GYA North-South Interdisciplinary Grant 2019/20
Final Report

Title of the Project: Citizen Science for reducing exposure to urban air pollution

Participants: Ibrahim Sidi Zakari, Lisa Herzog, Robert Lepenies

Goals: The overall goal of this project is to investigate the potential of citizen science to advance air pollution-related Sustainable Development Goals (SDGs) in Niger and Germany in a way that is at the same time concrete, ethically informed and collaborative, in order to be effective.

Outcomes:

In December 2019, Ibrahim Sidi Zakari was a visiting scholar at the Helmholtz Centre for Environmental Research (UFZ) in Germany, where he collaborated with Robert Lepenies and Lisa Herzog as well as with local researchers in the field of environmental politics, statistical modeling and urban sociology. The team worked on the problem of air pollution, its impact on health, recruitment of volunteers for crowdsourcing activities as well as the optimal sample size. They also addressed practical and ethical questions related to data collection, validation, processing of data from citizen science initiatives and their management, and reached out to open source platforms. With the acquisition of 6 latest generation *flow 2* type pollution sensors capable of measuring ultrafine particles, the team performed local measurements in Leipzig (Germany) in December(see interim report) and additional measurements campaigns(Figure 1) are in progress in Niamey(Niger) since January 2020. These measurements are very important for air quality monitoring, modeling and forecasting.
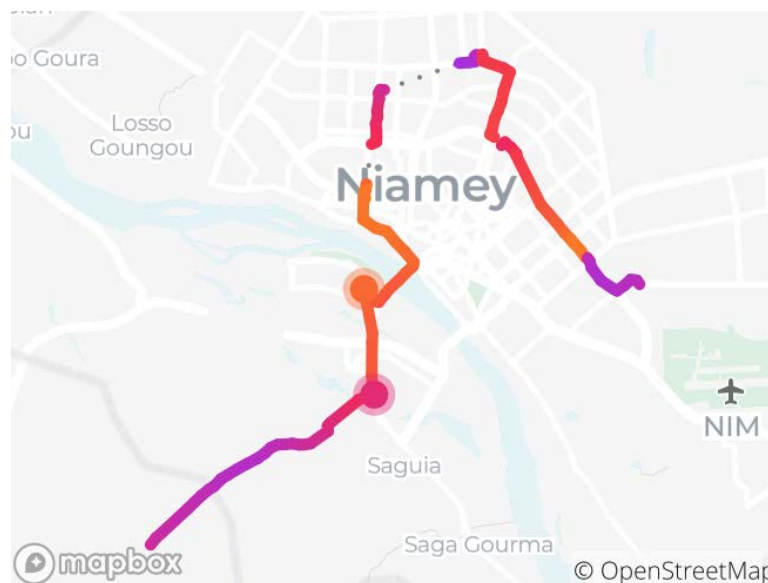

Figure 1. Air quality measurement in Niamey(Niger) based on flow 2 sensor

Our project also led to the integration of crowdsourced data on cooking technologies and fuels into mobile and web apps (*ENERGY TSAPP*) for promoting clean cooking (Figures 2-3).
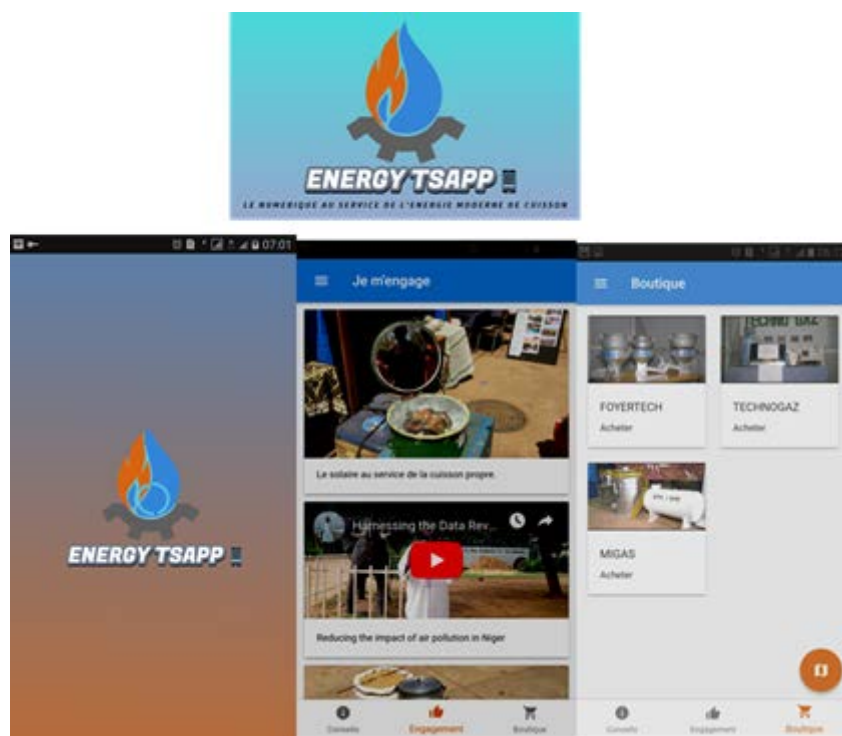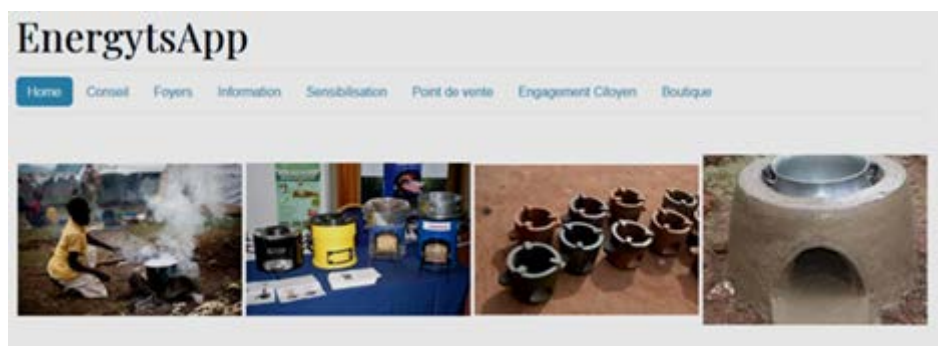

Figure 2. ENERGY TSAPP mobile app prototype

Figure 3. ENERGY TSAPP web app prototype

The aforementioned activities were conducted in a collaborative manner involving scientists and citizens throughout in person (and online) meetings (Figure 4).

Figure 4. Presentation on local software and tools dedicated to air quality monitoring in Niamey

In addition to collaborative research, the team has concentrated on outreach: presenting on the topic at conferences and in papers, and connecting to organizations in Europea and Africa (for example, World Wide Generation to explore possible collaboration on SDG reporting). Due to current pandemic travel and contact restrictions, planned workshops on citizen science in Niger and Germany are on-hold, but the group continues to collaborate on statistical modeling options, papers and dissemination. The group also linked to and attended meetings of the EU funded project https://www.weobserve.eu/about/.

Regarding the broader societal and political questions concerning the role of citizen science, Robert Lepenies and Lisa Herzog are finalizing a paper to appear in a special issue of *Minerva*, on the role of citizen science from the perspective of deliberative systems theory, in which they connect the literature on citizen science with the literature on epistemic justice and deliberative politics. Moreover, Herzog is co-organizers of a conference that was cancelled due to Corona but will soon take place as an online event, on "Knowledge, Citizenship and Democracy".
See a full interim report here.

Publications:

[1] Ibrahim Sidi Zakari. «*Bridging data gap for understanding emerging issues in Niger: challenges and opportunities in the era of smart cities and smart villages*». Proceedings of the 1st IEEE International Conference on Natural and Engineering Sciences for Sahel's Sustainable Development-Impact of Big data application on society and environment. Ouagadougou, Burkina Faso, 04-06 February 2020.
https://ieeexplore.ieee.org/document/9069593

[2] Ibrahim Sidi Zakari. «*Harnessing the potential of real-time data analysis and statistical modeling for mapping exposure to air pollution*». Advances and Applications in Statistics' Journal. Volume 61, Number 2, 2020, pp. 169-181, **2020.** http://dx.doi.org/10.17654/AS061020169

[3] Robert Lepenies, Ibrahim Sidi Zakari. «Citizen Science for transformative air quality policy in Germany and Niger». Under review in Sustainability journal; special issue on Citizen Science Projects for Environmental

[Challenges and Sustainable Development Goals](#).

[4] (*to be finalized and submitted for review*) Herzog, Lisa, and Robert Lepenies: "Citizen Science from the perspective of deliberative systems", for special issue of *Minerva* (edited by Peter Weingart)

Communication:

[1] Ibrahim Sidi Zakari, Robert Lepenies. *«Harnessing the potential of Citizen Science for advancing air pollution related SDGs in Germany and Niger». Knowledge for Change: A Decade of Citizen Science (2020-2030) in Support of the SDGs' Conference*, Berlin(Germany). 14-15 October 2020. *https://www.cs-sdg-conference.berlin/en/*

[2] Lisa Herzog, „Wer entscheidet, wessen Wissen zählt?", Conference „Demokratie und Wissen", Bayerische Akademie der Wissenschaften, 27./28. Jan 2020, http://faktizitaet.badw.de/veranstaltungen/demokratie-und-wissen.html

Challenges and insights:

- Covid-19 impacts on project activities
- cancellation of many events
- postponement of other events, then online versions
- additional burdens because of online teaching and childcare for some project members
- Reliability of measurements from air quality low cost sensors
- Language barriers when interacting with citizen scientists who speak only one language (English, French or German)
- Difficulty of starting a citizen science project without being longer term institutionally embedded

(if applicable) Activities expected to be continued (either as a group or individually, based on grant project work):

- Submitting Research Assistants(RAs) work for publication. It is important to recall that we have recruited three (3) RAs who respectively worked on :
1. Air quality data analysis and statistical modelling (measurements from low cost sensors and online estimations/forecasting).
2. Air quality data analysis and statistical modelling (measurements from reference ground stations in Niger).
3. Development of interactive tools for assessing citizen science literacy and air pollution exposure awareness.
- Applying for additional funding/ competitive grants
- blog post about the *Minerva* article once it gets accepted
- Improvement of *ENERGY TSAPP* mobile and web apps for promoting clean cooking (based on crowdsourced data) in Niger.

APPENDIX

1. Overview of additional activities conducted after the interim report.

Activity
2.1 Prototyping and pilot tests for calibrating low cost sensors
2.2 Logistics, field visits, interviews and research dissemination
3.1 Two (2) students assistants from Abdou Moumouni University(AMU)for data analysis and statistical modeling, Number of hours: ca. 60
3.2 Two(2) Flow 2 air quality personal sensors for measurements in Germany
3.3 One (1) student assistant (from AMU): for developing interactive tool (online quiz) for assessing citizen science literacy and air pollution exposure awareness Number of hours: ca. 35
3.5 Participation to Berlin Conference on Citizen Science and SDGs(Robert and Ibrahim)

Breakdown of activity 2.1: Prototyping and pilot tests for calibrating low cost sensors
Equipment
Digital data collection and processing device with accessories
Field tests internet modem device
Data storage units(hard drive 3.0+microSD card+usb 3.0)
Portable power station/rechargeable baterry power

Arduino kits for humidity, temperature, wind, gas and particulate matters sensors
Portable sensor's data visualisation device

Data collection, simulation and monitoring
Development of data collection/processing infrastructure(ODK framework)
Development of multi agents based pollutants emissions simulation tool
Development of data visualisation tool/analytics (sensors, reference instruments)