Framing Citizen Science for Climate Assemblies

Aelita Skarzauskiene
Vilnius Gediminas Technical University
Vilnius, Lithuania
https://orcid.org/0000-0003-1606-0676

Monika Mačiulienė
Vilnius Gediminas Technical University
Vilnius, Lithuania
https://orcid.org/0000-0002-8527-7468

Gianni Rondinella
Cambiamo Sociedad Cooperativa Madrilena
Madrid, Spain
https://orcid.org/0000-0002-8215- 8340

Mohammad Azizur Rahman
Technovative Solutions
Manchester, UK
aziz@technovativesolutions.co.uk

Floridea du Ciommo
Cambiamo Sociedad Cooperativa Madrilena
Madrid, Spain
https://orcid.org/0000-0001-9826-4458

Yago Bermejo Abati
Deliberativa
Madrid, Spain
yago@deliberativa.org

Abstract— **Citizen engagement in Citizen Science (CS) means an active involvement of individual citizens in scientific research, policy and program development. However, it should be noted that including stakeholders in CS organisation, planning, decision-making, implementation of activities and evaluation requires adequate technological capacity, the understanding of roles and clear communication. The possibility to engage users in data science together with the power of AI algorithms presents no doubt opportunities for crowd sourced data science and collective intelligence to be brought to bear on fundamental challenges facing humanity like poverty, diseases, famines and developmental challenges. The focus of the interdisciplinary multinational consortium CLIMAS (Horizon Europe project) is research on empowerment of citizen scientist, researchers, civil organizations, SMEs, innovators, and policy makers by offering practical insights for co-creation of collective intelligence, aligning values and build trust between stakeholders. The project is based on idea that Climate Assemblies can be a perfect domain for participating in citizen science projects, with an active contribution of citizens by tackling environmental issues. In this sense, citizens participate in the collection of evidence, but also in the co-creation of new knowledge to increase awareness of climate change and ultimately to drive changes in climate policy.**

Keywords—Citizen Science, Climate change, Citizen assemblies, Climate assemblies, co-creation

I. INTRODUCTION

Citizen engagement in Citizen Science (CS) means an active involvement of individual citizens in scientific research, policy and program development. "Active" engagement implies an active role in defining issues, considering solutions, contributing with their own effort, knowledge and resources. Citizen engagement can take place at various stages of the establishment and implementation. However, it should be noted that including stakeholders in CS organisation, planning, decision-making, implementation of activities and evaluation requires adequate capacity, the understanding of roles and clear communication. Citizen science can accelerate production of new scientific knowledge and innovations that meet the needs of disadvantaged population groups. Citizen science projects have contributed to research [1], science education [2], environmental advocacy [3] or public understanding of science. Active citizenship and civic education could be conceptualised as a social capital of the community and enable faster and evidence-based reactions to events and better territorial coverage. On the other hand, citizen scientists may have problems collaborating in international research projects, difficulties by getting funding or engaging in long-term activities or publishing research results. Citizen science also can be a powerful practice for both the inclusion of marginalised communities and the design of new evidence-informed policies supported by the participation of citizens.

The possibility to engage users in data science together with the power of AI algorithms presents no doubt opportunities for crowd sourced data science and collective intelligence to be brought to bear on fundamental challenges facing humanity like poverty, diseases, famines and developmental challenges. Citizens and stakeholders, in general, bring their values and ideologies and new voices to the CS. The paradox of citizens' exclusion from the online ubiquitous presence of Data Science (DS) and Artificial Intelligence (AI) has many negative effects (fake news, filtered recommendations, echo chambers, etc.). Citizen Science offers the most meaningful way to explore, measure and experiment on such DS and AI critical issues. The focus of the interdisciplinary multinational consortium CLIMAS is research on empowerment of citizen scientist, researchers, civil organizations, SMEs, innovators, and policy makers by offering practical insights for co-creation of collective intelligence, aligning values and build trust between stakeholders. The project is based on idea that Climate Assemblies can be a perfect place for participating in citizen science projects tackling environmental issues. A Climate Assembly brings together randomly-selected everyday people to learn, deliberate and to make recommendations on the aspects of climate crisis. In this sense, citizens participate in the collection of evidence, but also in the co-creation of new knowledge to increase awareness of climate change and ultimately to drive changes citizen behaviour.

II. CITIZEN SCIENCE AND CLIMATE ASSEMBLIES

Climate change is one of the most critical issues to tackle today because it has detrimental social, environmental and economic impacts in the near future. According to the last IPCC (Intergovernmental Panel on Climate Change) on Impacts, Adaptation and Vulnerability, effective adaptation options will reduce risks to people and nature [4]. If "business-as-usual" is to continue without any changes, studies have found that food, welfare, and industrial production will cease in the next decade [5]. Even in Europe, facing Climate change impacts is not anymore a future risk but a fact. Climate scientists are unequivocal: a transition away from our current system is needed for carrying out the transformation to climate resilience in the diverse biogeographical regions of Europe [6]. This transition to climate-neutral and resilient societies adapting to climate change situations requires major transformation to citizen engagement and empowerment. Since COP16 in Paris, civil society has been admitted to observe the formal and informal Climate change negotiations including the negotiation on the adaptation funding mechanisms. Later on, Europe has started a process for emphasizing the role of the civil society and all citizens in the climate resilience action through the Mission on Adaptation to Climate change - at least 150 European regions and communities to become climate resilient by 2030. This is an ambitious objective in terms of time frame (2030) and scope (adaptation to Climate change). The last Climate change events show that the policy makers, experts and stakeholders actions are not enough and a 360º citizens` engagement is urgently needed. Therefore, the society needs to learn from the good experience in citizens' engagement and to build citizens' supporting infrastructure for climate adaptation measures to help the European regions and local communities to resist.

Ensuring citizen engagement in Climate change adaptation and mitigation is a complex and multi-layered problem that requires contributions from diverse cultural, sociological, psychological, and behavioural perspectives. However, public discourse and policy debates are often coloured by an overly simplified framing of Climate change adaptation in terms of individual's awareness, attitudes and choices, and the various behavioural mechanisms through which the latter can be targeted. While valuable for illuminating the importance of individuals' knowledge, emotions, motivations and decision-making, such approaches underestimate the role that social and cultural dynamics play in shaping citizen engagement with Climate change, and fail to explain why citizen engagement has been underwhelming despite the positive changes in awareness, values and attitudes. To address this gap, the empowerment of citizens was activated by European Commission through 'Open Science' and 'Citizen Science' approaches and in order to co-identify and co-create solutions to societal challenges. 'Citizen' in definition mean 'citizens, publics, social groups and communities' [7], in other words, social actors that are not necessarily professional scientists. Their unique expertise comes from everyday experiences, including of their neighbourhoods, health, gender discrimination [8], and climate action [9].

Together with CS, Citizens` assemblies approach to public engagement has gained popularity following perceived successes in different countries [10]. "Citizens` assemblies" can be defined as 'carefully designed forums where a representative subset of the wider population come together to engage in open, inclusive, informed, and consequential discussions on one or more issues" [11]. Citizens' assemblies are a type of mini-public. "They recruit a representative, or diverse, selection of members of the public through various forms of civic lottery (stratified random selection), provide the participants with information on the topic to be considered, and facilitate their discussion to promote deliberative norms and enable the participants to address the assembly remit"[12]. Given the increasing prominence of the climate emergency in the political agenda, especially on the approach to COP26, citizens' assemblies have been used increasingly to address climate change issues [13].

Conference on the Future of Europe [14] and the initiative of the European Climate foundation [15] are fostering the building-up of Climate Assemblies at State level and EU level. Climate assemblies are considered as sustainable and reasonable tools to stimulate deliberative democracy in climate policy making and a perfect domain for participating in Citizen Science projects tackling environmental issues. Climate Assemblies are a citizens' assembly that addresses the issue of climate change. Various state governments such as France, UK, Scotland, Ireland, Germany, Denmark and Austria have experience in developing their own mechanisms for engaging and empowering their citizens such as the Climate Assemblies where citizens are invited to deliberate about the adaptation measures for reducing the costs specially for more vulnerable groups. Now, most assemblies to date have focused on addressing general questions such as "How do we tackle Climate change?" or "Which are the general principles for building-up a Climate change law?". In most cases the main output by assembly members have been recommendations in the form of prioritized lists of measures, inspired by experts from different disciplines. In some places, these processes have led to a genuine participatory success by including the principle of the Citizen science, civic lottery and citizens' deliberation.

III. FRAMING CLIMATE ASSEMBLIES

In order to enact co-creation and facilitate participatory design in Citizen Science projects, it is important to establish a process and associated technological tools that combine materials and instructions [16]. An abundance of methods, tools, toolboxes, databases and online repositories are currently already available for participatory design-enabled innovation. Many of them are adapted to Citizen Science. In the international field, the selection of guidelines carried out by the Doing It Together Science (DITOs) project [17], currently available on the European Citizen Science Association (ECSA) website should be highlighted [18]. Another leading example of a Citizen Science guideline is "Choosing and Using Citizen Science: A Guide to When and How to Use Citizen Science to Monitor Biodiversity and the Environment" by Pocock [19]. Moving onto CS, the work of the MICS project stands out, as it created and implemented a CS impact assessment framework, specifying society, science, environment, economy, and governance as its five domains of interest [20]. A key conclusion stemming from this project is that the impact pathways of CS are typically non-linear and that impact assessment of CS is much more than impact reporting since it facilitates crucial learning for the future. Lastly, the SciShops` (2022) materials represent

From (what has been usually done)	To (what we propose to do)
Technical questions.	Value/moral based questions.
Lists of solutions	Balanced resolutions to dilemmas. Trade-offs considerations.
Which are the best solutions to solve the problem?	How do these solutions affect us? Which is the cost for the administration? Who pays? Where does the money come from? Which minorities or interest groups are affected?
Brainstorming solutions after hearing experts	Experts select the best possible solutions and present them to citizens with their costs and benefits.
Prioritization taking into account it's benefits	Comparison taken into account cost and benefits. -> Recommending the right balance.
Example What are the solutions to a more intense drought?	**Example** What are the dilemmas related to the different solutions? For example, to build a dam? Or to save water? Or to reduce irrigated crops? Citizens can compare the costs and benefits of each of them and opt for a balanced solution.

another valuable addition to CS guidelines. Namely, SciShops base their approach on gathering data at the micro-level from actual CS project participants, scaling it up to demonstrate that CS can be a valuable source of community-level impacts.

After analysing scientific sources and existing CS guidelines and evaluation frameworks, two pillars were identified, which are crucial for Citizen Science project performance: value choices and agenda setting. In this chapter the importance of two different methods for organizing citizen assemblies will be discussed and practical guidelines provided. Further research in CLIMAS project will test and adopt these methods for organizing Climate assemblies. The co-design approach carried out within the 3 EU living labs (Spain, Greece and Lithuania) will produce guidelines for the facilitators for engaging and empowering citizens in the climate resilient decision making process as well as for policy makers for improving their selection of climate resilience issues.

A. Value-based dilemmas approach

Following a horizontal approach and a distributed expertise model [22] participants in Climate Assemblies can be considered as competent in-the-field experts and therefore able to produce socially robust knowledge. Value-based dilemmas approach could be used as guiding idea of engagement and empowerment mechanisms for Climate assemblies. Current participants of assemblies are already convinced that they address societal needs in terms of Climate resilience. Some participants who have no idea how to address the Climate resilience dilemmas pick up the experts' lectures or written down reports and enter into a traditional school classroom dynamic without questioning. Some others are even unable to understand the Climate change shared documents because they are expressed in a too complex language or even in a language that citizens don't understand very well [23]. Following the current experience of Climate assemblies, it turns the process that should be guided by citizens into a process guided by experts' ideas and aspirations. Citizens, in general, are not experts and therefore when trying to solve questions for which they have no answers they draw considerable inspiration from what they

hear, particularly from ideas presented by experts or interest groups.

This is why filtering and prioritizing experts' proposals on all Climate change-related issues is not the best way to take advantage of their potential as a group. The main value of citizens is that they know the reality of ordinary people, they represent it themselves. They know their problems, but they also know what their values are, by which they govern their behaviour. Adaptation to climate change requires major changes that society must face. These changes may involve modifications of the landscape, the urbanism or the economy of a region. In this way, communities need to face dilemmas related to their identity and way of life. Some questions related to those dilemmas could be: What incentives do we need to be able to make this leap as citizens? How far do we want to modify the identity of our region? How much should our administration spend to adapt to this ongoing climate transformation? The assembly has to evaluate the costs and benefits of each one of them and present different scenarios for change in order to provide balanced solution. Table 1. shows the methodological leap we propose for the climatic assemblies.

By applying value-based dilemmas approach, the solutions generated in Climate assemblies have to be discussed and evaluated evaluation based on the values present in the society. This leap from technical language based solutions (e.g. experts discourse and aspirations) to the moral trade-off considerations has the ambition to empower citizens and consolidate their engagement in the policy making process. Technical possibilities must inform the debate, but ultimately, a democratic decision must be based on the values of society and focus on the moral dilemmas implicit in order to adapt to climate change.

B. The general-purpose methodology: a knowledge and evidence based support tool for climate assemblies agenda setting

Setting the climate assembly's agenda is always a complex task as several factors play a role on it: future climate scenarios, evidence from different case studies across the continents, citizen's perception, etc. Differences in climate data standards and the need to set the data and information in an easy and understandable way even more increases the complexity. Service-oriented architecture (SoA) approaches in resolving data interoperability issues for enabling data and knowledge integration are broadly classified into three categories: 1) organisations are increasingly making their data available via APIs granting access to all web users; 2) domain-specific data standards and abstract level architecture standards are adopted to make data easily accessible and transferable, and 3) data transformation services are provided to end users [24]. The current research project proposes a general-purpose methodology whose primary goal is to generate a Knowledge and evidence based tool built by applying a Climate change resilience ontology whose concepts are mapped to already existing community-accepted standards for data and knowledge representation (Fig. 1). The key enablers of the interoperability feature for data and knowledge integration are the ontology and the data standards combined with machine learning and AI algorithms for

aligning data and data formats found in different sources of data including Copernicus, GEOSS and Earth Observations.
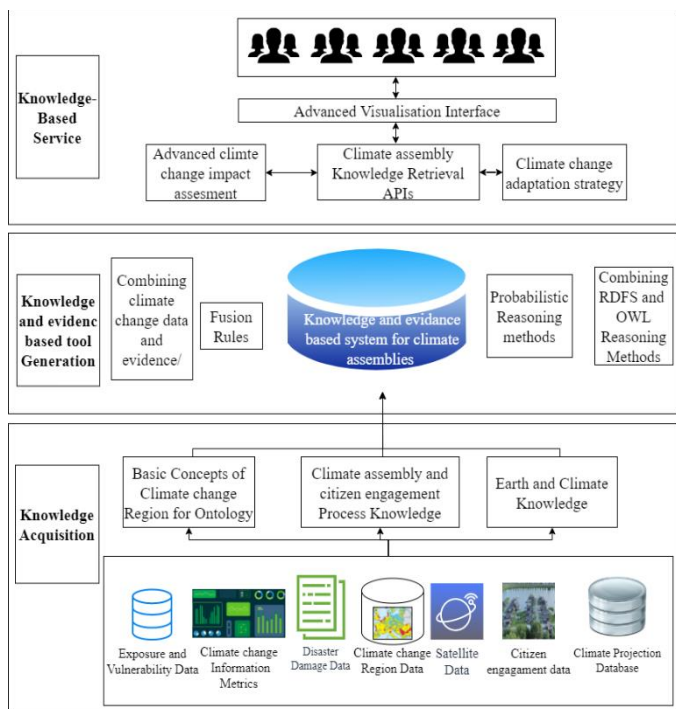

Fig. 1. Overall framework of the knowledge and evidence based system

The concept of building a unique approach for enabling data interoperability will result in efficient knowledge integration, paving the path to the faster and cost-effective development of advanced knowledge and evidence based services to improve information and understanding of the climate assemblies. This data-centric research activity will generate novel insights and predictions and enhance the Knowledge with quantitative and qualitative data to support the settings of climate change assembly and follow up.

CONCLUSIONS

The research project invites citizens` communities to take action in a radical and innovative CS-based transformation with continuous citizens` presence. The conceptual shift turns citizens from mere passive individuals that nurture DS and AI technologies, to active change makers able to express their own voice in the overall research and scientific planning. At this paradigm citizens take multiple roles as receivers of systematic evidence, auditors of data, contributors for citizen-centric research and supporters of ethical and unbiased solutions. These first considerations point out that citizens' engagement for climate resilience can be raised if we tackle these issues related with:

- Shift climate assemblies from technical based deliberations that belong to climate change experts to multi-stakeholders' deliberations based on solving the dilemmas from a bottom-up, more societal and value-based perspective

- Democratize the Climate Assemblies and move them from an extraordinary policy event towards an ordinary policy event

- Set Climate Assembly agenda from technical questions to values-based resolutions considering the trade-offs of the adaptation measures impacts

- Ensure the citizens access to training about the technical aspects of climate adaptation through the Citizen Science approach

- Monitor and disseminate the CA data.

REFERENCES

[1] McKinley, D. C., Miller-Rushing, A. J., Ballard, H. L., Bonney, R., Brown, H., Cook-Patton, S. C., ... & Soukup, M. A. (2017). Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*, 208, 15-28.

[2] Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science?. *Public understanding of science*, 25(1), 2-16.

[3] Haywood, B. K., Parrish, J. K., & Dolliver, J. (2016). Place-based and data-rich citizen science as a precursor for conservation action. *Conservation Biology*, 30(3), 476-486.

[4] IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A.Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press. IPCC, 2022.

[5] Ferguson, P. (2015). The green economy agenda: business as usual or transformational discourse?. Environmental Politics, 24(1), 17-37.

[6] Herrington, G. (2021). Update to limits to growth: Comparing the World3 model with empirical data. *Journal of Industrial Ecology*, 25(3), 614–626.

[7] Kennedy 2016.The Rightful Place of Science: Citizen Science,Consortium for Science, Policy.

[8] Cigarini et al. 2020, Participation and Co-creation in Citizen Science, The Science of Citizen Science, pp 199–21.

[9] Vicens, J., Bueno-Guerra, N., Gutiérrez-Roig, M., Gracia-Lázaro, C., Gómez-Gardeñes, J., Perelló, J., et al. (2018). Resource heterogeneity leads to unjust effort distribution in climate change mitigation. *PLoS One*, *13*(10), e0204369. Retrieved on 10.02.2023 from: https://doi.org/10.1371/journal.pone.0204369.

[10] Farrell, D.; Suiter, J. Reimagining Democracy: Lessons in Deliberative Democracy from the Irish Front Line; Cornell University Press: Ithaca, NY, USA, 2019.

[11] Curato, N.; Farrell, D.M.; Geißel, B.; Grönlund, K.; Mockler, P.; Pilet, J.-B.; Renwick, A.; Rose, J.; Setälä, M.; Suiter, J. *Deliberative Mini-Publics: Core Design Features*; Bristol University Press: Bristol, UK, 2021.

[12] Elstub, S. Mini-publics: Issues and Cases. In Deliberative Democracy: Issues and Cases; Elstub, S., McLaverty, P., Eds.; Edinburgh University Press: Edinburgh, UK, 2014; pp. 166–188

[13] Elstub, S.; Carrick, J.; Farrell, D.M.; Mockler, P. The Scope of Climate Assemblies: Lessons from the Climate Assembly UK. Sustainability 2021, 13, 11272. Retrieved on 10.02.2023 from: https://doi.org/10.3390/su132011272.

[14] Conference on the Future of Europe. Retrieved on 10.02.2023 from: https://cor.europa.eu/en/Documents/CoFE_Report_with_annexes_EN.pdf

[15] European Climate foundation. Retrieved on 10.02.2023 from: https://europeanclimate.org/stories/the-growing-traction-of-climate-citizens-assemblies/

[16] Senabre H. et al. 2018, Co-designed strategic planning and agile project management in academia: Case study of an action research group. *Palgrave Communications, 5*(1), 151.

[17] DITOs Consortium (2016) Doing It Together science: Terms of reference and evaluation templates. UCL, London.

[18] European Citizen Science Association. Retrieved on 10.02.2023 from: https://ecsa.citizen-science.net/.

[19] Pocock et al. 2014, Developing the global potential of citizen science: Assessing opportunities that benefit people, society and the environment in East Africa. Retrieved on 10.02.2023 from: https://doi.org/10.1111/1365-2664.13279.

[20] MICS (2022) Developing metrics and instruments to evaluate citizen science impacts on the environment and society. Retrieved on 10.02.2023 from: https://cordis.europa.eu/project/id/824711.

[21] SciShops (2022) Enhancing the Responsible and Sustainable Expansion of the Science Shops Ecosystem in Europe. Retrieved on 10.02.2023 from: https://cordis.europa.eu/project/id/741657.

[22] Nowotny, H. 2003. Democratising expertise and socially robust knowledge. *Science and Public Policy, 30*(3), 151–156.

[23] Young Barcelona Forum (Foro Joven BCN). Retrieved on 10.02.2023 from:https://www.decidim.barcelona/processes/forumjoveBCN?locale=es.

[24] Hoffamnn and Pteoro 2020: Demystifying the.. and sharing debate, J of IP, Information Technology and Electronic Commerce Law.