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Maximising the relevance and excellence of citizen science

Topic 3 Discussion Paper

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Independent
Expert
Report



Mutual Learning Exercise on Citizen Science Initiatives – Policy and Practice

Topic Three Discussion Paper: Maximising the relevance and excellence of citizen science

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Maximising the relevance and excellence of citizen science

Discussion Paper

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MAXIMISING THE RELEVANCE AND EXCELLENCE OF CITIZEN SCIENCE

“Citizen science is likely to lead to greater relevance of research and innovation for citizens and society, and hence facilitate uptake and behavioural changes in support of action...

...Citizen science already provides high (and sometimes best) quality data in a variety of scientific domains, but there are difficulties enabling citizen science-derived data to be taken up in official monitoring exercises...

...How do we ensure that citizen science builds on sometimes well-established good practices and avoids ethical and other pitfalls that could be harmful to participants and the field as a whole?...

...These are things we need to be mindful of’.”

- Linden Farrer, Policy officer in the DG Research & Innovation “Open Science” unit

1. Introduction

1.1. Scope, Purpose and Structure of this Discussion Paper

The overall goal of Topic 3 in this series is to delve into the key factors identified as ensuring excellence and relevance of citizen science (CS) across all disciplinary areas of research. The purpose of this Discussion Paper is to introduce Topic 3 to the participants in the Mutual Learning Exercise (MLE) and provide inputs for discussion in advance of the Topic 3 meeting that will take place in Ljubljana (Slovenia) in October 2022. This Discussion Paper can be found in the online repository of the EC Policy Support Facility².

1.2. What do relevance and excellence mean?

The terms “relevance” and “excellence” have become buzzwords in the European research ecosystem and are used in many different contexts by scholars, funding agencies, policy makers and other stakeholders. On the one hand, the notion of relevance in research, in particular societal relevance which is sometimes used interchangeably with “societal impact” in the literature, generally refers to the importance of research in addressing matters that are significant to society. Across the European Research and Innovation system, substantial efforts are being made to steer research towards a scientific research process, results and outcomes that are closely aligned with the grand and pressing social, economic and environmental issues the society is facing (e.g., climate change, clean energy and food security)³. On the other hand, the notion of excellence, although there is not a universal consensus on its definition, often reflects a collection of attributes that are important to make

¹ Interview for the CS Track with Linden Farrer, 30 August, 2021. <https://cstrack.eu/format/opinion/citizen-science-and-policy-making-an-interview-with-linden-farrer-from-the-european-commission/>

² PSF Challenge / MLE on Citizen Science Initiatives - Policy and Practice. <https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-citizen-science-initiatives-policy-and-practice>

³ Păunescu et al. 2022

high quality research conducted by professional researchers and scholars⁴. Aiming for excellence thus influences the conduction of science and can, among other things, refer to ensuring scientific quality (e.g., by limiting possible biases during data collection), undertaking research with rigor (e.g., by adhering to an ethical and responsible conduct), and producing reliable, verifiable and reproducible results.

Moreover, excellence within research funding is an important aspect of the European Framework Programme, and it is the first pillar of Horizon Europe. As noted in the information from the European Commission, excellence includes frontiers research that can support breakthrough scientific ideas, support the best scientists in Europe and beyond, provide world-class expertise, and provide support through world-class infrastructure⁵. The investment in the European Research Council, Marie Skłodowska-Curie Actions, and in research infrastructure are all aimed at achieving excellence. This, sometime elusive, scientific excellence is important when considering the role and relevance of citizen science within the national and international scientific efforts.

1.3. Why does maximising the relevance and excellence of CS matter?

The specific context of CS and the variety of projects applying it have been shadowed in the past by certain preconceptions and doubts from various stakeholders, undermining the establishment of the credibility, authority and validity of CS in mainstream scientific research⁶. Concerns raised have included the worry that CS leads to poor data quality and may deviate from standard research protocols since the volunteers collecting the data are untrained and lack years of experience. There is now extensive experience and evidence in practice to counter this concern with precedents set by several CS projects for the production of valid, accurate and useful data⁷. In this context, one of the main reasons for maximising excellence of CS is for this approach to gain legitimacy in mainstream science and in the policy-making process. CS research projects that uphold the requirement for excellence in science could increase the extent of policy use of citizen-generated data (CGD) and encourage more scientists to adopt CS in their research projects. Maximising the relevance of CS and giving it a role to play in addressing many global issues, from protecting biodiversity to tackling climate change, is of great importance. In fact, the societal value of CS lies in its ability to “empower people to draw attention to local issues, provide the evidence base to call for, propose or co-create solutions and contribute to increased participation and sustained involvement”⁸. Maximising relevance of CS can help align CS activities with local issues, and, in turn, foster the spread and scalability of CS projects to address larger-scale societal and environmental challenges.

1.4. Factors of relevance and excellence of CS

When considering maximising the excellence of CS, a good start would be to refer to the European Citizen Science Association (ECSA) Ten principles of citizen science⁹. The Ten principles form a framework of standards to foster excellence in all aspects of CS since it provides a set of core principles to consider when funding, developing or assessing high-

⁴ Jong et al. 2021; Langfeldt et al. 2020

⁵ EC 2021

⁶ Ekström, 2022; Freitag et al. 2016

⁷ See examples of precedents for credibility in CS cited in Freitag et al. 2016

⁸ De Rijck et al. 2020

⁹ The Ten Principles are described in the MLE on citizen science initiatives: policy and practice. First topic report, Introduction and overview of citizen science, Publications Office of the European Union.

<https://data.europa.eu/doi/10.2777/29886>

quality CS projects¹⁰. However, these principles remain broad. A more detailed and recent reference would be the collection of criteria for quality and good practice developed by Heigl and colleagues¹¹. It is important to note that this set of quality criteria is based on the experience of Austrian CS projects and the existing international literature. Therefore, attention and reflection are needed when adopting this set of criteria in other countries or contexts. The current version of the catalogue consists of 20 criteria covering seven areas: (1) what is not CS; (2) scientific standards; (3) collaboration; (4) open science; (5) communication; (6) ethics; and (7) data management. Without listing all the specific criteria for each area, let's take as an example the sets of criteria "Ethics", topic highly linked with excellence in CS research:

The project objectives must be ethically sound (i.e., in compliance with human and basic rights).

- The project must follow transparent ethical principles in compliance with ethical standards, such as obtaining informed consent from participants or the parents of participating children, among others.
- Clear information on data policy and governance (regarding personal and research data) must be published within the project, and participants must consent to this information prior to participation.
- Project management must reflect and consider ethical aspects (e.g., diversity, inclusion, gender equality, reflection on in- or exclusion of specific groups).

For this Discussion Paper, we present in greater detail three broad key factors that we believe can ensure high relevance and excellence in CS across all research disciplines. As such, we deem important that CS projects:

- Align with and support the Sustainable Development Goals (SDGs).
- Consider and address novel ethical issues.
- Manage data in line with the FAIR principles in order to impact policy.

2. Factor #1: Alignment with and support of the SDGs

2.1. What are the SDGs?

In 2015, the United Nations (UN) General Assembly defined and implemented universal priorities to ensure a better and more sustainable future for all. These priorities, better known as the 17 sustainable development goals, are meant to be achieved by 2030 (Figure 1). To help measure the progress towards these goals, each goal has approximately eight to 12 targets, and each target is tracked between one and four indicators. In total there are 169 targets and 231 unique indicators (measurable outcomes)¹². The Inter-Agency Expert Group

¹⁰ Robinson et al. 2018

¹¹ Heigl et al. 2020

¹² Inter-Agency Expert Group on SDG Indicators, 2017

on SDG Indicators (IAEG-SDGs) is the entity responsible for developing, implementing and updating regularly the protocols for indicators, including metadata standards, methodological development and data availability¹³.



Figure 1. The 17 Sustainable Development Goals set by the UN General Assembly.

2.2. How can CS help achieve the SDGs?

While the awareness of the potential of CS for reporting on the SDG was recognised early¹⁴, in 2017, a dedicated brief from the Stockholm Environment Institute presented how CS could contribute to the SDGs¹⁵. A year later, in 2018, a workshop, organised by WeObserve, on CS and the SDGs, brought together several representatives from CS associations, researchers, citizen observatories (COs) practitioners, and UN agencies. This workshop initiated the discussion on how CS can be integrated into SDG monitoring and implementation. From these activities stem two seminal research works on the potential of CS and COs for SDG monitoring¹⁶. In the same year, CS was identified by the UN Environment Programme as one important component to solve the most salient challenges related to the collection, management and use of environmental data¹⁷. Based on all this work, the potential of CS approaches and COs in contributing to the SDGs has been identified in:

- Defining targets and metrics and improving reporting coverage:** The international targets, although already established by the UN, include wording that would require further definition adapted to the local context. Fritz et al. (2019) indeed suggested that the complexity of the SDG indicators seems that they have not been developed with a view to enabling lay people to monitor them. CS could thus play a role in defining criteria on a scale that is more relevant to citizens, i.e., capturing social realities at the community level. It could also help to highlight or even prioritise the situation of marginalised/disadvantaged groups for which granular official data or targets might not be available or defined. For example, for the Target 7.1 “By 2030, ensure universal access

¹³ Fraisl et al 2022

¹⁴ Lu et al., 2015; Hsu et al., 2014

¹⁵ West et al. 2017

¹⁶ Fritz et al. 2019; Fraisl et al. 2020

¹⁷ Jensen and Campbell 2018

to affordable, reliable and modern energy services”, citizens could help define the metrics and ensure that “reliability” and “affordability” are measured in a way that is contextually relevant for them¹⁸.

- Monitoring progress and closing data gaps in a more cost-effective way:** Currently, there is not enough data for tracking several dimensions of the SDGs (e.g., environmental dimensions). Reasons for the lack of data sufficiency can be explained by the fact that usually data is collected by national statistical offices (NSOs), government ministries and international organisations (e.g., through household surveys, censuses, and official sensors) which is a costly and lengthy collection process, and in turn, makes data often outdated. There is thus a lack of technical and financial capacities from such official instances to collect the data for global SDG reporting. Plus, official data are often reported at the national level where spatial variations across a country are not often captured, let alone general concerns about the accuracy, openness, and coverage of some official data sets. Since traditional data sources alone are not enough for monitoring SDGs, it becomes interesting for the SDGs to rely on data generated by CS projects as a non-traditional source of data to complement and improve the official systems of the SDGs reporting process. All in all, CS can help achieve the SDGs by providing updated and detailed data at lower costs and faster than official data collections. For a more detailed look at the value of CGD for the SDGs see Figure 2 by Fritz et al. (2019) which presents the five dimensions of CS data, their characteristics, and their value for the SDGs. Additionally, Fraisl et al. (2020) found that CS is already contributing to the monitoring of five SDG indicators and that it could contribute to 76 of them, meaning that CS could contribute to around 33% of the total number of SDG indicators. Recent literature discussed the contributions of CS data to SDG monitoring in specific areas such as soil health, water quality, land use and energy¹⁹.

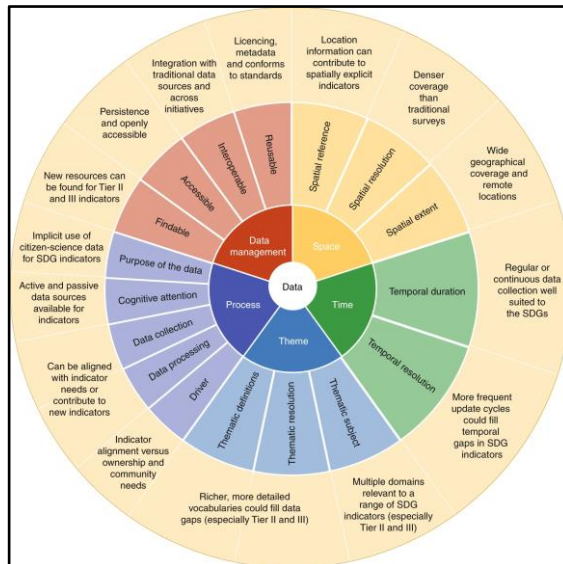


Figure 2: The five dimensions of citizen-science data (inner ring), their features (middle ring) and their value for the SDGs (outer ring). From Fritz et al. (2019)

¹⁸ West et al. 2017

¹⁹ Head et al 2020; König et al 2020; Laso Bayas et al 2020; Wuebben et al 2020

- **Fostering actions towards implementing and achieving the SDGs:** Not only it is suggested that CS can provide an alternative and complementary way of measuring SDGs, but it can support the achievement of the SDGs by creating and strengthening new kinds of relationships or partnerships between government, NSOs, civil society and local communities, identifying gaps in data acquisition, highlighting community concerns, informing public policy, inducing behavioural and attitude change and other actions towards implementing and achieving the SDGs.

2.3. The role of CS and CGD beyond the SDGs

Even if the SDGs are meant to be achieved by 2030, the context of the CS and SDGs provide important insights for R&I bodies in the future. Experience and evidence of the use of CS for the SDGs encourage R&I bodies to consider how CS and CGD can support the development of high-quality excellent data sources and knowledge on how to produce them. The number of CS and CGD projects in Europe is growing and, with the capacity of these projects to generate richer and trusted data to address social and environmental challenges, a greater influence of these projects is expected on decision-making at the local, regional and international government levels²⁰.

2.4. Challenges CS is facing in its contribution to SDGs

One of the main barriers for data derived from CS projects to be used for SDGs monitoring is the inherent lack of trust and acceptability in CGD by national agencies. The concern raised about CGD is that data gathered will be of poor quality, not valid or reliable. A lack of an environment of trust for the use of CGD is conflicting since this type of data needs to be validated by a NSO before inclusion in official SDG reporting. But, beyond the uncertainty around data quality, CGD are usually naturally limited in scope and scale. Consequently, there are important discrepancies between the focus taken by the CGD and the official data provided for SDGs. All these differences constrain CGD to be easily joined to official data sets and be compatible with their standards. According to Lämmerhirt and colleagues, the mismatches are due to the fact that data from CS projects tend to²¹:

- **Focus on local action rather than high-level policymaking:** Many CS projects are local and are not replicated at a larger scale to have national coverage. Plus, CS projects do not always consider using the SDGs as a framing for their work. This obliges governments to go to all different projects to pull information (and where data is not necessarily standardised) instead of from one central location or national database. There is also a problem of coverage and representativity of CGD where several CS projects focus on urban areas and developed countries.
- **Focus on SDG targets rather than indicators:** CGD is more instrumental and action-oriented rather than involved in tracking progress. Usually, CGD are gathered to drive change around a particular issue of importance to citizens, which explains why it tends to fit with the targets and not necessarily the indicators.

²⁰ Ponti and Craglia 2020

²¹ Lämmerhirt et al. 2017

2.5. Recommendations to better support CS for SDG

The promising benefits and challenges of CS in contributing to the SDGs have motivated a handful of scholars and CS practitioners to provide several recommendations to ensure the support of CS for SDGs. According to experts, to overcome the challenges mentioned in the previous section there is a need for a coordinated approach by different stakeholders. In the next subsections, we will present recommendations to better support CS for SDGs based on different European references.

2.5.1. WeObserve SDGs CoP

The research led by Fritz et al. (2019) under the WeObserve SDGs CoP outlined how CS can be integrated into the formal SDG reporting mechanisms. The authors concluded that for a successful integration there is a need for 1) leadership from the UN, 2) innovation from NSOs and 3) a focus from the CS community to identify the indicators for which CS can make a real contribution. WeObserve also recommended some main actions to support future integration of COs and CS initiatives with these international systems²²:

- **Enable the uptake of CS data:** Collaborate with NSOs to explore options to integrate CS data streams into NSO practices, at the national level and with relevant UN custodian agencies to create an environment that enables the uptake of CS data, through building and maintaining infrastructures, capacities and key partnerships.
- **Elevate CS initiatives' capabilities:** Support initiatives that could contribute to SDG monitoring to modify and improve their data collection and analytical tools, data validation, interoperability measures to ensure that the data comply with NSO requirements and for their potential to be realised for SDG monitoring.
- **Disseminate and support best-practices:** Create an inventory of best practice examples and success stories and develop further case studies where Cos/CS data are used in innovative ways by NSOs and disseminating these examples through appropriate channels. Further stimulate and support SDG-relevant CS activities, at the local level, e.g., by creating brokerage systems where CS practitioners can map their CS projects and data against SDG indicator needs.
- **Align data protocols:** Identifying data quality criteria or data quality assurance procedures that can align with requirements from NSOs and other government agencies. Investigate the feasibility of aligning data collection methods across projects with global definitions to implement internationally comparable methods and data for global level SDG reporting.
- **Secure investment and engagement:** Secure investment and encourage the development of business cases linked to the sustainability of the CO/CS initiatives to maintain essential technical infrastructures and the engagement of citizens for SDG monitoring longer-term.

2.5.2. CS-SDG Conference Declaration

In October 2020, a hybrid conference was held to showcase, evaluate, and discuss the contribution of CS to frame and achieve the SDGs. The event entitled "Knowledge for

²² Hager et al. 2021

Change: A Decade of Citizen Science (2020-2030) in Support of the SDGs” took place as an official event of Germany’s 2020 EU Council Presidency and was organised by the *Museum für Naturkunde Berlin* (MfN) with many partners, supported by the European Commission and the Federal Ministry of Education and Research (BMBF). A playlist with all the recordings of the CS SDG Conference is freely accessible online²³. A Declaration was drafted and proposed stemming from this conference to form a social contract and voluntary commitment between citizen scientists, academics, and policy makers to help and shape CS engagement and advancement of the SDGs²⁴. More specifically, this Declaration includes policy recommendations grouped into three central policy directions.

Declaration “Our World – our goals: Citizen Science for the Sustainable Development Goals”

Harness the benefits of citizen science for the SDGs

- (1) Through citizen science, citizens must be supported and encouraged to generate new scientific knowledge to support the SDGs, in collaboration with policymakers, academia, research institutions, research funding agencies, researchers, citizens and civil society organisations and according to recognised and tested standards.
- (2) Academia, universities and research institutes must be supported to restructure and open up to give space and opportunity for citizen involvement. Citizen science needs organisational forms to provide the approach with a route and framework and at the same time guarantee for quality.
- (3) Policy makers and research funders should provide strategic and financial support to citizen science networks, capacity-building activities and initiatives, as well as to changes in research organisations, whilst also supporting the active engagement of EU citizens in implementing the SDGs.

Strengthen citizen science and its connections with other communities

- (1) Citizen science networks and communities must interact more closely with thematic research communities that produce scientific knowledge and technological innovation for the different SDGs, such as R&I for the environment, health R&I, food R&I, energy and transport R&I. Policies should be put in place to encourage and support citizen science networks and communities of practice focused on sustainability to enhance networking with diverse stakeholders (e.g. research organisations, non-governmental organisations, civil society organisations, policy-makers and private companies), and help to align citizen science activities with policy and research needs.

²³ Link to the youtube playlist with all the recordings of the CS SDG Conference: <https://www.youtube.com/playlist?list=PLeTIYFAGADkOHH3DyfkBkfGEmJzfDDpIp>

²⁴ Link to the CS SDG Conference Declaration: <https://survey.naturkundemuseum-berlin.de/sites/default/files/uploads/Citizen%20Science%20SDG%20Declaration.pdf>

- (2) To promote and create synergies, systems should be established to increase the coordination and exchange of citizen science, information and tools relevant to the SDGs, across countries and at the global level, and across thematic areas.
- (3) To ensure and increase the usability and acceptance of citizen science data and evidence in efforts to achieve the SDGs, citizen science communities should communicate transparently on the methodologies they use, potential bias in the data they generate, and their data quality management strategies.
- (4) Authorities across Europe should further promote, encourage and support the application of data-management and data-sharing principles (e.g., FAIR and open data), and the release of technologies and tools that are open source and open access in citizen science initiatives, in order to ensure that citizen science data, technologies and tools are fit for science and policy purposes and, eventually, policy implementation.

Strengthen future citizen science systems

- (1) Citizen science should be mainstreamed across the new Horizon Europe framework programme; this programme should also incorporate lessons from citizen science projects, and advice from citizen science experts, on all issues related to the European Green Deal.
- (2) Curricula related to citizen science and the SDGs needs to be developed for schools, higher education institutions and lifelong learning programmes, and adapted to different target groups. EU funding bodies should set up actions: support training and education institutes in incorporating citizen science; provide technical and legal support for citizen science practitioners; and reach out to local communities and schools.
- (3) Funding for research into the science of citizen science is needed to advance the field, and how it can help achieve the SDGs and build expertise in a sustainable way.
- (4) Funding for citizen science should allow for the special requirements of citizen science initiatives, including (among others) support for a series of often small-scale experimentation, as well as for exploring different routes for the upscaling and long-term sustainability of initiatives aiming for social change.

2.5.3. Crowd4SDG

According to the Crowd4SDG project report on relevance and quality-related considerations of CGD, NSOs can use both “passive” (NSO playing the role of standard-setter) and “active” (NSOs proactively develop and manage projects and partnerships with citizen science initiatives) approaches to leveraging CGD²⁵. To boost the capacity of NSOs to leverage both active and passive approaches, Crowd4SDG suggested to:

- Updating, if necessary, the legal basis to ensure NSOs have the right mandate to engage with CSOs, academia and communities.

²⁵ Crowd4SDG 2021 <https://crowd4sdg.eu/wp-content/uploads/2021/10/D5.1-Initial-report-on-relevance-and-quality.pdf>

- Strengthening partnerships with CSOs, academia and communities who may potentially contribute to data production.
- Introducing a protocol/quality assurance mechanism.
- Providing training and capacity development for stakeholders involved in citizen data production to enhance statistical literacy (for CSOs), improve the knowledge of the principles of official statistics and the awareness about the needs and the work of NSOs.

3. Factor #2: Consideration of novel ethical issues

3.1. What is ethics in research?

"Ethics" generally refers to standards of conduct that distinguish between acceptable and unacceptable behaviour in scientific research²⁶. Nowadays, every researcher must adhere to ethical norms and principles guaranteeing the responsible conduct of research. Many universities, government agencies and professional associations have adopted specific codes relating to research ethics. In fact, research ethics review has become an integral component of scientific research. For instance, almost every university institution supports at least one ethical review board (ERB) (also called "research ethics committee" or "institutional review board"). As such, ERBs are now a standard part of approval for most publicly funded scientific research involving human beings and animals. A key ethical framework for the self-regulation of the European research community, across all disciplines and in all research settings is The European Code of Conduct for Research Integrity²⁷. This document sets out four fundamental principles of research integrity (reliability, honesty, respect, and accountability) and lists several good research practices.

3.2. Novel ethical issues raised by CS

Because CS is a new approach, it raises novel ethical issues that traditional research ethics frameworks may not adequately address. There is therefore an "ethic gap" between traditional research and CS²⁸. It is only recently that different actors in CS raised discussions on the unique landscape of ethical issues across the spectrum of CS. There is, for example, a growing body of academic literature (e.g., the journal Citizen Science: Theory & Practice created a special issue in 2019²⁹) and working groups (e.g., the US Citizen Science Association Ethics Working Group, ECSA CS for Health Working Group³⁰) on ethical challenges of CS. Listing all ethic problems is not easy given the widely distributed nature of CS across many disciplines with varying norms. Still, examples of general ethical issues identified on CS are related to data quality and integrity, data sharing and intellectual property, conflict of interest and risk of exploitation³¹. CS done to an ethically high standard will allow for better experiences for participants and more responsible and sustainable research projects.

²⁶ Resnik 2020

²⁷ ALLEA — All European Academies 2017

²⁸ Rasmussen 2017

²⁹ Special Collection Ethical Issues in Citizen Science:

<https://theoryandpractice.citizenscienceassociation.org/collections/special/ethical-issues-in-citizen-science/>

³⁰ CSA Ethics Working Group: <https://citizenscience.org/get-involved/working-groups/ethics-working-group/>

³¹ ECSA CS for Health Working Group <https://ecsa.citizen-science.net/working-groups/citizen-science-for-health/>

There are specific concerns about participant treatment related to several ethical issues including: 1) Sharing credit/intellectual property 2) Exploitation, 3) Overburdening, 4) Ensuring respect and 5) Pay/labour issues. Another challenge unique to CS is the fact that citizens may have a double role in which they are both a member of the research team (citizen scientists), whilst simultaneously taking part in the study as a research subject³². The duty of the researcher to act in accordance with the ethical and epistemological standards of “good science” also extends to the citizens. Hence, citizens have a new responsibility, which is to comply with traditional ethical standards of scientific activity.

3.3. Main challenge for addressing ethical issues in CS

At present, there is only a few examples of frameworks addressing the ethical issues relevant to CS that have been developed:

- Resnik et al.'s ethics framework for CS³³
- Cornell Ornithology Lab's ethical guidelines³⁴
- British Trust for Ornithology's Code of CS Research Ethics³⁵
- GalaxyZoo's Code of Ethics³⁶

There is thus a lack of governance (or of a governing body) of ethical issues in CS. Although ethicists may propose broad guidelines for CS, a one-size-fits-all set of ethical requirements is not realistic considering the broad variety of CS projects and forms of engagement. CS projects have to think of possible mechanisms for addressing ethical issues³⁷. Some possible mandatory mechanisms CS projects could use are federal regulations, state laws, institutional policies, journal/publication policies, funders (require ethics training and/or oversight), community ERBs and voluntary mechanisms are the best practice guidelines, voluntary research ethics consultation, ethics toolkit, etc. This is particularly challenging if the CS project is not affiliated to or conducted at an academic institution or takes place without grant funding.

4. Factor #3: From data management to policy impact

Data in CS is a very large and dense topic and for this Discussion Paper we have decided to focus on data management, its longevity and policy impact.

4.1. What are the FAIR principles and why are they needed?

The increasing production and availability of data means that the latter needs to be created with longevity in mind³⁸. Data management encompasses measures to ensure the usability

³² Resnik 2019

³³ Resnik 2015

³⁴ <https://www.birds.cornell.edu/landtrust/aba-code-of-birding-ethics/>

³⁵ British Trust for Ornithology's Code of CS Research Ethics: <https://www.bto.org/our-science/bto-approach-science/citizen-science-research-ethics>

³⁶ Galaxy Zoo 's Code of Ethics: <https://blog.zooniverse.org/tag/ethics/>

³⁷ Rasmussen, 2017

³⁸ Wilkinson et al, 2016

and reusability of research data before, during and after the research project³⁹. The FAIR principles—Findability, Accessibility, Interoperability, and Reusability—are a good framework to follow when managing data as they describe how research outputs should be organised so they can be more easily accessed, understood, exchanged and reused. In fact, major funding bodies, including the European Commission, promote FAIR data to maximise the integrity and impact of their research investment.

4.2. Why use the FAIR principles in CS to impact policy?

Data is often one of the lasting legacies of a CS project, so it must be managed and stored effectively to improve the chance that the project has lasting impact⁴⁰. According to the MLE session on Topic 2, only four projects seem to follow the FAIR principles⁴¹. Similarly, a recent study found that in general, CS projects were not implementing or aware of best practices for research data management⁴². Writing a data management plan and promoting the use of the FAIR principles will aid CS projects throughout the data life cycle and increase the sustainability of the data. The four foundational principles can help maximise the added value of CGD in the present and in the future:

“Through the use of data and metadata standards and other mechanisms to promote interoperability, we can support multiple research questions and use cases across numerous science domains, allowing CS to help address issues and problems on local, regional, national, and global scales.”⁴³

Increasing the sustainability of the data can thus be very useful for various decision-making processes. However, in order to maximise the use and impact of CS data, there is a need for a good management of data and metadata:

“Establishing the evidence that citizen science can be used effectively for policy will take time... However, in order for policy to realise its full benefit, the ability to share and use data across platforms and stakeholder groups is essential.”⁴⁴

4.3. Challenge: Absence and maintenance of data infrastructures

The main challenges in passing from good data management to policy impact is the lack of data infrastructures and sustaining those. Data infrastructure refers to all the tools and technologies including hardware and software that support data collection, management, and access⁴⁵. In fact, many CS initiatives suffer from a lack of infrastructure to efficiently hold, manage, analyze and interpret CS data⁴⁶. Owen and Parker (2018) suggested that there is a need for infrastructures to be developed and provided for by authorities, such as environmental protection agencies (EPAs), or, which already occurs, by consortia funded for example by the EU⁴⁷. On that note, see in Annex I examples of CS air quality monitoring projects across Europe gathered by Mahanjan et al (2022) to gain insights into how these projects engage citizens, translate data into evidence, and create opportunities for dialogue

³⁹ Hansen et al. 2021

⁴⁰ UKEOF, 2020

⁴¹ Link to the second thematic report: <https://data.europa.eu/doi/10.2777/389967>

⁴² Bowser et al. 2020

⁴³ Workshop Report: Geneva Declaration on Citizen Science Data and Metadata Standards: <https://cs-eu.net/news/workshop-report-wg-5-geneva-declaration-citizen-science-data-and-metadata-standards>

⁴⁴ Williams et al. 2018

⁴⁵ Bowser et al. 2020

⁴⁶ Owen and Parker 2018

⁴⁷ Higgins et al 2016

with decision-makers. However, long-term data management (particularly its infrastructure) needs secure funding. The lack of funding may hamper the possibility to maintain technologies e.g., platforms and apps. One challenge of data management of CS is how to sustain interoperability of software or technology used in CS projects. However, many projects develop apps and platforms that are never reused because of discontinuation of the project or unavailable documentation⁴⁸.

4.4. Examples of recommendations and actions to link CGD to policy-making

The European Commission published a Staff Working Document on CS and it includes several recommendations and possible actions that aim to harness the potential of citizen-generated data and to link them more closely to environmental monitoring and policy-making⁴⁹. To better link the under-used data from CGD to EU environmental monitoring, the recommendations in this document identify a number of possible actions in four key areas:

- Matchmaking between knowledge needs for environmental policy and citizen science activities
- Promoting awareness, recognition, and trust
- Promoting standards for data quality and interoperability, and sharing tools
- Supporting coordination, cooperation, and resources for policy impact.

Based on these recommendations, examples of possible actions for EU and Member State authorities are:

- Promoting the availability of CS data on existing or new open platforms and ensuring that official reporting mechanisms can accept and integrate these data
- Reviewing and communicating relevant data quality requirements and methodologies
- Promoting the application of data management and sharing principles
- Giving explicit credit and feedback when using CS contributions
- Promoting the application of data management and sharing principles
- Providing training and resources on data (quality) management methodologies and standards of good practices
- Fostering innovation by sharing open tools and investigating emerging scientific and technological trends

⁴⁸ Williams et al. 2018

⁴⁹ De Rijck 2020

5. Questions to be discussed

In this Discussion Paper, we have reflected on some of the key challenges faced in maximising the relevance and excellence of CS. We have also shown that there is still a lot of work to be done towards mainstreaming CS as an accepted methodology (i.e., following an ethics framework and good data management plan) and source of data for SDGs monitoring and reporting. Although we have presented each of these three factors separately in this Paper, in practice they are very interdependent. For instance, capitalizing on the accessibility, interoperability, and reusability of data, which will lead to larger and more integrated datasets, can help CS contribute to monitoring the SDGs and to addressing ethical issues related to data sharing and integrity. The questions that we now pose to the participants is to reflect on the current status and on potential opportunities and barriers regarding the above-described factors that can help maximise relevance and excellence of CS. These questions are easier to answer with a specific CS project in mind.

Alignment with and support of the SDGs⁵⁰

- Is the project team aware of what the SDGs are? Is it relevant for them to consider it?
- What types of involvement does your CS project have with the SDGs? (e.g., non-existent, superficial, substantial)
- For which purposes does your CS project produce data? (e.g., communities, public governance, scientific research, statistics). Could it fit with one of the 17 SDGs?
- How could your CS project support the SDGs and which specific target?
- Do you see any opportunities when it comes to CS data helping track progress on SDG indicators? or does the project include data which match a specific indicator of a SDG?
- Does the project contribute to the official reporting of a SDG?
- What are the main opportunities and barriers your project faces in linking CGD to the SDGs?
- Is your government already adopting regulations that can create a data ecosystem that supports CGD and recognizes its legitimacy as a separate but equally important source of information for decision making?
- Which kind of support is already in place and which one is lacking to make CS a means to help implement the SDGs? (e.g., financial support, structural support, technical support, etc.)
- Is your NSO able to become a partner for organisations collecting data by providing technical support and ensuring that data and its benefits are owned by the organisation?
- What other kinds of opportunities does CGD offer for monitoring the SDGs in your country?

⁵⁰ Some questions were inspired from the work of Ballerini and Bergh 2021

- We recommend reading this Paper⁵¹ which presents a collection of 51 questions and a corresponding set of answers which can be used by CS projects to self-assess their impact towards the SDGs.

Consideration of novel ethical issues

- How are the project goals compliant with fundamental ethical values?
- Did the project have to go through an ERB? If so, did the researcher encounter issues related to the fact that this was a CS project?
- Does the ERB hold the appropriate knowledge and expertise to support CS projects?
- Are there national regulations, laws, and practices that require specific consideration with respect to CS?
- Which ethical principles does the project adhere to, e.g., is a declaration of consent (informed consent) obtained from the participants?
- Is the project following a specific ethics framework?
- What unique ethical challenges could be faced when doing CS in a specific field of research?
- What ethical issues will need to be confronted in the conduct of the research?
- Do you know the ethical framework in place in your country/institution/professional organisation that could help frame ethical tension in CS projects?

From data management to policy impact

- Is there an effort of promoting standards for data quality and interoperability, and sharing tools to help CS projects to maximise scientific rigor?
- Does your project include an explicit data management plan? And does the project have a data management plan that complies with the EU General Data Protection Regulation?
- What are the ethical and legal implications of data gathering and storage in relation to different countries and cultures? Do you need to store the data in the country in which it is collected?
- Is the data and all associated metadata from your project findable through catalogues and search engines? If the data collected by the project is accessible via an online download service, how can it be accessed?
- Do you provide access to raw datasets or aggregated values?
- Do you make the data available for reuse? Which are the conditions for re-use? (e.g., public domain, i.e., completely free from any restriction of intellectual property; with attribution, i.e., giving credit to the original creator)
- For how long do you ensure access to the data from your project?
- Does your EPA support or is aware of the potential contributions of CS? What are the opportunities and barriers of linking EPA and CS projects in your view?

- What are the main impediments to the broader use of CS data for decision making in your country, in terms of data management?

⁵¹ Parkinson et al. 2022

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The purpose of this Discussion Paper is to introduce Topic 3 to the participants in the Mutual Learning Exercise and provide inputs for discussion in advance of the Topic 3 meeting that will take place in Ljubljana (Slovenia) in October 2022. This present Paper presents the three factors that have been identified as those that could ensure the relevance and excellence of CS and an understanding of the importance of maximising the relevance and excellence of CS. Specific challenges and recommendations to fostering CS relevance and excellence for each factor are discussed. Finally, this Paper provides some next steps and questions to be potentially discussed during the working session of Topic 3.

Research and Innovation policy

