



The Contributions of Citizen Science to the United Nations Sustainable Development Goals and Other International Agreements and Frameworks

CITIZEN SCIENCE:
THEORY AND PRACTICE

COLLECTION:
CONTRIBUTIONS OF
CITIZEN SCIENCE TO
THE UN SDGS

EDITORIAL CONTENT

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The United Nations (UN) Sustainable Development Goals (SDGs) are a series of global development targets that were adopted by all UN member states in 2015 to address the world's most pressing societal, environmental, and economic challenges by 2030 (UN 2015). They include 17 goals and 169 targets covering a wide range of topics from inclusive and equitable education to climate change. The achievement of the SDGs depends on our ability to accurately measure progress towards these topics using timely, relevant, and reliable data (Dang and Serajuddin 2020). To help in the development and implementation of such data and of monitoring mechanisms, a Global Indicator Framework was adopted by the UN General Assembly in 2017, which currently includes 231 unique indicators as a set of metrics to deliver information on the status and trends in each SDG target (UN 2017). However, the lack of resources and institutional capacity makes the monitoring of these indicators very challenging for the producers and users of official statistics, including National Statistical Offices (NSOs), line ministries, UN agencies and others that are responsible for compiling and disseminating official statistics (Fraisl et al. 2022).

Citizen science, along with other new sources of data such as remote sensing and mobile phone records, offers a novel solution to complement and enhance official statistics, and to provide more detailed information that cannot be captured through traditional sources of data such as household surveys (Fritz et al. 2019; Dörler et al. 2021). Accordingly, Fraisl et al. (2020) found that citizen science data are contributing or could contribute to the monitoring of 33 percent of the SDG indicators. In addition to the SDGs, there are other frameworks such as the Paris Agreement (UNFCCC 2023), the Sendai Framework for Disaster Risk Reduction (UNDRR 2015), the New Urban Agenda (UN HABITAT 2016), and the post-2020 Global Biodiversity Framework (UN 2022a) that also require better monitoring and implementation, to which citizen science could contribute. For example, Danielsen et al (2014) have previously shown that 63 percent of the 186 indicators of 12 multilateral environmental agreements can be informed by citizen science data.

Citizen science can also help to achieve transformative change, which can be defined as an extensive and foundational shift across social, environmental, economic, technological, and

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political systems, including a shift in values and paradigms (IPBES 2023). For example, citizen science can help raise awareness and mobilize action, which can support the attainment of the SDGs and other frameworks (Johnson et al. 2014; Van Brussel and Huyse 2019; Sauermann et al. 2020). It can help empower individuals, communities, and society, including the most hard-to-reach and vulnerable groups (Cooper et al. 2021; Pateman et al. 2021; Benyei et al. 2023). More specifically, it can enable people to take control over the management of natural resources cognitively, politically, socially, and economically (Danielsen et al. 2021; Andrianandrasana et al. 2022). It can also inform policies at local, national, and global levels, helping to achieve more democratic decision-making (de Sherbinin et al. 2021; Owen and Parker 2018; Schade et al. 2017).

This collection brings together 21 papers that address the relationship between citizen science and the SDGs and/or other international agreements and frameworks. It considers different perspectives including those of citizen science researchers and practitioners, NSOs, and international organizations, among others. In line with the frequently cited geographical bias in citizen science studies (Cunha et al. 2017; Vasiliades et al. 2021; Fritz et al. 2022), most papers had authors located in the Global North, particularly Europe (12 papers) and, to a lesser extent, Australia (two papers). Only five papers included authors affiliated to more than one region including the US, South America, Africa, and New Zealand. The limited submission from the US is notable, possibly indicating less interest in the link between citizen science and international frameworks such as the SDGs compared with the European citizen science community.

Here, we synthesize the core themes related to data and monitoring, and the transformative potential of citizen science for the SDGs and other international frameworks. We reflect on how progress has been achieved over the past few years both in scientific literature and through action. In a nutshell, this collection demonstrates that several issues need urgent attention to leverage citizen science approaches for the SDGs and other frameworks, while simultaneously utilizing these frameworks to fully realize the potential of citizen science. These issues include insufficient inclusiveness and lack of long-term participant engagement in many citizen science initiatives, which is in part related to the lack of sustainable funding. Additionally, a lack of awareness of the SDGs and other frameworks within the citizen science community and a lack of understanding of citizen science data and approaches among the official statistics and policy communities was also highlighted, which requires establishing partnerships between these actors and other stakeholders.

A number of papers touch directly on the use of citizen science for monitoring and data collection related to the SDGs and/or other international frameworks, as more recently appeared in the literature (e.g., Ajates et al. 2020; Head et al. 2020; Fraisl et al. 2022). This includes biodiversity studies, in which citizen science has always played a significant role. In this collection, Vercelloni et al. (2023; this issue) focus on data quality and integration in the context of citizen science biodiversity research, while Varga et al. (2023; this issue) emphasize the relationship between inclusiveness and data quality, arguing that more inclusive citizen science increases the representativeness of the data. Data sharing is a topic discussed by Voigt-Heucke et al. (2023; this issue), who highlight the need to share the data produced by citizen science initiatives with government agencies to ensure the policy uptake of these data. Daniel and Underhill (2023; this issue) discuss the link between data quality and long-term participant engagement, whereas Cronemberger et al. (2023; this issue) highlight the role of sustainable funding in the continuous engagement of participants for biodiversity citizen science in a Brazilian context. The issue of funding in citizen science is also echoed by Elias et al. (2023; this issue), who argue that inadequate funding affects the sustainability of citizen science projects on the African continent, which is a barrier to their meaningful contributions to the SDGs.

Although the potential of citizen science for monitoring the SDGs is widely acknowledged by practitioners and researchers (Fritz et al. 2019), there is still a lack of awareness of the SDG framework among members of this community, as shown by Müller et al. (2023; this issue) and Voigt-Heucke et al. (2023; this issue). Results from Proden et al. (2023; this issue) demonstrate similar findings amongst the official statistics community. This aligns with findings from earlier studies in the field (Fritz et al. 2019; Fraisl et al. 2020; Ballerini and Bergh 2021). Despite significant efforts (WeObserve 2018; IIASA 2021; UNEP & Science Policy Business Forum 2021; CSGP 2022; Olen 2022; UN Statistical Commission 2022), little progress has been made to bridge the gap between the two communities in the past few years. The taxonomy developed by Statistics Norway and the Norwegian Association of Local and Regional Authorities, and presented by Grossberndt et al. (2023; this issue), can help users better understand the data sets produced by citizen science initiatives, which is one way to enhance the dialogue between the two communities.

Antoniou (2023; this issue) and Vercelloni et al. (2023; this issue) also focus on the potential of citizen science in complementing authoritative data or official statistics in their contributions. In fact, the official statistics community is demonstrating a growing interest in exploring and harnessing the potential of data produced in different

ways by members of society. For example, Arevalo Cabra et al. (2023; this issue) from the National Statistics Office of Colombia (DANE) have experimented with social media data to understand its potential for SDG monitoring. They conclude that these data could provide contextual information on a specific topic or trend, but currently cannot be used as official statistics due to a number of issues such as representativeness of data and quality assurance. Moreover, as highlighted by Stankiewicz and König (2023; this issue), there is no single perfect data source or data set, demonstrating the need for integrating data sets and combining data sources, both traditional and nontraditional, as a way forward for successful monitoring of sustainable development.

In a similar vein, the importance of building partnerships between the official statistics and citizen science communities, as well as among the citizen science project leaders and other stakeholders to advance the SDGs is recognized both in the literature and in this collection (Gacutan et al. 2023; Elias et al. 2023; Cronemberger et al. 2023; Pasgaard et al. 2023; this issue). Early and recent case studies in the field highlight the need to center these partnerships around citizen science data, and involve all relevant actors to overcome the barrier to use these data for official monitoring and statistics (Danielsen et al. 2014; Fritz et al. 2019; *Global Partnership for Sustainable Development Data 2021*; Olen 2022).

While the potential contribution of citizen science to the SDGs from a monitoring perspective is widely acknowledged both in the literature and in this collection, Lorenz and Lepenies (2023; this issue) encourage those advocating for global-level monitoring through citizen science to consider that this can result in more inequitable power relations in knowledge production. The authors argue that a “globalizing citizen science” approach may ignore the voice of local communities, which is a barrier to achieve truly transformative and inclusive citizen science. However, bridging community and local-level citizen science projects and data with national and global-level monitoring processes by leveraging the SDG framework can help to empower those individuals and communities. It can also build trusted partnerships between these initiatives, policy actors, and other stakeholders, as evidenced by the experience in Ghana to tackle the marine plastic litter problem (Olen 2022). Pasgaard et al. (2023; this issue) offer an alternative view to this debate, highlighting the need to expand citizen science beyond the “translation of science into communities,” while also integrating local, traditional, and Indigenous knowledge (Tengö et al. 2021; Castello 2023) with conventional science to bring about transformative change.

In addition to inclusiveness, the importance of design to realize the transformative potential of citizen science for the SDGs is also explored in this collection. de Agustin Camacho et al. (2023; this issue) note that contributing data and empowering individuals and communities with clear societal outcomes are not exclusive but require successful integration of productivity (data and monitoring) and democratization (transformative) goals of citizen science by building genuine partnerships. Bedessem et al. (2023; this issue) discuss the role of communication in building such partnerships and enhancing trust in science, and they argue that citizen science can help foster trust, especially in vulnerable territories and in disaster risk reduction. Masselot et al. (2023; this issue) demonstrate that the importance of communication and trusted partnerships applies to the relationships between a diverse set of actors including the citizen science project teams. The authors suggest that social interaction dynamics within citizen science project teams are important to consider when designing initiatives that aim to leverage citizen science for the SDGs.

Fulfilling the transformative potential of citizen science and education in attaining the SDGs is a topic addressed in this collection by Mondarini and Grey (2023; this issue), Gonzalo and Sanz-García (2023; this issue), and Lakeman Fraser et al. (2023; this issue), all of which focus on the engagement of youth in addressing the SDGs. While Mondarini and Grey (2023; this issue) present a challenge-based approach through an online coaching and e-learning program designed for young innovators, Gonzalo and Sanz-García (2023; this issue) describe engaging young people in a collective intelligence exercise using an online platform to address challenges related to the SDGs. Finally, Lakeman Fraser et al. (2023; this issue) involve students in undertaking various citizen activities related to insect pollination in the UK and Italy, showing that young people are interested in the SDGs and global sustainability issues, and that participation in citizen science offers a way to engage them.

Overall, this collection compiles the latest research, results, and actionable recommendations from a diverse set of actors such as citizen science researchers and practitioners, NSOs, and international organizations working at the intersection of citizen science and the SDGs and/or other international frameworks. It reflects on how this new field of research has been evolving over the past few years and provides an agenda for future research and action. This collection also demonstrates that citizen science approaches offer great potential for contributing to both the monitoring and achievement of sustainable development. However, the case examples also show that this potential is very far from being realized today, even though there is

a growing interest within the official statistics community in citizen science approaches, and amongst citizen science researchers and practitioners in the SDGs (Henke 2022). This interest is translating into action but is occurring at a very slow pace. This is especially worrisome given the short timeline for achieving the goals of these frameworks. For example, we are now eight years into the SDG process, yet almost half of the 92 environmental SDG indicators still lack data (UNEP 2023), let alone the achievement of their targets and goals. Likewise, although the potential of citizen science for monitoring and achieving the goals of international agreements was already demonstrated, and clear recommendations were made, almost ten years ago (Danielsen et al. 2014), indicators of new international frameworks and agreements continue to be developed with limited or no attention to citizen participation.

To make better progress, we call for an urgent dialogue and action among citizen science practitioners and researchers, the official statistics community, citizens, and other actors to build partnerships and to work together to advance citizen science for sustainable development. We urge the Citizen Science Global Partnership (CSGP 2022), a network of networks that aims to advance citizen science to achieve sustainability at scale, to bridge the gap between these communities and actors. At the same time, we call upon the official statistics community to reflect on the inclusiveness and relevance of their practices to individuals, communities, and to society, to keep an open mind for a more constructive discussion and not to get lost in an unproductive debate about citizen science data quality with a biased perception. Finally, we invite funders to rethink their strategies, to go beyond short-term pilot studies, and to provide genuine financial support to citizen science initiatives working towards monitoring and achieving sustainable development.

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The authors have no competing interests to declare.

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