



An Ecosystem of Citizen Observatories for Environmental Monitoring

# **D4.6**

## **Monitoring of SDGs by COs/CS: Recommendations and priorities**



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## Abbreviations and acronyms

Abbreviation	Description
CO	Citizen Observatory
CS	Citizen Science
UN	United Nations
SDGs	Sustainable Development Goals
CoP	Community of Practice
SDGs CoP	WeObserve SDGs and COs/CS Community of Practice
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
NSO	National Statistical Office

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## Executive Summary

Designed as a universal plan to “transform our world”, the UN Sustainable Development Goals (SDGs) aim to end poverty, protect our planet and improve the wellbeing of everyone everywhere. They include 17 goals, 169 targets, and an additional 244 indicators that are used to measure progress on these goals and targets. The monitoring of the SDGs is expected to happen at the sub-national, national, regional and global levels, but national governments have the primary responsibility for their official reporting. However, many countries do not have the infrastructure or systems in place for monitoring many of the indicators, especially the environmental ones. Therefore, the funding required to measure them creates a huge barrier for their effective and timely monitoring. As a result, 68% of the environmental SDG indicators currently lack data (UN Environment 2019). In order to address this challenge and track progress on the SDGs more effectively and efficiently, new sources of data, such as satellite and mobile data, and citizen science (CS)/citizen observatories (COs) data, among others, need to be tapped into.

Citizen science, i.e., the voluntary public participation in scientific research, offers a great potential to monitor progress on the SDGs as referenced in the literature (Fritz, et al 2019; Campbell et al, 2020). However, there has been no comprehensive research undertaken so far demonstrating where and how exactly this potential could be realized and which indicators could be supported by data from COs/CS. Therefore, members of the WeObserve SDGs and Citizen Science Community of Practice (SDGs CoP), launched as part of the WeObserve project, held a workshop to discuss this potential, leading to a perspective piece and a roadmap for mainstreaming citizen science into the SDG process. Secondly, they undertook a systematic review of all SDG indicators and CO/CS initiatives globally, to identify where and how these initiatives are already informing or could inform the SDG indicators by providing evidence to support these claims. The results of this comprehensive analysis showed that data from COs/CS are already contributing and could contribute to the monitoring of 33% of the SDG indicators. According to the analysis, the greatest contribution from citizen science data to the SDG indicator framework would be in SDG 15 Life on Land, SDG 11 Sustainable Cities and Communities, SDG 3 Good Health and Wellbeing and SDG 6 Clean Water and Sanitation.

This report presents the findings of this research, along with the recommendations and priorities regarding how to bring COs/CS data into official statistics for SDG monitoring. The results are presented as the summary of two peer-reviewed articles recently published in the journals *Nature Sustainability* and *Sustainability Science*, stemming from activities of and being supported by the WeObserve project.

# 1 Introduction

The rising trend in citizen science has led to the development of Citizen Observatories (COs) for environmental monitoring. COs have been supported by the European Commission in several research and innovation programmes. The **WeObserve** project improves coordination between existing COs and related regional, European and international activities. Through various tasks, activities and a series of events, the project aims to raise awareness, improve acceptability and ensure sustainability of COs across Europe and globally.

## 1.1 Background

The SDGs are a set of goals and targets to improve the world by 2030. They are designed to address the global issues we face such as poverty, climate change, poor health, inequalities and many others, to achieve a sustainable future for all, while “leaving no one behind”.



FIGURE 1: THE 17 UN SUSTAINABLE DEVELOPMENT GOALS

In the year 2020, five years after the adoption of the SDGs, achieving these global goals remains a challenge. Despite some progress, the data needed to measure progress on the SDGs are still scarce, incomplete, inaccurate and not timely enough to inform decisions for guiding policy formulation and implementation. Traditional data sources that are used to monitor progress on the SDGs have some issues such as high costs, infrequent data collection cycles, lack of spatial variations across a country, lack of openness of data and inadequate data accuracy, among others. These issues are described in detail in the first scientific paper that this document reports on (Fritz et al, 2019). As a result, only about half of the 247 SDG indicators that are used to monitor progress towards the SDGs and their

targets can be measured globally at present. For example, Africa is not on track to achieving 14 of the 17 SDGs, and it can only provide data on 40% of the indicators, but many of those data are outdated (SDG Center for Africa, 2019). Considering that achieving the SDGs requires informed decisions that are based on accurate, timely and comprehensive data, a better evidence base is crucial. New approaches to data collection and analysis using Earth Observation, mobile data, social media, sensors, etc. need to be developed and adopted. Once coupled with existing data sources and methods, they would provide a unique opportunity to address this issue. One new source of data is from Citizen Observatories (COs)/Citizen Science (CS). COs/CS have a huge potential to provide an unprecedented opportunity for monitoring the SDGs.

One of the main objectives of WeObserve is to “demonstrate the added value of COs in environmental monitoring mechanisms within regional and global initiatives such as Global Earth Observation System of Systems GEOSS, Copernicus and the UN Sustainable Development Goals”. Accordingly, one of the main focuses of the project is to facilitate the adoption of COs/CS into EO initiatives such as GEOSS and Copernicus, as well as the UN SDGs as a global framework. This SDGs focus of WeObserve translates into a specific task (Task 4.4) about *identifying where COs can contribute to the SDGs*, which has resulted in this report on “*monitoring of SDGs by COs/CS: Recommendations and priorities*”. Hence, this report provides an overview of how COs/CS could support the SDG monitoring efforts. IIASA led two scientific research efforts that are published in peer-reviewed journals to deliver on this task (Annex 1-2):

1. Fritz, S., See, L., Carlson, T., Haklay, M., Oliver, J.L., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L., Schade, S. et al. (2019). Citizen science and the United Nations Sustainable Development Goals. *Nature Sustainability* 2: 922-930. DOI:10.1038/s41893-019-0390-3.
2. Fraisl, D., Campbell, J., See, L., Wehn, U., Wardlaw, J., Gold, M., Moorthy, I., Arias, R., Piera, J., Oliver, J. L. et al. (2020). Mapping citizen science contributions to the UN sustainable development goals. *Sustainability Science* DOI:10.1007/s11625-020-00833-7.

Both papers were produced through the WeObserve Community of Practice on the UN Sustainable Development Goals and Citizen Observatories/Citizen Science (SDGs CoP).

Within the scope of this task and report, an all-encompassing approach was adopted and the focus was kept general to identify the current and potential contributions of COs and CS to the SDG indicator framework. The definitions used to describe both of these terms within the framework of this research are provided below:

- Citizen Observatories (COs): “A specific form of citizen science characterised by their focus on observing the environment (rather than other phenomena), the scale of their activities (typically local) and their timeline (typically long term)” (Wehn & Velzeboer, 2018);
- Citizen Science (CS): “Intentional collaborations in which members of the public engage in the process of research to generate new science-based knowledge” (Shirk et al., 2012).

It needs to be highlighted that citizen science, as a concept, has diverse definitions, terms, and interpretations, where no single term or definition is suitable for all contexts (Eitzel et al. 2017). The above definitions were chosen for the scope of our research, and our comprehensive interpretation of CS includes any initiative that produces scientific knowledge through the participation of volunteers, such as community-based monitoring, participatory action research, citizen-generated data, and crowdsourcing, among others. We took this approach due to the urgent need to address the data gaps and needs in the SDG framework using any type of data produced voluntarily by citizens as described above and in more detail in Fraisl et al. (2020) (Annex 2).

## 1.2 Purpose and scope of the report

This report provides a summary of the two research efforts outlined above. This includes an overview of the contributions of COs/CS to SDG monitoring through a mapping of the current and recent past CO/CS activities onto SDG indicators and targets to identify where and how they can support SDG monitoring and implementation efforts. Additionally, the report aims to provide concrete recommendations and priorities to realize the untapped potential of COs/CS for achieving the SDGs. Through a systematic review of the metadata and work plans of all SDG indicators, as well as the past and ongoing CS/CO initiatives, this report provides systematic evidence regarding where these initiatives currently contribute or could potentially contribute to the SDG indicator framework. The report is supplemented by the full papers (Annex 1-2), which include additional materials such as a table showing the results of the full mapping of citizen science projects against SDG indicators.

## 2 Methodology

### 2.1 Workshop on citizen science and the SDGs

A workshop was held at IIASA on 5-6 October 2018 in which representatives from different citizen science associations, researchers and practitioners in citizen science (including representatives from different COs), and UN agencies were invited to discuss how citizen science can be integrated into SDG monitoring and implementation. At the workshop, the SDGs CoP was also formally launched.

During the two day workshop, participants presented their activities and perspectives on citizen science and the SDGs, followed by breakout groups on specific topics including: (i) mapping of citizen science projects and indicators to determine where synergies exist; (ii) identifying data gaps in tier II and III indicators; (iii) data issues related to the SDGs; and (iv) development of a roadmap for how citizen science can be integrated into the SDG reporting process. The main outcomes from the workshop were an outline of a paper to be submitted as a 'Perspective' piece to Nature Sustainability (resulting in the paper provided in Annex 1) and an action plan for writing the sections of the paper based on the work undertaken by the breakout groups. Section leads continued to meet virtually with their breakout group members to draft sections of the paper, and IIASA then compiled these contributions into a coherent storyline to produce the final paper. Throughout the process, there were high levels of engagement with the workshop participants, ensuring that the diversity of perspectives were taken into account.



The paper provided a general overview of citizen science and the SDGs, and highlighted the need for a more systematic review as part of the proposed roadmap, which was then carried out by the SDGs CoP.

## 2.2 Systematic review of SDG indicators and citizen science

The methodology of this systematic review consisted of several steps, which is shown in Figure 2.

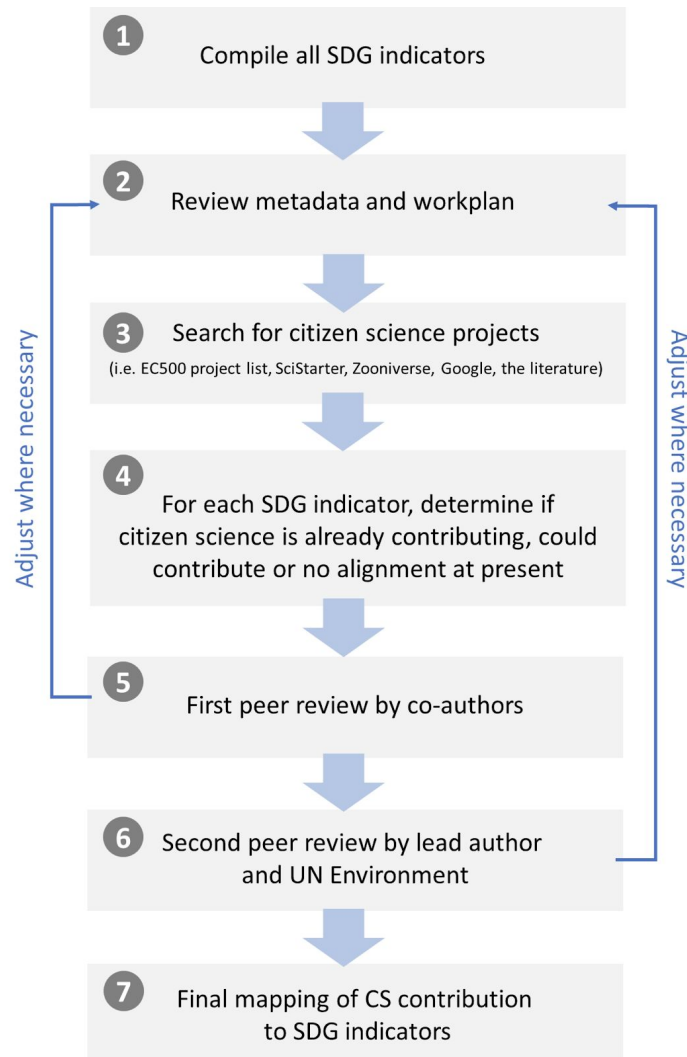


FIGURE 2: METHODOLOGY FOR THE SYSTEMATIC REVIEW OF THE SDG INDICATORS FOR CITIZEN SCIENCE

- **Step 1:** Compiling a list of all SDG indicators (see Table S1 - Supplementary Material - Fraisl et al. (2020) (Annex 2) for the complete list), which was downloaded from the UN Statistics Division website on 13 April 2019;
- **Step 2:** Consulting the metadata documents of the indicators that describe the methodology and data sources associated with each indicator (<https://unstats.un.org/sdgs/metadata/>);

- **Step 3:** Identifying CO/CS projects to provide a strategic overview on relevant CO/CS initiatives that capture the breadth of different types of projects relevant to each indicator;
- **Step 4:** Determining the category for the indicator from the following three choices:
  - (i) Already contributing: data from a CO/CS project is already used for reporting on a specific SDG indicator at the national or global level;
  - (ii) Could contribute: data from a CO/CS project could be used for a specific SDG indicator, but it is not used so far and the project and/or data requirements might need modification before the resulting data can be used (provided this modification is feasible); and
  - (iii) No alignment at present.

When a project was found to relate to an indicator (step 3), it was then assigned to either “already contributing” to that indicator or “could contribute”. These assignments to categories (i) and (ii) involved finding evidence for this claim. These indicators were then further classified into “direct contributions” or “supplementary contributions”, which are described below:

**Direct contributions:** CO/CS data are already contributing or could contribute to the calculation of the official SDG indicator. This would include indicators that could utilize COs/CS data as the primary data source (e.g., bird species prevalence can be primarily based on CO/CS data from bird watchers) or indicators where COs/CS are part of the indicator or used to fill spatial or temporal gaps in data (e.g., air quality reference stations can be coupled with CO/CS data on air quality).

**Supplementary contributions:** COs/CS data could provide information that is useful to contextualize an SDG indicator or target.

For example, the SDG indicator 3.3.3 is about “malaria incidence per 1,000 population”. MAHEFA (MA-lagasy HE-althy FA-milies) is a community-based health project by USAID and the Madagascar Ministry of Public Health. MAHEFA has trained thousands of volunteers, who are people chosen by their communities, to provide basic health services, to identify serious diseases and to get people the help they need. MAHEFA and other similar initiatives could “directly” contribute to the monitoring of incidence in identified communities and feed into national level SDG monitoring efforts. On the other hand, initiatives such as the Humanitarian OpenStreetMap’s (HOTSM) Malaria Elimination Program in Botswana was adapted to understand people’s exposure to mosquitos through locating houses and conducting field surveys to check if these houses had complete walls and roofs. Additionally, Mosquito Alert and Global Mosquito Alert collect data on mosquito populations and their possible breeding sites. These two initiatives could provide “supplementary” data to inform this indicator.

Note that we did not consider the robustness of the quality procedures used in the CO/CS projects listed in Table S1 (Fraisl et al., 2020) (Annex 2). Instead, we only considered whether projects are already contributing (where high quality can be assumed) or where they could

potentially contribute (where data quality protocols would require compliance if the data were to be used for SDG reporting in the future).

- **Step 5:** The first peer review process, where each co-author was assigned a different set of indicators to those they initially reviewed in order to peer review the work of others; This involved reading the metadata documents for the indicator (step 2), reviewing the category chosen (during step 4), searching the five sources (step 3) and modifying the category of SDG contribution as appropriate.
- **Step 6:** The second peer review process was undertaken (step 6) in two phases. In the first phase of step 6, the lead author reviewed the mapping done by all other co-authors to ensure that the metadata documents had been interpreted correctly and to modify those indicators that were initially mapped as having “no alignment”, changing them to “could contribute” where needed, due to additional searching and knowledge of potential initiatives. The research lead also addressed any outstanding disagreements between the reviewer and the peer reviewer identified in step 5. This involved reviewing all the projects identified and all the evidence provided, and then applying the definition of citizen science outlined in the paper to determine whether the CO/CS projects are applicable. The second phase involved a review of all indicators by the chief statistician of UN Environment, who works on the development of the environmental SDG indicators for which UN Environment is a custodian agency. In the situation where there were disagreements or divergences in the results of the lead author and the chief statistician of UNEP, the lead author contacted the custodian agencies such as the World Bank, UNODC (UN Office on Drugs and Crime), UN FAO (the Food and Agriculture Organization of the UN) and WHO (World Health Organization) for relevant indicators.
- **Step 7:** Final mapping of CO/CS initiatives to the SDG indicators provided in Table S1 in the Supplementary Material of Fraisl et al.,2020) (Annex 2).

## 3 Results

### 3.1 Perspective on citizen science and the SDGs

The overall aim of the perspective piece was to demonstrate the value of using data from citizen science for the SDGs, providing examples of where citizen science is currently being used to support existing SDG indicators and their potential for contributing to future indicators. Below is a summary of the main messages from the paper:

#### → Evidence is provided that citizen science is already contributing to Tier I and II indicators. Some examples include:

- BirdLife International provides data from its network of volunteers to [15.5.1 Red List Index](#)
- Community volunteers in the Philippines collect household census data on poverty, nutrition, health, education, housing and disaster risk reduction, which the Philippine Statistics Authority uses to enhance their statistics on 32 SDG indicators, including both Tier I and II

→ Tier III indicators have the most potential for citizen science. Three examples of where citizen-science approaches could contribute include:

- Monitoring the amount of food wasted over time, contributing to SDG target 12.3
- Increasing human and institutional capacity to act on climate change (SDG Indicator 13.3.2) through climate smart agricultural approaches, sensors provided to farmers, etc.
- Monitoring of nutrient pollution and marine debris in coastal waters (SDG Indicator 14.1.1).

→ Citizen science also has potential for the development of new goals and targets in the future, e.g. in air pollution monitoring.

In addition, a roadmap was presented (Figure 3) containing a set of actions for mainstreaming the use of data from citizen science into official SDG reporting at global and national levels. At the global level, this requires having a dialogue with the UN custodian agencies and being formally part of the indicator development process. At the national level, a series of actions are proposed (Figure 3) including the systematic mapping of citizen science and the SDG indicators, where progress has already been made in the systematic review outlined in this deliverable. At the local level, SDG-relevant citizen science activities should be stimulated.

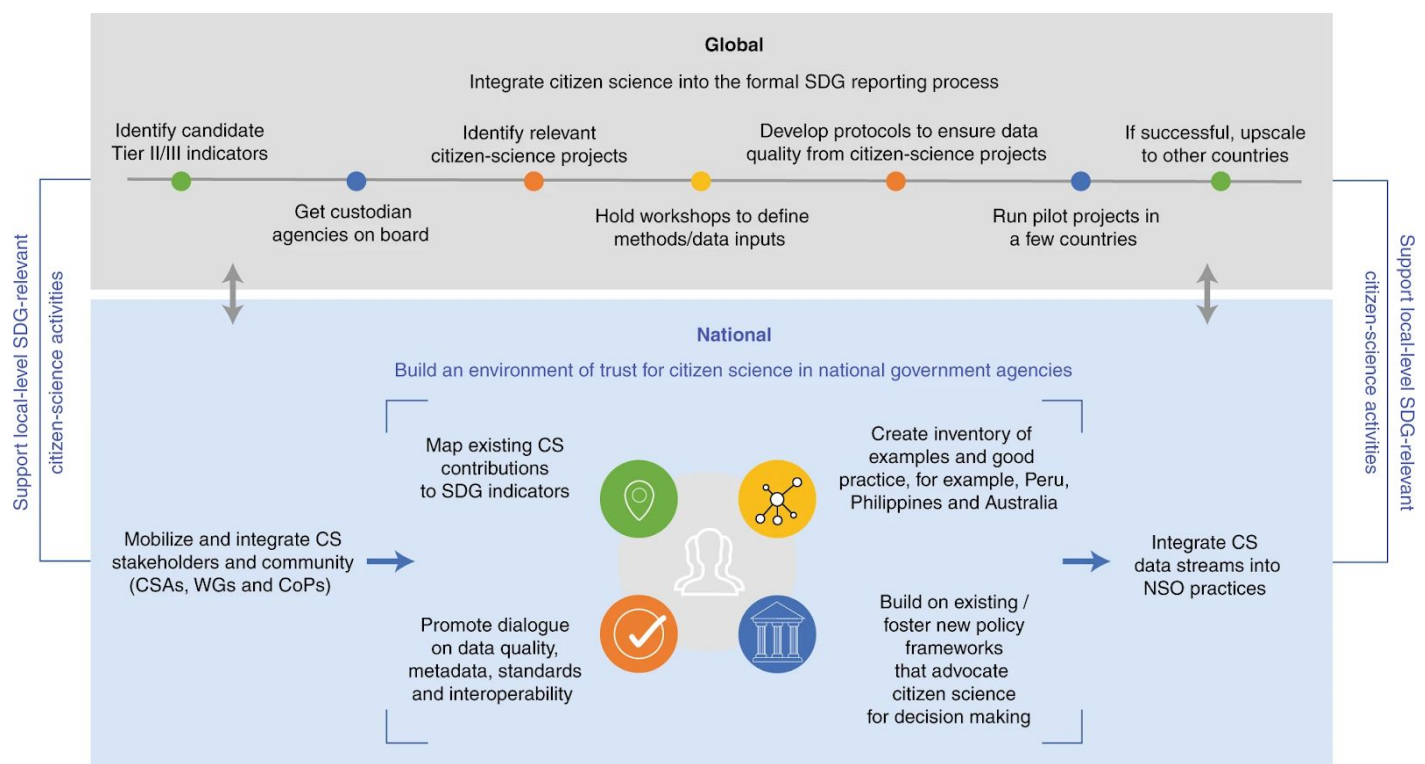


FIGURE 3: ROADMAP OF ACTIVITIES FOR INTEGRATING CITIZEN SCIENCE INTO SDG REPORTING

## 3.2 Systematic review of SDG indicators and citizen science

The results of the systematic review are summarized in Figure 4. Additional figures and the detailed results can be found in Fraisl et al. (2020) (Annex 2). In this report, we summarize the most important findings. These are as follows:

→ All 17 SDGs have at least one indicator that is already measured or could be measured using CO/CS approaches (Figure 4).

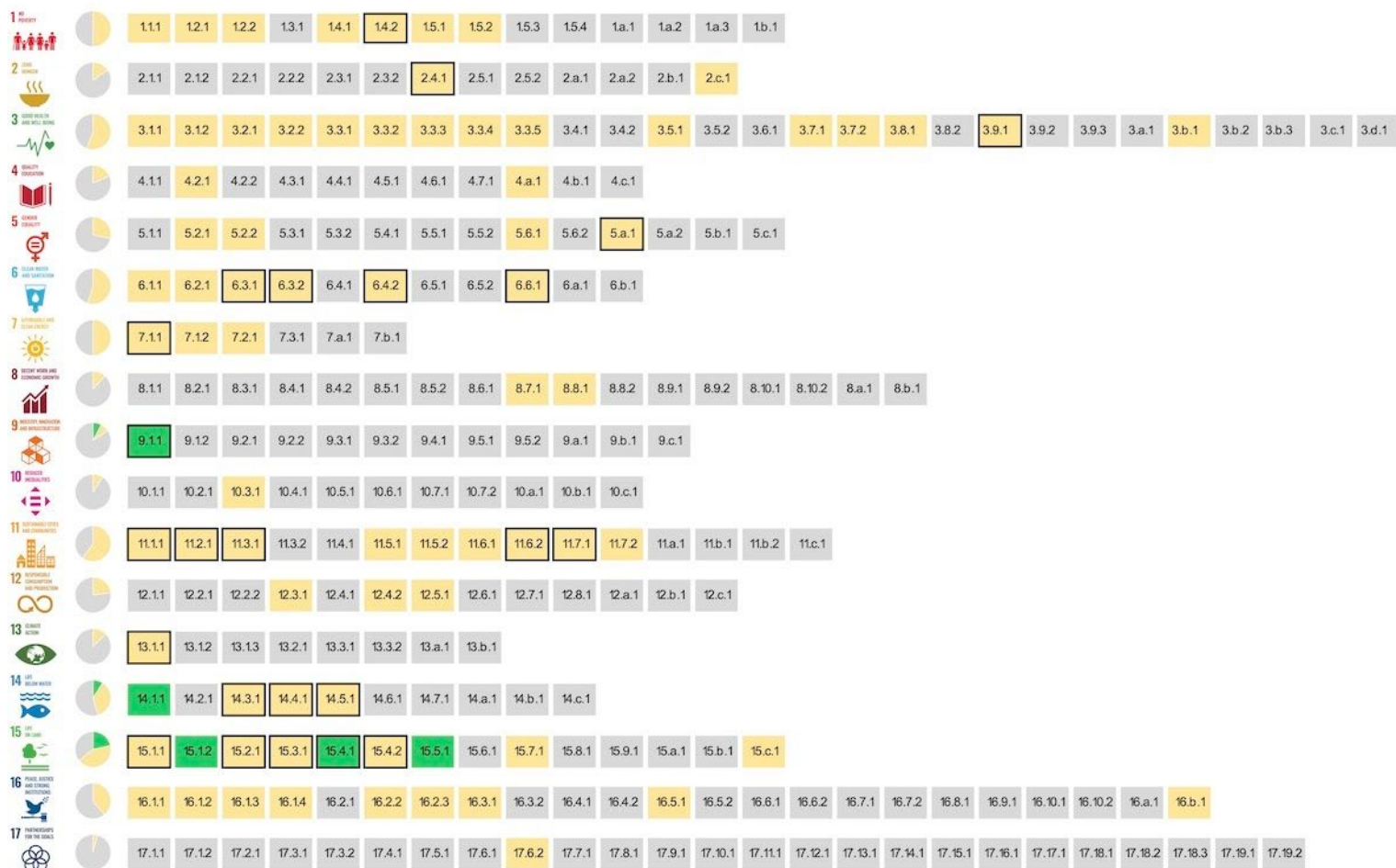


FIGURE 4: THE SDG INDICATORS WHERE CITIZEN SCIENCE PROJECTS ARE “ALREADY CONTRIBUTING” (IN GREEN), “COULD CONTRIBUTE” (IN YELLOW) OR WHERE THERE IS “NO ALIGNMENT” (IN GREY). THE OVERALL CITIZEN SCIENCE CONTRIBUTIONS TO EACH SDG ARE SUMMARIZED AS PIE CHARTS. BLACK BORDERS AROUND INDICATORS SHOW THE OVERLAP BETWEEN CITIZEN SCIENCE AND EO, AS IDENTIFIED BY GEO (2017).

→ COs/CS are already contributing to the monitoring of 5 SDG indicators:

- **Indicator 9.1.1** Proportion of the rural population who live within 2 km of an all-season road
- **Indicator 14.1.1** Index of coastal eutrophication and floating plastic debris density

- **Indicator 15.1.2** Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type
- **Indicator 15.4.1** Coverage by protected areas of important sites for mountain biodiversity
- **Indicator 15.5.1** Red List Index

A detailed explanation regarding which CO/CS projects are contributing to the monitoring of the aforementioned indicators and how, is provided in the published results (Fraisl et al., 2020, Annex 2).

### → COs/CS could contribute to the monitoring of 76 SDG indicators.

A detailed explanation and evidence of how these contributions could potentially be realized are outlined in Fraisl et al. (2020) (Annex 2). Some examples of the indicators include:

- **Indicator 1.5.2** Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)
- **Indicator 6.3.2** Proportion of bodies of water with good ambient water quality
- **Indicator 11.6.2** Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)
- **Indicator 15.1.1** Forest area as a proportion of total land area
- These potential contributions could happen either in a direct or supplementary way. The definitions of direct and supplementary contribution along with an example are provided in the methodology section of this report.
- For the remaining 165 indicators, we could not identify any ongoing or past CO/CS initiatives. These are mostly policy-relevant indicators that are designed to monitor a policy or a national or global initiative and depend on official records and statistics. An example for such an indicator is 12.7.1 Number of countries implementing sustainable public procurement policies and action plans.

### → Our analysis shows that COs/CS data are already contributing or could contribute to the monitoring of around 33% of the SDG indicators.

### → The greatest potential for COs/CS (existing and potential future contributions combined) could occur, respectively, in the following SDG indicators:

- **SDG 15** Life on Land
- **SDG 11** Sustainable Cities and Communities
- **SDG 3** Good Health and Wellbeing
- **SDG 6** Clean Water and Sanitation

A related figure is included in Fraisl et al. (2020) (Annex 2).



→ **The results illustrate that current COs/CS data have the greatest potential for input to the environmental SDG indicators.**

Of the 93 environmental indicators in the SDG indicator framework, COs/CS could provide inputs for 37 (around 40%) indicators. As 68% of these environmental SDG indicators lack data, CS/COs have a great potential for SDG monitoring (UN Environment 2019).

→ **Based on the mapping exercise undertaken by GEO (2017), of the 29 indicators identified by GEO, CO/CS could support 24.**

Hence, there is a great potential for CO/CS and EO approaches to complement each other.

## 4 Discussion and Recommendations

The first paper on citizen science and the SDGs (Annex 1) provided an overview of the potential for integrating citizen science with the SDGs where the main recommendations were in the form of a roadmap as presented in Figure 3.

The in-depth systematic review that followed as the second paper represents the first comprehensive analysis of the contribution of COs/CS to SDG monitoring at the indicator level. A detailed discussion as well as recommendations and next steps can be found in Fraisl et al. (2020) (Annex 2). Herein, we highlight the most important recommendations, which include:

- **Most of the initiatives identified as “could contribute” to SDG monitoring need different levels of modification and improvement such as the use of quality assurance processes for their potential to be realized for the SDGs.**
- **An “enabling environment” for the integration of COs/CS data into official statistics is the key to realizing the potential of COs/CS for SDG monitoring. This can be achieved through:**
  - **Building awareness and sharing experiences** on the use of COs/CS for the SDGs by integrating the CO/CS community into SDG monitoring processes through initiatives such as the Community of Practice on the SDGs and COs/CS (SDGs CoP) established as part of the WeObserve project.
  - **Developing case studies or success stories** where COs/CS data have been used in innovative ways by National Statistical Offices (NSOs) and disseminating these examples through appropriate channels to reach out to the relevant communities, e.g., the SDGs CoP, data and statistics events and conferences, etc.

- **Identifying data quality criteria or data quality assurance procedures** that are coupled with requirements from NSOs and other government agencies regarding their quality standards and protocols;
  - **Integrating COs/CS into the methodologies of SDG indicators**, which has happened in the case of SDG indicator 14.1.1b on marine debris (detailed in the supplementary document of Fraisl et al. (2020) (Annex 2);
  - **Identifying consistent data collection across projects through aligning definitions with global definitions** to produce internationally comparable methodologies and data for global level SDG reporting;
  - **Supporting open COs/CS data that are formatted using standards**, e.g., a new data and metadata standard for Public Participation in Scientific Research (PPSR)<sup>1</sup> is currently being developed by COs/CS associations;
  - **Sustaining COs/CS initiatives through new funding schemes**, e.g., European funding initiatives such as the ‘Science with and for Society’ programme, national research funding schemes, etc.
- **Partnerships between governments, NSOs, and CO/CS researchers and practitioners need to be created to turn these ideas into actions that could also lead to building on each other’s experiences, needs, and capacities.**
    - The WeObserve SDGs CoP is a great example of this. The SDGs CoP is an open platform for COs/CS and the SDGs. It connects CO/CS practitioners and researchers, NSOs and government officials, UN and other international agency representatives, and the broader data and statistics communities to create such an enabling environment. The sustainability of such practices should be supported through adequate funding.

## Further considerations

Data from COs/CS may be considered a low-cost option compared to other traditional sources of data that are currently used to monitor progress on the SDGs such as censuses, household surveys, etc. However, this does not mean that it comes without a cost. CO/CS data collection and analytical tools, data validation processes, interoperability, etc. should be improved to ensure that the data comply with NSO requirements to inform policies. This requires investment and clear business cases, as well as the sustainability of the CO/CS initiatives. Creating this enabling environment, therefore, requires new funding schemes. Running CO/CS initiatives also requires funding to maintain the infrastructures and engagement of citizens.

Finally, even though the purpose of this report is to highlight the potential of COs/CS for SDG monitoring, it is important to stress that COs/CS could also support SDG implementation processes by stimulating action and informing decisions through data. Hence, COs/CS do not only offer data that could fill gaps, but they place citizens at the heart of the SDG monitoring processes as a science- and action-driven approach.

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<sup>1</sup> <https://www.citizenscience.org/get-involved/working-groups/data-and-metadata-working-group/>



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## Annexes

### Annex 1

Fritz, S., See, L., Carlson, T., Haklay, M., Oliver, J.L., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L., Schade, S. et al. (2019). Citizen science and the United Nations Sustainable Development Goals. *Nature Sustainability* 2: 922-930. DOI: [10.1038/s41893-019-0390-3](https://doi.org/10.1038/s41893-019-0390-3).

### Annex 2

Fraisl, D., Campbell, J., See, L., Wehn, U., Wardlaw, J., Gold, M., Moorthy, I., Arias, R., Piera, J., Oliver, J. L. et al. (2020). Mapping citizen science contributions to the UN sustainable development goals. *Sustainability Science*. DOI: [10.1007/s11625-020-00833-7](https://doi.org/10.1007/s11625-020-00833-7).