



**ExCiteS**

Extreme  
Citizen  
Science



# **Synergies of Citizen Science and Frontier Research**

Muki Haklay, Extreme Citizen Science group  
Department of Geography, UCL

Twitter: @mhaklay / @ucl\_excites

“

# Defining citizen science

Citizen Science is part of Open Science in the EU policy framing.

*“citizen science can be described as the voluntary participation of non-professional scientists in research and innovation at different stages of the process and at different levels of engagement, from shaping research agendas and policies, to gathering, processing and analysing data, and assessing the outcomes of research.” (Citizen Science factsheet 2020)*



**CITIZEN SCIENCE**  
ELEVATING RESEARCH &  
INNOVATION THROUGH  
SOCIETAL ENGAGEMENT



*Interaction between citizens, scientists and policy makers is essential to enrich research and innovation, and reinforce trust of society in science. I am proud of the hundreds of thousands involved citizens that already contributed to research and innovation and look forward to continue opening up research towards society and the world.*

**Mariya Gabriel**, Commissioner for Innovation, Research, Culture, Education and Youth

## WHAT IS CITIZEN SCIENCE AND WHY IS IT IMPORTANT?

Citizen science can be described as the **voluntary participation of non-professional scientists in research and innovation** at different stages of the process and at different levels of engagement, from shaping research agendas and policies, to gathering, processing and analysing data, and assessing the outcomes of research.

Active engagement with citizens and society has the potential to **improve research and its outcomes and reinforce societal trust in science**. It can increase

- **relevance and effectiveness** by ensuring that R&I aligns with needs, expectations and values of society
- **creativity and quality** by enlarging the collective capabilities, the scope of research and the quantity and quality of data
- **transparency, science literacy and confidence of the public in research**

## CITIZEN SCIENCE AS PART OF EU POLICY

Citizen engagement is at the core of the Von der Leyen Commission's **New Push for European Democracy** and more participatory decision-making, and an **integral part of the EU's Open Science policy priority** and the **European Research Area**.



Research and  
Innovation

”

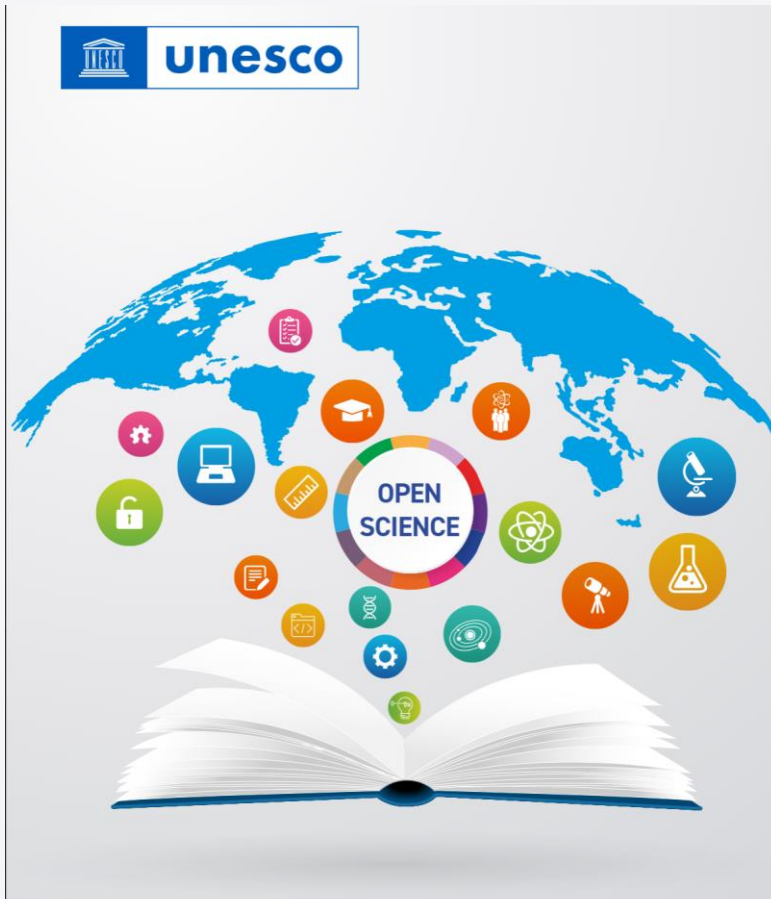


European  
Commission

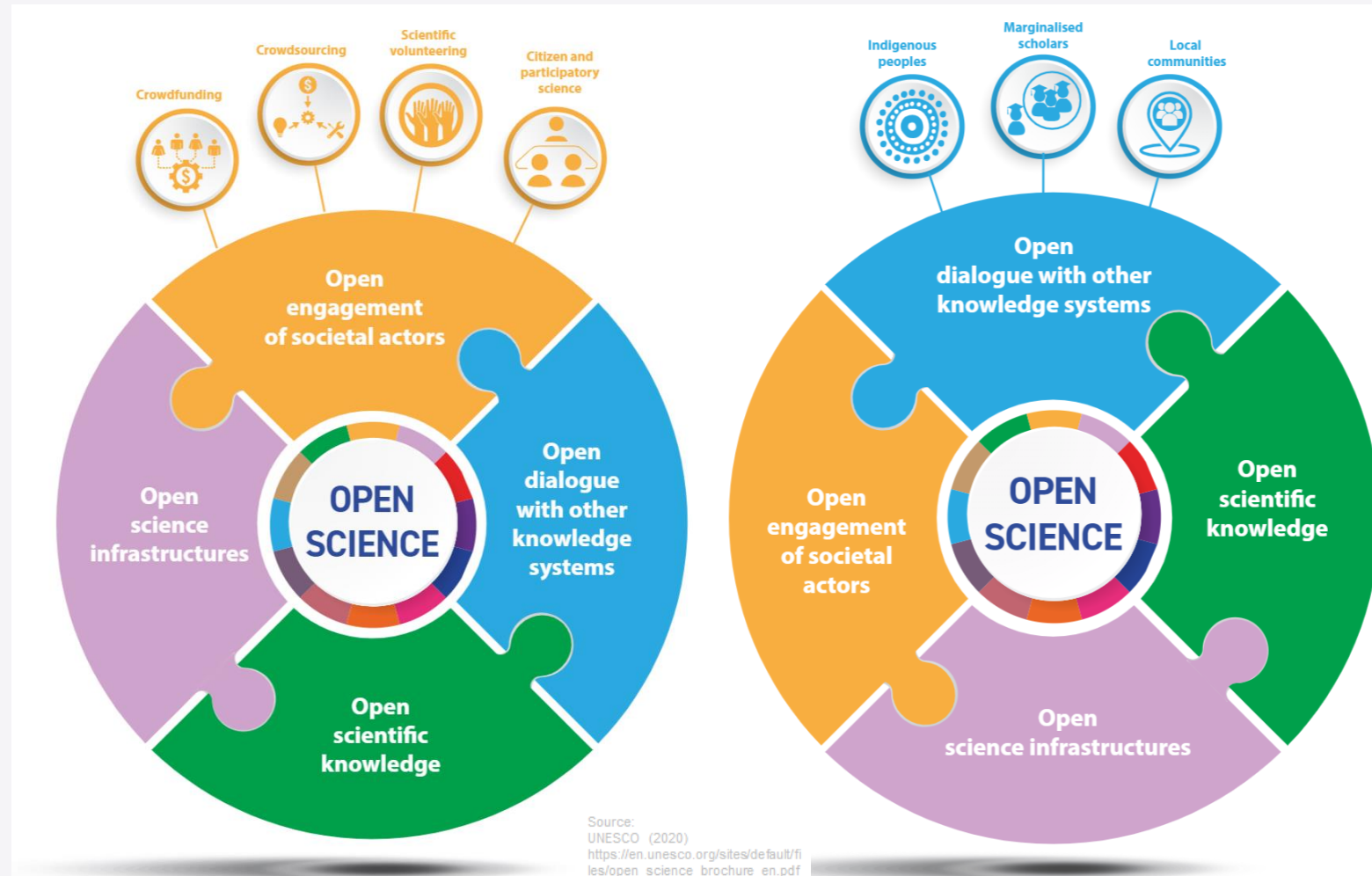




# UNESCO Recommendation on Open Science



**UNESCO Recommendation  
on Open Science**



## Mutual Learning Exercise on Citizen Science Initiatives- Policy and Practice

An increasing number of citizen science projects and initiatives are being implemented across Europe – mostly taking place at local or national levels, but some also being co-ordinated internationally. This rapidly emerging mode of research and innovation shows substantial potential in terms of achieving greater societal impact and increasing trust in science, by leveraging collective societal capabilities, by enlarging the scope of the R&I, and by increasing relevance, responsiveness and transparency. However, national or regional policies to support and mainstream them, if they exist, are in many countries at an early stage of development. Europe would benefit from greater attention to promoting citizen science within Member States and regions, and from greater cooperation and shared approaches across the European Research Area as a whole.

The MLE thus aims to facilitate an exchange of information, experiences and lessons learned, as well as to identify good practices, policies and programmes in relation to the various approaches at local, regional and national levels, towards supporting and scaling up citizen science. In addition, the objective is to identify citizen science campaigns that have high potential to be implemented in a collaborative way across the European Research Area.


<b>01 DEC</b>	<b>28 FEB</b>
2021	2023

### PSF Geo coverage

Norway Austria Belgium  
France Germany Hungary  
Italy Portugal Romania  
Slovenia Sweden

### PSF Exercise type

Challenge/ MLEs



**Citizen Science initiatives**  
Policy and Practice

#HorizonEU

PSF CHALLENGE – MUTUAL LEARNING EXERCISE (MLE)

An increasing number of citizen science projects and initiatives are being implemented across Europe. This rapidly emerging mode of research and innovation shows substantial potential in terms of achieving greater societal impact and increasing trust in science, by leveraging collective societal capabilities, by enlarging the scope of the R&I, and by increasing relevance, responsiveness and transparency. The following topics of interest have been identified for the MLE:

- Topic 1: Introduction and overview on citizen science
- Topic 2: Ensuring good practices and impacts
- Topic 3: Maximising the relevance and excellence of citizen science
- Topic 4: Enabling environments and sustaining citizen science
- Topic 5: Scaling up citizen science

Visit the website for more information: <https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility>

Participating countries: Austria, Belgium, France, Germany, Hungary, Italy, Norway, Portugal, Romania, Slovenia and Sweden.

**Chair**  
Alan Irwin

**Rapporteur**  
Margaret Gold (Rapporteur and Expert on Topic 4)

**Independent Experts**  
Muki Haklay (Expert on Topic 1)  
Rosa Arias (Expert on Topic 2)  
Marzia Mazzonetto (Expert on Topic 3)  
Antonella Radicchi (Expert on Topic 5)  
Ingeborg Meijer (Support Rapporteur and Support Expert on Topic 4)

**DG RTD Policy Officer**  
Annamaria Zonno (Annamaria.ZONNO@ec.europa.eu)

**Scheduled meetings**

- January 2022: Topic 1 meeting
- March 2022: Topic 2 meeting
- June and September 2022: Topic 4 meeting
- October 2022: Topic 3 meeting
- November 2022: Topic 5 meeting
- December 2022: Final Meeting
- Early 2023: Dissemination event

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Research and Innovation



# Citizen Science

Long running  
Citizen Science

Citizen  
Cyberscience

Community  
Science

Ecology &  
biodiversity

Meteorology

Archaeology

Volunteer  
computing

Volunteer  
thinking

Passive  
Sensing

Participatory  
sensing

DIY Science

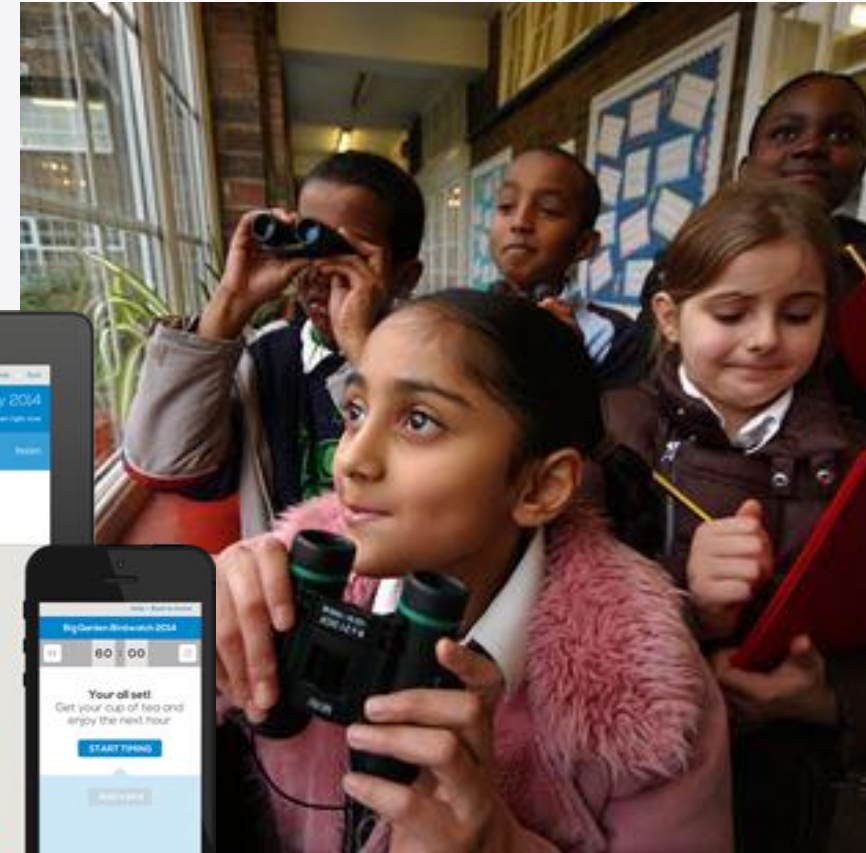
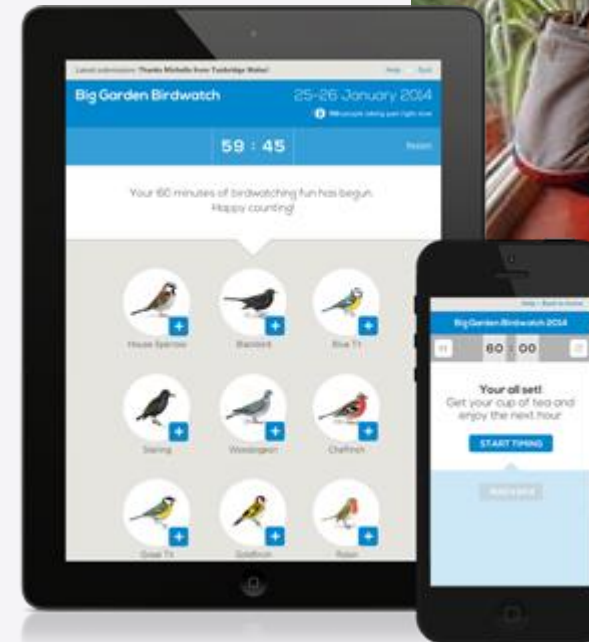
Civic Science



# Biodiversity/Ecology/Biological recording

- Ecological observations of plants and animals (esp. birds), continue to be popular
- A review in 2012 identified 234 projects in the UK
- Big Garden Birdwatch – 1 hour, end of January, structured reporting, and over million participants in 2021

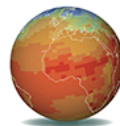
Participating in Big Garden Birdwatch (source: RSPB)







# Volunteer computing



climateprediction.net

the world's largest climate modelling experiment for the 21st century

Home About People Join! Projects weather@home Climate science Publications Education

weather@home > 2015 December Extreme weather in the UK >

In this section:

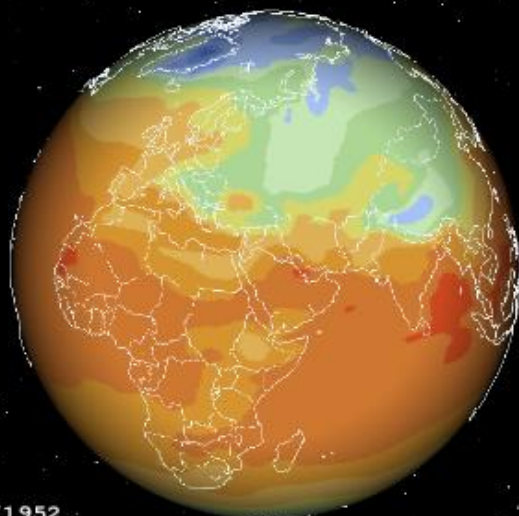
2015 December Extreme weather in the UK

Observational Analysis

BBC

This globe shows your climate model running

Model date and time: 19/10/1952 00:30



Atmos Model Time - 00:30  
Atmos Model Date - 19/10/1952  
Hours Elapsed - 0685:15:50 (2.99 s/TS)  
Timestep - 826417 of 4147560  
Progress - 19.93 %

bbc.co.uk/climatechange

created by  
climateprediction.net

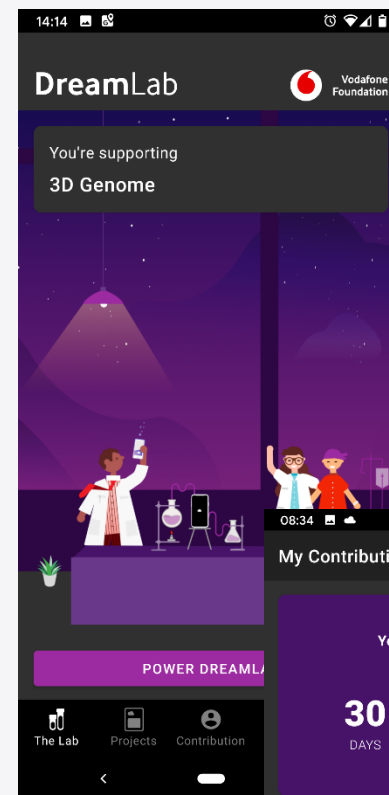
## 2015 December Extreme weather in the UK

Applying three independent methodologies of extreme event attribution, we show that temperatures and precipitation in the UK in December 2015 were extremely unlikely even in a warming world with observed SST patterns, including El Niño, as an additional driver. This indicates that random weather noise played a very large role in December's weather. At the same time, the event was much less likely in the representations of a climate without human influence, showing that climate change greatly affected the odds of such a month occurring.

The observed temperature anomaly is so far outside the expected distribution that the odds are difficult to determine. We find that anthropogenic climate change approximately doubled the occurrence probability of the event for lower return times. Analysis of the historical link between the observed CET dataset and El Niño shows no discernible influence on the CET in winter. This is confirmed by a coupled model analysis that only shows a weak connection. The weather@home simulations including all ocean temperatures are warmer than the Climatology ensemble. This includes El Niño, but also the warm subtropical Atlantic Ocean, which was the source region of the mild air flowing to Britain in December 2015.

Similarly all three methods show an increase in the likelihood of high precipitation in Northern English winters due to human-induced climate change. The connection with the El Niño signal is weak in December, but the weather@home simulations reveal an increase in the likelihood of very wet Decembers due to the ocean temperatures observed in December 2015.

What happened with the weather in December 2015?



My Contribution

You have powered DreamLab for

30 05 42  
DAYS HOURS MINUTES

Lifetime calculations I've crunched  
3,935

Currently powering

Imperial College London  
Imperial College London  
Corona-AI (Phase 1)

The Lab Projects Contribution News Settings

EN • Galaxy Zoo is a **ZOO**NIVERSE project

...just like **MOON** **ZOO**

## GALAXY ZOO

## HUBBLE

[Home](#) [The Story So Far](#) [The Science](#) [How To Take Part](#) [Classify Galaxies](#) [Forum](#) [Zoo Media](#) [Blog](#) [FAQ](#) [Contact Us](#)



[Pictures](#)

### Welcome to Galaxy Zoo, where you can help astronomers explore the Universe

Galaxy Zoo: Hubble uses gorgeous imagery of hundreds of thousands of galaxies drawn from NASA's Hubble Space Telescope archive. To understand how these galaxies, and our own, formed we need your help to classify them according to their shapes — a task at which your brain is better than even the most advanced computer. If you're quick, you may even be the first person in history to see each of the galaxies you're asked to classify.

More than 250,000 people have taken part in Galaxy Zoo so far, producing a wealth of valuable data and sending telescopes on Earth and in space chasing after their discoveries. The images used in Galaxy Zoo: Hubble are more detailed and beautiful than ever, and will allow us to look deeper into the Universe than ever before. To begin exploring, click the 'How To Take Part' link above, or read [The Story So Far](#) to find out what Galaxy Zoo has achieved to date.

Thanks for your help, and happy classifying.

*The Galaxy Zoo team.*

#### Classifier Log In

[Click here to log in](#)

- [Register](#)
- [Forgotten Password?](#)

#### Latest News

**Galaxy Zoo gets highlighted by the 2010 Decadal Survey**

by Kevin - 16 Aug 2010

Every decade, the US astronomy community gets its leaders together to write up a report on the state of the field and to

- [Win a Signed Comic Book](#)
- [Galaxy Zoo gets highlighted by the 2010 Decadal Survey](#)
- [Zoo 1 data set free](#)
- [Happy birthday to us.](#)

*Hanny's*



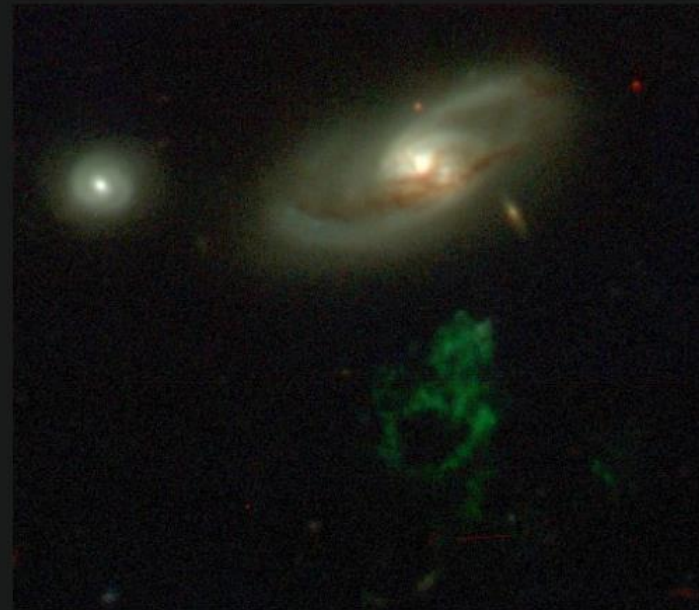
[voorwerp discovery](#) | [public appearances](#) | [astronomy adventures](#) | [everyday life](#)

### 04 | VOORWERP

[IN THE PICTURES](#)

[THE STORY BEHIND](#)

[WHAT IS IT](#)



Credit: William Keel, Anna Manning, 3.5-m WIYN Telescope

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#### Archives

▼ 2010

Hanny van Arkel. “The Dutch schoolteacher and Queen admirer who discovered Hanny’s Voorwerp”.





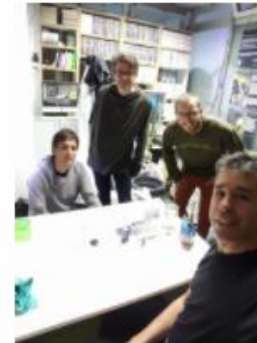
# DIY Science



Imane Baiz, CRI Paris



Finally back in Ljubljana Urs, Oli and Aurelio gave a workshop on how to build your own wild  
OpenPCR at BioTehna Lab.



<http://www.hackteria.org/wordpress/projects/biotehna/biotehna/>

The participants, all with solid biotech background, learned about resistive heaters, thermoelectric cooling using peltier elements and thermo sensors. After 4 hours and heavy soldering actions we had 2 complete PCR machines up and running. The next days the participants kind of took over the workshop and the mentors had to undergo strict instructions on lab practice and pipetting. The evening program with a science café was already in course when the first results of the electrophoresis gel came in. The reference machine (also DIY) and one of the newly build device showed amplification while no lines where to be seen on the tests for the second device. We assume that this is due to the not so well applied heated lid, as we saw quite some evaporation during the runs. This should be easy to fix with building a proper case.



# Modes of Citizen Science



## Mode 4 'Extreme'

- Collaborative Science – problem definition, data collection and analysis



## Mode 3 'Participatory science'

- Participation in problem definition and data collection



## Mode 2 'Distributed Intelligence'

- Citizens as basic interpreters



## Mode 1 'Crowdsourcing'

- Citizens as sensors





# **EXTREME CITIZEN SCIENCE: ANALYSIS AND VISUALISATION (ECSANVIS)**





# Extreme Citizen Science

Extreme Citizen Science (ExCiteS) is a situated, bottom-up practice that takes into account local needs, practices and culture and works with broad networks of people to design and build new devices and knowledge creation processes that can transform the world.



# Engagement: Free, Prior Informed Consent (FPIC)

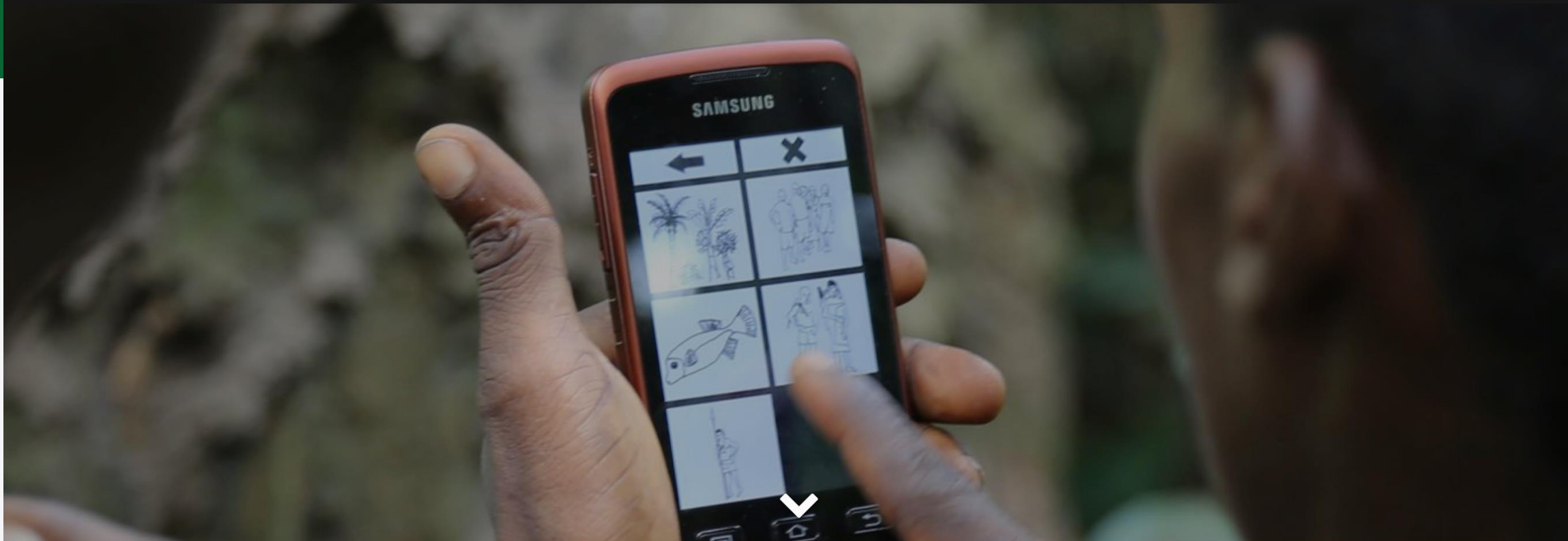




# Participatory software design

A photograph of a participatory software design session in a rural setting. A white chicken stands on a path of paper cards laid out on the ground. The cards feature various illustrations: a red fruit, a green fruit, red pods, a yellow flower, a palm tree, a pine tree, a pine cone, and a mechanical device. Several children are sitting on the ground in the background, and two plastic bottles are on the right.

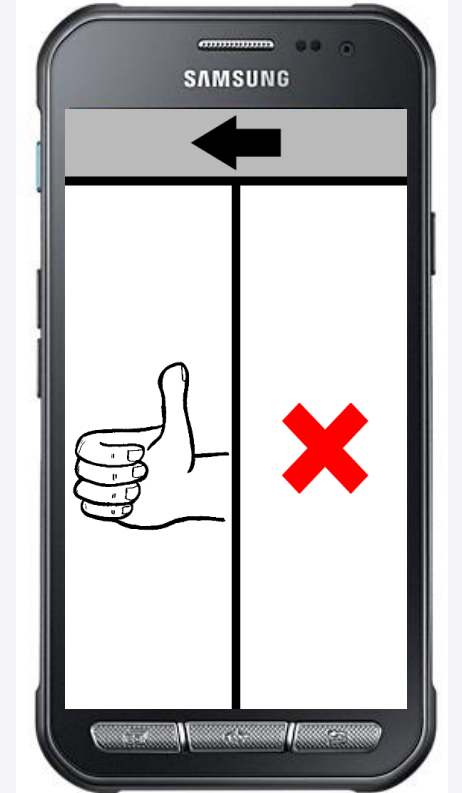
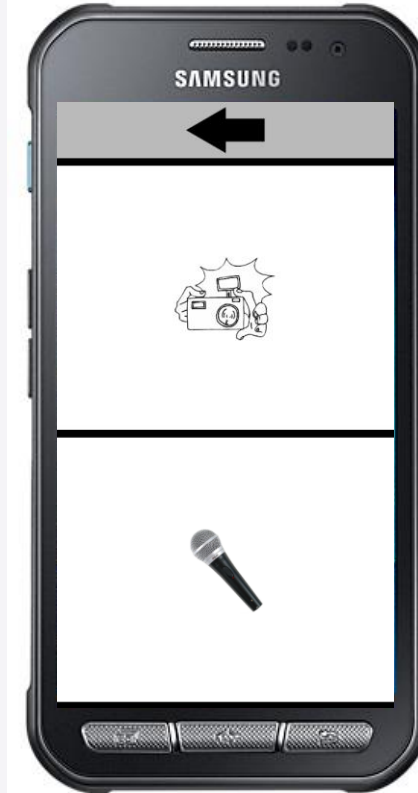
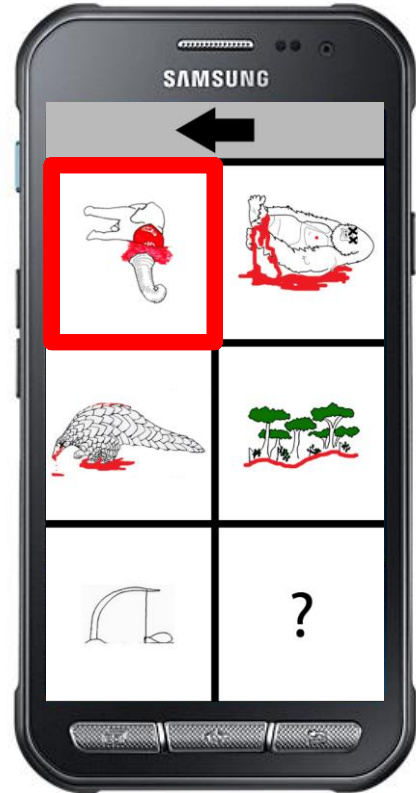
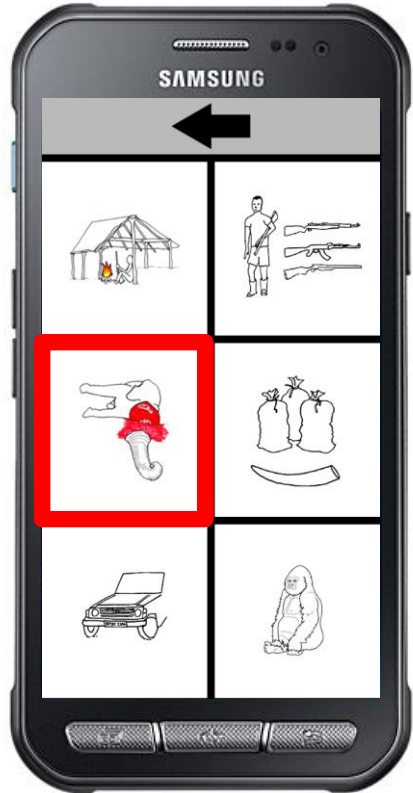




Sapelli is an open-source project that facilitates data collection across language or literacy barriers through highly configurable icon-driven user interfaces. We encourage people to download the app from the [Google Play store](#), or from our [GitHub repository](#) and deploy it for their own purposes.

The sequence of interfaces that will be presented to the user in the project is described in the project's XML file. The transmission of complete records is handled autonomously by the Sapelli platform, which periodically checks for connectivity and determines the most appropriate means by which to transmit the compressed data to another phone or a [GeoKey](#) web server.

This website should help to get started with creating bespoke data collection apps that meet individual requirements.







# Training and support





# Data collection

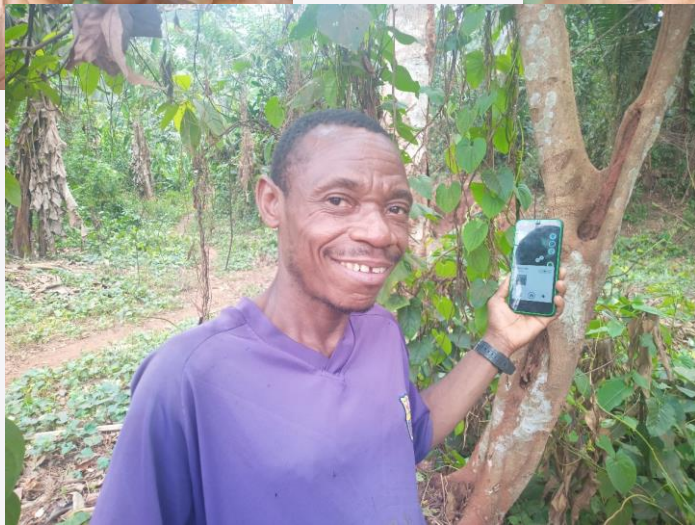
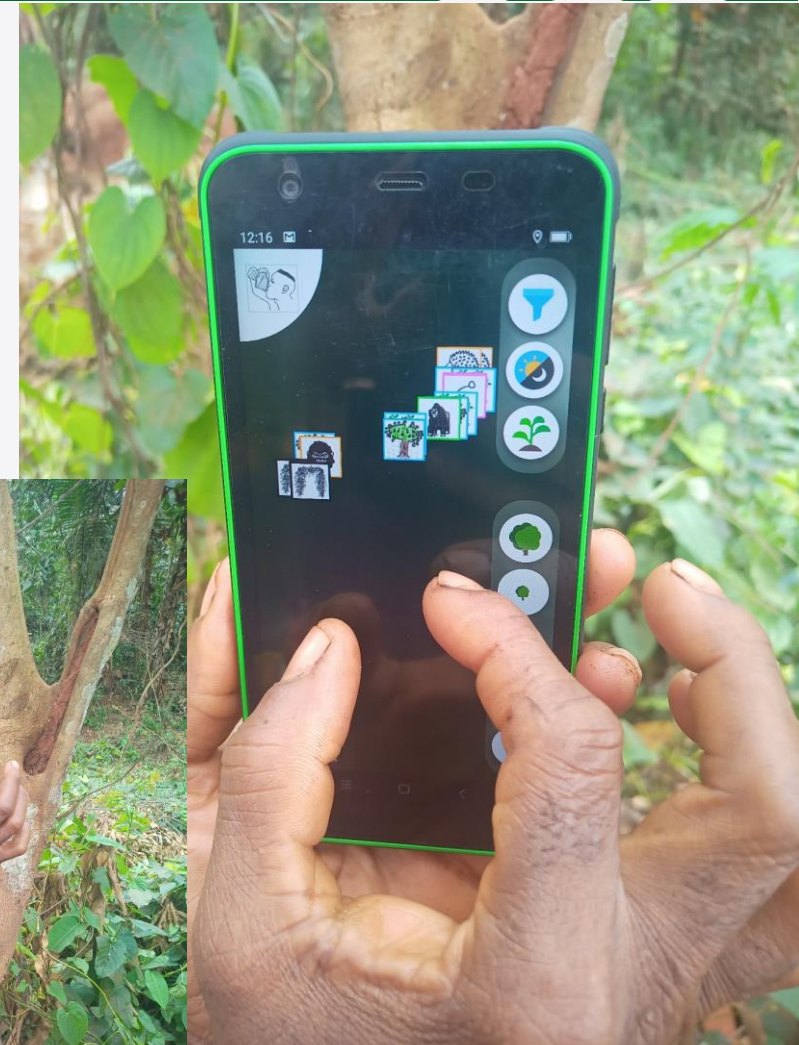
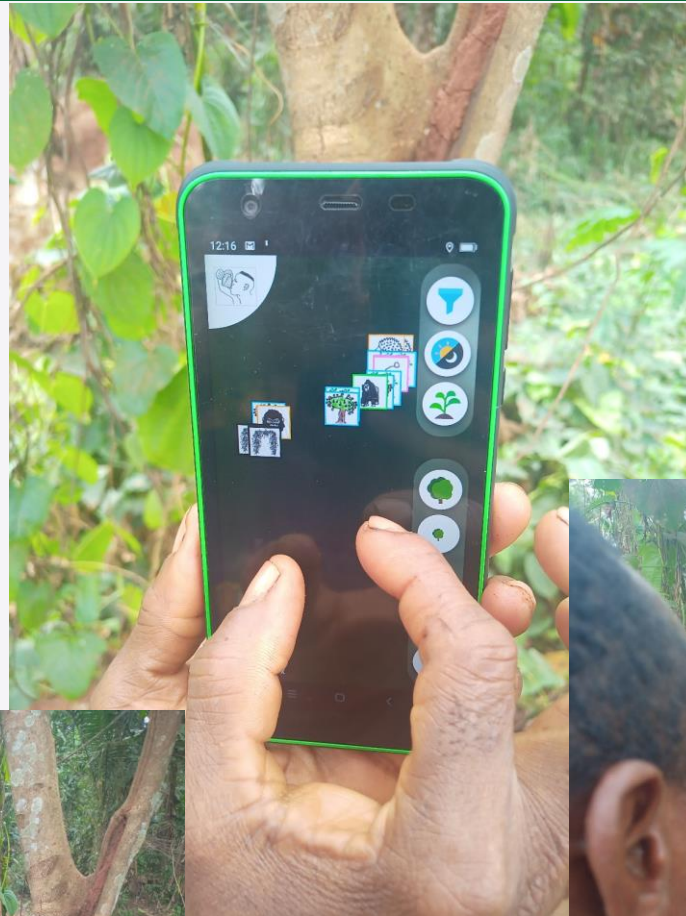


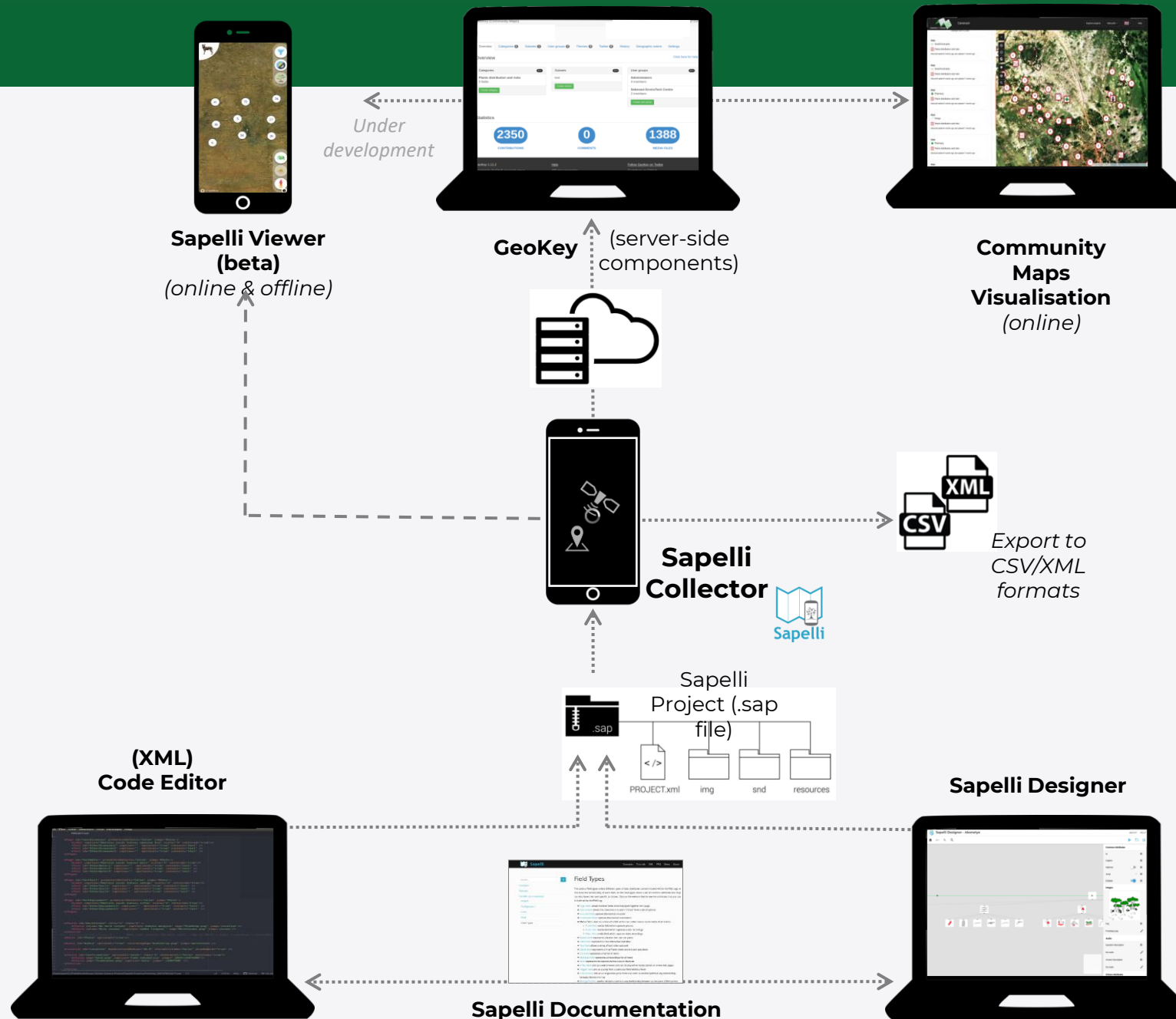




**ExCiteS** | Extreme  
Citizen  
Science

# Sapelli Viewer







UCL ECSanVis Project



Extreme Citizen Science

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## THE PROCESS OF SETTING UP A SAPELLI PROJECT

- We're now going to describe 4 steps we take in ExCiteS projects when we collaborate with local and indigenous people who want to use citizen science to tackle some of the issues they face.
- Each of these steps is essential to each project, but we present four different case studies to illustrate these steps below.

**Step 1 - Free, Prior and Informed Consent**

Working with local and indigenous communities involves ethical considerations. With examples from **Kenyan** case studies with **Maasai** and **small-scale farmers**, we illustrate the implementation of a Free, Prior and Informed Consent process, and the establishment of community protocols to help harmonise and equalize relationships between groups of different power and means ([Lewis, 2012](#)).

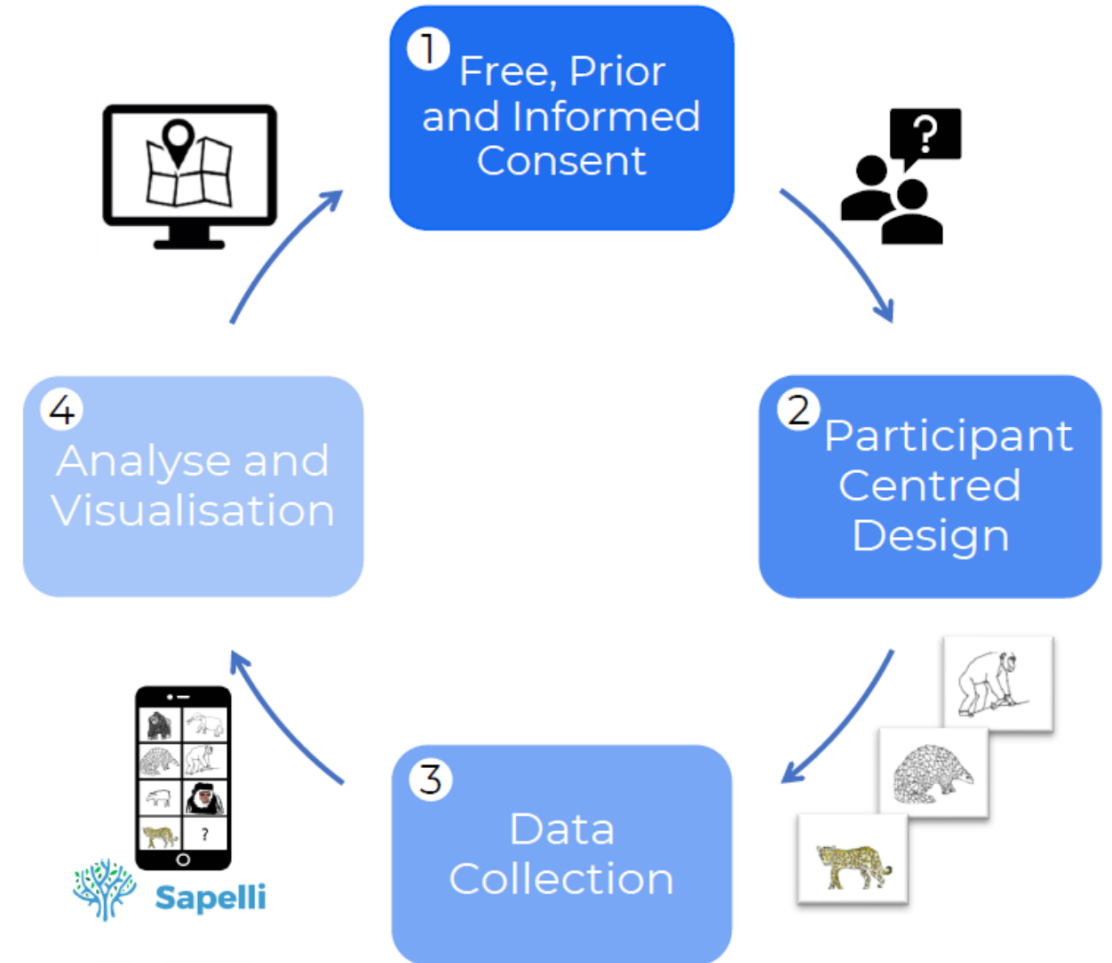
**Step 2 - Participant Centred Design**

To make Sapelli technology relevant to indigenous users, it is necessary to focus on the participants, their experiences and their concerns to [design a Sapelli project](#). To illustrate this process we will move to **Brazil - Amazon** where the **Ashaninka** community monitors poaching and logging.

**Step 3 - Data Collection**

When technology is adapted to the users, they can collect data according to their definition of the problem and their routines. We will see how **Mbendjele BaYaka Pygmies** collect data about poaching and logging issues in the **Republic of the Congo**.

**Step 4 - Analyse and Visualisation**



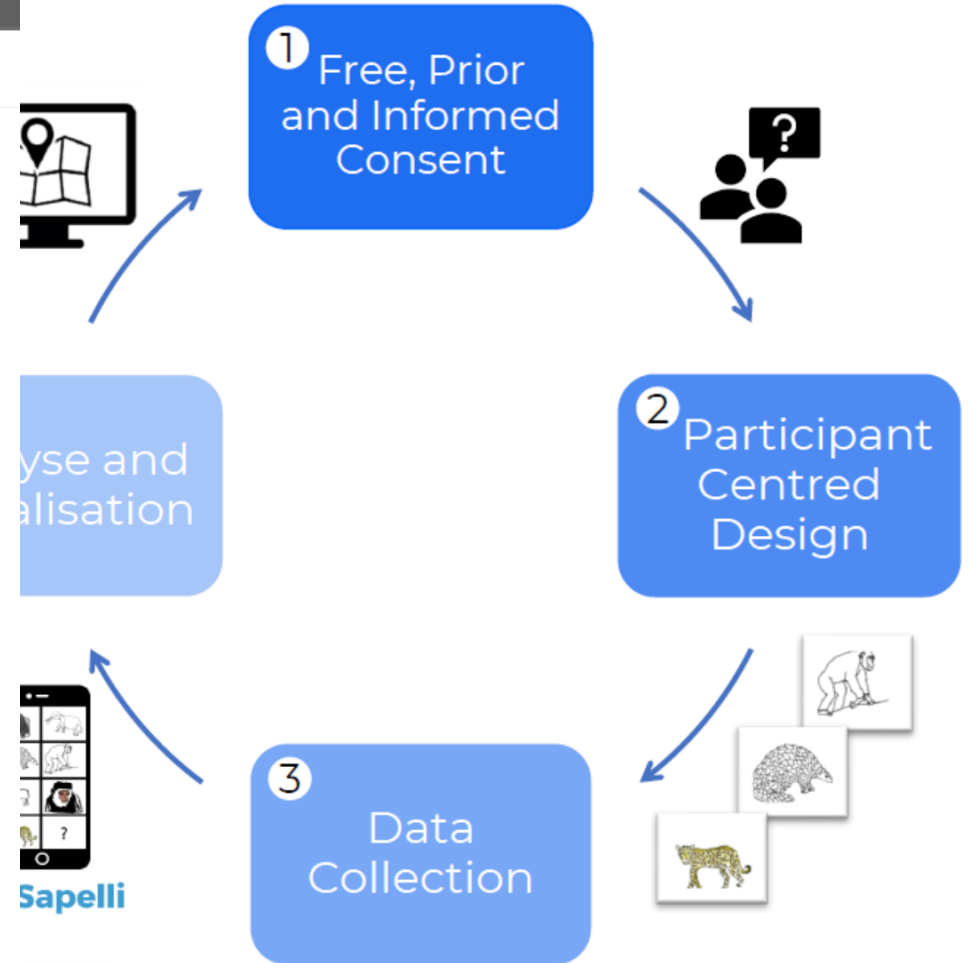
**METHODS article**  
Front. Ecol. Evol., 01 July 2021 | <https://doi.org/10.3389/fevo.2021.638870>

# Using Sapelli in the Field: Methods and Data for an Inclusive Citizen Science

Fabien Moustard<sup>1\*</sup>, Muki Haklay<sup>1</sup>, Jerome Lewis<sup>1</sup>, Alexandra Albert<sup>1</sup>, Marcos Moreu<sup>1</sup>, Rafael Chiaravalloti<sup>1,2</sup>, Simon Hoyte<sup>1</sup>, Artemis Skarlatidou<sup>1</sup>, Alice Vittoria<sup>1</sup>, Carolina Comandulli<sup>1</sup>, Emmanuel Nyadzi<sup>3</sup>, Michalis Vitos<sup>1</sup>, Julia Altenbuchner<sup>1</sup>, Megan Laws<sup>1</sup>, Raffaella Fryer-Moreira<sup>1</sup> and Daniel Artus<sup>1</sup>

<sup>1</sup>Department of Geography, Department of Anthropology, University College London, London, United Kingdom  
<sup>2</sup>Smithsonian Conservation Biology Institute, Conservation Ecology Center, Washington, DC, United States  
<sup>3</sup>Department of Environmental Science, Wageningen University and Research, Wageningen, Netherlands

The Sapelli smartphone application aims to support any community to engage in citizen science activities to address local concerns and needs. However, Sapelli was designed and developed not as a piece of technology without a context, but as the technical part of a socio-technical approach to establish a participatory science process. This paper provides the methodological framework for implementing and using Sapelli in the field. Specifically, we present the role of Sapelli within the framework of an “Extreme Citizen Science” (ECS) methodology that is based on participatory design. This approach enables Sapelli’s users to decide, with the help of professional scientists, which challenges they wish to address, what data to collect, how best to collect and analyse it, and how to use it to address the problems identified. The process depends on the consent of participants and that the project is shaped by their decisions. We argue that leaving ample space for co-design, local leadership and keeping Sapelli deployment open-ended is crucial to give all people, and in particular non-literate people who we have found are often the most ecologically literate, access to the power of the scientific process to document and represent their concerns to outsiders in a way that all can understand, and to develop advocacy strategies that address the problems they identify.



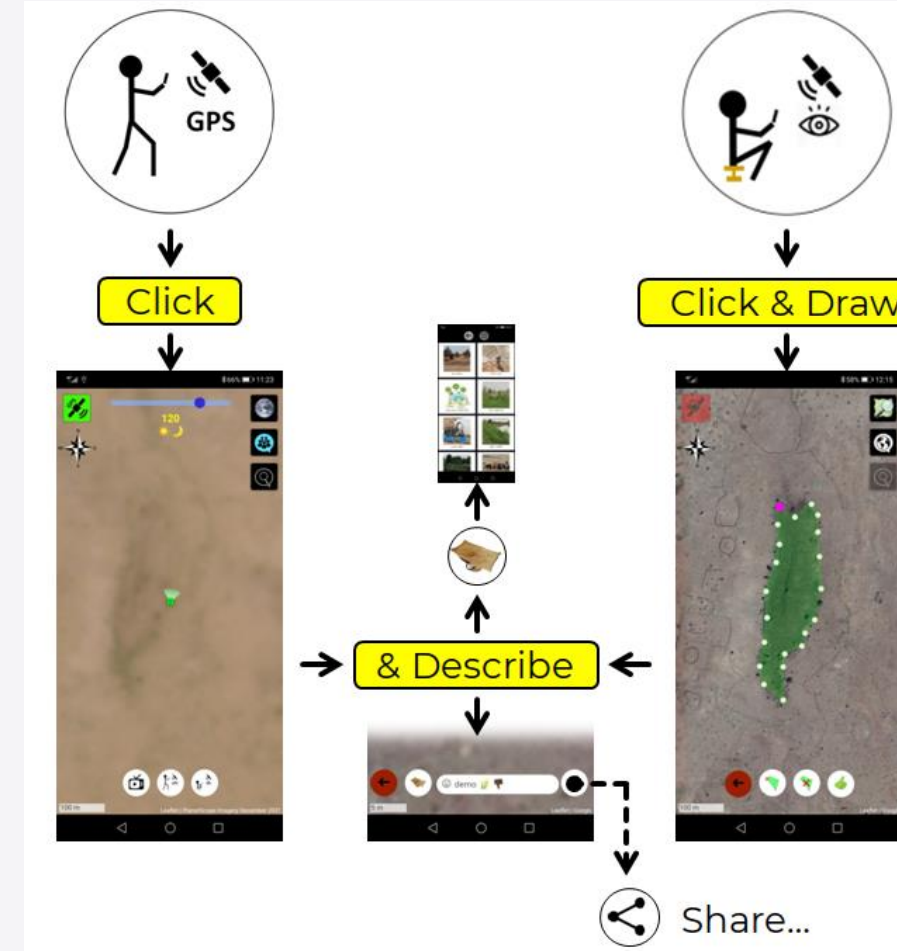
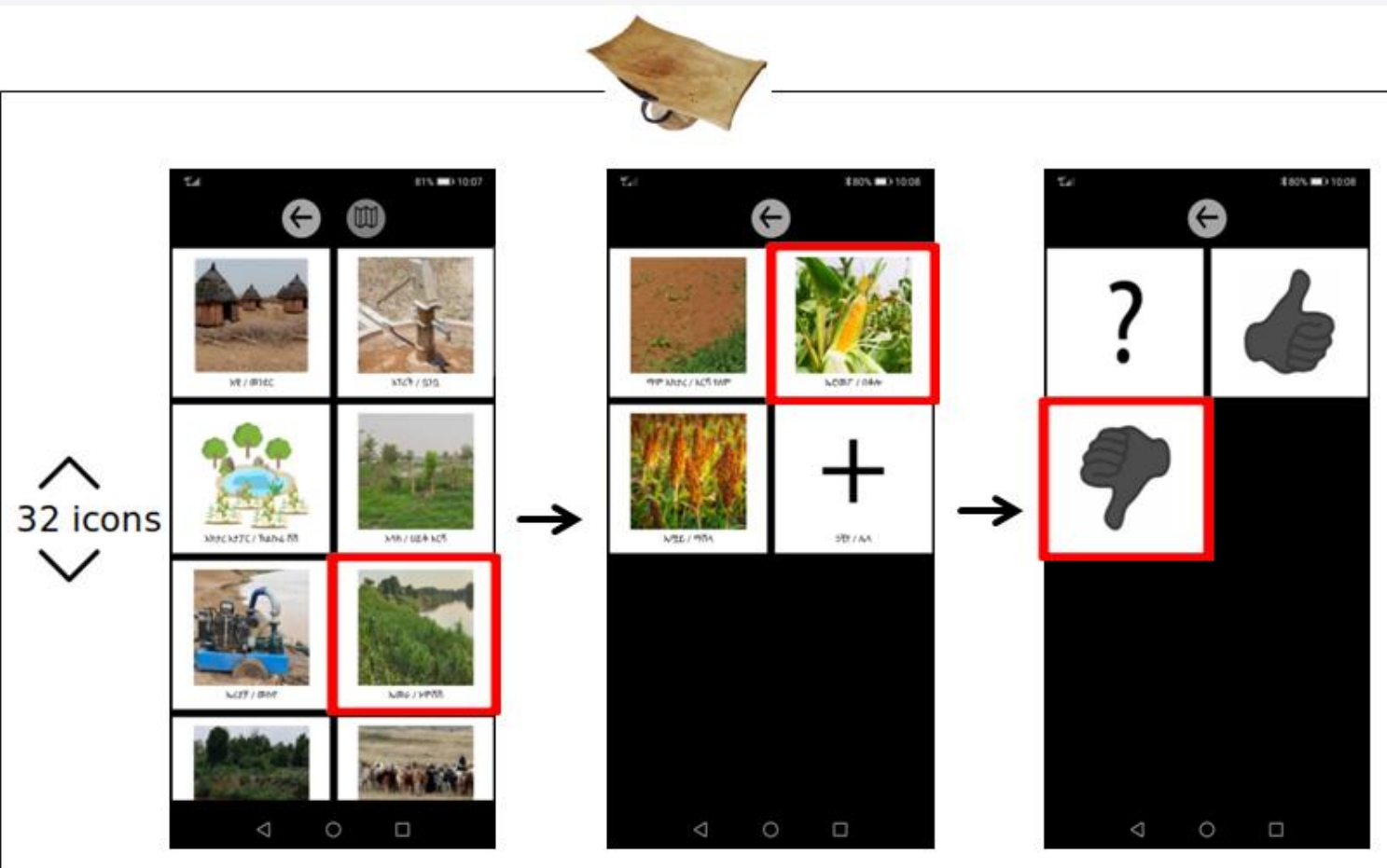


- With appropriate support, anyone can co-create citizen science





- Co-production can include sophisticated and complex data collection





**Extreme Citizen Science (ExCiteS)** is a situated, bottom-up practice that takes into account local needs, practices and culture and works with broad networks of people to design and build new devices and knowledge creation processes that can transform the world.

#### Collaborators:

Locacons project, Arba Minch University, British Institute in Eastern Africa, Maasai Mara University, University of Eldoret, Procol Kenya, Environmental and Economic Resource Centre, Nyae Nyae Conservancy (NNC), Ju/'hoan Traditional Authority Namibia (JUTA), Nyae Nyae Development Fund Namibia (NNDNF), Association Sanguia Baka Buma a Kpodé (ASBABUK), World Wild Fund (WWF), The Minister of Forests and Wildlife (MINFOF), London Zoological Society (ZSL), Wageningen University, University for development studies, HydroSense Lab, Indian Institute of Technology Delhi (IITD), Keystone Foundation, National Biodiversity Authority (NBA), Danmission, Copenhagen University, Forest & Peoples Organization, Ecology and Action (eoca), Brazilian agency for protected areas (Icmbio), Brazilian ministry for the environment (Ibama), Kunangue Aty Guasu, Mapping for Change, Congolaise Industrielle des Bois (CIB), PALF-Congo, World Resources Institute, African Parks, Wildlife Conservation Society, Congolese Human Rights Observatory, Ndima-Kali.

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#### Acknowledgements:

We wish to acknowledge all the community members around the world who collaborate with us. They play a central role in helping to shape the implementation of Sapelli.

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 694767 and ERC-2015-AdG).



**Ghana: Combining Indigenous Weather-forecasting with Satellite Forecasts** Local farmers developed a project to collect indigenous ecological indicators and forecasts towards the development of climate services that combine indigenous and scientific forecasts.  
*Emmanuel Attah*



**Cameroon: Anti-poaching and wildlife monitoring** As poaching and exclusion from conservation are key concerns of Baka and Nzime/Fang communities, Sapelli projects empower local people to report activities and monitor the forest around them. *Simon Hayte*



**Cameroon: Recognising Indigenous Territories** The Sapelli digital tool supports the recognition of the key role of Baka hunter-gatherers indigenous people in protecting forests.  
*Fabien Moustard*



**Central African Republic: Resource protection during logging** Bayaka and Sangha-Indigenous People developed a Sapelli project to protect their key forest and aquatic resources from damage during logging operations.  
*Gil Conquest*



**Ethiopia: Crisis mapping by affected agro-pastoralists for food security** Agro-pastoralists communities in the Lower Omo, co-designed a project to map their natural resources to address issues related to food insecurity, water inaccessibility and conflict.  
*Marcos Moreu Badia*



**India: Monitoring human-forest relations** Nayaka people together with local environmentalists, are developing a Sapelli project to monitor human-animal conflict, forest resources and landslide and floods-related damage in the forest.  
*Isaac Lavi & Simon Hayte*



**Cambodia: Monitoring illegal logging** This Sapelli-inspired forest monitoring tool supports the advocacy of indigenous Kuy and Khmer communities and their efforts to protect their forest and livelihoods (The Prey Lang app).  
*Dimitris Argyriou*



**Brazil Amazon: Mapping land invasions on Indigenous territory** Ashaninka developed a Sapelli project to record illegal invasions by loggers, drug traffickers and poachers on their territory.  
*Carolina Comandul*



**Brazil Pantanal: Mapping fishers' territories** Pantanal fishers developed this version of Sapelli to allow them to represent their traditional areas of fishing to claim tenure rights.  
*Rafael Chavarinho*



**Brazil Pantanal: Mapping restoration areas** Pantaneiros are helping to monitor restoration initiatives in the Pantanal. They use their local knowledge to inform about the effectiveness of the restoration activities.  
*Rafael Chavarinho & Thiago Izzi*

**Brazil: Mapping violence** Developing a Sapelli project with Guarani and Kaiowa communities who don't separate nature from culture - showed us that environmental monitoring involves social and humanitarian monitoring too.  
*Rafaela Priyler-Moreira*

**Nigeria: Land use messaging & mapping for collaborative Climate-smart Agriculture** Smallholders co-designed a project to map their farms and report farming issues through WhatsApp to receive timely advice from agricultural extension officers and other farmers. *Marcos Moreu Badia*

**Namibia: Protecting water holes for wild animals from damage by cattle herds** A Ju/'hoansi effort to identify cattle herders invading their conservancy by photographing ear tags on cattle, with time, date and geotag to provide evidence to police. *Megan Laws*

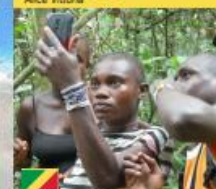
**Namibia: Monitoring and reporting on the health of wildlife** Ju/'hoan rangers using Sapelli to monitor and report on the health of wildlife in the conservancy for the purposes of setting quotas for sustainable hunting.  
*Megan Laws*

**Republic of the Congo: Human - Wildlife conflicts** Local communities suffering crop damage caused by elephants, buffalo and apes developed a project to record the damage and report it to the relevant authorities in order to receive compensation. *Gil Conquest*

**Zambia: Mapping urban flooding and supporting rural livelihoods** Mapping urban flooding and Chikanda orchids to support sustainable livelihoods for women and improve Community Forest management.  
*Nicholas Wrightman*

**Republic of the Congo: Conservation - IPLC conflicts** BaYaka hunter-gatherers developed a Sapelli project to record abuses against them by Eco-guards, to report on poachers and animal sightings.  
*Jerome Lewis*

**Republic of the Congo: Participatory forest management** BaYaka hunting and gathering communities designed a Sapelli project to map key forest resources and community areas in an effort to participate in forest management within a logging concession.  
*Alice Vittoria*







# Summary

- Citizen science has a potential at all levels of research – from applied to frontier
- ECSAnVis demonstrated that with appropriate support, any community can engage in citizen science – science is too important to be only for scientists
- As citizen science gains its place within science, we should consider when to use it, how, and ensure that it remains inclusive and open