Citizen Science as a Tool for Transdisciplinary Research and Stakeholder Engagement

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Abstract

This presentation describes a vector-borne disease risk reduction project conducted in Brazil and Peru as part of USAID's Combating Zika and Future Threats Initiative. The myriad factors contributing to vector borne disease risk stem from interactions in a system that includes local ecology and environmental parameters, urbanization, access to health services, economic resources, human behavior, and the presence of disease vectors and pathogens. The emergence of technologies such as smart phones, cloud-based data servers, and data visualization and analysis tools have fostered rapid growth in citizen science programs and tools. The phenomenon of citizen science is seen by many as an important sociocultural development that has the potential to democratize science. While a number of citizen science projects may be characterized as transdisciplinary research, in many cases stakeholder engagement is limited to participation in crowd-sourced data collection. In this project, the stakeholders- educators, students, community leaders and public health officials- all contributed to the project at levels of effort and in ways that were most meaningful for them. A key innovation employed in this project was a mobile citizen science app that enabled stakeholders to locate, identify and mitigate mosquito breeding habitats. While there are many data collection apps that enable citizen scientists to report environmental observations for use by the science community, the NASA GLOBE Observer Mosquito Habitat Mapper also enables users to tally their efforts as they eliminate mosquito oviposition sites. This app capability supports municipalities keen on promoting behaviors that reduce the risk of vector-borne disease. We discuss the transdisciplinary approach employed through each phase of the project: ideation, realization, experimentation and evaluation, and how prioritizing local stakeholder knowledge and experience resulted in recommendations that will be used to improve a citizen science app that is employed internationally.

GC23F-1463 Citizen Science as a Tool for Transdisciplinary Research and Stakeholder Engagement

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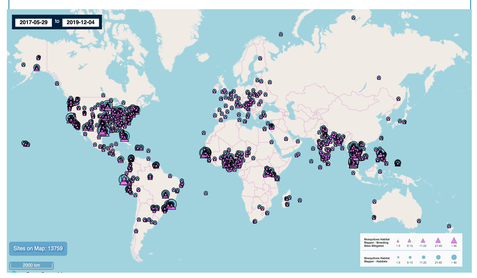
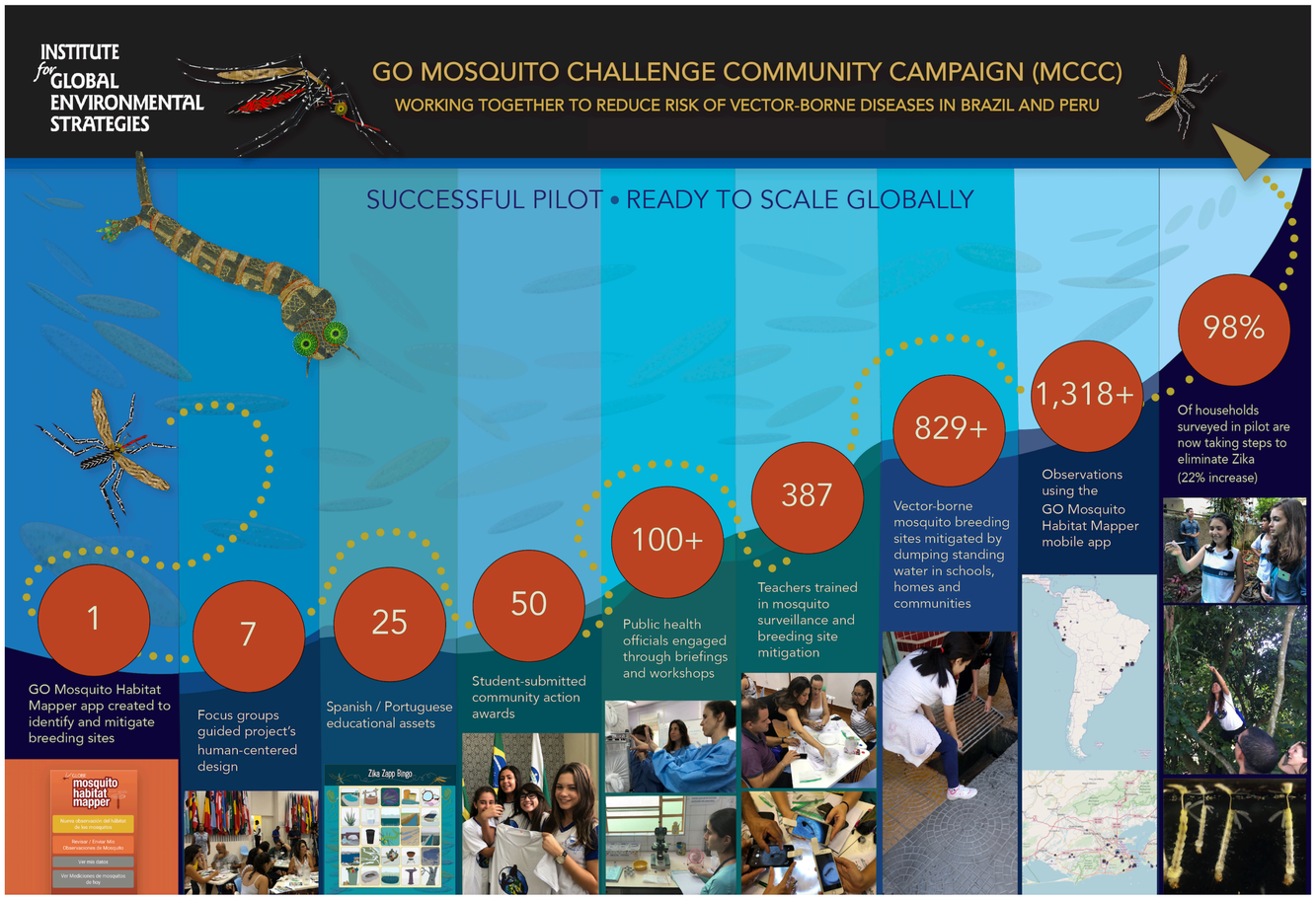
Introduction

The GO Mosquito Challenge Community Campaign was a vector-borne disease risk reduction project conducted in Brazil and Peru through USAID's *Combating Zika and Future Threats* Initiative. When a mosquito- borne disease has no vaccine, there are only 3 options available for communities to protect themselves from disease risk: surveillance, mitigation and education. This project engages stakeholders in all three. We employed a citizen science mobile app and open database (screenshot, below) to engage teachers, students, parents and the community in vector research, education and adoption of vector-borne disease risk-reducing behaviors.





Discussion

In this project we used a transdisciplinary case study approach, employing a, "process of mutual learning and joint problem solving, in which scientists from different disciplines collaborate with practitioners to solve real-world problems," (Scholz et al. 2006). We engaged 6 communities which participated in a 2-year pilot in which citizen science project stakeholders in this study actively contributed to research, engaging both their interest and knowledge in co-creation of local outcomes. The educators, students, community leaders and public health officials co-created this project and contributed at levels of effort and in ways that were most meaningful for them.

COMMUNITY INFLUENCERS

Currently the children, their parents and the teachers are all involved and engaged in collecting data in their communities, encouraged by each other. This lets the app multiply its impact outside school activities and expand its reach to community organizations or institutions.

"When placing traps we went all together as a family to do it. Let's do it in this place, it looks more strategic. This is good because we can contribute to reducing disease." Parent, Montessori School, Piura.

"We are from Catacao and during the 2017 el Niño event, our town and school was flooded. My son's teacher gave us 5 mosquito traps and we put them in our home and around the neighborhood. We captured mosquitoes and used the app to identify them." Parent, Montessori School, Piura, Peru.

"Two of my students live in a borough without basic services. They took larva samples from their water storage tank. They had the community to put a lid on the tank so mosquitoes can't lay eggs there." Teacher, Minas Gerais School, Rio de Janeiro.

TECHNOLOGY AND PUBLIC HEALTH

People use the data they collect from the app to influence change in their community by sharing their findings. Letting people have access to data they upload more easily can help them impact their environments positively.

"The local municipality used to tell us there are no (Zika) mosquitoes here in Negritos. The students presented where they found mosquitoes to the mayor. We went there to show them our data findings of Aedes mosquitoes developing in standing water and proved them wrong. We did it so that the municipality would know where to focus for eradication and fumigation." *Parent, José Pardo School, Negritos, Peru.*

CO-CREATING IDEAS

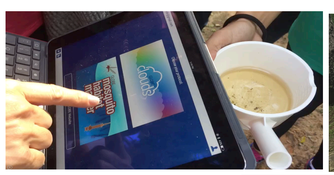
After participating in the project, participants were invited to describe what improvements they would like to see in the tools used in the project and the engagement process.

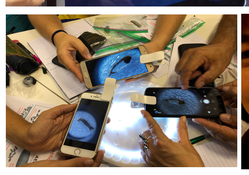
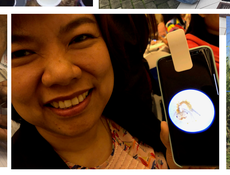
"I think the work you are doing is really good because it involves the students, but don't just invite one parent, invite and train them all." Parent, Montessori School, Piura, Peru.

"We like the different guides and instructions that the app gives us with different videos, but it would be good to add more didactic content (more images, less text. We young people get bored by reading." Student, San Isidro School Tombogrande, Peru.

Mosquito Habitat Mapper

The ***Mosquito Habitat Mapper*** is a citizen science tool found on NASA's *GLOBE Observer (GO)* mobile app. The *Mosquito Habitat Mapper* is directed at improving human health in three ways, by: (1) teaching the user to recognize and mitigate the habitats where mosquitoes preferentially oviposit, (2) providing an interface for users to be part of a global observation network documenting the relationship between mosquito vectors and the environments they occupy, and (3) tallying and rewarding users each time they remove an oviposition site from use, thus encouraging vector risk reduction behavior. Citizen science observations are used by scientists to build risk models of future disease threats, but a powerful Incentive for collecting data is how users become agents of change, reducing the risk of mosquito-borne disease in their communities. This project partnered with the Country Coordinators of the GLOBE (*Global Learning and Observations to Benefit the Environment*) Program in Brazil and Peru.


Results

"The app informs my daughter- she informs me and then I can tell my neighbor. It's beautiful because then all of us learn and have the information and can prevent diseases, and even can talk to the mayor about it." *Parent, José Pardo School, Negritos, Peru.*

The transdisciplinary approach contributes scientific data used both by communities to develop mosquito control strategies and by scientists who develop risk-forecast models of disease. By conducting field research with adolescents, we supported community will for improved science instruction in classrooms and thus obtained high household buy-in. Metrics of success were obtained through pre- post surveys to 177 households that described statistically significant improvement in the adoption of disease-reducing behaviors. Vector education is critical, but unless it promotes a change in behavior that leads to fewer breeding habitats, it will have minimal effect on vector control (Castro 2016). A total of 50 science research projects were submitted by adolescent student teams across 6 communities, and cash awards to each of the teams were used for actions they identified to reduce the risk of disease in their communities- from cleaning and repairing gutters to hosting community awareness events and creating public service announcements. The outcomes of this intervention inform implementation of a follow-on initiative, *GLOBE Zika Education and Prevention*, operating in 21 countries at vector-borne disease risk (Wegner et al. 2019).

Survey Results

Survey Prompt: Since you heard about Zika, have you taken any action to prevent your community from getting Zika? (Data demonstrated a 22% increase in risk reduction action in participating households one year after beginning of project)

	Baseline				Endline			
Response Option	**Parana**	**Rio**	**Sao Jose**	**Overall**	**Parana**	**Rio**	**Sao Jose**	**Overall**
No	9%	40%	12%	23%	0%	4%	1%	2%
Yes	91%	59%	85%	**76%**	100%	96%	99%	**98%**
Don't know	0%	0%	3%	1%	0%	0%	0%	0%
Refused	0%	1%	0%	1%	0%	0%	0%	0%
Total:	32	70	75	177	32	70	75	177

Source: IGES Final Report to USAID, Appendix 2a: Evaluation report by NORC at the University of Chicago, *Key Findings: MCCC Pilot Household Survey in Brazil*, July 15, 2018 (unpublished report)

Conclusions

The emergence of technologies such as smart phones, cloud-based data servers, and data visualization and analysis tools have fostered rapid growth in citizen science programs and tools. The citizen science movement is an important sociocultural development with the potential to democratize science. We need to put citizen science tools in the hands of people that need them most, enabling the to be agents of change in their communities. As of 12/19 more than 13K mosquito habitat observations have been uploaded. Data is open and available for use by public health officials, community members, scientists and students.

References

Castro, M.C. (2016) Zika virus and health systems in Brazil. From unknown to a menace. *Health Systems and Reform.* 2(2):119-122.
Scholz, R.W., Lang, D.J., Wiek, A., Walter, A., and Stauffacher, M. (2006)Transdisciplinary case studies as a means of sustainability learning: historical framework and theory. Int J Sustain Higher Educ 7:226-251.
Wegner, K., Murphy, A., Barfield, A., Wigbels, L., Malmberg, J., and Andersen, T.J. (2019) The GLOBE Zika Education and Prevention Project: An Interdisciplinary Project. 2019 AGU Fall Meeting, Poster GH1B-1209, Thursday AM, Moscone South Poster Hall.

Websites

GLOBE Observer: https://observer.globe.gov
GLOBE Mission Mosquito Campaign: https://www.globe.gov/web/mission-mosquito
GLOBE Database and Visualization System: https://www.globe.gov/globe-data
GO Mosquito Challenge Community Campaign: https://mosquito.strategies.org/index.php/en/

COMBATING ZIKA AND FUTURE THREATS
A GRAND CHALLENGE FOR DEVELOPMENT

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