Routledge
Taylor & Francis Group

Local Environment

The International Journal of Justice and Sustainability

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/cloe20

The data treadmill: water governance and the politics of pollution in rural Ireland

Arielle Hesse, Patrick Bresnihan & James White

To cite this article: Arielle Hesse, Patrick Bresnihan & James White (2023): The data treadmill: water governance and the politics of pollution in rural Ireland, Local Environment, DOI: 10.1080/13549839.2023.2169668

To link to this article: https://doi.org/10.1080/13549839.2023.2169668

Published online: 27 Jan 2023.

LOCAL ENVIRONMENT
https://doi.org/10.1080/13549839.2023.2169668

Routledge
Taylor & Francis Group

The data treadmill: water governance and the politics of pollution in rural Ireland

Arielle Hesse[a]*, Patrick Bresnihan [b] and James White[c]

[a]Building Resilient Infrastructure and Communities, Federal Emergency Management Agency, Washington, DC, USA; [b]Department of Geography, Maynooth University, Kildare, Ireland; [c]Department of Technology and Society, Lund University, Lund, Sweden

ABSTRACT

This paper draws on fieldwork in rural Ireland to argue that environmental data can reinforce knowledge systems that shield structural problems and blunt efforts to rethink the role of community engagement in environmental governance. It offers a cautionary reading of how data has been instrumentalised by the EU and Irish State by showing how data diffuses responsibility and depoliticises environmental activism in cycles of funding and data collection. Since the 2000 Water Framework Directive, water governance in the European Union has increasingly relied upon extensive scientific, evidence-based decision-making and community and stakeholder involvement. We explore how these changes shape efforts to document and remediate water pollution. We expand upon Shapiro et al.'s (2018)'s "data treadmill" to understand how data rescales responsibility for pollution and its effects. The "data treadmill" gives name to cycles of data and funding that propel logics and strategies of environmental governance. We show how the data treadmill operates by perpetuating a narrative that effective action requires more precise data and evidence and solves questions of responsibility through bespoke approaches to environmental pollution. The data treadmill constrains communities through prevailing logics that surround data and environmental governance: communities become tied into European funding programmes that require, on one hand, the expertise of various professionals and consultants, on the other, place-based knowledge and social relationships to deliver innovative responses to structural problems. We offer a critical analysis of current institutional and policy in the EU and Ireland to highlight perils and contradictions of data-centric environmental governance as practiced.

ARTICLE HISTORY
Received 13 June 2022
Accepted 20 December 2022

KEYWORDS
Environmental governance; environmental data justice; public participation; environmental policy; uncertainty; responsibility

1. Introduction

This paper draws on fieldwork in rural Ireland to illustrate how environmental data reinforces knowledge systems that shield structural problems and blunt efforts to rethink the role of community engagement in environmental governance. The 2000 Water Framework Directive (WFD) reshaped water governance in the European Union (EU). First, it used an integrated approach to river basin management that utilised ecological rather than political boundaries for water management (Kaika 2003; Kallis and Butler 2001). Second, many member states adopted catchment-scale

CONTACT Patrick Bresnihan patrick.bresnihan@mu.ie Department of Geography, Maynooth University, Kildare, Ireland
*The views expressed in this document by this author are hers alone and do not necessarily represent the views of FEMA, the Department of Homeland Security, or the United States Government.

initiatives, enrolling the efforts of experts and citizen scientists to manage environmental pollution through data. Emblematic of broader shifts towards data-centric environmental governance and monitoring (Bakker and Ritts 2018; Fortun 2004; Gabrys 2016), data and expertise manage the risk, uncertainty, and complexity of hydrological systems. Our case study offers a cautionary reading of current institutional and policy configurations that shape environmental governance in the EU and the Republic of Ireland, as these serve to instrumentalise data in ways that diffuse responsibility for environmental pollution.

In recent years, the concept of environmental data justice has drawn attention to issues of accountability, transparency, and trust in environmental data and governance (Dillon et al. 2019; Vera et al. 2019), and is connected to wider efforts to critically examine what environmental justice means and how knowledge is valued (Massarella, Sullu, and Ensor 2020). New data infrastructures and data practices are not only considered but also enacted through a lens that acknowledges how knowledge and data are tools to shape environmental governance. This framework draws attention to the tensions that data produces for those claiming environmental justice and remediation for environmental harm. Namely, by using data and scientific knowledge, these efforts necessarily reproduce hierarchies of knowledge. Data practices combine with policy configurations to reinforce knowledge claims and circumscribe possible remediation strategies. Despite efforts to bridge the divides between "experts" and "citizens", data becomes a broker of valid participation in governance, raising the stakes of having data that is trusted, believed, and given authority. It becomes a cycle. The implications of environmental policies that seek to increase the use of environmental data as a governance tool and public and stakeholder participation warrant attention.

From this starting point, we extend Shapiro et al.'s (2018) concept of the "data treadmill" to describe how this data-driven governance focuses responsibility in response to environmental pollution. We draw on our fieldwork in rural Ireland to highlight how the data treadmill frames environmental problems as complex but discrete, uncertain but manageable, obscuring longer histories of pollution and environmental harm and constraining the scale at which action is deemed feasible. The "data treadmill" gives name to cycles of data and funding that propel logics and strategies of environmental governance. Insofar as environmental problems are perceived as controversial or uncertain, the data treadmill incentivises ever more localised scales of analysis and response, while ensuring that responsibility for remediation is only ascribed to the "appropriate" actor. While our findings highlight perils and contradictions of environmental governance, our goal is not an argument against data. Instead, we caution against ways that data has been instrumentalised by the EU and Irish State because it diffuses responsibility and depoliticises environmental activism in cycles of funding and data collection.

We explore three related dimensions of the data treadmill. First, it perpetuates a narrative that effective action requires more precise data and evidence. Second, it resolves questions of responsibility through bespoke approaches to environmental pollution. Finally, it facilitates a re-scaling of governance and expertise – various professionals and consultants enrol place-based knowledge and relationships to deliver innovative responses to structural problems. This is particularly prescient as environmental governance increasingly relies on more environmental data and data infrastructures to support it.

2. Conceptual framework

We elaborate on the concept of the data treadmill through a conceptual framework that draws from Science and Technology Studies (STS), environmental data justice, and critical data studies. We begin by discussing uncertainty as a feature of environmental governance, where data plays a central role in managing uncertainty (Section 2.1). We then turn to the concept of the data treadmill (Section 2.2) to situate our arguments and critiques. We expand on the concept of the data treadmill by focusing our attention to the rhythms of data-driven epistemologies and practices, where more data is seen as

the response to quell the uncertainty and complexity that surrounds environmental problems and renders "efficient" and "effective" remediation at only depoliticised scales.

2.1. Uncertainty and data in environmental governance

Uncertainty and its relationship to risk have been a focus of STS and environmental governance scholars for decades (Beck, Lash, and Wynne 1992; Mitman, Murphy, and Sellers 2004; Murphy 2004, 2006, 2013; Shackley and Wynne 1996; Underdal 2010). Uncertainty and risk are characterisations of ecological systems' complexity, unpredictability, indeterminacy, and contingency that buttress forms of neoliberal governance and shape our understandings of the politics of science and expertise (Brown and Damery 2002; Nelson 2015; Pellizzoni 2011). STS has drawn attention to the character and effects of data-driven epistemologies and practices, especially as data is seen as the corrective to manage uncertainties that surround environmental problems (Fortun 2012; Oreskes 2015). Many understandings of uncertainty call attention to two dimensions: how it functions as both a quality of knowledge (unknowns, incomplete knowledge, etc.) and how it functions as an epistemic condition for which data offers clarity, and supposedly unbiased measurements through which to make decisions. Forms of unknowing and lack of knowledge justify and undermine forms of environmental governance often to limit oversight or diminish "non-expert" forms of experience. In particular, the production and manipulation of knowledge as doubt has been used as a tool to undermine environmental governance and scientific knowledge and reinforce corporate interests (Boudia and Jas 2014; Mah 2017; Michaels 2008; Oreskes and Conway 2010).

The role of data and information in environmental governance is elaborated by Fortun (2004) and others who describe "the informating of environmentalism", a mode of neoliberal governance that emphasises the measurement and monitoring of environmental systems. Increasingly large volumes of data and a widening variety of data have entrenched the primacy of data to manage risk (Nost 2019). Environmental sensors and monitoring technology further transforms environmental problems into data problems and demands more data to become more "accurate" and efficient through its automation (Gabrys 2016). "The problem of environmental change then often becomes a problem of gathering data and acting on that data within the terms set by these modes of calculation" (Gabrys 2016).

The explosion of quantified forms of environmental data follows from expanding technologies that enable passive sensing, automation, and real-time data, the linking of environmental data sets, and the requirements by governments to gather more data of this type. These data are all seen to provide better bases on which to make assessments and act (Nadim 2016; Taylor and Richter 2017). Data and statistics are tools that guide decision-making around natural resource use, but also insulate decision-makers from accountability for these choices (Rieder and Simon 2016). These new forms of data, data infrastructures, and the decision-making it facilitates are transforming governance (Bakker and Ritts 2018; Nadim 2016; Walker et al. 2018).

Data can make things appear "real". Enumeration, counting, and data generation is a form of recognition and legitimation (boyd and Crawford 2012; Crawford, Gray, and Miltner 2014; Kitchin 2014). Yet, this "realness" or perceptibility is intrinsically linked to what is measured, how it is measured, and the norms and standards of scientists and experts (Murphy 2006; see also Lampland and Star 2009; Nash 2006). This STS perspective shows how data can obscure responsibility and accountability for toxic exposures, and how citizen science offers opportunities to make other data visible and real (Jasanoff 2017). Moreover, through citizen science and the engagement of local knowledges, individuals can perform and make visible their attachment and care of their environments, deepening longstanding and enduring relationships (Dunkley 2019; McEwen et al. 2020). There is potential with citizen science to fundamentally rethink knowledge production in relationship to the environment, particularly when efforts are focused on the co-production knowledge between communities and scientists (Lane et al. 2011).

Increasingly states have incorporated "alternative" forms of knowing into environmental governance drawing upon local and citizen science to achieve environmental governance goals (McCormick 2007; Strasser et al. 2019). Yet efforts to increase citizen science and the inclusion of local knowledge often do so in ways that reinforce existing power relations. Public participation has been critiqued extensively; despite its often-touted purpose as a tool to democratise science and governance and pluralise knowledge, these outcomes are rare and can be depoliticised by experts who seek to diffuse disagreement (Chilvers and Kearnes 2019; Mitchell and Ejderyan 2020; Rollason et al. 2018; Whatmore 2009). The technologies and tools by which environmental data is collected, managed, and regulated, function in ways that continue to reinforce "scientific" way of knowing. Often when the state moves to incorporate "local knowledge", the state instrumentalises it by seeing it as something that is, "extracted and appended onto existing formal knowledge frameworks, without fundamentally altering the kinds of questions that are asked or the way problems are framed in research, without in other words shaping water governmentalities" (Sarmiento, Landström, and Whatmore 2019, 373).

In raising these issues, we are mindful of the tension that data produces for addressing environmental problems: it can offer a form of recognition, validation, and power within environmental justice struggles, but it also can be a tool of the state and corporate power masked by the depoliticisation and neutrality of data (Dillon et al. 2019; Vera et al. 2019). Data collection can be a form of resistance, a form of making things count where the state and corporate interests have rendered those experiences invisible. Data also has political power in its ability to advance claims on the state, particularly where communities and individuals are ignored, dispossessed, and harmed (Dillon et al. 2019; Mah 2017; Vera et al. 2019). Neimark et al. (2019) argue that without denying or obfuscating environmental harm, but we can question forms of expertise and governance that reproduce systems responsible for such harms. The authors stress "affirming diversity in both knowledge and reality (i.e. epistemology and ontology, respectively) regarding the drivers of environmental change" (Neimark et al. 2019, 613). This builds on arguments made by feminist scholars (Haraway 1988; Harding 1993) some thirty years ago, that a critique of the dominant mode of Western (universalist) science should not lead to relativism but a reconsideration of objectivity as founded on a plurality of epistemic practices. Despite the political power of data, hesitancy and caution surround its potential.

2.2. Data treadmill

The data treadmill emerges from the tension between data and environmental justice struggles. In reflecting on their ambivalence towards experiences of formaldehyde testing in emergency housing, Shapiro, Zakariya, and Roberts (2018) use the "data treadmill" to characterise the limits of a politics based on chemical detection. For while data generated through environmental testing can service social justice goals, continuous measurement and validation, and the broader systems that require them, perpetuate social inequalities in other ways that work against more fundamental change (Dillon et al. 2019; Liboiron 2016; Shapiro, Zakariya, and Roberts 2018; Walker 2006). Not only can the data practices of citizen science become trapped on a treadmill where its rewards are held out of reach by ever-more-specific demands(Wylie, Shapiro, and Liboiron 2017), but it furthers the scientisation of society (Shapiro, Zakariya, and Roberts 2018). Science, when used to make a claim of justice, can reproduce hierarchies of knowledge and expertise and reinforces ways of explaining environmental harm. Moreover, pursuing data becomes a task unto itself as it confers legitimacy to environmental groups' voices and their access to participate in decision-making (Shapiro, Zakariya, and Roberts 2020).

These ideas shape how we understand the rise of data-backed solutions to environmental problems, particularly as they arise from the combination of national and transnational environmental policy, the datafication of society, and the ecological degradation caused by industrial agriculture across Ireland and Europe. The data treadmill elicits the rhythm of environmental data and its role

in environmental governance. There is a push for more data and local scales of analysis. These data practices also have geographies and temporalities, patterns of knowing that fit into political economies of funding that entrench incentive-based approaches linked to problematic ways of ascribing responsibility. In our analysis, the data treadmill emerges from a context of uncertainty and insufficient knowledge, where greater granularity and higher levels of certainty are seen as necessary to solving environmental issues. Our paper expands on the data treadmill concept by showing how environmental concerns can be depoliticised by a framework that demands more data to address political-ecological problems and reinforces policy and funding solutions that seek to tame their politics and entrench forms of responsibility.

In seeking to move beyond the constraints of the "data treadmill", Shapiro, Zakariya, and Roberts (2020) introduce the concept of "inviting apprehension". "Inviting apprehension" is about enabling conditions in which different questions can be posed and including different forms of expertise (see also, Whatmore 2009). They emphasise modes of thinking that exceed enumerative data will likely create unease in scientists and data-driven policymakers, but that this can be a productive tension necessary for moving beyond the narrow terms of established questions and agendas.

Complimentary to their approach is Shattuck's (2021) concept of "epistemic emergence" which confronts the impasses that arise when the complex relations between agricultural pesticides, environments, regulatory institutions, and human health produce uncertainties that favour the status quo. Drawing on Liboiron, Shattuck calls for working with uncertainty such that complex forms of harm become articulate enough for action. This does not mean having to work up from lay to expert knowledge or of proving expertise under the terms of institutional science. Rather, it can mean triangulating multiple epistemic perspectives, many kinds of partial, situated, and imperfect data in relation. Shattuck argues that this can evade the data treadmill "and orient toward questions of what kind of knowledge, and for who might spur action" (2021, 2).

In extending the data treadmill metaphor, we identify three dimensions that help articulate its implications. (1) It perpetuates a narrative that effective action requires more precise data and evidence. (2) It resolves questions of responsibility through localised and individualised approaches to environmental pollution to address uncertainty, contingency, and complexity. (3) It localises governance by tying communities to funding programmes which, on one hand, require the expertise of professionals and consultants, and on the other, the place-based knowledge local communities that tasked with delivering innovative responses to structural problems. In concluding, we draw on these insights to consider how the data treadmill might be escaped through different knowledge regimes.

3. Methods and context

Our findings arise from our fieldwork undertaken as part of research on water politics around community-managed water supplies in rural Ireland. We take the next few sections to describe our methods and the context of water and environmental governance in the EU and Ireland before turning to our study around the Lough Carra.

3.1. Materials, methods, and methodology

This paper draws on the results of participatory and ethnographic mixed methods research conducted between late 2018 and early 2020. This included participant observation at approximately ten community meetings, fifteen visits to walk on the shores of and sail on the waters of Lough Carra, and over thirty open-ended interviews and interactions with members of the Lough Carra Catchment Association (LCCA), the Local Authority Waters Program (LAWPro), the Environmental Protection Agency (EPA), and other stakeholders.

We also employed auto-photography and photo-elicitation to surface concerns and attachments to the lake.[1] The perspectives, backgrounds and expertise of catchment scientists, local ecologists,

farmers, anglers, and residents shape different ways of experiencing and perceiving the catchment. To better elicit these differences, the project utilised autophotography to give individuals a way of representing their perspective visually (Johnsen, May, and Cloke 2008; Lombard 2013). Ten LCCA members of diverse backgrounds were given disposable cameras and two weeks to take photos in response to the prompt: what affects the quality of water where you live and work? The resulting photographs were used as the basis for semi-structured follow-up interviews, of approximately 60 min in length. This methodology allows participants to form, solidify, and share connections and relationships to places and their communities visually and verbally.

This study's mixed methods approach allowed us to trace the progress of the LCCA and the evolution of the catchment-based approach to water governance in Ireland. We paired our fieldwork with analysis of environmental and agricultural policy materials, attendance at regional water governance meetings, and expert interviews with academic and state scientists.

Moreover, our methodological approach was collaborative; all research activities were undertaken by two of our three-person research team. The data generated was analysed in an iterative and explorative manner, through regular team discussions of observations and findings. Although the mixed methods used in this project enabled us to capture and triangulate across many sources of data, it has limitations. Most significantly, in most cases our points of entry into the LCCA and LAWPro were through authoritative individuals in leadership positions. Although we were able to develop relationships outside of those points of entry through our presence at community meetings, our "official" role conveyed a sense of authority and power in our research process. In this paper, we draw on these materials and reflections to illustrate and interpret how the data treadmill is generated, and how it reinforces prevailing ideas about how to scale solutions for water pollution.

3.2. Environmental governance in Ireland

Historically an under-populated country without the presence of heavy industry, Ireland is a relative latecomer to environmental governance within the European context. During the 1970s and 1980s, economic development was a more pressing issue for the state, with efforts to attract investment from abroad often overriding social and environmental concerns. However, community-led campaigns highlighted the pollution that resulted from economic development and illustrated the need for a more effective approach to monitor and regulate industrial pollution (Allen 2004; Deckard 2016; Leonard 2007). A growing emphasis on environmental protection within the EEC also contributed to the establishment of Ireland's Environmental Protection Agency (EPA) in 1993. The EPA's role, albeit often fraught, has been to protect and improve the environment and is responsible for setting, monitoring, regulating, and enforcing permissible levels of pollution.

Importantly, Ireland's history of environmental pollution and environmental governance is layered by its relationship to agriculture. Critical commentators sought to implicate farming in the bracket of toxic industries as early as the 1990s (see Allen 2004), and European directives aimed to curb the well-recorded excesses of nitrates and phosphates polluting water systems. Yet Ireland has consistently simultaneously managed agricultural pollution through scientific and regulatory regimes amidst economic goals of continued expansion the animal-intensive agricultural industry.

3.3. Water governance in the EU and Ireland

"The right measures in the right place" – Ireland's River Basin Management Plan, 2018–2021.

In its efforts to implement the WFD, Ireland's 2nd River Basin Management Plan (2018–2021) embraced integrated catchment management (ICM) to manage water systems through ecological rather than political boundaries. ICM's philosophy requires a holistic approach to water governance that factors in political, economic, and social contexts in management decisions. Widely pursued for

its integrated and "bottom-up" approach, ICM and catchment projects often focus on empowering local land-users, in particular farmers, to remediate sources of pollution through grants and funding schemes, or agri-environmental schemes (Image 2016). Under Ireland's under the River Basin Management Plan, 189 Areas for Action were identified as locations where this empowerment could have meaningful changes.

Despite ICM's encouragement of public participation, it often relies most on scientific data. In Ireland, scientific data, seen as apolitical and uncontroversial, partners with voluntaristic approaches to water governance. State agencies work with rather than penalise polluters. Environmental oversight is chiefly facilitated by the EPA, however, ICM is largely coordinated by the Local Authority Waters Program (LAWPro). LAWPro employs a team of environmental scientists and community engagement officers to facilitate analysis of environmental pressures within the Areas for Action. Data gathered by scientists focuses on identifying specific points of pollution so that farmers and landowners deemed to be polluting can remediate their practices. However, the implementation of environmental policies to govern water generates a push for more data at local scales. It also produces an uneasy relationship between what are espoused to be bottom-up approaches, and expert knowledge seen to diffuse politics surrounding natural resource use.

This perspective fits within prevailing ideas about how to manage agricultural production and pollution. The most significant agricultural policy in the EU is the Common Agricultural Policy (CAP), developed to assist farmers in response to food shortages following World War II and has consistently accounted for a substantial part of the EU's operating budget, roughly 37% in 2019 (Europa 2020a). In recent years, CAP has focused on managing environmental problems through agri-environmental schemes (Lastra-Bravo et al. 2015). Within Ireland, this has meant a focus on farm-scale decision-making through incentive schemes to encourage different farming practices. Such direct funding mechanisms reinforce a discursive space in which environmental problems are addressed at a local level, often on a farm-by-farm basis, which avoids blaming the agricultural sector more generally. The Lough Carra Catchment Association (LCCA) sits at the junction of these policy dynamics.

3.4. The Lough Carra catchment association

The LCCA is a diverse community organisation that aims to reverse the decline of Lough Carra, a marl lake in County Mayo. Many living in vicinity of the lake have long been concerned by its deterioration. They have expressed worries about nutrient levels for several decades and have documented changes to the colour of the lake's bottom, once white now turned green due to nutrient-related plant growth. An ecologist-photographer team published a book about the lake that consolidates theirs and others' research (Huxley and Huxley 2015). Despite these efforts to identify and remediate the causes of the lake's deterioration, which are presumed to be the slow intensification of nearby agricultural activities, the issue has failed to gain enough recognition to bring about change. The LCCA was formed from this community of motivated local inhabitants in 2018 to co-ordinate and focus their activities.

The LCCA is an organisation that policy makers would identify as a local community organisation. The LCCA is organised around concerns for within a particular location. There is, however, a wider "community" that policy makers are seeking to incorporate in addition to these groups. Recognising that this concept is often loosely, and problematically used, in this paper, we often refer to "the community" or "the community group" to identify the group of individuals – landowners, businesspeople, citizens, scientists, politicians, and organisers – who show their concerns and attachments to the lake through their collective actions through the LCCA. Although many do, not all these individuals live in the boundaries of the Lough Carra Catchment.

In addition to these community activists, scientists at major Irish universities and the National Parks and Wildlife Service have documented the lake's decline. Much of this research confirms the findings of community members, that adjacent agricultural and forestry activities are contributing

too many nutrients to the water. Nevertheless, specific actors and pathways have not been mapped to the satisfaction of all.

At its first meeting in late summer 2018, the new chairperson of the LCCA asked, "Do we need more science?" (Ward 2018), the unstated implication being that more science was not needed to tell them what they already knew. However, by the autumn of 2018, the answer to that question had become an emphatic "yes". In the subsequent months, the LCCA applied for and was awarded rural development funding to study the lake to identify pollution pressures. This research supported an application for EU LIFE funding for agri-environmental schemes to incentivise farm-specific remediation strategies of agricultural pollution. The LCCA decided that more data would allow them to justify and target interventions suitable to prevailing environmental governance practices in Ireland and the EU. The LCCA has directed its efforts towards data collection and funding applications for agri-environmental schemes (Figures 1 and 2).

4. Results: the data treadmill

We analyse three dimensions of the data treadmill, connected to the work ongoing by LAWPro and the LCCA. We focus on how the data treadmill entails a narrative that more precise data are required for effective action, produces bespoke approaches to environmental pollution, and facilitates the re-scaling of governance in which communities become tied into European funding programmes. Together, this reinforces ways of ascribing responsibility that demand certainty and causal pathways, but also that is scaled in such a way that subsumes meaningful discussion of the agricultural and environmental policies that have produced environmental harm.

4.1. More data, more evidence

There is a long history of data collection on Lough Carra. When the LCCA first organised, some felt that there was already sufficient data to point to the sources of pollution. The problem, however, has

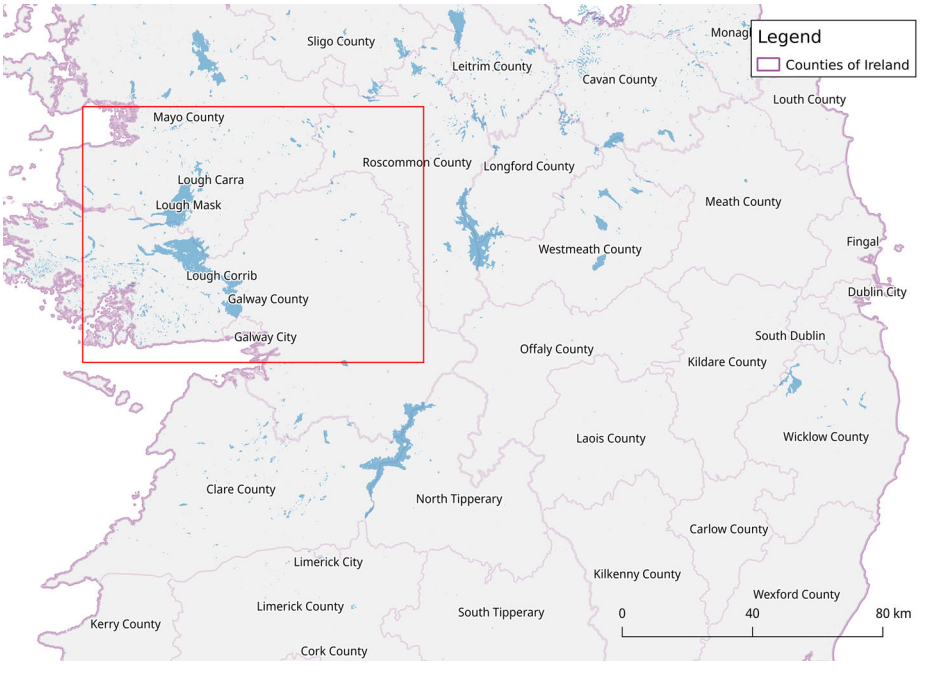

Figure 1. Location of Lough Carra.

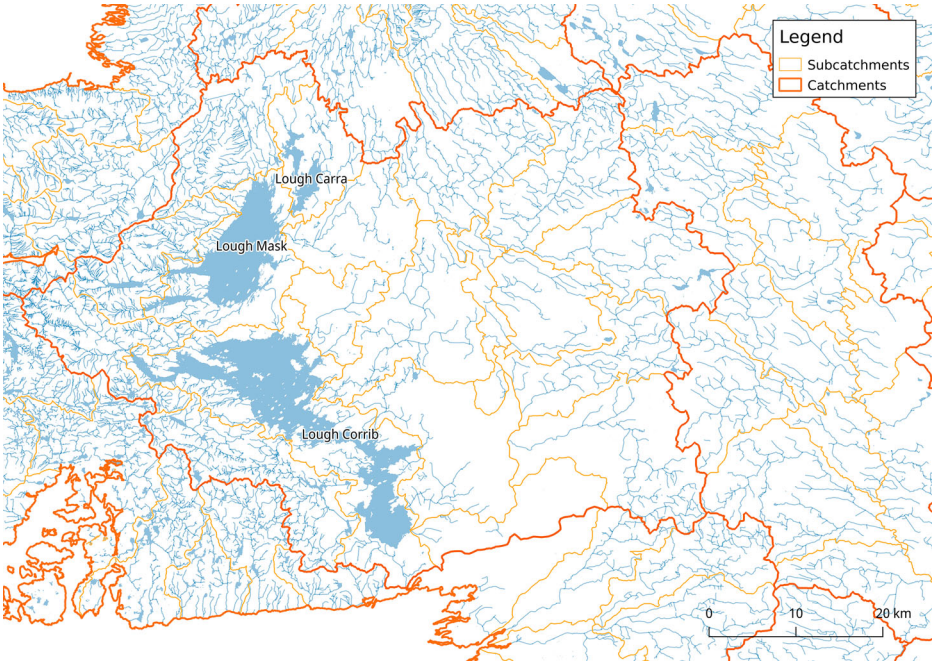

Figure 2. Catchment and sub-catchment boundaries, Lough Carra.

been who has the authority to define pollution – experts and authorities – and at what scales. Without the scientific legitimacy to interpret them, however, observations made by LCCA members could only bear witness to environmental damage. What we highlight here is both the necessity of local knowledge but also the perils that arise when such knowledge is valued in constrained ways.

For example, local inhabitants have long struggled to get the EPA to address their concerns. Although the EPA has monitored the lake for years, data has often been collected without community input. Members of the LCCA have challenged how, when, and where data has been collected for the purposes of characterisation, particularly as these measurements, in their view, have not been taken at the right times and locations to capture the flow and impacts of pollution. With the LCCA, prevailing forms of expert-driven environmental governance have shaped relationships to the EPA, reproducing a sense of misrecognition (Tovey 2009). This was most notable with the classification of the lake. When the EPA first classified the lake's status under the WFD, it classified Carra as "high" (i.e. high quality). Locals demanded to see the data and the justification on which the determination was made, and when this was not done their satisfaction elevated concerns that the EPA's methodology was inappropriate and had failed to monitor some inlets into the lake. Eventually, the EPA reclassified the lake to "good" and included the Lough Carra in an Area for Action under the 2nd RBMP. While this has helped drive attention towards the lake, it has not allayed fears about the EPA and its data practices.

LAWPro, in contrast to the EPA, has sought to involve local communities in assessing their water bodies. LAWPro has a mandate to integrate state agencies with community stakeholders to make localised improvements in the Areas for Action. It has two sets of officers: community engagement officers and catchment scientists. Catchment scientists were tasked with producing a desk study from the existing available EPA and other data, before engaging in on the ground data collection, sometimes using local knowledge to help improve where and when they take measures. These efforts involve community groups by facilitating citizen science activities and have had tangible benefits. Still, to the extent that these efforts democratise science or governance, there is reason

to be sceptical. At the centre of LAWPro's community engagement strategy is a community meeting in which the project is presented, and public input is directed towards well-defined ends. While local knowledge is tapped as a resource, locals are not given the opportunity to direct the management strategy or its implicit politics in a meaningful way. This is done in the interest of preserving objectivity.

This approach to data and data gathering has further political implications. LAWPro tends to abstain from environmental action until it has amassed a body of evidence that identifies the source of pollution. This requires highly localised and detailed data, and ultimately protects members of a polluting industry from implementing remediation, often under the auspices of not placing financial burdens on individuals who are not to blame for the locally defined problem. With agriculture, this means focusing on the development of farm and field-scale data to implement farm and field-scale solutions, rather than pointing to the longer histories of agricultural intensification that have shaped land-use choices and legacies of pollution and poor water quality. Due to the complexity of these systems, where impacts are seasonal and may have interacting ground and surface water components, these determinations are challenging.

LAWPro operates within a context where data is seen to provide a more accurate representation of complex processes, specifying the causes and flows of pollution in ways that depoliticise and diffuse contention. As a geologist instrumental to the introduction of ICM in Ireland puts it: "Critical pressures and conflicts in the catchments are often 'skirted around'" (Daly, Archbold, and Deakin 2014). This is most evident in its approach to managing agricultural sources of pollution. Although agriculture has been repeatedly identified as a significant negative pressure on water quality, "pointing the finger at farmers", is extremely unpopular and politically fraught, and is reflected in the institutional arrangements through which LAWPro operates.

Alongside the catchment scientists, LAWPro community engagement officers work in a less prescribed manner, developing capacities within communities, and supporting community-led initiatives. These engagement officers are charismatic, passionate, and outgoing, and focus on finding different ways of connecting organisations to supports. Thus, on the one hand, they help communities fill in paperwork, negotiate bureaucracy, and access funding. On the other hand, by steering local groups, community engagement officers shape what is considered legitimate and proper action. We observed these activities first hand at community meetings we attended as well as learning about the perspectives and objectives of community engagement officers from interviews with them.

Shortly after their formation, and with the advice of a community engagement officer, the LCCA secured more than €27,000 in EU funding – under the LEADER programme – to undertake a feasibility study of the Lough Carra to identify specific sources of pollution. The data that comes out of the LEADER study provides the evidentiary basis on which the LCCA has pursued EU-LIFE funding for remediation schemes around the Carra. To successfully win EU development funding, LCCA needed to speak and present themselves in certain ways. LCCA retained a professional environmental consultant to give them the greatest chance of being awarded European funding. They have embraced the outreach of the LAWPro catchment scientists, engaged in dialogue with the EPA, and welcomed the Geological Survey of Ireland and other experts at meetings. Even our participation and research with the group can be understood as one way they have sought to embrace scientific knowledge and outsider expertise.

4.2. Bespoke remediation, voluntary participation

Agri-environmental schemes like those the LCCA has pursued are a key voluntarist tool used to incentivise farmers to take action to improve the environment and are regulatorily required. The EU also has dedicated funding streams for agri-environmental schemes that stem from efforts to address the environmental impacts of agriculture. This is most notable in the 2003 CAP revision that addressed overproduction, sustainability, and rural decline. First, direct payments to farmers

became linked to meeting environmental regulations (cross-compliance). Second, substantial funding was made available for rural development, especially to support community environmental initiatives and agri-environmental schemes. Within Ireland, this has already led to multiple cycles of community development funding and agri-environmental schemes to incentivise farmers to implement farm-specific plans around particular environmental goals. The funding streams supported are those that the LCCA has pursued in its efforts to fund agri-environmental schemes to remediate agricultural pollution on Lough Carra, which was a key focus of the community meetings we attended, including devoting meeting time to examining successful projects in other places to determine their own course of action.

Many models for agri-environmental schemes that target any water quality focus on targeted, local scale opportunities, which fit within comfortable ways of ascribing responsibility for sources of agricultural pollution; namely the farmer(s) that are found to be responsible. Thus, the approach taken by LAWPro is a targeted form of participation where assistance and access to funds is predicated on data to show that such efforts will help. Not only is this model seen as more efficient and cost-effective, but it also aligns with the reluctance and hesitancy to "blame" farmers and have certainty surrounding where funds are most "efficiently" distributed. Extensive conversations occurred during LCCA meetings about how to engage with farmers and talk about agriculture, even as members of their own group were farmers themselves.

LAWPro community engagement officers utilise a strategy that places funding at the centre of engagement, and where a focus on finding funding sources, even before goals, objectives, and a vision are established. Community groups are directed towards big pots of money to implement strategies and schemes to remediate pollution. These objectives are reflected in documents and visualisations that characterise LAWPro's responsibilities, but it was also a key focus of the LAWPro engagement officers we interviewed and worked with throughout the course of our research. These funding schemes are highly competitive, and often require specialised forms of expertise to complete the application process. The nature of competitive funding pools is that not every catchment will have a group that is successful at garnering big funding, but their resources, efforts, and concerns will be channelled this way. This focus on local funding incentivises pilot projects and bespoke agri-environmental schemes.

This approach has dominated water management in Ireland. Our review of the EPA's quarterly publication "Catchment Newsletter" identified at least 160 mentions of these funding sources between November 2015 and November 2018. Yet, while the embrace of such a structure may be framed as a reaction to the failures of command-and-control regulation to improve water quality, it can also be interpreted as an instrumentalist approach to facilitating and supporting community groups. Understood in this way, Ireland's responsibility to achieve water quality and public engagement requirements under the WFD falls on communities but also fits within Ireland's paradigm of water management. Our point is not to debate the positive impacts of agri-environmental schemes on local environments, but rather to illustrate the problematic implications of directing so much attention towards them.

Incentivise schemes and cross-compliance occur within a context where the Irish government policies seek to expand the agricultural sector, specifically the powerful and profitable dairy sector. While it promises to promote sustainable growth, the Government's Food Wise 2025 policy has set ambitious targets to increase exports by 85%, increase value-added by 70%, increase primary production by 65%, and will result in increases to beef and dairy herds (Food Wise 2025 2015). However, these structural concerns about the relationship between agriculture and environmental problems are subsumed in the push for more localised sources of data and more innovative, place-based, and community-led solutions.

4.3. Data and the diffusion of responsibility

Data becomes a mechanism to "prove" environmental harm and seek recognition from the state. Yet, pursuing data is not unilaterally beneficial. Despite all the research that has been done on the lake –

which we heard extensively about as we attended community meetings, interviewed LCCA members, and spent time with them on the lake – the LCCA finds itself gathering data to identify specific sources of pollution to pursue funding streams to implement strategies at the farm level. The data treadmill is evocative here because it helps to show not only how the LCCA is pursuing more data to manage the complexity and uncertainty that arises around the lake, but it necessarily is connected to short-term funding. It illustrates a broader trend to focus on localised analysis and localised solutions, to make sure that responsibility for remediation is only incentivised to the appropriate actor. LCCA's efforts parallel much of the work that LAWPro is undertaking, but with the hope of providing payments for farmers.

For a small, voluntary group to shift politically and economically entrenched agricultural system is hard to sell. Whereas, more ready-made is a route, facilitated by state agencies, professionals, and funding bodies to channel those concerns into a discrete, local project that can emulate "successes" of other pilot projects. The problem with this is that it is precisely such projects that prevent any meaningful debate on drivers of agricultural pollution and water quality decline. To paraphrase Fortun and Fortun (2005), this kind of civic science can make the worst forms of environmental harm more bearable, but it does so by retreating from a substantial questioning of the state of things (Shapiro, Zakariya, and Roberts 2020).

This pursuit of data and cycles of funding has material effects on how environmental problems are defined and managed. LEADER funding, for example, is no small task. As we learned from attending community meetings and our interviews with the LCCA, While the Community Development Officer at LAWPro assisted the LCCA in putting together a proposal, the proposal drew on the collective expertise of the LCCA, drawing knowledge from ecologists, local government officials, and county councillors, and utilising the advice of the Community Development Officer at LAWPro. However, it became a launching point for more funding. Based on advice from the Community Development Officer at LAWPro, the LCCA used the LEADER funding to pay an environmental consultant to assist them in applying for LIFE funding, a highly competitive EU source of funds for environmental projects. EU LIFE funding offers awards between €1 and €5 million that last for 3–5 years (Europa 2020b). Proposals must undergo a two-step proposal process, which LCCA undertook with the assistance of the environmental consultancy group they hired with LEADER funds.

Since our research project ended, we have continued to follow the LCCA through our community photography exhibit and their monthly newsletters. Their first LIFE application was not successful, but they were encouraged to apply again and continued to do assessments and gather data. In their revised application, the LCCA included significant financial commitments on the part of Mayo County Council, the National Parks and Wildlife Services, and the Department of Agriculture. This application was successful, and the LCCA's LIFE project was awarded roughly €5 million in May 2021. However, the LCCA is no longer the leading organisation. The LCCA moves to a stakeholder role in the LIFE project, as the Mayo County Council takes the lead.

This is a big change from just a few years ago when the group had struggled to gain recognition from state agencies or organisations. The diverse concerns, experiences, and relationships of LCCA members to the lake have been channelled towards prevailing logics, and the groups' resources, their time and money, have been depoliticised by a data-centric understanding of not only the problem, but the solution. Members often display an intense knowledge of the lake – from the contours of its shores to the biodiversity in its waters – and a seemingly insatiable interest in knowing ever-more about the lake. Yet to pursue recognition from the state, this knowledge has become secondary, "local" knowledge, supplanted by "scientific" evidence and actors pursing remediation at an individualised, politically convenient level.

What is perhaps most concerning is that a water governance model so heavily tied to short-term funding cycles is being adopted nationally. This approach to ICM, which focuses on connecting individual communities to pools of funding, limits the communities which can be successful and entrenches a narrow model of responsibility that recasts sources of pollution that result from national and EU agricultural and land-use policy to an individual actor. It perpetuates a logic in

which the agricultural policies and economic models of developments are not up for debate. This does not have to be the case.

5. Discussion: escaping the data treadmill

The data treadmill shifts reshapes the concerns of the LCCA's members. At meetings of the LCCA, their passion and deep concern for the lake's past and future, its connections to senses of self and community were palpable. When LCCA members spoke about the lake and their concerns, they were connected to sense of a self and community, a sense of identity and wellbeing. Individuals spoke passionately about how their lives have unfolded in relation to the lake through activities like boating and fishing. How their concerns for the lake weighed on them was evident as they recalled experiences on the lake like the disappearance of the mayfly, the changing colour of the lake's bottom, and the thick reeds that have developed around its shores.

At the same time, the pursuit of funding structures LCCA's activities. Its meetings have entailed long discussions of funding strategies, crafting media narratives, and not publicly mentioning farmers until they have the science to show the specific agricultural concerns that are to blame. The LCCA's concerns and efforts have been valued by state institutions insofar as they have been expressed within the dominant frame through which environmental problems are understood and addressed. This framework enables data to be a tool to depoliticise and diffuse broader discussion of industrial agriculture by making a problem too big to name as a local issue.

This framework matters. Despite state agencies' attention on Lough Carra, the LCCA's path is constrained by prevailing logics that surround data and environmental governance. Even the name of the organisation reflects how dominant modes of thinking have influenced the LCCA. Although the organisation is focused on concern for the lake, its use of the term "Catchment" reflects the branding of water governance in Ireland. However, according to LAWPro, the formal catchment encompasses two lakes, Lough Carra and the adjacent Lough Mask. Yet, because of the LCCA, LAWPro, to engage the community, treats these lakes as separate. How the LCCA has pivoted towards funding and more data collection is striking given this broader policy context.

The binds and contradictions of environmental data, particularly for communities who have struggled to gain recognition, are well documented. Addressing these power imbalances, concerns, and hesitancies around creating new data requires "an evolving project of reflexively critiquing and repairing the relations of power that always accrue to data as it is made and used" (Vera et al. 2019). Data is not good for data's sake. Data have lives that live on in the infrastructures they produce and the ways that it is (re)used and interpreted. There is a need to resist the data treadmill – and its connections to locally-focused funding schemes – by thinking differently about environmental problems without diminishing the potential and political power of data. This will require engagement with the forces of scientisation that propel data generation and valorisation, above other ways of experiencing and understanding environments (Gabrys 2016; Mah 2017).

The entrenchment of these ways of thinking is underscored in the public discussion from the LCCA's inception. As reported in the Irish Times's article on the LCCA's first meeting, an expert stated, "If you plan to increase dairy output, as the Government is doing, how many lakes will you destroy in doing it?" The article goes on to report that "the elephant in the room was intensification of agriculture and associated pollution". Yet it also reported, in a quote not attached to anyone in particular: "Lough Carra should be designated as a top priority pilot project for special catchment management, with suitable incentives for positive agricultural action and disincentives for negative activities" (Ward 2018).

From our research, there is no shortage of sophisticated, empirically grounded analysis from members of the LCCA regarding the causes of water quality decline in Lough Carra. To different degrees, these "unqualified" individuals were able to draw effective connections between their own observations of environmental change in the places they lived and worked, policy histories, technological change, agricultural practice, and the economic pressures weighing on many

farmers. The problem then is not that such understandings do not exist, but that there is no way for it to become articulated as anything other than background knowledge. It is a tokenist way of including the public. Even community engagement events organised by LAWPro fail to provide any space or time for the raising of questions or inputs that are not strictly related to the formal activities of LAWPro.

Industrial agriculture, its role in the economy and the powerful lobbies that sustain its grip on public discourse, make it very challenging for individuals to even attempt to make change on a wider level. By using local projects to address environmental pollution, the data and solutions that address these problems are subject to the politics in which they emerge.

The question of how to move beyond the "data treadmill" requires ways of articulating these other forms of situated expertise and ways of framing the problem of the declining lake differently. To produce data that re-scales the problem of declining water quality, away from local and the community, away from limited funding channels, and towards the national policies and economic systems that reproduce the harm, and the broader questions of rural development, land-based work, and food production that are inseparable from water pollution in Ireland. Extending the data treadmill concept helps us illustrate how the prevention of such environmental harms requires interventions beyond the mere incentivisation of individual farmers living adjacent to one lake.

6. Conclusions

While our paper has been a cautionary reading of the institutional configurations that surround environmental data and its use, there is room to be optimistic. The institutional configurations LAWPro utilises do not meaningfully move the public from a tokenistic role within water governance. But this is not a given. Community groups can work alongside (rather than as source of data for) scientists and policy makers to co-produce the knowledge that helps guide good governance. Rather than looking to pots of funding for local projects that solve local problems, funding bodies (the EU and the Irish State) should offer supports to local groups that help them organise, fund, produce data, and find solutions that connect local concerns and sources of pollution to broader systemic issues. Right now, the data treadmill traps community groups in a cycle of funding to address local problems with more and more local data. Escaping the data treadmill means identifying policy tools and knowledge infrastructures that can help reframe the problem, the solution, and the data needed for more effective action to take place.

Data is central to environmental governance as practiced by state institutions and community groups, amplifying the necessity of tracing the effects it has through the context in which data is created and demanded. We extend the data treadmill concept by examining how the pursuit of more data is related to the valorisation of more and more precise data, bespoke approaches that frame environmental problems locally and individually. The data treadmill names the pursuit of more data to manage the complexity and uncertainty that arises in environmental governance, which we connect to the short-term funding and policy cycles that help power it. The data treadmill facilitates the attribution of responsibility to polluters and polluting industries, obscuring the long-standing political-economic policies and practices that contribute to environmental problems.

By tracing these dimensions of the data treadmill, we see how rhythms of data-driven epistemologies and practices are self-reinforcing. More and more local data quells the uncertainty and complexity while also depoliticising environmental pollution. It scales the actions deemed "efficient" and "effective". The effects of the data treadmill also raise points of intervention. Decisions around data – how much data, at what scale, and to what ends – are political decisions. They also operate within a policy realm that is materially limited with respect to funding and produces material effects on communities and government scientists – those tasked with implementing environmental governance. While data has the potential to offer legitimacy and authority, particularly for environmental groups, the context in which that data emerges has further effects. Most significantly, the data treadmill's effect is to obscure environmental harms and focus attention on finer-grained analysis and

responsibility. This overlooks broader structural contradictions that underpin the practices contributing to environmental pollution in the first place.

Note

1. Images from the project are here: https://conifer.rhizome.org/MULibWeb/waterschemes/http:/waterschemes.ie/ .

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by EPA RESEARCH PROGRAMME 2014–2020 Learning from Group Water Schemes: Community Infrastructures for Sustainable Development [2017-W-MS-27].

ORCID

Patrick Bresnihan http://orcid.org/0000-0003-1109-9782

References

Allen, R. 2004. *No Global: The People of Ireland Versus the Multinationals*. London: Pluto Press.

Bakker, K., and M. Ritts. 2018. "Smart Earth: A Meta-Review and Implications for Environmental Governance." *Global Environmental Change* 52: 201–211. doi:10.1016/j.gloenvcha.2018.07.011.

Beck, U., S. Lash, and B. Wynne. 1992. *Risk Society: Towards a New Modernity*. Vol. 17. London: Sage.

Boudia, S., and N. Jas, eds. 2014. *Powerless Science? Science and Politics in a Toxic World*. Vol. 2. New York: Berghahn Books.

boyd, D., and K. Crawford. 2012. "Critical Questions for Big Data: Provocations for a Cultural, Technological, and Scholarly Phenomenon." *Information, Communication & Society* 15 (5): 662–679. doi:10.1080/1369118X.2012.678878

Brown, J., and S. Damery. 2002. "Managing Flood Risk in the UK: Towards an Integration of Social and Technical Perspectives." *Transactions of the Institute of British Geographers* 27 (4): 412–426. doi:10.1111/1475-5661.00063

Chilvers, J., and M. Kearnes. 2019. "Remaking Participation in Science and Democracy." *Science, Technology, & Human Values* 45 (3): 347–380.

Crawford, K., M. L. Gray, and K. Miltner. 2014. "Big Data| Critiquing Big Data: Politics, Ethics, Epistemology| Special Section Introduction." *International Journal of Communication* 8: 10.

Daly, D., M. Archbold, and J. Deakin. 2014. "Water Framework Directive Implementation and Integrated Catchment Management: Where Are We Now? Where Are We Going?" *National Hydrology Conference*.

Deckard, S. 2016. "World-Ecology and Ireland: The Neoliberal Ecological Regime." *Journal of World-Systems Research* 22 (1): 145–176.

Dillon, L., R. Lave, B. Mansfield, S. Wylie, N. Shapiro, A. S. Chan, and M. Murphy. 2019. "Situating Data in a Trumpian Era: The Environmental Data and Governance Initiative." *Annals of the American Association of Geographers* 109 (2): 545–555. doi:10.1080/24694452.2018.1511410.

Dunkley, R. A. 2019. "Monitoring Ecological Change in UK Woodlands and Rivers: An Exploration of the Relational Geographies of Citizen Science." *Transactions of the Institute of British Geographers* 44 (1): 16–31. doi:10.1111/tran.12258

Europa. 2020a. *CAP Expenditure in the Total EU Expenditure*. Accessed 22 December 2020. https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/cap-expenditure-graph1_en.pdf.

Europa. 2020b. *LIFE Programme*. Accessed 22 December 2020. https://ec.europa.eu/easme/en/life#:~:text=The%20LIFE%20programme%20is%20the,budget%20of%20€3.4%20billion.

Food Wise 2025. 2015. *Food Wise 2025: A 10-Year Vision for the Irish Agri-Food Industry*. Dublin: Department of Food and the Marine, Republic of Ireland.

Fortun, K. 2004. "From Bhopal to the Informating of Environmentalism: Risk Communication in Historical Perspective." *Osiris* 2 (19): 283–296. doi:10.1086/649407

Fortun, K. 2012. "Ethnography in Late Industrialism." *Cultural Anthropology* 27 (3): 446–464. doi:10.1111/j.1548-1360.2012.01153.x

Fortun, K., and M. Fortun. 2005. "Scientific Imaginaries and Ethical Plateaus in Contemporary U. S. Toxicology." *American Anthropologist* 107 (1): 43–54. doi:10.1525/aa.2005.107.1.043

Gabrys, J. 2016. "Practicing, Materialising and Contesting Environmental Data." *Big Data & Society* 3 (2). 2053951716673391. doi:10.1177/2053951716673391

Haraway, D. J. 1988. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14 (3): 575–599. doi:10.2307/3178066

Harding, S. 1993. "Rethinking Standpoint Epistemology: What is "Strong Objectivity"?." In *Linda Alcoff and Elizabeth Potter*, edited by Feminist Epistemologies, 49–82. New York: Routledge.

Huxley, C., and L. Huxley. 2015. *Lough Carra*. Castlebar: Carra Books.

Image, P. 2016. *Evaluation of the GLAS. Phase 1 - Literature Review. Adas UK Ltd*. Report Prepared for Department of Agriculture, Food and the Marine.

Jasanoff, S. 2017. "Virtual, Visible, and Actionable: Data Assemblages and the Sightlines of Justice." *Big Data & Society* 4 (2). 2053951717724477. doi:10.1177/2053951717724477

Johnsen, S., J. May, and P. Cloke. 2008. "Imag(in)ing 'Homeless Places': Using Auto-Photography to (Re)Examine the Geographies of Homelessness." *Area* 40 (2): 194–207. doi:10.1111/j.1475-4762.2008.00801.x.

Kaika, M. 2003. "The Water Framework Directive: A New Directive for a Changing Social, Political and Economic European Framework." *European Planning Studies* 11 (3): 299–316. doi:10.1080/09654310303640.

Kallis, G., and D. Butler. 2001. "The EU Water Framework Directive: Measures and Implications." *Water Policy* 3 (2): 125–142.

Kitchin, R. 2014. *The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences*. London: Sage.

Lampland, M., and S. L. Star, eds. 2009. *Standards and Their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life*. Ithaca: Cornell University Press.

Lane, S. N., N. Odoni, C. Landström, S. J. Whatmore, and S. Bradley. 2011. "Doing Flood Risk Science Differently: An Experiment in Radial Scientific Method." *Transactions of the Institute of British Geographer* 36 (1): 15–36. doi:10.1111/j.1475-5661.2010.00410.x

Lastra-Bravo, X. B., C. Hubbard, G. Garrod, and A. Tolón-Becerra. 2015. "What Drives Farmers' Participation in EU Agri-Environmental Schemes? Results from a Qualitative Meta-Analysis." *Environmental Science & Policy* 54: 1–9. doi:10.1016/j.envsci.2015.06.002.

Leonard, L. 2007. *The Environmental Movement in Ireland*. New York: Springer Science & Business Media.

Liboiron, M. 2016. "Redefining Pollution and Action: The Matter of Plastics." *Journal of Material Culture* 21 (1): 87–110. doi:10.1177/1359183515622966

Lombard, M. 2013. "Using Auto-Photography to Understand Place: Reflections From Research in Urban Informal Settlements in Mexico: Using Auto-Photography to Understand Place." *Area* 45 (1): 23–32. doi:10.1111/j.1475-4762.2012.01115.x.

Mah, A. 2017. "Environmental Justice in the Age of Big Data: Challenging Toxic Blind Spots of Voice, Speed, and Expertise." *Environmental Sociology* 3 (2): 122–133. doi:10.1080/23251042.2016.1220849

Massarella, K., M. S. Sullu, and J. E. Ensor. 2020. "Reproducing Injustice: Why Recognition Matters in Conservation Project Evaluation." *Global Environmental Change* 65. doi:10.1016/j.gloenvcha.2020.102181.

McCormick, S. 2007. "Democratizing Science Movements: A New Framework for Mobilization and Contestation." *Social Studies of Science* 37 (4): 609–623. doi:10.1177/0306312707076598

McEwen, L., L. G. Barnes, K. Phillips, and I. Biggs. 2020. "Reweaving Urban Water-Community Relations: Creative Participatory River "Daylighting" and Local Hydrocitizenship." *Transactions of the Institute of British Geographers* 45 (4): 779–801. doi:10.1111/tran.12375

Michaels, D. 2008. *Doubt is Their Product: How Industry's Assault on Science Threatens Your Health*. New York: Oxford University Press.

Mitchell, N. B., and O. Ejderyan. 2020. "When Experts Feel Threatened: Strategies of Depoliticisation in Participatory River Restoration Projects." *Area*, doi:10.1111/area.12686.

Mitman, G., M. Murphy, and C. Sellers. 2004. "Introduction: A Cloud Over History." *Osiris* 19: 1–17. doi:10.1086/649391

Murphy, M. 2004. "Uncertain Exposures and the Privilege of Imperception: Activist Scientists and Race at the US Environmental Protection Agency." *Osiris* 19: 266–282. doi:10.1086/649406

Murphy, M. 2006. *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers*. Durham: Duke University Press.

Murphy, M. 2013. "Chemical Infrastructures of the St Clair River." In *Toxicants, Health and Regulation Since 1945*, edited by S. Boudia, and N. Jas, 103–115. London: Pickering and Chatto.

Nadim, T. 2016. "Blind Regards: Troubling Data and Their Sentinels." *Big Data and Society* 3: 2. doi:10.1177/2053951716666301.

Nash, L. 2006. *Inescapable Ecologies: A History of Environment, Disease, and Knowledge*. Berkeley: Univ of California Press.

Neimark, B., J. Childs, A. J. Nightingale, C. J. Cavanagh, S. Sullivan, T. A. Benjaminsen, S. Batterburym, S. Koot, and W. Harcourt. 2019. "Speaking Power to "Post-Truth": Critical Political Ecology and the New Authoritarianism." *Annals of the American Association of Geographers* 109 (2): 613–623. doi:10.1080/24694452.2018.1547567

Nelson, S. H. 2015. "Beyond the Limits to Growth: Ecology and the Neoliberal Counterrevolution." *Antipode* 47 (2): 461–480. doi:10.1111/anti.12125

Nost, E. 2019. "Climate Services for Whom? The Political Economics of Contextualizing Climate Data in Louisiana's Coastal Master Plan." *Climatic Change* 157 (1): 27–42. doi:10.1007/s10584-019-02383-z

Oreskes, N. 2015. "The Fact of Uncertainty, the Uncertainty of Facts and the Cultural Resonance of Doubt." *Philosophical Transactions of the Royal Society, A* 373: 20140455. doi:10.1098/rsta.2014.0455

Oreskes, N., and E. Conway. 2010. *Merchants of Doubt*. New York: Bloomsburg Publishing.

Pellizzoni, L. 2011. "The Politics of Facts: Local Environmental Conflicts and Expertise." *Environmental Politics* 20 (6): 765–785. doi:10.1080/09644016.2011.617164

Rieder, G., and J. Simon. 2016. "Datatrust: Or, the Political Quest for Numerical Evidence and the Epistemologies of Big Data." *Big Data & Society* 3 (1): 2053951716649398. doi:10.1177/2053951716649398.

Rollason, E., L. J. Bracken, R. J. Hardy, and A. R. G. Large. 2018. "Evaluating the Success of Public Participation in Integrated Catchment Management." *Journal of Environmental Management* 228: 267–278. doi:10.1016/j.jenvman.2018.09.024

Sarmiento, E., C. Landström, and S. Whatmore. 2019. "Biopolitics, Discipline, and Hydro-Citizenship: Drought Management and Water Governance in England." *Transactions of the Institute of British Geographers* 44 (2): 361–375.

Shackley, S., and B. Wynne. 1996. "Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority." *Science, Technology and Human Values* 21 (3): 275–302. doi:10.1177/016224399602100302

Shapiro, N., N. Zakariya, and J. Roberts. 2018. "A Wary Alliance: From Enumerating the Environment to Inviting Apprehension." *Engaging Science, Technology, and Society* 3 (0): 575–602. doi:10.17351/ests2017.133.

Shapiro, N., N. Zakariya, and J. Roberts. 2020. "Beyond the Data Treadmill: Environmental Enumeration, Justice, and Apprehension." In *Toxic Truths*, edited by T. Davies, and A. Mah, 301–325. Manchester: Manchester University Press.

Shattuck, A. 2021. "Toxic Uncertainties and Epistemic Emergence: Understanding Pesticides and Health in Lao PDR." *Annals of the American Association of Geographers* 111 (1): 216–230.

Strasser, B., J. Baudry, D. Mahr, G. Sanchez, and E. Tancoigne. 2019. "Citizen Science?" Rethinking Science and Public Participation. *Science & Technology Studies* 32: 52–76.

Taylor, L., and C. Richter. 2017. "The Power of Smart Solutions: Knowledge, Citizenship, and the Datafication of Bangalore's Water Supply." *Television and New Media* 18 (8): 721–733.

Tovey, H. 2009. "Managing Rural Nature: Regulation, Translations, and Governance in the Republic of Ireland and Northern Ireland." In *A Living Countryside? The Politics of Sustainable Development in Rural Ireland*, edited by J. McDonagh and T. Varley, 107–122. Surrey: Ashgate.

Underdal, A. 2010. "Complexity and Challenges of Long-Term Environmental Governance." *Global Environmental Change*, doi:10.1016/j.gloenvcha.2010.02.005.

Vera, L. A., D. Walker, M. Murphy, B. Mansfield, L. M. Siad, and J. Ogden. 2019. "When Data Justice and Environmental Justice Meet: Formulating a Response to Extractive Logic Through Environmental Data Justice." *Information, Communication & Society* 22 (7): 1012–1028. doi:10.1080/1369118X.2019.1596293.

Walker, P. A. 2006. "Political Ecology: Where is the Policy?" *Progress in Human Geography* 30 (3): 382. doi:10.1191/0309132506ph613pr

Walker, D., E. Nost, A. Lemelin, R. Lave, and L. Dillon. 2018. "Practicing Environmental Data Justice: From DataRescue to Data Together." *Geo: Geography and Environment* 5 (2): e00061. doi:10.1002/geo2.61.

Ward, M. 2018. ""Time is Running Out for Lough Carra." *The Irish Times*, June 7. Accessed 20 January 2023. https://www.irishtimes.com/news/science/timeis- running-out-for-lough-carra-1.3513993.

Whatmore, S. J. 2009. "Mapping Knowledge Controversies: Science, Democracy and the Redistribution of Expertise." *Progress in Human Geography* 33 (5): 587–598. doi:10.1177/0309132509339841

Wylie, S., N. Shapiro, and M. Liboiron. 2017. "Making and Doing Politics Through Grassroots Scientific Research on the Energy and Petrochemical Industries." *Engaging Science, Technology, and Society* 3 (0): 393–425. doi:10.17351/ests2017.134.