The State-of-the-Art of Citizen Science in Brazil

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Abstract. Citizen Science emerged in Brazil in the 90s and began to grow in 2008 with projects focused on biodiversity. In 2022, an online platform was created by the Brazilian Institute of Information in Science and Technology (IBICT), which contains information about projects spread across Latin America. The objective of this article is to present the results of an ongoing project, whose objective is to research the state of the art of citizen science projects in Latin America. The data collection method was inspired by DUŽÍ, B., OSMAN, R., et al. (2019), and adapted to the context and available information, the projects were grouped into two categories: before methodological analysis (N=107) and after methodological analysis (N=86). To classify projects, we used citizen science concepts from the European Citizen Science Association (ECSA) 'sharing good practice and building capacity' working group. Furthermore, it was found that most projects receive resources from public-academic initiatives (30) and Non-Governmental Organizations (NGOs) (20). Further research into citizen science in the country is strongly encouraged so that this social phenomenon is fully understood and becomes more common throughout the country.

Keywords. Citizen science, participatory science, citizenship, public engagement, natural sciences, physical sciences, social sciences, Brazil

1. Introduction

Citizen Science seeks to bring academia and society closer together, not only with the aim of involving citizens in scientific research, but also of developing the science of popular knowledge. This co-participation can be transformed into the implementation of public policies that meet the specific needs of each community. According to some authors (e.g., Haklay et al., 2021), one should not seek a consensus to define citizen science, but consider the plurality of understandings that practitioners and communities have on the topic, and identify the common characteristics between citizen science activities.

To make science become public domain, open access to scientific publications is essential, in addition to access to data tools, hardware, notebooks, education, and science itself (e.g. Witt, A.S.; & Silva, FCC, 2022; Albagli, 2015). Therefore, the understanding of the nature, which each community has, is the key to building this open science, where citizens themselves can carry out scientific research and develop the autonomy to collect data and address issues that are dear to them. This open access to the productivity of professional scientists can make reproduction and collaborative research easier between groups inside and outside universities (Novais, M., & Tolentino, R.J.V. 2024).

In Brazil, most projects are focused on biological sciences, more specifically in biodiversity. For this reason, projects are concentrated in coastal regions or environmental preservation areas. The sectors that finance these projects are varied; they can be non-governmental organizations, the public sector, the private sector, and academia, which is generally linked to the public sector; this is justified by the large number and quality of the research at federal universities and institutes in Brazil. It is also worth mentioning that there is already a platform that concentrates the mapping data of citizen science projects in the country, CIVIS, developed by the Brazilian Institute of Information in Science and Technology (IBICT) in open source from the EU-Citizen.Science. CIVIS has already mapped more than 100 projects in Brazil, in addition to other projects spread throughout Latin America. The objective of these platforms is to share resources, tools, knowledge and training on citizen science.

2. Environmental Sciences

2.1 Biological Sciences

During the research, a greater incidence of projects related to the biodiversity of species in various Brazilian biomes was noticeable, in coastal, rocky, mangrove, river and lake environments. Considering the enormous biodiversity of the Brazilian country, it is justifiable that projects in these areas are more numerous. However, even though it is known that there is enormous biodiversity in the northern region of the country, only 7 projects were found in total and 6 projects after methodological analysis, which ended up excluding a project whose objective is to inform the population about native reptile species. The methodologies used on the projects focused on biological sciences, whose frequent theme is ecology, biodiversity, environmental preservation, and environmental education, generally used the participatory monitoring method, using applications or data storage networks (e.g. iNaturalist).

2.2 Physical Sciences

In addition to biological sciences, some projects were also found in the area of exact and Earth sciences, more specifically in physical sciences, whose methodology also involved participatory monitoring. However, as they involve climate monitoring, mineral cataloging and meteor capture, greater instrumentation was required in these cases. For this reason, citizen participation in this type of project requires greater prior training. We found that most of the organisations involved in these projects are producing materials that guide interested parties. Among these materials is the production of videos for YouTube, providing guidance on setting up meteor capture stations, what software is needed for this task and how to use them (e.g Brazilian Meteor Observation Network).

2.3 Social Sciences

Projects to encourage citizenship were also found, they were developed in Brazil's favelas. The LabJaca project works to generate data, through a partnership between residents of the Jacarezinho favela, in Rio de Janeiro, and other institutions. The objective is to demarginalize the favela resident's narrative and value the knowledge of the communities, so that public policies that generate social impact in these territories can be guided. In addition to the LabJaca – Favela Collecting Data project, there is the data_labe project, which emerged in 2016 and became an autonomous non-profit association in 2018. The objective of this project is to democratize knowledge, focusing on race, gender and territory, for through the generation, analysis and dissemination of data in Complexo da Maré, in Rio de Janeiro.

3. Methodology

3.1 Search for CS projects in general databases

The research was based on the methodological approach described by DUŽÍ, B., OSMAN, R., et al. (2019) and took place between January and April 2024, it was carried out in a series of stages (**Fig. 1**), in order to investigate the state of the art of citizen science projects in Brazil. First, we reviewed the scientific literature using keywords, in Portuguese and English, in Google search tools, Google Scholar, and on the journal platform of the Coordination for the Improvement of Higher Education Personnel (CAPES in Portuguese) of the Federal Government Ministry of Education. With the aim of identifying national academic productions, the terms Citizen Science, Science and Society, Participatory Science, Participatory Methodologies were combined with Brazil, Latin America, and South America. After that, we used the Sci-Starter and Zooniverse platforms to map possible citizen science projects operating in the country; subsequently, it was possible to compare the methodologies used by the projects listed in different areas of science.

After collecting all the projects, the second stage of the research consisted of classifying them through analysis of the databases where they had been found

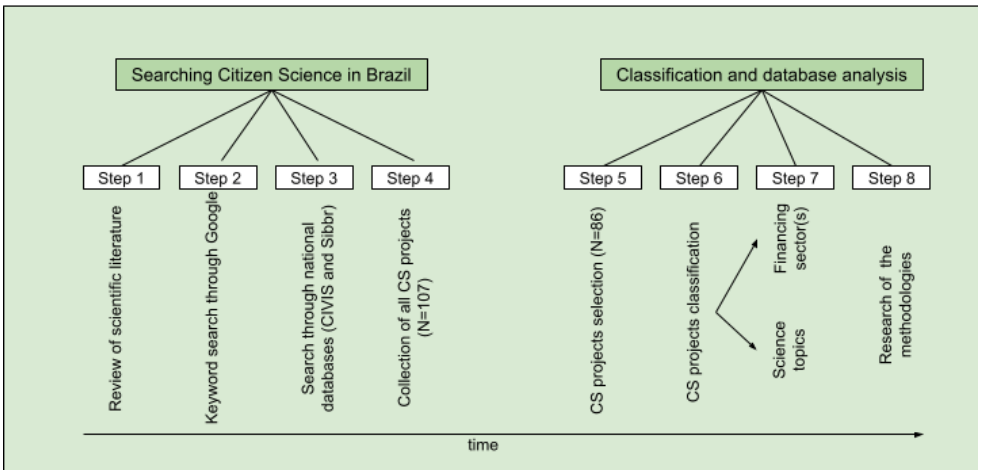

Fig. 1 - Phases of investigation, classification and database analysis inspired by DUŽÍ, B., OSMAN, R., et al. (2019) Source: authors' elaboration.

(**Fig. 1**). At this time, some projects were excluded and those that remained were classified according to their start date, end date if already completed, financing sector, field of science and methodology applied. This information is represented by graphs, figures or discussion in the results part of this article.

3.2 Search for CS projects through general databases

To find more details about citizen science projects, we used the virtual platform CIVIS and SiBBr, from which it was possible to determine the regions and states of Brazil in which the projects had been applied. These platforms facilitated the identification of these projects for the other stages of the research, which required more individualized searches. At that time, 107 projects were identified, which were part of the general collection to be analyzed. Therefore, the existence of a national database, containing a list of ongoing and completed projects, distributed by regions, with their area of activity in science, start date and methodological approaches used, contributed greatly to the data collection process in the national territory.

3.3 CIVIS and Brazilian Biodiversity Information System (SiBBr)

CIVIS is a citizen science platform, developed by the Brazilian Institute of Information in Science and Technology (IBICT), created in 2022 in open source from EU-Citizen.Science. The Brazilian Biodiversity Information System (SiBBr) is the national data and information infrastructure on biodiversity, which is responsible for organising, indexing, storing, and making available data and information on biodiversity and Brazilian ecosystems, providing subsidies for management government related to conservation and sustainable use. The Ministry of Science, Technology and Innovation - MCTI is responsible for the implementation, development and support of SiBBr.

3.4 Databases and Limitations

Several challenges arose due to the lack of specific information, the lack of updating contact details, project data, in addition to not recording the start dates of activities, which made the process of searching for information difficult. For this reason, there was a need to individually search for each of the projects on Google, on social networks (Facebook and Instagram), websites, data storage platforms – iNaturalist, and on the CVs of the responsible researchers. In the case of projects whose dates were not found in any of the databases mentioned above, the date of registration on the SiBBr or CIVIS website, the first publication on the project's Instagram, or the date of creation of the group on Facebook was considered.

3.5 CS projects classification

The classification of projects was carried out according to the 10 citizen science principles (**Tab. 1**) published by the European Citizen Science Association (ECSA) 'sharing best practice and building capacity' working group. According to the ECSA members, who are part of this working group, citizen science is a flexible concept that can be adapted and applied in different situations and areas of science. Therefore, the goal of this community with these principles is to establish good practices in citizen science.

Tab. 1 - ECSA (European Citizen Science Association). 2015. Ten Principles of Citizen Science.

1. Citizen science projects actively involve citizens in scientific endeavor that generates new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.	2. Citizen science projects have a genuine science outcome. For example, answering a research question or informing conservation action, management decisions or environmental policy
3. Both the professional scientists and the citizen scientists benefit from taking part. Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence e.g., to address local, national and international issues, and through that, the potential	4. Citizen scientists may, if they wish, participate in multiple stages of the scientific process. This may include developing the research question, designing the method, gathering and analyzing data, and communicating the results.

	to influence policy.		
5.	Citizen scientists receive feedback from the project. For example, how their data are being used and what the research, policy or societal outcomes are.	6.	Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for. However, unlike traditional research approaches, citizen science provides opportunity for greater public engagement and democratization of science.
7.	Citizen science project data and meta-data are made publicly available and where possible, results are published in an open access format. Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this.	8.	Citizen scientists are acknowledged in project results and publications.
9.	Citizen science programs are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.	10.	The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

3.6 Heterogeneity of citizen science definitions

During the project classification phase, it was important to consider the heterogeneity in definitions of citizen science, given that it is an international concept, it is possible that each region has its own particularities when involving citizens in scientific research. In Brazil, 'extension' is a concept that is close to what is called citizen science in Europe; recently curricularized in Higher Education, it has brought the exchange of experiences between society and academia. For this reason, only projects that did not involve the effective participation of society were removed from the list after being analyzed. In addition to these, we also removed projects that have already been completed and projects whose data could not be found.

4. Results and discussion

4.1 Geographical distribution of CS projects in Brazil

The north, northeast and central-west regions of Brazil represent approximately 82.4% of the national territory and have 44% of projects classified within ECSA's basic principles of citizen science. On the other hand, the southeast and south regions represent 17.6% of the national territory while having 56% of the mapped projects (**Fig. 2**). Therefore, the occurrence of citizen science projects in Brazil is not directly related to territoriality, most of them are found in regions where there are public institutions focused on research and regional development.

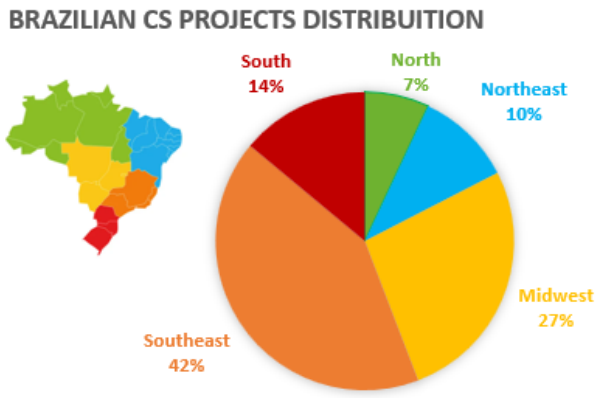

Fig. 2 - Geographical distribution of the 86 CS projects. Source: authors' research, 2024.

4.2 Development and coordination

The oldest citizen science project in Brazil, found

during our research, dates back to 1991, the 'Observando Rios' project, coordinated by a NGO named SOS Mata Atlântica. Later, the Tuco-Tuco project in 1996, involving the public sector, academia and the private sector, then, in 2002 and 2003, the 'Meros do Brasil' and Aves 'Migratórias do Nordeste' projects emerged, financed by the private sector (PETROBRAS) and a NGO, respectively. There has been a significant growth in the number of projects only since 2008 (**Error! Reference source not found.**).

It is also important to note that approximately 63% of the projects were directly related to biodiversity research in coastal areas, rivers, lakes, forests, and mangrove regions. There was also a frequent occurrence of projects on environmental education, water quality and environmental impacts generated by mining in Brazil. The project 'What mud is this?' (Que lama é essa? In Portuguese) developed in the southeast region of the country, at the Geosciences Institute (IGC) of the Federal University of Minas Gerais (UFMG) in partnership with the Environmental Education and Research Laboratory (LEA) of the Federal University of Ouro Preto (UFOP), whose methodology is the geoparticipatory monitoring, have trained citizens to play an active role in monitoring areas at risk of dam failure.

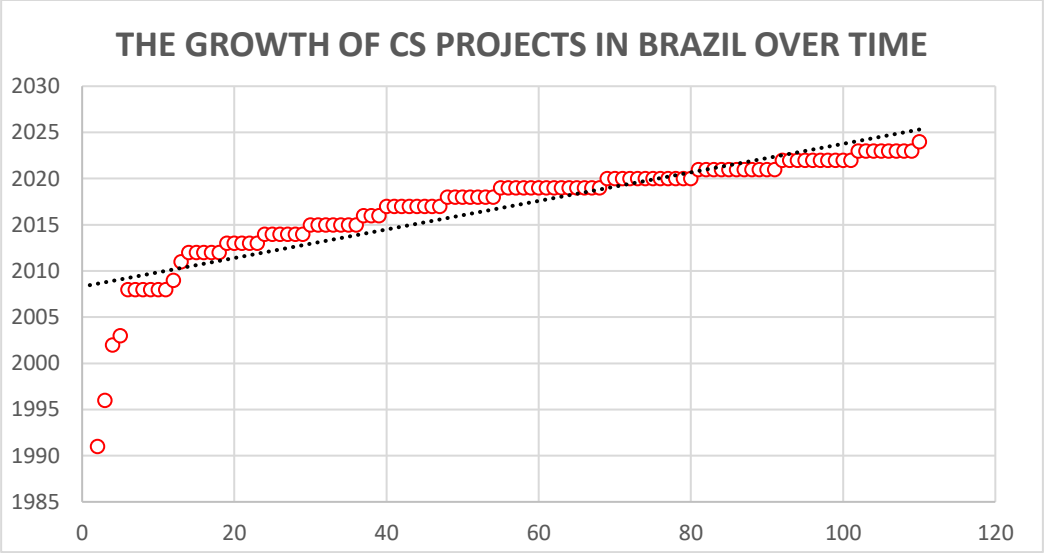

Fig. 3 - Citizen Science projects development in Brazil. Source: authors' research, 2024.

Project coordination, supervision and financing activities were carried out mainly by public-academic (32) and nongovernmental (20) initiatives (**Fig. 4**). In this research, we consider that the public sector and academia constitute two different coordination sectors. However, more than 90% of the country's higher education institutions, which were involved in the projects, are public, which means that the majority of projects are public-academic initiatives. These initiatives are developed by academia and financed by the federal government through research funding bodies, such as CAPES, CNPq, ICMBio and ministries, with emphasis on the Ministry of the Environment and the Ministry of Education.

In the analysis, the public sector (10) and the private sector (3) also coordinate the projects individually. The public sector also leads projects with NGOs (2 cases), between NGOs and academia (4), international cooperation (1) and with universities abroad (1), private and NGO (1), private and academia (1) and with all sectors (NGO, private, public and academia – 1 case), which highlights cooperation between all sectors leading the projects. In **Error! Reference source not found.**, the other intersections between sectors are highlighted, except for the international-academia-NGO partnership (1), due to graphic limitations.

5. Conclusion

There are particularities in the development of citizen science in each territory. In Brazil, there is a concept that is close to citizen science, but taking into account the basic principles, it was necessary to remove some of the projects. Another point observed was the concentration of projects in the southern and southeast regions of the country, which represent 17.6% of the national territory with 56% of the projects. Taking into account the enormous biodiversity of the biomes of the north, northeast, and central-west regions, a lot is lost when projects are concentrated in a region that barely represents the entirety of Brazil's diversity.

It is also important to note here that projects developed according to the needs of communities can generate a huge social impact. This impact can be justified by the need to listen, so that public policies are built based on the knowledge of those who live there. Furthermore, citizen science, combined with open access, can enable citizens to have contact with a new way of observing natural phenomena through astronomic observation techniques and the

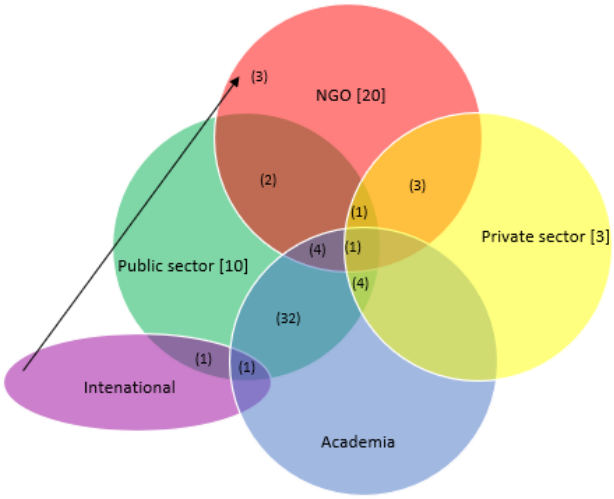

Fig. 4 - Coordination of Brazilian CS projects. Source: authors' research, 2024.

construction of low-cost telescope**s** or meteor capturing station**s**.

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7. Data accessibility

The data used in this research is available on the CIVIS platform and on the projects' website. A reasonable request to use or reproduce the data produced by the study is required, accompanied by a more detailed expression of interest.

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