ECHO

ENGAGING CITIZENS IN SOIL SCIENCE:
THE ROAD TO HEALTHIER SOILS

Deliverable 1.2

"Assessment framework for citizen science methods for soil monitoring"

Co-funded by the European Union

UK Research and Innovation

Project information

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Disclaimer

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Short description of the deliverable

Deliverable D1.2 – Assessment Framework for Citizen Science Methods for Soil Monitoring constitutes an integral component of the work undertaken within WP1 - Enabling high-impact citizen science for soil monitoring. This deliverable addresses the need of selecting methodologis appropriate for utilization within the ECHO project for the activities developed by citizens. The framewrok will be applied to the projects listed in the matrix created in T1.1 and, together with the deliverable D1.3 Citizen-generated Soil Data Quality Assessment Framework, will facilitate the evaluation of soil monitoring methods and the quality of the data collected.

Versioning and contribution history

Version	Date	Modified by	Notes
0.1	29/03/2024	Silvana Munzi & Cristina Cruz (FC.ID/CIENCIAS)	Draft version

Foreword

Soil is a vital, yet often disregarded, resource that supports life on Earth by providing the foundation for agriculture, forests, and various other natural ecosystems. However, soil degradation is a growing concern around the world, and it can have severe consequences for our planet like reduced crop yields, increased greenhouse gas emissions, and decreased biodiversity. The ECHO project aims to prevent this by bringing together citizens and volunteer scientists from around Europe to work towards a common goal of protecting and preserving our soils, thus contributing to the transition towards healthy soils of the EU Mission: "A Soil Deal for Europe".

ECHO will generate new data on the health status of EU soils, complementing existing soil mapping and monitoring in EU Member States and Scotland, including the EU Soil Observatory (EUSO). The project will develop and deploy 28 tailor-made citizen science initiatives across EU Member States and Scotland, taking into account different land-uses, soil types, and biogeographical regions, as well as stakeholder needs. With 16 participants from all over Europe, including 10 leading universities and research centres, 4 SMEs, and 2 Foundations, under the coordination of the Free University of Bolzano-Bozen, ECHO will assess 16,500 sites in different climate and biogeographic regions to achieve its ambitious goals.

The project aims to engage citizens in protecting and restoring soils by building their capacities and enhancing their knowledge. Citizens will thereby not only actively contribute to the project's data collection but also promote soil stewardship and foster behavioural change across the EU. The ECHOREPO, a long-term open access repository with a direct link to the EUSO, will make the citizen science data available for exploitation not only by scientists but also by citizens, policy makers, farmers, landowners and other end-users, providing added value to existing data and other relevant soil monitoring initiatives. ECHOREPO will thus provide valuable information about the state of soil health in various regions, and help citizens make informed decisions about land use and conservation.

We believe that the ECHO project will have a significant impact on soil health and citizen engagement across Europe and become an important step towards protecting and preserving our soil for future generations. By working together, we can ensure that our soil remains healthy and productive, and that we continue to enjoy the many benefits it provides.

Purpose of the assessment framework

One of the main aims of WP1 is identifying citizen science initiatives focused on soil monitoring, gathering and analyzing pertinent details for ECHO, including methodology, technology employed, scientific data, and engagement strategies. As a result, a matrix of citizen science projects has been produced in T1.1. Task 1.2 was responsible for developing the assessment frameworks required to evaluate the suitability of methodologies utilized in these projects for inclusion in ECHO's activities.

The purpose of an assessment framework for citizen science methods is to establish structured guidelines and criteria for evaluating the effectiveness, reliability, and validity of citizen science projects and methodologies. This framework serves to ensure that citizen science initiatives meet scientific standards, produce high-quality data, and contribute meaningfully to scientific research. Additionally, it helps in identifying areas for improvement, enhancing project design, and fostering transparency and credibility within the citizen science community.

Evaluation comprises a systematic assessment of the process and the outcomes of an activity or programme, against a set of explicit or implicit standards and criteria. There are two aspects to evaluation: (i) outcome-based evaluation, which assesses the overall goals of activities or programmes and the benefits to participants and recipients of the results and (ii) process-based evaluation, which identifies the operational strengths and weaknesses of activities or programmes. In citizen science, evaluation methods demonstrating impact on individual participants are common. However, the sole assessment of personal learning outcomes can lead to overlooking other important aspects, such as wider societal impacts. Thus, we will take a holistic approach to project evaluation, which considers the three core dimensions of citizen science: i) scientific, in the sense of impact on scientific knowledge; ii) participants, as in individual development and personal learning outcomes; and iii) socio-ecological and economic, namely wider societal impacts and innovation potential. This framework of evaluation criteria is focused on both the process and outcome level of citizen science projects.

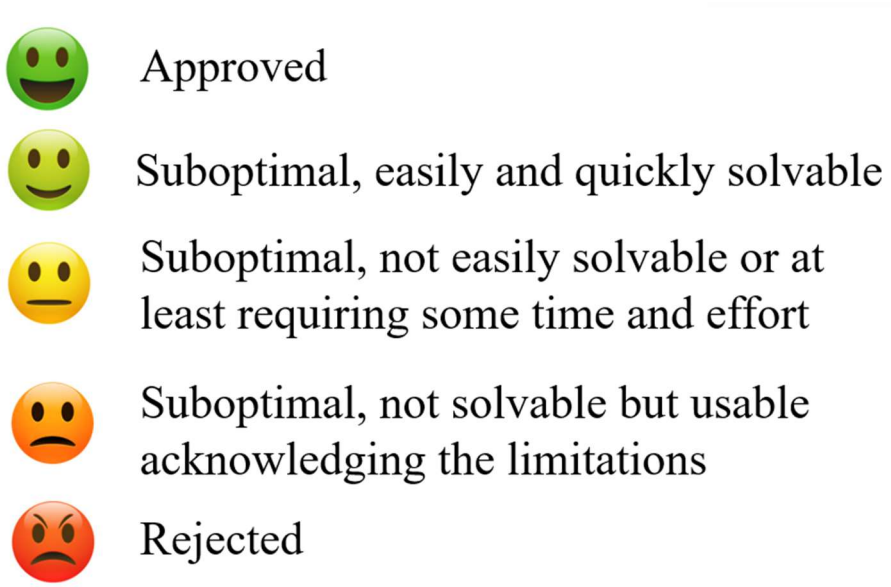
This open framework can be tailored according to the different contexts and goals of citizen science projects, and is aligned with the Ten Principles of Citizen Science developed by the ECSA, which are recognised key principles that the community considers as pillars of good practice in citizen science.

Description of the assessment framework

The assessment framework evaluates citizen science methods and toolkits for soil health assessment and monitoring. The framework will be based on the following criteria: i) simplicity – can be carried out by a non-expert with no or minimal training (i.e., simple training manual or explicative videos); ii) low-cost - does not require specialised/costly equipment; iii) temporal and spatial granularity – can be carried out within a particular time frame and repeated several times both in the same and different locations; iv) replicability – appropriateness for its implementation in any soil; and v) data reliability – the quality of data generated should be as close as possible to the one obtained through official or professional soil sampling methods.

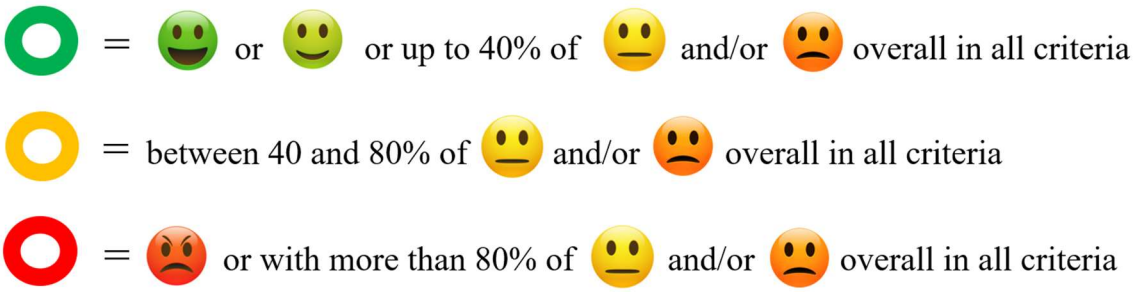
Scoring

For each criterion, a scoring scale is set up to evaluate its potential and robustness for its adoption in this or further research projects. A set of questions takes in considerations different aspects (sub-criteria) of each criterion that are scored using the following scale:

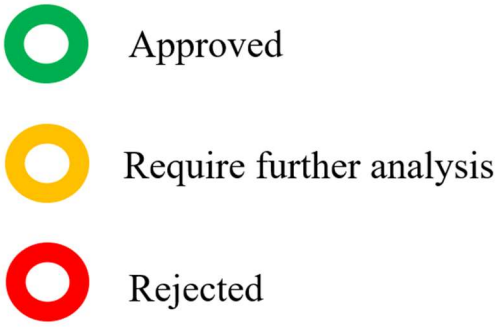


The establishment of such a scoring scale not only facilitates the systematic evaluation of sub-criteria but also enhances transparency and consistency in the assessment process. By quantifying the potential and robustness of each criterion, researchers can make informed decisions regarding their suitability for integration into the project. Moreover, this approach provides valuable insights into areas of strength and areas for improvement, thereby guiding future research directions and methodological refinements.

Thresholds are established based on the comprehensive evaluation of the criteria to ascertain whether a particular methodology meets the requirements for integration into ECHO's activities.



Where the circles indicate the possible final scores for the methods and mean:



Therefore, in addition to being either approved or rejected, a method may necessitate additional analysis and discussion among the partners involved in T2.1. That allows a certain degree of flexibility to optimize the selection of soil citizen science methodologies.

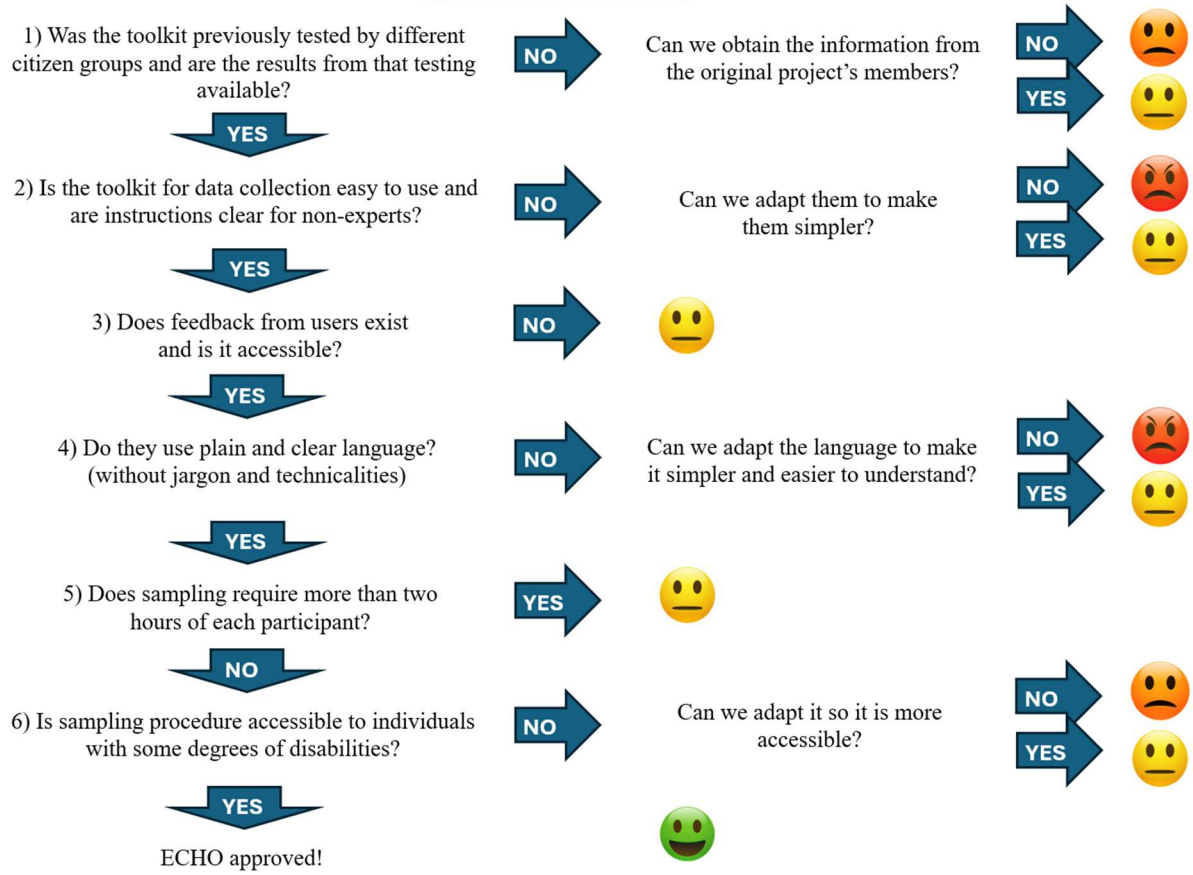
How to use the framework

For each criterion, a set of questions is identified. The scoring is designed as a dichotomous path where you can choose one of two answers to each question. One of the answers allows you to proceed to the next question, where the dichotomy is repeated, until the final answer is reached. The other answer leads to a score or to another question with two possible scores.

It is important to note that the lowest score identifies flaws so serious that even one of them is sufficient to warrant rejection of the methodology. Typically, these situations are also the least likely to occur.

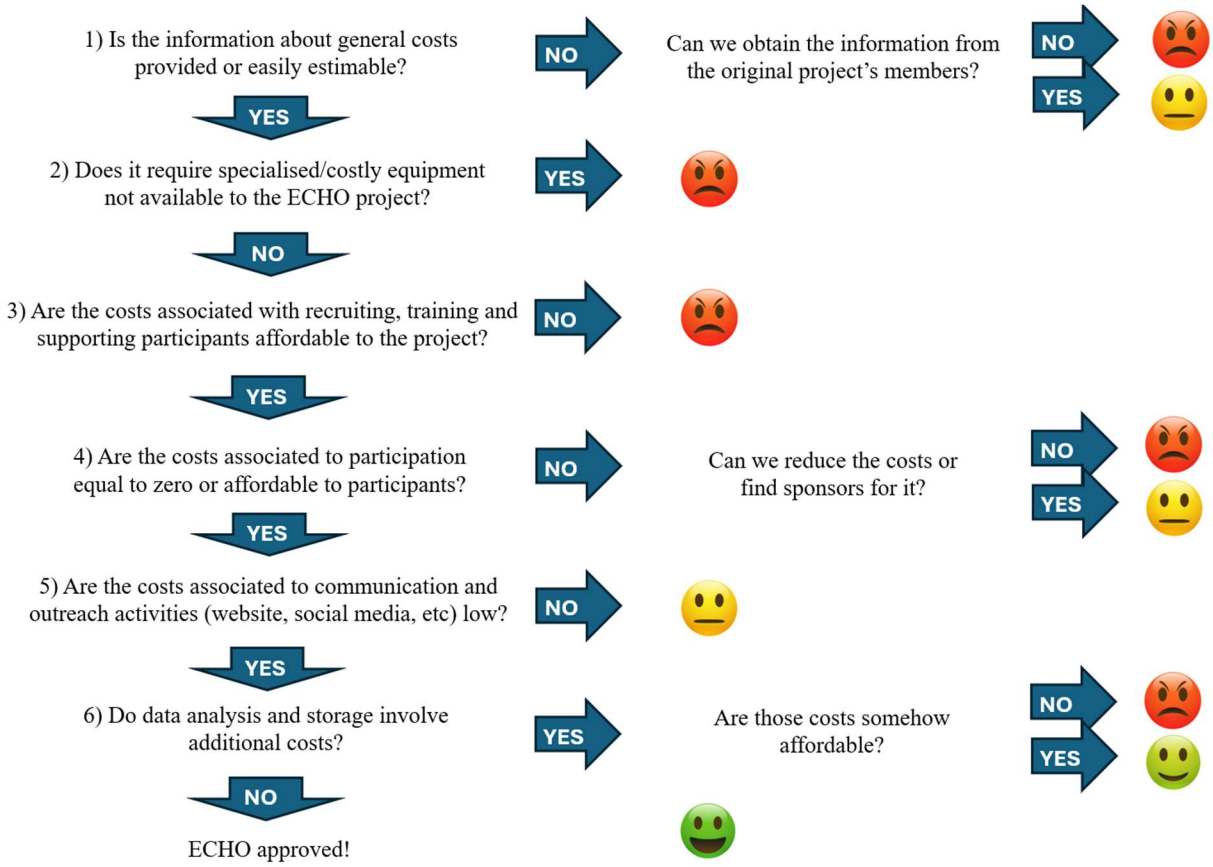
1. Simplicity

Simplicity in citizen science is important to ensure that activities are accessible and engaging for a wide range of participants. Simplicity can enhance the inclusivity of citizen science initiatives and improve data quality. In the context of ECHO simplicity is related with the fact that one activity can be carried out by a non-expert with no or minimal training (i.e., simple training manual or explicative videos).



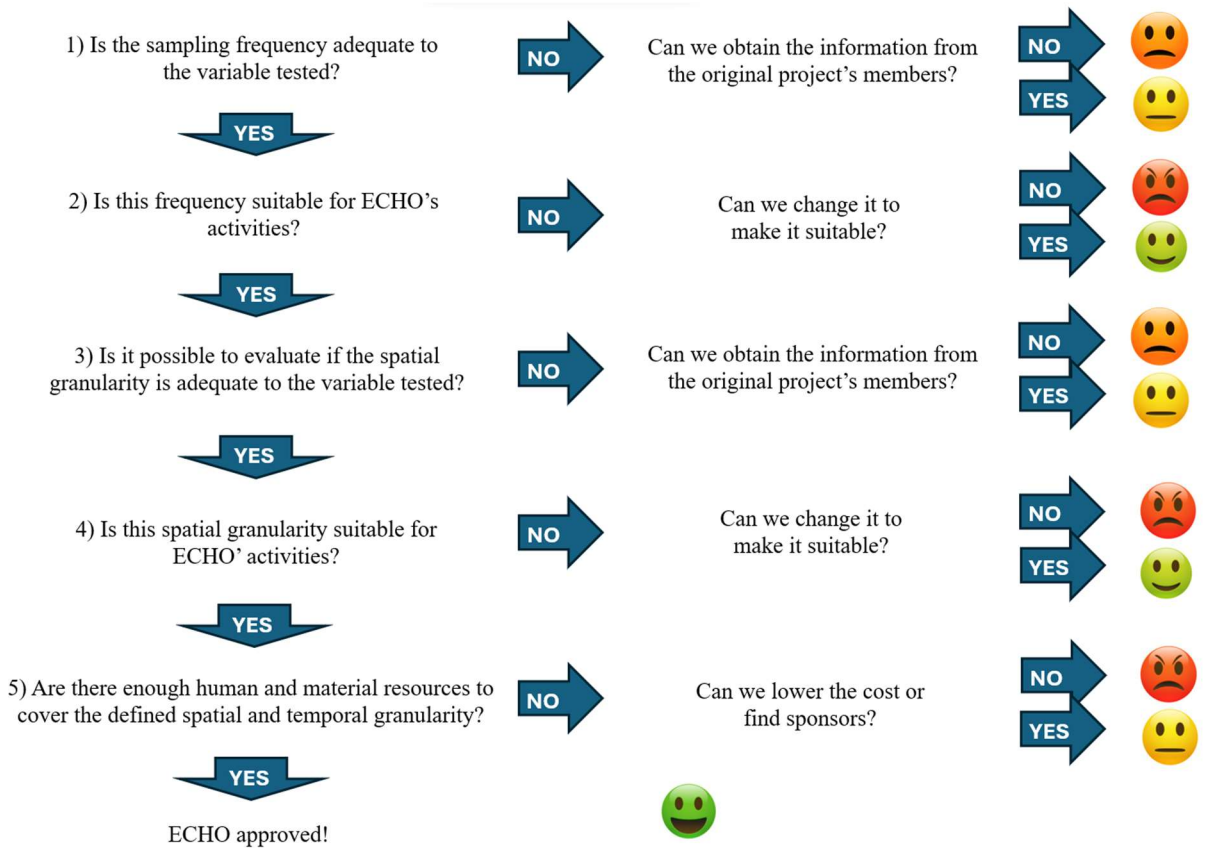
2. Costs

Evaluating the cost of a citizen science activity is essential for effective planning, budgeting, and resource allocation.



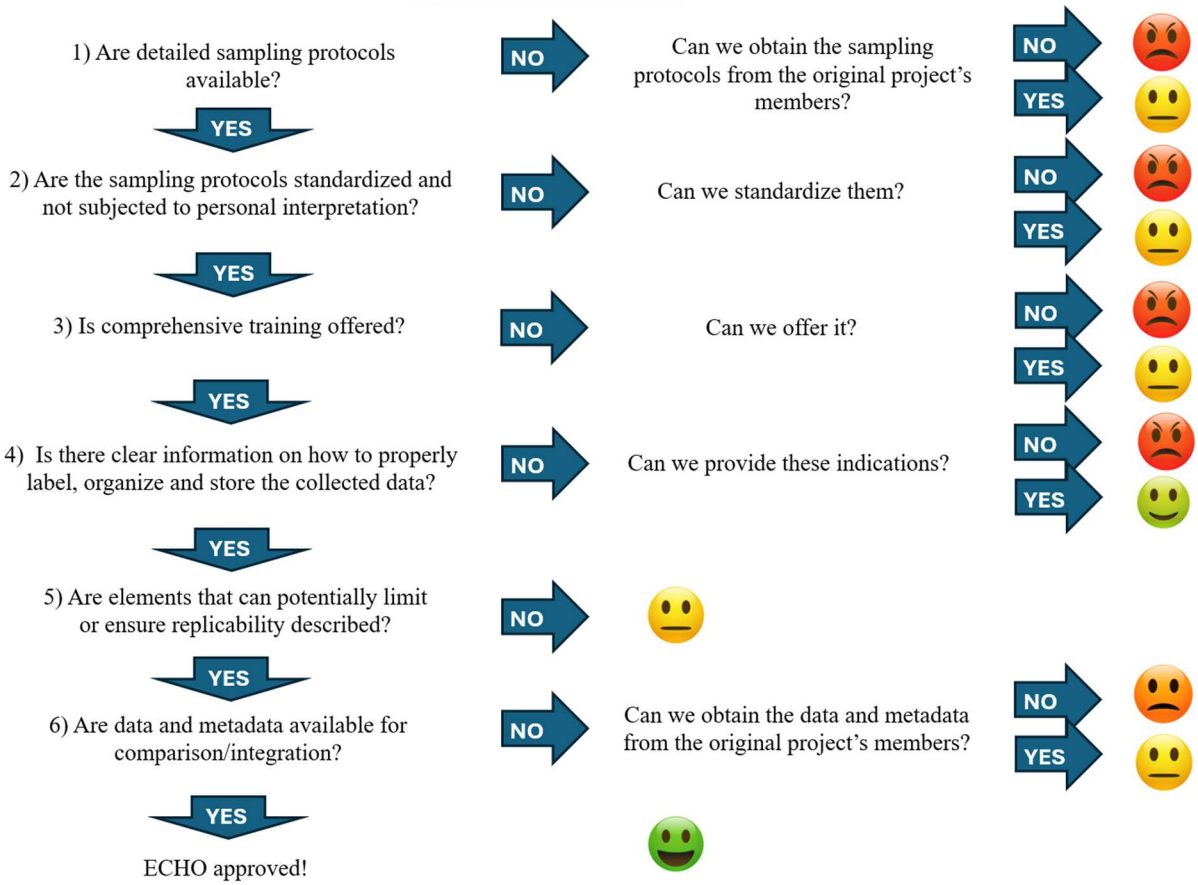
3 – Temporal and spatial granularity

Evaluating temporal and spatial granularity is relevant for designing effective data collection and analysis strategies that align with the activity goals and research questions. Temporal granularity refers to the frequency or time intervals at which data is collected, while spatial granularity relates to the level of detail or resolution in the spatial aspects of data.



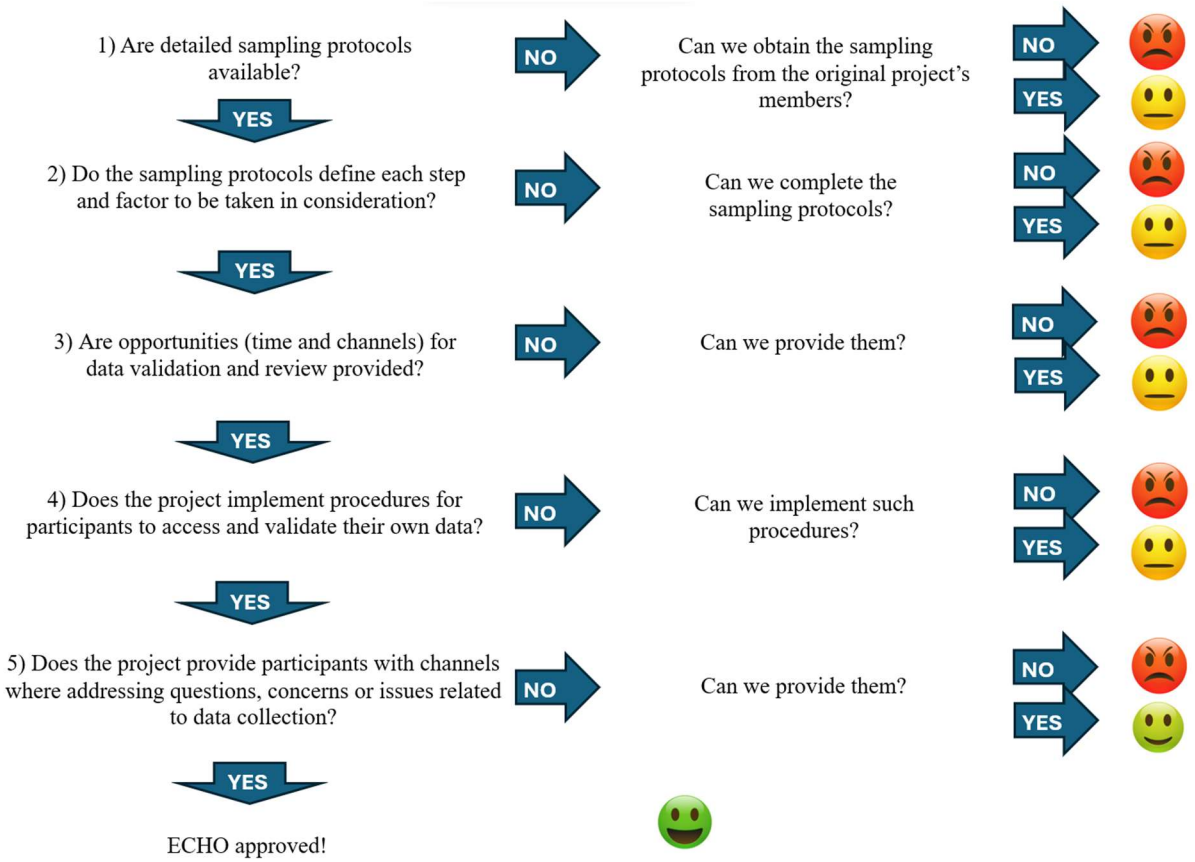
4- Data replicability

Evaluating data replicability in citizen science is crucial to ensure that the data collected can be independently verified and used by other researchers or organizations. Replicability enhances the scientific data value.



5- Data reliability

Evaluating data reliability is crucial to ensure that the data collected is trustworthy and can be used for scientific research or decision-making.



This framework will be applied in T2.1 to evaluate the citizen science methodologies identified in T1.1 and refined according to results obtained.