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When Concerned People Produce Environmental Information: A Need to Re-Think Existing Legal Frameworks and Governance Models?

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RESEARCH PAPER

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ABSTRACT

When faced with an environmental problem, locals are often among the first to act. Citizen science is increasingly one of the forms of participation in which people take action to help solve environmental problems that concern them. This implies, for example, using methods and instruments with scientific validity to collect and analyse data and evidence to understand the problem and its causes. Can the contribution of environmental data by citizens be articulated as a right? In this article, we explore these forms of productive engagement with a local matter of concern, focussing on their potential to challenge traditional allocations of responsibilities. Taking mostly the perspective of the European legal context, we identify an existing gap between the right to obtain environmental information, granted at present by the Aarhus Convention, and "a right to contribute information" and have that information considered by appointed institutions. We also explore what would be required to effectively practise this right in terms of legal and governance processes, capacities, and infrastructures, and we propose a flexible framework to implement it. Situated at the intersection of legal and governance studies, this article builds on existing literature on environmental citizen science, and on its interplay with law and governance. Our methodological approach combines literature review with legal analysis of the relevant conventions and national rules. We conclude by reflecting on the implications of our analysis, and on the benefits of this legal innovation, potentially fostering data altruism and an active citizenship, and shielding ordinary people against possible legal risks.

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INTRODUCTION

From detecting suspicious odours in the air to inquiring about chemicals in waters and collecting soil samples, concerned local residents are often among the first social actors to notice and act upon an environmental problem. They often do so by spontaneously tracking an issue, through collecting and analysing data that will be used to make sense of the issue at stake and to potentially support claims. This shall be considered a manifestation of citizen science, that is, the active engagement of ordinary people in scientific research (Irwin 2018). Citizen science is a term with manifold definitions, depending on the context, of which we regard as key components "the generation of scientific data," engaging volunteers, and addressing "a politically relevant issue" (Haklay et al. 2021, pp. 13, 15).

In this article, we focus on the data gathering stage of citizen science as we posit that through data collection, engaged people aim to contribute to the framing of or offer a different perspective on an environmental issue they care about. We take stock of studies that have discussed how informational innovations in monitoring are changing the way we deal with environmental issues and have consequences for democracy and power relations (Mol 2008). These forms of productive engagement with a local environmental issue—such as self-organizing in communities, hypothesizing about the causes of the problem, and collecting and analysing data—can substantially challenge traditional allocations of responsibilities, suggesting an eventual need to re-think existing legal frameworks and governance models. However, instead of being regarded as an occasion to regenerate the system, citizen-led efforts are often resisted or disregarded as not valid or not legitimate by institutions.

Several authors have begun to explore the possible intersections of environmental citizen science with the legal system, questioning its effect on legal provisions and on human entitlements (for example Berti Suman 2020a and 2020b; Aragão 2019; Haklay and Francis 2018; Smith 2014). In parallel, studies into the impact of actions and environmental data flows from below on governance models are multiplying (Balestrini et al. 2017; Bio Innovation Service 2018; Wyeth et al. 2019). Especially in the United States (US), literature often deals with the legal implications of volunteered geographic information (VGI) (Foody et al. 2017; Cho 2014; Cuff et al. 2008), including the exposure to liability that the volunteers may face (Rak et al. 2012).

Situated at the intersection of legal and governance studies, this article examines the growing trend of concerned people seeking to produce environmental information (Berti Suman, Schade, and Abe 2020) and to see these data included in decision-making. We identify an existing gap between the right to obtain environmental information—granted at present by the Aarhus Convention[1]—and a right to provide information and have that information considered by appointed institutions. Further, we elaborate on the opportunity to re-think existing legal frameworks and governance models to fit these transformations and to ensure that the civic ability to offer data from below is properly accommodated rather than resisted.

In summary, the article is guided by two key questions:

- From the combined interpretation of the rights recognized under the Aarhus Convention, should a right to meaningfully contribute environmental information be derived, and (if so) under which conditions?
- What would be required to effectively practise this right, in terms of legal and governance processes, capacities, and infrastructures, and which of these requirements are still lacking?

Our approach combines grey and academic literature review with legal analysis of the relevant conventions and national rules. We, the authors, also bring in our own experiences as we have been involved in multiple citizen science interventions. Based on these sources, we define three scenarios that are a simplification of a multifaceted reality. We analyse the scenarios according to theory-informed categories and extract findings. We identify three case studies that best illustrate the outlined scenarios.

The structure of the paper is as follows. We start from acknowledging a trend and interpreting it through the Aarhus Convention, which could possibly open an avenue for a fourth right. We address the promises and perils of introducing a new right. From there, we propose a set of governance adaptations that are required to enforce such a right. We primarily focus on Europe to narrow down the legal and governance context. Based on the above, we identify different possible scenarios of interplay between citizen-generated data (CGD) and the institutional system, pinpoint cases illustrative of each scenario, and outline their strengths and weaknesses. We subsequently define a framework for integration of CGD in the institutional system. We stress the implications of our analysis for communities, researchers, and practitioners. We conclude with a reflection on how this legal innovation could foster data altruism and an active citizenship, and shield ordinary people producing CGD against legal risks.

LEGAL AND GOVERNANCE MODELS UNDER PRESSURE?

CGD deriving from broader citizen science practises could be used in many different forms within environmental governance. Community-based water quality monitoring, for example, can provide a way to maintain regulatory oversight under conditions of reduced funding (Kimura and Kinchy 2019). In other cases, CGD can challenge official and industry-reported data, especially in the case of shortcomings in official monitoring. This could contribute to detecting violations of the law and infringements on human environmental rights. Yet, to date, no substantial evidence of legal adaptation to this trend has emerged across Europe, whereas internationally and in the US more explicitly a right to submit data exists, as illustrated below. As the legal traditions and the existence of mechanisms such as the Aarhus Convention differ substantially from the US to Europe, in this article, we will note the US experiences but focus primarily on European cases.

The opening statement of Chapter 40 of Agenda 21, stemming from the 1992 United Nations (UN) Rio Conference can be interpreted as supporting citizen-led data production. The chapter states: "in sustainable development, everyone is a user *and provider* of information considered in the broad sense. That includes data, information, appropriately packaged experience, and *knowledge*." [emphasis added]. This can be understood as a recognition that local knowledge (also in the forms of CGD) should be integrated into decision-making.

Another legacy of the Rio Conference is in Principle 10 of its outcome declaration, which highlights three pillars of participation in environmental decision-making: the right to access environmental information, the right to participate in decision-making, and the right to access justice.

The principle evolved in the UN Economic Commission for Europe (UNECE) Aarhus Convention,[2] or in its full name, the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. It was signed on the 25th of June 1998 in the city of Aarhus in Denmark and entered into force in October 2001. It is considered a leading international agreement on environmental democracy as it guarantees the public three key rights on environmental issues: i) access to information, which refers to the public's right to receive information about the environment that are held by public authorities; ii) public participation, which refers to the public's right to participate in environmental decision-making; and iii) access to justice, which refers to the public's right to review by a court or an independent body to ensure that public authorities respect the rights to access environmental information and to public participation in environmental decisions.

As with Principle 10 of the Rio Conference, the Aarhus Convention recognizes only the right to access (already existing and officially provided) environmental information. The Convention does not recognise forms of spontaneous environmental data production from ordinary people, although some provisions may justify an extensive interpretation of the notion of environmental information to also include CGD in case of official governmental or industry failures to duly report (Berti Suman 2020b).

Yet, despite this declaration, for most of the past three decades, environmental information that was used in decision-making was created by professional scientists and technicians in government and industry. Some examples of legal recognition for data generation by nongovernmental actors are represented by the US Crowdsourcing and Citizen Science Act (15 USC 3724) and by the Ecuadorean Organic Law of the Amazonian Special Territorial Circumscription (*Ley Organica de la Circunscripcion Territorial Especial Amazonica*), which in Article 58 endorses community environmental monitoring mechanisms.

At the level of governmental practice, noteworthy is the US notice and comment process for agency rulemaking (and other processes such as permitting and environmental impact review).[3] The process requires government agencies to use informal rulemaking procedures when creating new rules or when modifying or repealing existing ones. The agency must notify the public of the proposed change and accept public comments. Agencies are obliged to consider all material presented (including environmental CGD) during the comment period, and they must respond to all comments received but are not obliged to amend the rule itself considering these comments. Thus, an explicit right to submit information and advice by the public exists across the US at the federal and state level.

Furthermore, a duty to consider data fed by the public also exists as it is implied in the notice-and-comment process: Agencies must justify why data were disregarded, and those who submit data can request an independent audit. This all suggests that even an adaptation of the Aarhus Convention foreseeing a right to submit information alone is not sufficient if authorities are not compelled to consider the information (they still can discount it but must explain). Yet, even in the instance of such an obligation, the US experience reveals that often CGD is not actually considered seriously or acted upon for a variety of reasons. This motivates us to recommend that legal interventions must be flanked by governance changes.

Against this background, the goal of this paper is twofold. First, we aim to explore a potential need to adapt the Aarhus Convention to include a civic "right to contribute

environmental information" as a fourth pillar, in particular when institutions fail or struggle to fulfil their duties. We question who should oversee amending the Convention and national laws implementing it, that is, whether only appointed institutions or society at large through participatory and consensus processes. We use throughout the piece the word (right to) "contribute" because people do generate data all the time, but we aim to recognize a different entitlement to meaningfully contribute to inform policy-making with the data generated. Indeed, submitting data is of limited value if there is not a duty to consider and respond from the competent authorities. Second, we propose possible governance adaptation scenarios that may be needed, especially from competent authorities, if such a right is recognized. We also examine at which administrative level such governance adaptations should occur.

ZOOMING IN ON DISTINCTIVE TRENDS

THE LEGAL FRAMEWORK ADAPTATION

Building on Haklay's (2017) categorization, traditionally, environmental data flows occur between experts and scientists to be used by other experts and scientists (a first era); following that, we have witnessed the opening up of environmental information to the public while production stays with experts and scientists (second era). With the advent of the Web and the mass use of mobile devices with sensing capabilities, information has become increasingly available online. The traditional scheme became outdated as emerging flows—less formalized and less unidirectional—moved the other way around. Today, we are indeed in a third era in which the production and consumption of environmental information is no longer done only by experts and scientists, but also by the public (Haklay 2017). The legal framework has been responding to these developments only to a certain extent. Indeed, to date, the law crystallizes and protects the rights of citizens to receive (environmental) information held by authorities but does not recognize the contribution that citizens can bring to the formation of the evidentiary pool on environmental matters. As we highlight in the following section, governance models had (and have) to be adapted to mirror such transformations.

While the Aarhus Convention is an opportunity for those civic actors wishing to claim breaches of their environmental rights, it recognizes only traditional and unidirectional data flows from governmental actors to citizens. In fact, the environmental information that citizens are entitled to access are only those held by authorities (and not, for example, by private actors—although they are forced to report to the authorities under the Pollutant Release and Transfer Registers (PRTRs) established by the Kyiv Protocol of 2009. There is no recognition of a gap-filling or complementary role that citizen-generated environmental data can play. Building on previous work (Berti Suman 2020b), we question whether the Aarhus Convention can and shall be updated to recognize a civic right to meaningfully contribute environmental information and a consequent duty of authorities to consider such information.

Remarkably, discussions touched upon this new right during the 7th Meeting of the Parties (MoPs) of the Aarhus Convention held in Geneva in fall 2021.[4] In a keynote by the European Eco Forum on Access to Information, including electronic information tools, Christian Schaible from the European Environmental Bureau[5] affirmed: "Citizen science opens up for the parties of the convention a new source, and we might envisage a right to produce environmental information by citizens, which if it is produced at appropriate standards and rigor, needs to be accepted by the authorities. This can fill the data gaps and support monitoring efforts."

A discussion on a new right is even more urgent considering the threats that environmental defenders frequently experience, as was also stressed during the MoPs. We refer to the session organized by the Czech nongovernmental organization Arnika, "Defending the defenders 2021: Persecution of environmental activists."[6] Discussions also revolved around the non-compliance with the Convention that recurs in Europe and especially affects civil society. Citizen science can be a powerful tool to spot such instances.

Citizen science entered the MoPs in several other instances, including a session in which the civic nuclear radiation monitoring initiative Safecast[7] intervened and a side event titled "Using citizen science effectively within the Aarhus context."[8] Formal outcomes of the Meeting endorsed citizen science, namely the Strategic Plan for the Convention's Parties for 2022 to 2030[9] and the Recommendations on the more effective use of electronic information tools.[10]

Because a new right with no enforcement mechanism would be pointless, we explore the adaptation of existing legal frameworks to accommodate this development and to ensure that it is respected, considering that already the Aarhus Convention is often not respected.[11] We do so in the framework that we propose, with an eye to the actual enforcement of such a new entitlement. We consider it compelling to also assess to what extent the law is lagging, in the sense that this right is *de facto* already in place in practice and at a policy level (for example, in dedicated programs by the European Union (EU), such as the Horizon

Europe "Mutual Learning Exercise on Citizen Science" and the "Science with and for Society" programme of Horizon 2020).[12]

GOVERNANCE MODELS RESHAPED

The governance of environment-related issues relies heavily on public institutions (Lemos and Agrawal 2006; Bennet and Satterfield 2018). This governance structure is embedded in the general multi-governance framework spanning the globe—from global actors (such as the UN) via regional actors (such as the EU) and national actors (ministries and agencies), all the way to sub-national (including local actors). Overall, we can identify a global trend to follow more holistic and participatory governance approaches (Nesbit et al. 2019), in which environment-related matters are more closely integrated across different sectors, fields, and services (one can look to the framework for monitoring the Sustainable Development Goals [SDGs][13] and the European Green Deal).[14]

In line with the increased integration of environmental matters in political topics that were traditionally less environmentally aware, measures supporting a healthier environment are emerging in other fields. These developments go hand in hand with similar trends in health policies, where, for example, the "Health in All Policies" approach spans sectors (Pan American Health Organization 2015). Collaborations between authorities that are traditionally responsible for environmental issues and institutions dealing with other policy areas multiply.

Complementarily, another trend is emerging—a more active citizenship, including citizen science practices. In many countries, we witness not only changes in voting behaviour and social (environmental) activism in the form of protests,[15] but also more active engagements aimed at voluntary monitoring of the environment. Whereas different scenarios on how citizen science contributes to (public) governance have recently been explored by Göbel et al. (2019), we also see dedicated methods and tools for integrating citizen science in environmental data collection at different levels of administration as a means to co-design, co-develop, and co-deliver solutions.[16]

Policymakers can learn from scientists in this regard. In fields such as meteorology and biology, there is a long history of public participation in data creation, and it is common for scientists and consultants, who provide advice on environmental decision-making, to use data that originate from volunteers' observations (Pocock et al. 2015, 2017; WMO 2001). In most cases, the data provided by the public is not used directly, but it is first organised and reviewed by an expert who will work as an intermediary. The output from the expert is coming with their own and their institutions' credentials. In some cases, the source of the data is not even openly acknowledged (Cooper et al. 2014). This could suggest that CGD is accepted and routinely used within existing processes of environmental research, being considered fit-for-purpose also in terms of data quality. However, it can also signal an obfuscation of the civic contribution.

When civic actors' contribution is acknowledged and they can collaborate with policymakers in shared spaces, this can stimulate mutual trust and change traditional allocation of roles. Citizens learn how to contribute to data generation, analysis, and interpretation, while trust is generated for policymakers to officially adopt the data. It has been estimated that such data have the potential to contribute up to 33% of SDGs monitoring efforts (Fraisl et al. 2020). Moreover, shared agendas[17] are developed. Governance models should become more flexible to ensure the acceptance, integration, and acknowledgement of these data within official data. These interventions are in part already occurring in light with five principles for good governance: openness, participation, accountability, effectiveness, and coherence as recognized by the EU.[18] However, to date, similar interventions are episodic and left to the good will of governors.

GOVERNANCE ENCOUNTERS THE LAW

As governance adaptation is occurring but in a non-systematic way, one may wonder if a legal intervention should be needed to make these occurrences structural and to regulate them. CGD, to be heard by decision-makers, needs to enter through the channels put in place by authorities. Having a set of (legally binding) rules that all civic initiatives must follow to have their data considered could ensure more equality and transparency in how CGD is integrated. We argue further why this could be a way forward.

Governance adaptations are, at present, a way to give space to dimensions that are not allowed by the law. However, this clearly creates disparity and imbalances. In principle, every scientifically sound local monitoring initiative should be taken into account (whether a constructive, cooperative input or a disruptive, counter-system initiative) and, eventually, should provoke authorities to act upon a matter of concern for the people that can be associated with a governmental failure. As there is no legal obligation to consider CGD, it remains at the discretion of authorities.

Existing initiatives already integrated in formal monitoring processes in multiple ways could lead this legal innovation. For example, the European bird indexes[19] were designed from their very beginning in the 1980s as a data flow that relies on volunteer bird watching and strict quality

assurance. They remain one of the strongest indicators for biodiversity in Europe and are used to support policies. In the Netherlands, another leading example is an integrated platform hosted by an independent governmental agency to collect and compare air quality data from many different sources.[20] Here, official data is complemented by data from citizen scientists and others. The Mosquito Atlas in Germany is another good example as it is entirely based on volunteer data collection and it replaces previous monitoring mechanisms.[21]

These examples demonstrate a practice of CGD contribution. Such best practices have been analysed in an official document of the European Commission in 2020 (European Commission 2020). The document proposes a set of guidelines to systemise the support of citizen science approaches for environmental monitoring and data sharing, which can be regarded as a first step towards the official recognition of a right to contribute. Indeed, the guidelines also come with a set of possible actions to allow for a more systematic and enduring support to citizen science. A consolidated response by the network of Environmental Protection Agencies (EPA) in Europe was prepared (Rubio-Iglesias et al. 2020) and delivered to the EPA Network Interest group on Citizen Science.[22] Earlier, the European Environment Agency (EEA) published a report on how air quality could be assessed through contributions from citizen science (EEA 2019).

In the next section, we explore the conditions under which the recognition of a right to contribute is desirable and should be infrastructured, in the sense of providing the legal and organizational interventions that are needed to implement it. We consider scenarios as sets of possible situations in which the interactions between civic data production and institutional settings manifest.

FROM SCENARIOS TO A FRAMEWORK MIRRORING THE RIGHT TO CONTRIBUTE

SCENARIOS OF INTEGRATION

In this section, we outline hypothetical but realistic scenarios of interaction between CGD and existing environmental governance and legal structures. Parameters that we deem should matter in a systematization towards integration include

- the type of initiative producing CGD, from counter-system to cooperative initiatives;
- the initiator, whether they are state-, citizen-, or jointly-initiated, etc. efforts to acquire CGD (while acknowledging that often a combination of top-down and bottom-up efforts occurs;[23]
- the institutional attitude towards the initiative (different from, although related to, who initiated the effort);
- the presence of national legal provisions regulating CGD production;
- the existence of a legal obligation by authorities to consider CGD; and
- the existence of a platform open to CGD and its ownership (whether the infrastructure and the data therein is owned by the authority/the citizens/a third party/jointly between two or more of these actors).

Additionally, we conceive that different types of initiatives (from more reactive to more cooperative) will require different levels of integration (from less to more pervasive) of the civic data within official infrastructures. In addition, the maturity of the recipient authority in terms of experience relying on CGD will have to be taken into account in designing the different levels of integration. We argue that any integrative framework should not exclude the more counter-system initiatives, which should find their own way to be part of the debate. Recognizing a right to contribute to official environmental monitoring could ensure a more systematic and transparent adoption of CGD, but it also risks excluding initiatives that do not manage to meet the needed conditions. Nevertheless, we believe that such CGD can still impact policymakers in informal, spontaneous ways.

Another layer of complexity—which cannot be properly addressed here—is the fact that a right is understood and codified differently in different contexts. Also, what we understand governance to mean may vary substantially. In taking Europe as the main context for the scenarios that we outline, we try to mitigate this challenge of context-dependency. We assume that a certain homogeneity can be identified across different European countries. The three scenarios represented in Figure 1 should therefore be considered as situated in the context of European countries.

Figure 1 illustrates three possible scenarios from a cooperative and high-integration instance, where a right to contribute is recognized or derived from existing norms, to the least integrated scenario in which there is no legal recognition of CGD, authorities and citizens are in conflict, and the existing infrastructures do not make room for CGD. In the middle, we situate a middle-ground scenario mirroring all the other possible configurations, with nuances that go beyond what we can capture in a figure.

ILLUSTRATIVE CASES OF THE THREE SCENARIOS

We examine three case studies that help us illustrate the different conceptual positions, but they are by no means representative of the whole set of cases that each scenario can encompass. We selected these cases using our own

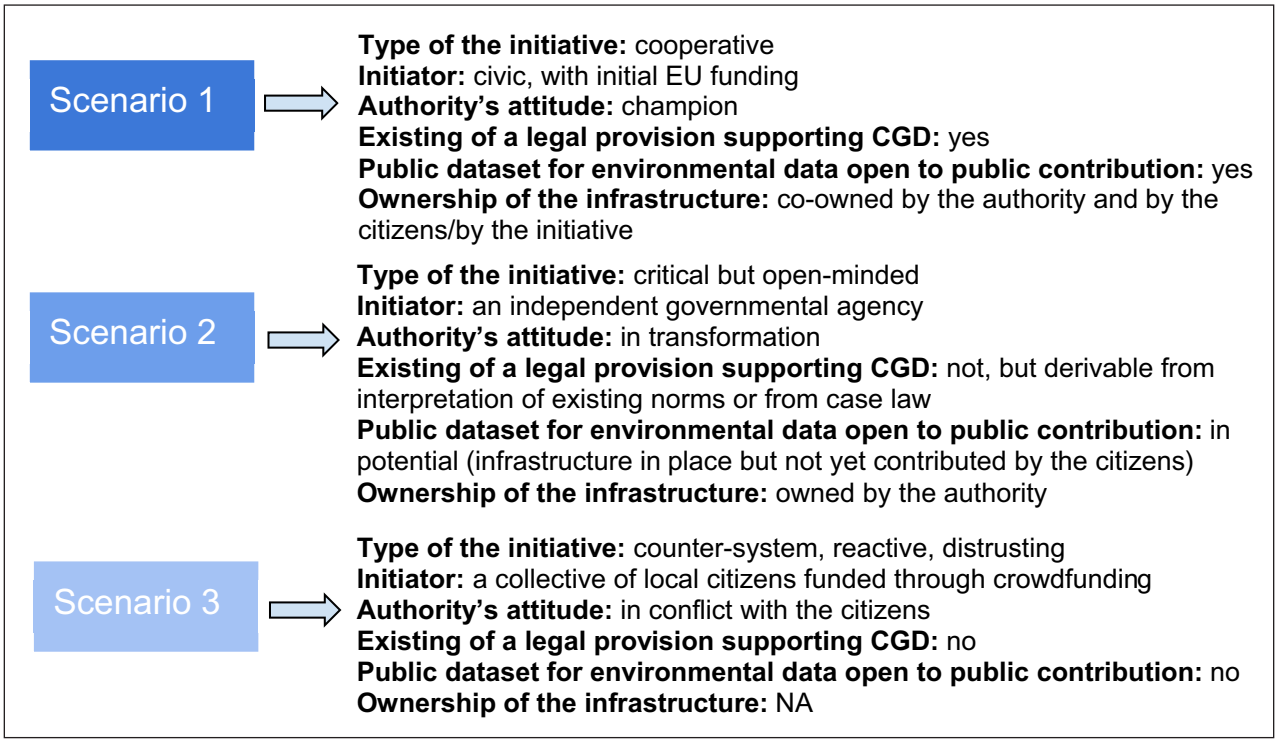

Figure 1 Possible scenarios of interplay between a civic initiative and public institutions.

previous knowledge rather than through a systematic analysis of a sample of cases. Future research may quantitatively assess the occurrence of the three scenarios in the citizen science reality out there. A brief analysis of each case follows, whereas a more extensive illustration of each case in light of the characteristics of the three scenarios can be found in Supplemental File 1: Appendix 1.

CGD on odour pollution. D-NOSES (Scenario 1)

Type of initiative: This is an EU-funded initiative tackling odour pollution through citizen science and co-creation of joint solutions to odour pollution-related issues.[24]

Initiator: The initiator is a researcher with civic concern who launched the first odour monitoring pilot.

Authority's attitude: The project received attention and recognition by environmental protection authorities at national (Spain) and international (EU, Africa, and Latin America) levels. For example, thanks to D-NOSES' advocacy, in 2022, the European Committee of the Regions adopted an Opinion "EU Action Plan: Towards Zero Pollution for Air, Water and Soil," recognizing the importance of citizen science for tackling odour pollution.

Existence of a legal provision supporting CGD: The initiative supports compliance with Principle 10 of the Rio Declaration and aims to go beyond it through a right to contribute data.[25] In this case, the recognition of a right to contribute and its conditions may be useful to foster transparency and equity.

Public dataset for environmental data open to public contribution: The initiative feeds CGD into the International Odour Observatory,[26] where all relevant data are made available both for citizens and for authorities.

Ownership of the infrastructure: The infrastructure is owned by the initiative, but partners of the project include local administration and public bodies.

CGD on air quality. Samen Meten (Scenario 2)

Type of initiative: Samen Meten is an initiative supported by the Dutch Institute for Public Health and the Environment (RIVM) consisting of a knowledge portal[27] and a related portal for data access.[28] The two portals provide capacity-building facilities and a supportive infrastructure for environmental citizen science.

Initiator: Samen Meten was initiated by RIVM, an independent Dutch agency. This is therefore a government-led effort that invites civic submission of data (Rubio-Iglesias et al. 2020; Volten et al. 2018).

Authority's attitude: RIVM demonstrates an open and transparent approach. Any community can enter the partnership and connect their air quality measurements as incoming raw data. RIVM corrects and calibrates the data to make them more useful. The CGD from the portals are not (yet) directly used for official air quality monitoring purposes, although this is the ambition (Ponti and Craglia 2020). The data have already served early detection and near-real-time mapping of cross-border air pollution

(Wesseling et al. 2019), and are being used for official experimental modelling (Ponti and Craglia 2020).

Existence of a legal provision supporting CGD: There is no specific provision focussed on CGD, but legal requirements for monitoring air quality exist, and supportive provisions can be derived from there. In this case, the recognition of a right to contribute would be an incentive for institutions to adopt CGD systematically.

Public dataset for environmental data open to public contribution: In the model of Samen Meten, citizen scientists buy and assemble, following instructions provided by the initiative partners, low-cost sensors. These partners bring in their own communities and develop data infrastructures. RIVM offers the integration of these datasets in the platform, where all data are published and shared openly.

Ownership of the infrastructure: Ownership is institutional (owned by RIVM), offering a central and sustained resource for interested communities and individuals.

CGD on oil extraction externalities. Analyze Basilicata (Scenario 3)

Type of initiative: The Analyze Basilicata initiative is a citizen science initiative by the association CovaContro aimed at collecting data on environmental externalities associated with oil extraction in Basilicata, in the south of Italy.[29] The case is counter-system, reactive, and distrusting.

Initiator: Analyze Basillicata is a collective of independent, crowdfunded local citizens.

Authority's attitude: The public sector at present does not officially recognize the initiative or the data collected, nor does it offer the participants any support. However, there were instances in which the initiative served as an alert for institutions, media, and public prosecutors' offices (Berti Suman 2022).

Existence of a legal provision supporting CGD: There is no specific provision, although the Italian Constitution recognizes the preservation of the environment and of human health and promotes civic forms of organization. In this case, the recognition of a right to contribute may not be effective, as there are not the conditions to implement it. Already existing legal guarantees should first be respected.

Public dataset for environmental data open to public contribution: Each actor has its own platform. Specific environmental information is published on the Val d'Agri Environmental Observatory, but the Analyze Basilicata initiative does not trust it and created a counter-knowledge base.

Ownership of the infrastructure: Ownership is not shared, and single infrastructures (private, public, and civic) are separated and owned by each actor.

THE STRENGTHS AND WEAKNESSES OF EACH SCENARIO

Scenario 1 has the key strength of maximizing resources allocation as competences and tasks are divided among citizen scientists and competent institutions with a cooperative mindset. Losses of energy due to conflicts and distrust is low. However, as a downside, the citizen science initiative can be at risk of (perceived or actual) government capture in the sense that peer citizens may perceive that the initiative is no longer representing the interests of the general citizens and has lost its independence, being instead at the service of the authority. In situations such as Scenario 1, the recognition of a right to contribute through a legal intervention may not be needed as existing legal and governance structures accommodate the cooperation. However, we deem that having an open definition of the criteria under which CGD will be considered by authorities may be useful to foster transparency and equity in this scenario. Citizens and institutions co-own the platform on which the civic and public data are published. This, however, can also be problematic (Kimura and Kinchy 2019). For example, especially when such a scenario emerges informally, a supportive champion may leave the organisation, and previous collaborations can collapse. Another risk is that without legally binding structures, the citizen-generated data could be at risk of being accepted when it does not challenge power, while dismissed when it bothers the establishment.

The strong point of Scenario 2 is that it is in evolution and therefore has a considerable potential in terms of social and governmental innovation. The fluidity of the situation can promote creative solutions and innovative adaptation schemes. However, it may be hard for actors operating in such an evolving context to make decisions due to uncertainties. The recognition of a right to contribute here would be particularly beneficial to push institutions to adopt systematically CGD. In addition, the presence of legal recognition would incentivize the offer of CGD to authorities. Interestingly, Scenario 2 can lead to stability in the long term, generating mutual recognition and setting an agreement on the standards to which the data should adhere. However, such early legal closure might lead to a lack of flexibility and agility that instead Scenario 1 affords.

The weakest allocation of resources is in Scenario 3, in which the conflict and distrust drain the energy of all actors involved and prevent shared interventions. From another perspective, however, conflicts and distrust attitudes can also stimulate a sense of responsibility among the citizens to watch over governments' actions and, in reverse, stimulate institutional actors to improve the transparency and effectiveness of their interventions. In Scenario 3, the

recognition of a right to contribute may not be effective, as there are not the conditions to implement it, given that even a public database for publishing environmental information coming from the citizens is lacking, and citizens and authorities are in conflict. Here, the first step would be to ensure that already existing guarantees, such as the Aarhus Convention, are respected and enforced, and only when the situation evolves to Scenario 2, a right to contribute could be implemented. Yet, as we stress further, the open recognition by agencies of the conditions for their consideration of CGD can be beneficial also in Scenario 3 as it can mitigate conflicts and encourage a more constructive relationship.

TOWARDS A SUPPORTING FRAMEWORK

The analysis presented in this paper suggests possible scenarios of integration (Scenario 1 and Scenario 2). In both scenarios, the initiative producing CGD wants integration (Berti Suman 2020a, p. 83, Figure 3–2). In Scenario 3, influence on policy- and decision-making can still occur at the levels of early warning and problem definition, and mediators fostering dialogue between the initiative and policymakers are of key importance (more in Berti Suman 2020a, p. 79). Despite a legal intervention recognizing a right to contribute is more game-changing in Scenario 2. In Scenario 1, the actors are already at a level of maturity that a legal intervention is not so needed or is already in place/in formation, whereas in Scenario 3, the civic actors are opposing institutions. Nonetheless, we argue that in all scenarios a legal intervention can be valuable to create the expectation that under set conditions CGD will be considered by authorities. A clear and transparent definition of these conditions can foster mutual understanding between citizens and authorities.

In the absence of an explicit recognition, a disconnect remains between overarching vertical regulations (usually not specifying the role of CGD, i.e., neither excluding nor including it) with horizontal civic rights (remaining general and thus open to interpretation). This can *de facto* hamper but also leave an informal yet accepted space for inclusion. On this fertile ground, co-created decisional processes and shared agendas should tend to the framing of a right to contribute as a fourth pillar of the Aarhus Convention, to be accompanied by a set of overarching implementation guidelines. Such an intervention could provide a common regulatory framework at the European level. Once the right is defined, the implementation should come both at a legal level, through adaptation of national legal systems adhering to the Aarhus Convention, and at a governance level.

Possible steps to adapt governance structures should include: (i) the creation of spaces where public and civic actors can meet and compare data, facilitated by mediators; (ii) the joint curation of public databases that can include CGD; (iii) the incorporation of CGD in agency portals such as in the case of RIVM but with a direct use by the agency; and (iv) a set of guidelines setting the standards on the type of CGD (including data quality and methodology) that can be used and for which decisions. This way, actors producing CGD will know under which conditions their data can be considered, in the spirit of a "match-making between knowledge needs for environment policy and citizen science activities" (Recommendation 5.1, European Commission 2020).

This guided and integrative approach is similar to programs in some US states in which, for example, citizens are involved in water quality monitoring and produce data that are used in formal regulatory determinations provided that they respect set criteria. Yet this approach may not be viable in all cases as it depends on agreement among all the parties on the correct process for gathering and evaluating data. Such agreement may be difficult for environmental justice communities with a history of distrust and friction with governmental authorities, especially where data is gathered using low-cost devices or procedures different from those normally used by government agencies. Nevertheless, a right to have data considered could still be the basis for managing expectations and for stimulating more constructive relationships between citizens and authorities.

Guidelines and policy structures should be put in place defining key aspects, including ownership of the CGD and the platform for managing the data. We favour co-ownership between civic and policy actors of data and platforms, in a commons fashion, but with authorities assuring sustainable technical and organisational infrastructure. In addition, technical standards for the methodology and data quality of the CGD should be defined, setting the conditions under which authorities have an obligation to act upon or accept the CGD (on this point see also Berti Suman 2020a). Inspirations can be taken from the example that we provided for Scenario 2.

SUMMARY, IMPLICATIONS, AND FUTURE DIRECTIONS

In the article, we build on the three rights guaranteed by the Aarhus Convention, which are also known as the pillars of environmental democracy: access to information, public participation, and access to justice. We argue in favour of recognising a fourth right: the "right to meaningfully contribute" data. We discuss existing literature, hinting at ongoing legal and governance adaptation processes

to use environmental CGD for institutional interventions, and we reflect on our own experiences of organising and researching citizen science interventions. We highlight gaps and complement existing literature with a scenario-building exercise and with cases that challenge existing legal frameworks and allocation of responsibilities. Our scenarios offer an illustration of various levels of integration and cooperation between civic initiatives producing environmental CGD and authorities.

A legal intervention, based on already ongoing governance adaptations, is advisable for all three scenarios to set expectations, although for the middle scenario, potential for transformation is the highest. Having a set of rules that all civic initiatives must comply with to have their data considered could ensure more equality and transparency in how CGD is integrated. This could be a way forward, although it is very demanding as authorities are often reluctant to openly inform the public of the conditions under which the data they may submit would be considered by these same authorities.

A recognition of CGD, to be practically realized through the insertion of a fourth right under the Aarhus Convention (binding for its signing Parties), could ensure that the conditions under which the data produced by the citizens will be considered by authorities are transparently disclosed. In short, the right should operate when:

- the matter is not duly monitored or addressed by the competent authorities; *or*
- access to information obligations is not (properly) complied with by the authorities; *or*
- in any instance in which the CGD produced is of quality and robustness that can reasonably complement and contribute to official data, keeping as a principle that CGD does not need to be technically equivalent to government data because even less precise data can provide useful complementary information.

For their part, authorities will have the duty to open their data pool to such contributions and i) either incorporate the civic data in their official portal (as in the Samen Meten case) or ii) provide the resources for setting a co-owned platform (as in the D-NOSES case). In both cases, authorities should also offer regulatory guidance, knowledge, and infrastructures to ensure that the consequent data flows respect data protection and privacy principles, especially when sensitive (e.g., health) data are at stake.[30] Competent institutions should also provide support to prevent fake information, possibly acting as (or engaging experts to act as) gatekeepers. Lastly, authorities should also ensure that the new right is balanced with other recognized interests. A recent Science for Policy Brief by the European Commission (Berti Suman 2023) offers guidance to policy- and decision-makers, making a case for how civic monitoring can contribute to official law enforcement and to the provision of public services.

Here, we have identified gaps in existing legal and governance structures for managing environmental information and have explored the challenges of integrating publicly contributed information into institutional responses. Our analysis is limited as our scenarios and any proposed framing efforts oversimplify the complexity of a multifaceted reality. Yet, we trust that our work makes a convincing case for establishing a new right to contribute and provides an important steppingstone in the creation of the required facilitating framework.

NOTES

All web pages have been accessed for the last time on 18 September 2022

1 UNECE Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (25 June 1998) 38 ILM 517. An informative page on the Aarhus Convention can be found at https://unece.org/environment-policy/public-participation/aarhus-convention/introduction.

2 Ibid.

3 See https://www.justia.com/administrative-law/rulemaking-writing-agency-regulations/notice-and-comment/.

4 See https://unece.org/environmental-policy/events/Aarhus_Convention_MoP7.

5 See https://eeb.org/who-we-are/staff/.

6 See https://english.arnika.org/events/defending-the-defenders-2021-protecting-environmental-activists-from-persecution.

7 See https://safecast.org/.

8 See recordings at https://youtu.be/it-EGGVS7Po.

9 See https://unece.org/sites/default/files/2021-08/ECE_MP.PP_2021_22_E.pdf.

10 See https://unece.org/sites/default/files/2021-08/ECE_MP.PP_2021_20_E.pdf.

11 See https://www.clientearth.org/media/fesgdu3u/clientearth_guide_2021_gb_bat.pdf.

12 See https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-citizen-science-initiatives-policy-and-practice and https://data.europa.eu/doi/10.2777/32018.

13 See https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2013&menu=35.

14 See https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

15 See https://theconversation.com/greta-thunberg-effect-people-familiar-with-young-climate-activist-may-be-more-likely-to-act-154146.

16 See, for example, the tool kits developed by the projects Making Sense (http://making-sense.eu/wp-content/uploads/2018/01/Citizen-Sensing-A-Toolkit.pdf) and ACTION (https://actionproject.eu/toolkit/), the engagement methodology developed by the D-NOSES project (https://dnoses.eu/), and the future roadmap provided by the WeObserve project (https://zenodo.org/record/4646774#.YaZ1md_TWUn).

17 See for example, the experience of the shared agendas by the Catalan government (http://catalunya2020.gencat.cat/web/.content/00_catalunya2020/Documents/angles/fitxers/shared-agendas.pdf).

18 Among the others, by the 2001 White Paper on Governance, see https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al10109.

19 See https://pecbms.info/.

20 See https://samenmeten.rivm.nl/dataportaal/.

21 See https://mueckenatlas.com/.

22 See https://epanet.eea.europa.eu/reports-letters/epa-network-interest-group-on-citizen-science/epa-network-interest-group-on-citizen-science. We could also review the document "Recommendations to Heads of EPAs following the European Commission's Best Practices in Citizen Science for Environmental Monitoring" presented at the 37th EPA Network plenary meeting, 12-13 May 2022 , Paris.

23 For an analysis of scenarios from an US perspective, see https://www.epa.gov/sites/default/files/2020-04/documents/epatoolswebinar_citizen_science_final_0.pdf.

24 See https://dnoses.eu/.

25 Exchange with Rosa Arias, D-NOSES Project Coordinator and CEO of Science for Change, in fall 2021.

26 See https://odourobservatory.org/.

27 See https://www.samenmetenaanluchtkwaliteit.nl/ and https://www.samenmetenaanluchtkwaliteit.nl/international.

28 See https://samenmeten.rivm.nl/dataportaal/.

29 The page of the initiative https://covacontro.org/la-campagna/. Accessed 28 September 2021. The website is only in Italian but Berti Suman (2022) provides an English account of the project.

30 See reflections by the DECODE project, https://decodeproject.eu/publications/final-report-barcelona-pilots-evaluations-barcelonanow-and-sustainability-plans. Experiences offering models of civic data governance include Salus Coop (Europe) (https://www.saluscoop.org/) and the Louisville Data Commons initiative (US) (https://louisvilledatacommons.org/).

SUPPLEMENTAL FILE

The supplementary File for this article can be found as follows:

- **Appendix 1.** Case studies illustrating each scenario discussed. DOI: https://doi.org/10.5334/cstp.496.s1

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The authors have no competing interests to declare.

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All authors contributed to the research design, implementation and writing and to the methodological aspects of the manuscript. The first author took the lead in coordinating the writing and review process.

DISCLAIMER

Views and opinions expressed in this article by authors Anna Berti Suman and Sven Schade are those of the authors only and do not necessarily reflect those of the European Commission.

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