (SI)) began with a set of categorical questions to establish each respondent's professional background and self-reported NFM expertise. Respondents were then asked to define NFM in their own words, report any NFM projects they had knowledge of or experience with, before answering Likert scale questions on the barriers and opportunities for NFM. A set of questions asked about respondent views on the future of NFM and mechanisms for enabling, implementing, and funding it.

2.2 Survey hosting and sampling procedure

The survey was configured with the BOS online survey tool[2] and hosted at the University of Leeds. It was open from January to March 2017. To disseminate the survey, the authors utilised their professional

[2] See, https://www.onlinesurveys.ac.uk/

networks, including water@leeds, the Ecosystems Knowledge Network, the Priestly International Centre for Climate, and The James Hutton Institute. Additionally, a snowball process was encouraged with an explicit request to circulate the survey link to respondents' networks. This may have introduced some selection bias and to counter this, the survey introduction included the disclaimer that all views, including negative ones, were welcomed. However, it is possible that selection bias remains.

2.3 Sample description

The survey did not presuppose nor require an expert understanding of, or support for, NFM, rather the sampling strategy was more generic targeting any individual "working on flood risk, water or environmental management: land managers and farmers; national or local government and public agencies; industry; voluntary and 'third sector' organisations; consultants; and academics". Respondents not self-identifying with this description were screened out from the survey. Furthermore, broader societal views were not captured.

Answers to initial questions established that respondents were diverse in terms of their current employment and professional training. Note we did not ask about specific roles, for instance, town planner. Of the total 118 respondents, 50 work in the public sector (30 public agency, 15 local and 2 national government, 1 National Park Authority, 1 retired EU, 1 government policy and land management), 30 in the private sector, 16 in the third sector, 13 as academics, and 9 in farming. For professional training, 90 respondents reported training in a single field and 27 in two or more fields (there was one non-respondent); the most common background was conservation/environmental management (51), then natural sciences (35), engineering (21, including 6 working for a public agency, 2 for local and 1 for national government), agriculture (14), and social sciences/economics (12).

Two-thirds (80) of respondents considered themselves familiar with NFM, however, only 8 strongly considered themselves experts. Understandings of NFM were informed, in many cases, by active participation in NFM projects; over half (62) have been connected to, or participated in, one or more. Their participation ranged from project commissioning and proposal development, modelling and project design and communication, to delivery, monitoring, and appraisal. Some respondents noted their specific roles on steering committees, in partnerships as NFM advocates and in the provision of written guidance for projects. Most respondents (98) were able to name specific projects, together listing 27 initiatives.

In September 2017, a two-page summary of results was circulated to the 91 survey participants who had provided contact details for this purpose. This contact provided respondents an opportunity to query our interpretation of the results or to provide feedback. All the farmers requested this summary and of the 27 respondents who did not, 17 were public sector (14 public agency, 1 national government, 4 local authorities), 5 private sector, 1 third sector and 4 academics.

2.4 Analysis of responses

There was strong engagement with the survey, as all 118 individuals who started the survey reached the final question. The response rate for individual (sub)questions varied from 98 to 118 and is reported in Table SI.1. In the table and figures below, the relevant question in Table SI.1 is provided.

Data analysis consists of a combination of descriptive and inferential statistics of quantifiable variables and thematic analysis of open-ended responses. We also tested for the relationship between personal attributes – stakeholder group – and responses as well as between responses using the Chi-square test of independence. NVivo 12 was used to manage the qualitative data. In the Results section, quotes are in italics and current occupation and fictional initials of the respondent are provided.

3. Results

3.1 Understanding of NFM

Open text answers defining NFM were received from 114 respondents. NFM was frequently described using terms such as 'working with', 'mimicking' and 'imitating' natural processes, more occasionally in terms of 'manipulating' and 'restoring' the environment. Specific measures were frequently listed to 'slow the flow' in the upper catchment, for example, peatland restoration, woody debris dams, and soil husbandry, and 25 respondents mentioned floodplain storage, reconnecting rivers to floodplains and use of washlands. NFM was also referred to as an approach that has 'co-benefits' and is: 'soft' explicitly contrasting it with hard-engineered approaches; 'targeted' or 'integrated'; and implemented at the catchment-scale. It was defined also by its outcomes; to reduce flood risk/flood peaks and flood impacts. Others noted it involves private landholders or deemed it ineffective.

To further explore stakeholders' understanding of the role of NFM – including in comparison to or in combination with existing dominant approaches to FRM – we asked for their views on whether a set of specific interventions are 'part of', 'complementary', or 'unrelated' to NFM, see Table SI.2. Tree planting, naturalising rivers, creating/restoring wetlands, installing woody debris dams, and restoring peatlands were identified by 85 or more respondents as NFM interventions. Respondents were split between choosing: 'part of' vs 'complementary' for no-till agriculture, earth bunds and preventing floodplain development; and 'complementary' vs 'unrelated' for embankments and flood defence walls. Overall, NFM is seen as distinct from a hard-engineering approach to FRM, but there are also areas of ambiguity both about what NFM consists of, and how distinct it is from, other approaches.

3.2 Expectations of NFM

To understand what respondents believe are the key opportunities for and barriers to NFM, we asked them to rate their agreement with a set of expectations and views of NFM. These were categorised post hoc into three themes.

Table 1. Views and expectations on NFM, grouped post hoc. % of respondents, note row may not sum to 100% if any respondents answered 'Unsure' (Table SI.1-Q11).

Statement	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
Effectiveness				
E1: To be effective NFM needs to be coordinated at the catchment scale	63	30	6	-

E2: There is sufficient evidence of the effectiveness of NFM	19	37	25	14
E3: NFM schemes are only effective at mitigating the effects of low flood flows	11	22	32	22
E4: NFM enables delivery of FRM to become more cost-effective	46	40	8	2
Wider benefits				
WB1: NFM raises awareness of the importance of catchment management to society	54	40	4	-
WB2: NFM aids delivery of multiple benefits (e.g. biodiversity, soil conservation)	78	19	2	1
WB3: Implementing NFM can provide a new source of income for land-managers	24	51	15	2
WB4: NFM will result in acceptable visual impacts to the UK landscape (e.g. tree planting on moors, flooding of farmers' fields)	56	26	7	3
Challenges				
C1: NFM measures take too long to establish to be useful	1	6	37	48
C2: It will be challenging to install NFM where there are tenant farmers	19	52	19	3
C3: It will be challenging to install NFM where there are multiple landowners	35	57	6	2
C3: NFM schemes risk unintended consequences (e.g. animal disease)	3	13	40	21
C4: NFM schemes will require too much maintenance	2	8	36	41

(Dark grey/light grey shading indicates that the 'agree' or 'disagree' options were chosen by over 75%/less than 50% of the respondents).

From Table 1, we can see there was broad agreement that NFM should be implemented at the catchment scale and that it should prove cost-effective even though there was a mixed response around evidence of its general effectiveness and at high flows. Further, there was almost unanimous support for the potential for NFM to deliver co-benefits. 'Technical' challenges were less concerning to respondents than issues of tenure and coordination. In four instances – E3, WB3, C3, C4 – ten or more respondents answered 'Unsure'.

Using Chi-squared tests of independence, we checked for consistency across answers in Table 1, i.e. for responses that convey implicitly shared or related expectations. We found evidence that some respondents are particularly supportive of NFM and refer to them as 'NFM enthusiasts'. Respondents who agreed with the statement on the sufficiency of evidence of NFM effectiveness (E2) also agree that it is cost-effective FRM (E4) (χ=11.27, p=0.02). Those that agree it is cost-effective FRM (E4) also agree that it delivers multiple-benefits (WB2) (χ=12.14, p=0.02) and that it will result in acceptable visual impacts (WB4) (χ=10.73, p=0.03).

Open-ended responses provided detail on the two key arguments provided by 'NFM enthusiasts'. The strongest theme was to assert NFM is a 'cost-effective' approach to FRM, including in the face of climate change: *'Because it's cost-effective, sometimes feasible where hard structures would be prohibitively*

expensive, and helps to achieve wider benefits, and also because hard defences are deteriorating and/or inadequate to deal with climate change impacts.' (KH: Private sector). Specific recent flood events were sometimes cited as part these explanations to demonstrate that existing hard-engineered approaches were insufficient by themselves. Additionally, co-benefits were critical in their support. Respondents (82) named specific co-benefits such as carbon sequestration and improvements to: soil, biodiversity, water quality, recreation, wildlife habitat, local communities, and visual amenity as well as engaging the public in flood risk attenuation.

'NFM enthusiasts' were undeterred by the challenges listed in Table 1. Respondents who agreed with: the sufficiency of evidence of NFM effectiveness (E2) did not view time lags (C1) as a serious concern (χ=10.34, p=0.04); and NFM as cost-effective FRM (E4) did not view unintended consequences (C3) or maintenance (C4) as significant barriers (χ=12.18 p=0.02; χ=26.90, p=0.00). Their open-ended responses revealed nuanced acknowledgement of such issues as challenges to be tackled rather than reasons to slow NFM efforts. For example, *AB*, an academic, noted the complexity of NFM implementation, including the fit with FRM, and the availability of evidence: *'Tricky balance between public opinion, landowner consent and rights and economic development. More evidence for benefits required and to be put into the public domain.'*

3.3 Prospects for NFM

In thinking about the future prospects for NFM, 76% of respondents were supportive of it being more implemented in the UK. Nevertheless, 95% of respondents acknowledged a need for other actions and changes. Practical steps were identified such as '*producing a consistent and accurate modelling and appraisal methodology that can be done by consultants without access to physically based models only used in academia'* (*SC: Public sector*) and integrating NFM in a wider UK strategy around natural capital across government departments. Public sector respondents were more explicit calling for: '*a massive culture shift in the farming and landowner community'* (*AR*); '*political will to create a 'sea change' to move to NRM*' (*KS*); and '*to live more in harmony with nature*' (*DS*). Whereas academics were keen to '*sell the benefits to insurance companies and other financial institutions offering mortgages and building developers'* (*CC*) and '*to educate politicians, planners, engineers and the public that hard engineering alone is not the answer'* (*JJ*).

More nuanced answers were provided by 115 respondents to a question about the number of NFM schemes in the UK in ten years time (Many more – 69, Several more – 35, Same number – 9, Removal of some schemes – 2). There is statistical evidence that the occupation of the respondent is important in shaping these responses (χ=34.62, p=0.02). In particular, farmers are more likely to respond "The same number of NFM schemes", than the other occupation groups. Open-ended comments demonstrate the personal nature of the concerns of the farming community, such as the farmer *JT*: *'How will it affect the viability of my family farm?'*

We tested for a relationship between expectations around NFM schemes and the statements in Table 1. Respondents who agreed that NFM should be more widely implemented also agree: that there is sufficient evidence of effectiveness (E2) (χ=16.45, p=0.01) and that NFM is cost-effective FRM (E4) (χ=39.05, p=0.00). Furthermore, they did not view unintended consequences (C3), maintenance (C4) or effectiveness at high flows (E3) as barriers (χ=14.67, p=0.02; χ=30.94, p=0.00; χ=17.24, p=0.01).

Amongst the most frequently mentioned reasons for supporting wider implementation of NFM schemes was alignment with high-level policy such as the 25 Year Environment Plan and reference to wider benefits. These include quotes around it being a *'no-regrets'* climate change action *(CR: Private sector)* and how it is viewed by communities: *'It has additional benefits to FRM, for example psychological benefits giving back communities some control over flooding and its impacts. It can also engender greater preparedness for flooding.' (RB: Private sector).*

3.3.1. Funding NFM

Respondents were asked if land managers/farmers should be paid to implement NFM and all 118 responded (Yes – 56, It depends – 59, Unsure – 4). All farmers responded 'Yes': '*I would need to be compensated for my inability to grow the crops needed, to keep me viable.' (JT: Farming).* This contrasts with an average of 43% of non-farmers (47% private sector, 46% public sector, 44% third sector, and 23% academics). Private sector respondents noted *'landowners.. and issues of equality'* (*BR*) strongly shape views on what is reasonable and had a pragmatic focus on additionality, i.e. that paid-for actions must be *'additional to existing behaviour'* (*DG*). Another tried to balance these viewpoints: '*We should not be paying subsidies just for ownership of huge tracts of land. There should be services provided in return for subsidies. If NFM and floodwater storage impact on yields or productive land, there should be reasonable compensation. They should also have reasonable monitoring and maintenance responsibility in return too.' (BF).*

Figure 1 breaks down the responses about who should pay for NFM. Respondents could choose more than one organisation/group.

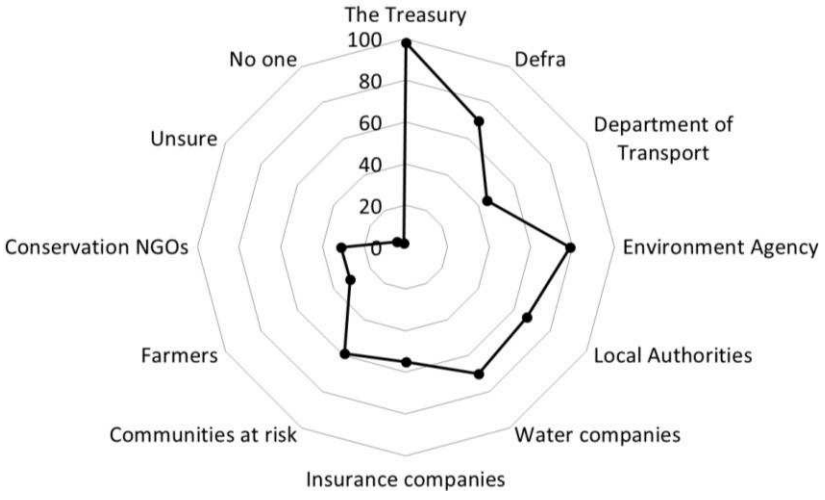

Figure 1: Organisations/groups with responsibility to pay for NFM (No. of respondents. Table SI.1-Q16.b). NGO=Non-governmental Organisations.

Most respondents expect payments should come from the public budget through key statutory bodies, however, the results also suggest some acknowledgment of a shared responsibility extending to water companies, insurers, and even directly from those at-risk. Some respondents suggested that our list was incomplete, for instance the local government respondent JC, *'how about residents in areas not at risk of flooding but which can contribute to NFM for instance in the upper catchment or all residents of urban areas'*.

There were differences between groups on how to calculate NFM payments, see Figure 2. A total 103 respondents answered this question including all farmers. Farmers' most favoured option was to base payments on lost income, followed by modelled effectiveness, and lastly on installation costs (36%, 29% and 14%, respectively). For non-farmers the most favoured option was to base payments on installation costs (37%) followed by lost income (27%) and within this academic views were divided equally amongst these three options (all 26%). This preference for installation costs might reflect a desire for straightforwardness as articulated by a public sector respondent (*NM*) drawing on their knowledge of a rural scheme.

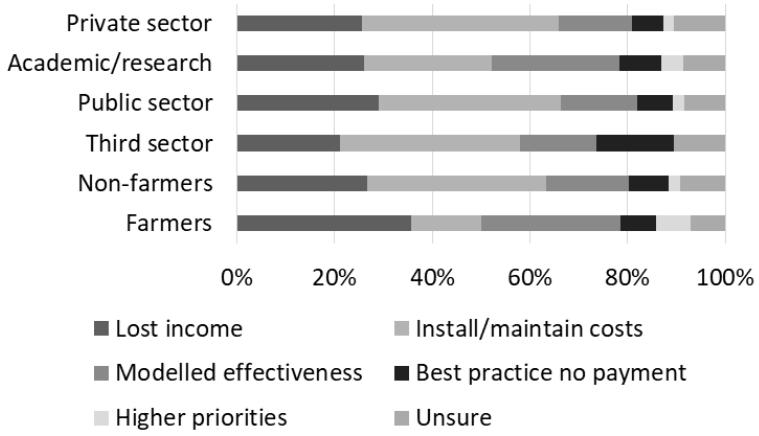

Figure 2: Group preferences for payment design (Key: Left to right. Table SI.1-Q16.c)

Another payments issue is whether to pay for co-benefits; 67% of farmers responded in the affirmative compared to an average 72% of non-farmers. Respondents from the third and private sectors had similar views to this average, however, public sector and academic respondents overwhelmingly supported paying for co-benefits (81% and 92%). Arguments in support centred around to win support, generate efficiencies, and boost holistic management. *TG* a public sector respondent noted the potential '*to match different funding streams together for integrated outcomes.*' Other actions raised to foster NFM included compensation procedures, such as a need for '*simpler mechanisms for farmers to bid for funding' (SA: public sector)* and compensation types, specifically for an '*inundation payment on productive land' (RS: third sector).* However, some respondents were opposed to paying for co-benefits as they are incidental to flood risk reduction and *'not why the work has been done' (RM: public sector*) or because some NFM interventions can directly benefit landowners/land managers.

3.4 Enabling and installing NFM

Using a list of organisations/groups[3] respondents were asked who should be involved in enabling (coordinating, assisting, advising, incentivising) and installing (carrying out physical activities to install and maintain NFM measures) NFM, see Figure 3.

[3] Eleven respondents suggested other organisations/groups, such as Internal Drainage Boards, developers, planning authorities, residents that are not at risk of floods and the EU (flood and climate change policies).

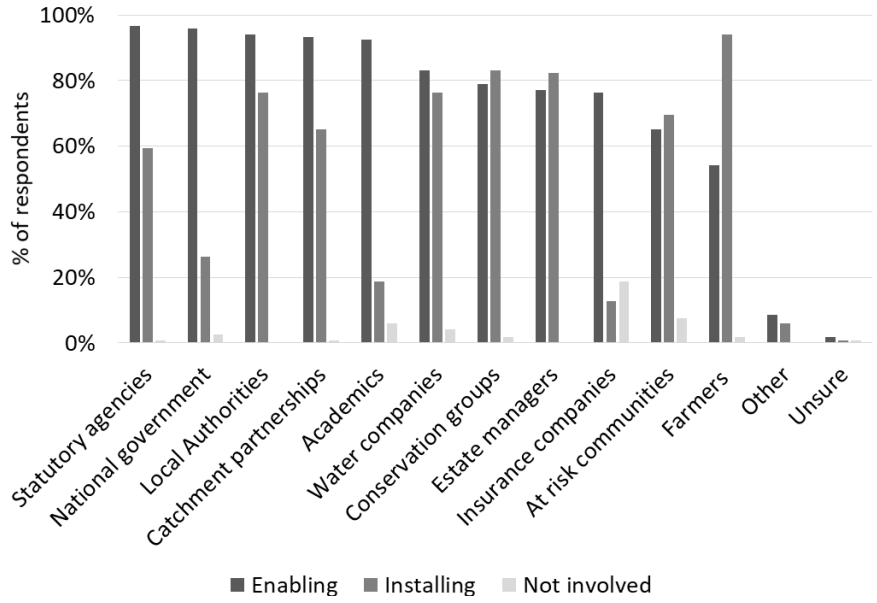

Figure 3: Respondents' choices on which organisations/groups could enable and install NFM (% of respondents' answering. Table SI.1-Q15)

Most respondents (92%) identified as enablers (in this order): statutory agencies, national government, Local Authorities, catchment partnerships, and academics. This leading group was closely followed by water companies, conservation groups, estate managers, and insurance companies. At-risk communities (not defined) and farmers were chosen by more than half of the respondents. For installation, land managers (farmers and estate managers) were identified as key as were other groups with land management experience, FRM obligations and practical and partnership experience (water companies and Local Authorities, conservation groups and catchment partnerships) and more than two-thirds believe at-risk communities and statutory agencies have a role. There were no significant differences between stakeholder groups.

An aspect of enabling NFM schemes is to identify research needs and implementation issues. A majority of respondents (86%) agree that there is a specific need for more evidence on NFM. Research gaps identified included an urgent need for: catchment-scale pilots across the nation and the rural-urban gradient and to test combinations of different NFM interventions; and social science research to understand societal acceptability of NFM interventions. Nonetheless, a number of respondents were concerned with research gaps being used an argument for delay, such as: '*I'm sure we do need more research and evidence for NFM and monitoring of NFM projects as they are delivered, but I'm equally sure we need to crack on now and not use this research imperative as an excuse for inaction'* (*JC: public sector*). To deliver on this call for action a precursor shift from farmers (and others), was identified by some respondents, such as, *'We need to change people's, particularly farmers' attitudes to how the landscape should look, be managed and what it is being farmed for' (AD: third sector).*

4. Discussion

Our findings highlight several key issues around the future prospects of NFM implementation in the UK, with broader implications for the implementation of other types of NBS and in other contexts. In summary, the

stakeholders we surveyed showed some support for NFM and acceptance of a shared responsibility for enabling, implementing and funding it but reported differing views over the detail of when, how and who could or should pay or be paid for its implementation. Public sector and academic respondents often were supportive of NFM and called for action despite various uncertainties and challenges (National Trust, 2015; Iacob et al., 2014; Wilkinson et al., 2019). In contrast, other groups, especially land-managers, are less convinced, which echoes earlier findings (Holstead et al., 2015; Milman et al., 2018).

Therefore, there is not yet a shared understanding of the details of how to enable and implement NFM even if the abstract concept itself is generally supported. This compounds the coordination, integration and resourcing challenges expected for NFM delivery (Waylen at al., 2017) and helps to explain slow progress towards landscape transformation (Wilkinson et al., 2019). We do not yet see activities at a scale that could be considered to reflect a paradigm shift, even though many discourses support it (e.g. DG Environment, 2015).

Differing perceptions represent a conflict, albeit one not often voiced, about what constitutes good land management and who should be responsible for it. Many NFM schemes rely on cooperative voluntary adoption of measures, such as floodplain storage or restoring wetlands, so may be resisted by land-managers who expect the right to decide their own management choices, and to be fully compensated for them. This does not mean that NFM implementation will never become widespread. Indeed there are many other positive prerequisites: eligibility for public funding (e.g. HM Government, 2020), willingness of some landowners to debate their participation (e.g. in pilots, National Trust, 2015), engagement of other stakeholders (e.g. in iCASP), and widespread agreement about problems with pre-existing approaches to FRM (e.g. leaving many areas unprotected, Paavola and Primmer, 2019). However, capitalising on these positive factors to achieve landscape transformation will require a deeper and widened engagement and reconceptualization, especially with landowners. It may also entail other sectors and stakeholders to become more active participants, especially water companies who often intervene in other aspects of catchment management to safeguard drinking water, and insurance companies with an interest in mitigating flood risk.

Differing expectations for enabling NFM may also reflect differing worldviews about relationships with nature and flooding, and also on the balance of rights and responsibilities of different societal groups. In the UK (with some similarities to what Milman et al. (2018) find in the USA), land managers – who are mostly private – have the right to use and manage their land as they please, subject to regulation by statutory bodies (Quinn et al., 2010; Paavola and Primmer, 2019). Regulations do not affect many existing practices that affect river hydromorphology – for example drainage and dredging are a 'normal' part of farming and legally permissible, and are seen as essential for helping to maintain lands agricultural productivity (Rust et al., 2014; Holstead et al., 2014; Dadson et al., 2017). Removing what are seen as established rights and/or requiring alterations to historical river course alterations without compensation could thus be hugely contentious. However, without change, the risk of downstream flooding will continue to persist and possibly increase due to climate change (Dadson et al., 2017).

Connecting these different viewpoints is a challenging task, as it is likely to confront existing values and interests (Cook et al., 2016). Our results suggest that being able to demonstrate the multiple co-benefits to society that arise from NBS initiatives may assist in galvanising wider societal support, for example, in the case of NFM, focusing on biodiversity and carbon sequestration (Iacob et al., 2014). Where payments and incentivisation are needed, co-benefits may also increase the set of potential actors willing to pay for

changes in landscape management – though doing so may trade-off with the desire for straighforward arrangements. Respondents' ideas about what is new or special about the NFM approach can also inform FRM policies, plans and communication, including connections and complementarity with existing approaches and issues connected with nature, communities, responsibility, and catchment land management. In a more radical conceptualisation of future FRM, NFM could even be incentivised and widely implemented across (sub)catchments as a standard, 'no-regrets' option thereby redirecting engineered defences to reduce residual flood risk.

Furthermore, better understanding of normative and information uncertainty in decision making (Newig et al. 2015) will be helpful, as uncertainty is often cited as a barrier to delivery of NBS and confirmed by this study of NFM. Where a decision has already been made to go ahead with implementing NFM, the normative uncertainty is about how to achieve it. In this case, our research provides some helpful guidance to promote schemes with social and environmental co-benefits and direct future support to stakeholder groups that currently do not yet play a big role in FRM or in NFM. Additionally it is important to learn about collaborative environmental management (Benson et al., 2013) and underpinning social processes that can enhance catchment-scale action (Bark and Acreman, 2020). For information uncertainty arising from a lack of knowledge and data, important research is being carried out, for example in Yorkshire where iCASP is: testing how to provide tailored modelling and monitoring support for NFM pilots; growing a NFM community of practice to increase regional capability; and contributing updates to the Environment Agency's national evidence base and guidance.[4] Other information needs are around cost-effectiveness which is a key argument in the advocacy of NBS (Coles and Tyllianakis, 2019) and also strongly reflected in our results. However, there are few comprehensive and systematic social and economic analyses of NBS (ibid). It is important that this research gap is filled to avoid confirmatory bias in the endorsement of NBS.

Better understanding of existing knowledges and their multiple uncertainties is helpful but unlikely by itself to achieve the paradigm shift that NFM represents. It is important to acknowledge that NFM – as for all NBS – will necessarily entail trade-offs between different groups, with winners and losers versus the status quo. In the UK, in the discussion of post-Brexit CAP arrangements, we see this tension more publicly aired, as commentators and scholars (Gawith and Hodge, 2017) debate the pros and cons and feasibility of basing agri-environmental payments on 'public goods for public money', i.e. England's new Environmental Land Management system. Evolving arrangements for incentivising and influencing land managers may offer a useful 'natural experiment' to inform and enable implementation of other NBS. This might lead to a deeper paradigmatic shift through which radically new relationships between land managers and flood mitigation could be imagined, for example, explicitly "*farming water*", i.e. receiving payment for flood attenuation and flood storage. A "re-imagining of what flood management is" (Cook et al., 2016, p323) also entails activities beyond the scope of this study, such as support to at-risk communities to live with flooding (Bark and Acreman, 2020). This highlights a wider issue of societal understanding – and responses – to risks and uncertainties arising from natural processes, which include but are not limited to flooding. Arguments for accepting and adapting to its multiple uncertainties may sit uneasily in dominant 'modernist' paradigms of command and control but are an essential to achieving more adaptive and holistic approaches to environmental governance (Nobert et al., 2015).

[4] See, https://icasp.org.uk/projects-2/natural-flood-management/

5. Conclusion

This research explored the views of NFM held by a diverse set of FRM stakeholders in the UK, as a key example of the challenge around integrating NBS into – or instead of – conventional FRM. There are signs that NBS has entered the UK's discourse on FRM, in part in response to the failure of conventional flood protection as well as the promise of NBS. However, our mixture of survey responses highlights the challenge of achieving change in the face of the practicalities of balancing multiple interests, objectives, and uncertainties. What are the implications for the NBS paradigm shift that NFM represents? Some progress has been made in achieving the needed conceptual and discursive shift – as reflected by the enthusiastic endorsement of some but not all stakeholders – but more intervention will be required if all relevant stakeholders are to work together for the landscape transformations that NFM implies.

There are several practical strategies that could help further implement NFM, such as landscape scale pilots, provision of land management extension services, pilot partnerships to navigate multi-level governance, and consideration of incentives for good practice across a range of sectors. Similar strategies may also assist in promoting delivery of other NBS. However, such specific initiatives may also need to be complemented by cross-sector societal debate concerning both the rationale and specific implications of greater implementation. In the case of NFM in the UK, evidence that stakeholders generally accept NFM should be a shared responsibility can provide a good basis for such debates. An opportunity for more explicit debate on the rights and responsibilities associated with land management would likely be of value to enabling NBS in many places and cases worldwide.

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