Open and collaborative science (OCS):
a tool for the conservation and development of local ecosystems

Final Project Report

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1. Executive Summary

State revised research objectives, and how they relate to OCSDNet's initial Themes and Objectives.

The project aims at creating a partnership between academia, the private sector and the community to address community-based environmental concerns through a collaborative and action-oriented process. The project calls for a public participatory approach (PPA) that initiates at the conception level and includes all the steps of designing the intervention, carrying out the experimental work and implementing mitigation measures. PPA will ensure knowledge transfer, building local capacity and empowerment of local citizens to take sustainable and locally suitable actions. This case study taking place in Lebanon will set the framework for a university-community partnership to promote open science as a tool for rural development.

Briefly describe the core activities undertaken by your project and associated methods

One of the 80 villages that have established a working relationship with the Nature Conservation Center (NCC) was contacted to do the study. In 2015, this particular village has expressed concerns about the quality of domestic water and had placed the need for "clean water" amongst the three top environmental priorities in the village. With the help of the local officials and volunteers, water samples from 10 vital sources were collected and physical, chemical and biological water tests were performed during winter and summer. Similar tests were also conducted in the lab at the American University of Beirut (AUB). The results were shared in a workshop open to all local residents. Discussions about the quality of the water and whether or not the water can be used for drinking, bathing and food washing actively engaged the local community. Participants in the workshop were enthusiastically willing to form a "water committee" that will follow up on water testing using the instruments that were donated to the village and consequently be able to propose remedial solutions based on the scenarios that were developed in a booklet that was distributed during the workshop.

Briefly outline key observations and project findings

The community welcomed the AUB team and facilitated their work by hosting them at the municipal and medical testing lab of the village. Following, men naturally assumed the role of outdoor water collection and women worked indoors on testing the sampled water. Despite the high commitment of the women and men of the village to the proposed project, it was clearly obvious that our project does not top their priorities and so scheduling the testing and discussion events were often postponed or cancelled. At the scientific level, the involvement of the local citizens led to choosing the water sources that are most relevant to local residents. The AUB team also recognized the need to prepare learning aid tools, which included power point presentations, fact sheets, and manuals, in a simple layman language. Unlike common university practices, the highlight of the project was the build up of the local lab by donating all the tools and supplies we used for the water testing.

Briefly outline main lessons learned and recommendations for future work

The key components that ensured the success of the project are the long time trust between the community and NCC and the local support from friends, the municipality, as well as the dominant religious and political parties. Despite our cultural differences, this project taught us how to respect and adapt to the local cultural practices. It also made us realize that our project is not a priority for the local residents and our schedule does not necessarily aligns with theirs. During the whole process, it was apparent that certain people can take leading roles and some others are happy to follow. In announcing the results, which were in some cases alarming and could cause the closing of local businesses, it was extremely important to build a trust with the stakeholders and discuss with them possible remedial solutions before sharing the results with the public.

2. Research Problem

<u>State your research question and describe research approach/methods</u>

Can local communities participate in taking actions towards remedial environmental solutions after generating the necessary scientific evidence/ information?

Mixed methods were adopted to address the research question. First, we asked community members to fill out a survey to evaluate their current perception to water quality in general and to water quality in their own village in particular. This was followed by a workshop where we defined clean water and the parameters that are usually measured to determine the quality of water. At the end of the workshop, citizens were asked to identify the main water sources that they would like to test. In subsequent visits during winter and summer, we collected water samples from 10 different public and private water sources, which were tested with the community and in the university labs. We shared the data with members of the community in public seminars and discussed with them possible treatment options. Before closing the project we insisted on creating an action-oriented committee that makes use of the equipment that were provided in order to check on the water quality regularly. A citizen guide was also prepared and disseminated to help the committee and community members assess and find solutions to the water quality problems.

<u>If your research problem has changed since project inception, please explain why/how.</u>

The research problem/question stated above did not change since the project inception; however the experimental design considered one village instead of two because even with one village the time and resources that were needed to complete the project were much more than we had anticipated.

<u>How has the literature relevant to your project changed since you commenced your project? Have there been new developments in the last 2 years on your topic? Explain.</u>

A thorough literature review was made to identify all community based water quality monitoring research studies. The most recent studies in the field were published in 2016 and were similar to previous studies in evaluating the validity of data generated by citizens and its significance in driving remedial actions. The water sources monitored in those studies varied between lakes, rivers, streams, ponds, recreational water, and coastal water. Groundwater sources were solely evaluated by one study where citizens measured aquifer water level. Interestingly, the search for "citizen science" and "water quality" on Google Scholar showed an increase in the publication by 55 times as shown in Figure 1.
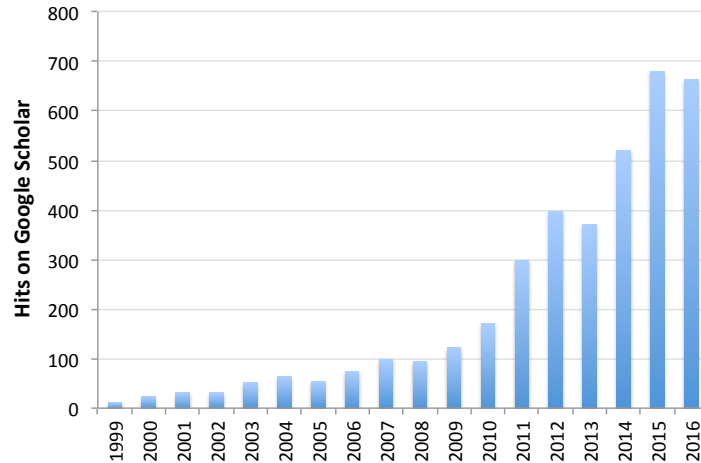
Figure 1   Increase in the number of publications derived from Google Scholar by searching for "citizen science" and "water quality" keywords

3. Research Objectives and Findings

Describe your project's specific research objectives, in relation to the objectives of OCSDNet as a whole, and how each objective has been achieved. Comment on challenges or barriers, if any.

Objectives, achievements, challenges and barriers

A. Form a partnership between academia, the private sector and the community to study and address community-based environmental concerns through a collaborative and empowering action-oriented process.

To address a community-based environmental concern, we contacted one of the villages that have previously raised a water pollution concern and explained to the municipal committee the PPA methodology that we intended to take to address the water quality in their village. The project was initiated by an open seminar that called for collaboration between NCC, the municipality, the community, and the private well owners in order to test the local water sources. Following, we trained the citizens on how to do water testing for 12 water quality parameters and held several workshops to discuss the results and most importantly how to fix some of the contamination problems in some of the water sources that distribute water to local residents. We also asked the community to form a committee from members who received good training to follow up on mitigation measures and testing the water regularly. The challenges included the commitment of the local residents, raising awareness about the danger of using polluted water at home even if they are not drinking from it, and the ability of these residents to raise their concern without accounting to political considerations.

B. Involve community members, organizational representatives and scientists in all aspects of the process, methods, results and interpretation.

The NCC team in collaboration with the municipal committee agreed to test the water quality at the source rather than testing it in households. The change in the proposed plan was based on the choice of the local residents and came after the Ministry of Health had closed one of the main public wells in the village. Following, water testing and analysis were co-implemented by the University and Community teams. It is important to mention that our efforts to make sure we

have a gender balanced participation led to the formation of two groups: men who did most of the field work (i.e. collecting water samples) and women who did the work indoors (i.e. water testing in the municipal lab). This separation came up naturally and reflected the dynamic in the local culture. Furthermore, the fact that women were quick learners, precise and cooperative emphasizes the local collaborative practices they undertake especially when they help each other prepare the household "Moune" (dried food, jams, herbal teas,..) for the winter season .

Results were disseminated in public seminars, which served as a platform for discussion between citizens, the local authority and the academic experts. During the closing event, we distributed a manual that describes the steps one can take to test the water, proposes possible quick remedial solutions, and gives links, information, and a road map on how to consult public authorities in case a major problem in the water is suspected. Water problems can be preliminary detected using the equipment that were donated by the project to the local water committee. In our opinion, the water committee empowered by scientific tools can ensure the sustainability of our initiative in the village.

C. *Build local capacity to combine knowledge with taking actions to ensure development of sustainable solutions as suggested by the whole community.*

This objective can be divided into three sections that include (i) build local capacity, (ii) combine knowledge into actions, and (iii) ensure development of sustainable solutions

(i) Build local capacity was completed via training, workshops, donation of equipment and formation of a local water committee.
(ii) Combine knowledge into actions was partially achieved by
   a. implementing corrective measures to the reservoir and connecting pipes of one of the water sources that showed contamination due to sewage infiltration and
   b. reopening the public well that was closed by the Ministry of Health after retesting the water and learning that it was safe to be used.
   c. Other water sources, which also showed bacterial contamination, have not been treated.
(iii) The development of sustainable solutions will rely on whether or not the water committee will be able to make use of the tools that were provided. Specifically, follow-up on the water quality with frequent water testing, suggest mitigation measures based on the water guidebook that was distributed, and consult with the academic team or public offices when necessary.

D. *Identify barriers and obstacles faced by actors practicing OCS coming from all stakeholders including government institutions and other scientific organizations, to understand whether and how they undermine open science practices' legitimization, and to identify and analyze tools to overcoming those obstacles and barriers.*

Several obstacles and barriers were identified throughout the implementation of this project; some of which may be applied to other actors practicing OCS and some were very specific to the local context. These obstacles are outlined below:

i. Transition from traditional science to open and collaborative science
Public participation has been the core of the Community Based Development project that NCC has experimented for the last 3 years. With the help of Municipal Councils in 80 villages across Lebanon, the team at NCC has developed a village "Green Map" database which consisted of spatially overlapped aerial photographs and valued landscape components through a

nationwide public participation GIS process. Considering the success of the green map model, researchers at NCC proposed to tackle the environmental concerns from air and water quality raised by the local communities of these villages using an open and collaborative science approach.

This approach was relatively new to us and thus we had to look into the relevant literature. It was found that the literature is rich of citizen science based studies that tackle a wide range of environmental issues such as marine litter on coastal areas, bird and frog species, oil spills, pollution in water bodies… However most of these studies focus on the validity of the data generated by citizens by comparing them to data generated by experts in laboratories. Citizens are involved in the studies mainly as data collectors after receiving the necessary education in an informal learning atmosphere. This education is thought to improve participants' scientific knowledge and engage them in the process of inquisitive thinking, and increase their ability to frame questions scientifically. However, these studies do not vary much from traditional science except in involving citizens in data collection. Further, citizens are mostly asked to contribute to data collection but their involvement in analysis and corrective measures seem to be modest.

Bearing all this in mind, our approach relied heavily on the community in all the scientific interventions, analysis and implementation phases. In our study, the community chose the water sources, formed the experimental teams, recorded and analyzed the results, discussed solutions and was committed to continue the water testing after the closure of the project. In this case we find it difficult to prepare a conventional citizen scientific publication and are trying to find a proper venue to share our open and collaborative experience with the international community.

ii.   Community outreach: political and cultural considerations

Reaching out to the community at large was a challenge. Our contact with the community was through the municipal council. We had asked the council to extend our letter of invitation to the first workshop to all local residents and emphasized on the need to have in the group balanced representation of gender and different socio-economic backgrounds. To our surprise, the letter was sent to two female-based NGOs representing the two most dominant political parties in the village. Around 50 people attended the first workshop but this number continued to decrease in subsequent meetings to reach only 8 women at the end of the study. Important to mention that our repetitive requests to involve a wider pool of citizens and organizations were ignored.

iii.   Public-private considerations

Water sources in the village included public wells operated by the Water Authority of the Ministry of Energy and Water, and private wells. Private well owners, who were reluctant to participate in the study, were assured that the water quality testing campaign aims to ensure the public good and not the shaming of private businesses.

iv.   Differences in the priorities of citizens and scientists

Research and community development in the context of an academic project are a high priority to the academic investigators. The same situation does not apply to citizens who are engaged in the project as volunteers. This creates an imbalance in the work progress since both parties are equally involved in the project. As such, citizen science projects conducted in a PPA puts the conventional methodology that is usually bound to timeline and clear deliverables into question.

Describe your project's findings - what do your findings suggest about the nature/context of open science in development?

In our project, a PPA approach was applied to assess the water quality in a Lebanese village and lay a groundwork for suitable solutions. The training of the citizens on water quality measurements required assembling a mobile laboratory that can be transferred to the village in addition to developing protocols, data forms, and educational support materials. After all the preparations were made, citizens performed the water tests, generated data was validated and interpreted, then results were disseminated and possible remedial solutions were discussed.

Specific findings and recommendations are:
- Establish an academic-community committee that takes into consideration the local socio-cultural and political affiliations and includes the marginalized groups.
- Respect and adapt to the local cultural practices
- Understand that citizen science projects are done on an ad-hoc basis and are not the citizens' priority
- Identify key personnel in the group and assign major tasks to people who can take leading roles and minor tasks to others who can follow
- Develop with the community an action plan that ensures the participation of all stakeholders.
- Prepare visuals and written learning aid tools that start by stating the obvious
- Build local capacity by providing the community with all needed materials that will ensure sustainability beyond the end date of the project
- Avoid scandals with the community and work on finding solutions that secure sustainability, avoid conflicts and ensure continuous trust.

4. Project Implementation and Management
Briefly describe completed activities in the table below.

Completed Activities (February 2015 - 2017)	
Type of Activity	*How does this activity relate to your research and OCSDNet's objectives*
Review village map database	This activity was essential to identify a target community for this study.
Prepare and submit IRB application	All research studies involving human participation must be approved by the university Institutional Research board.
Project introduction seminar	This seminar introduced the project to the local community and identified community members interested in participating in the proposed study.
Participatory identification of water sampling locations	This activity aimed to engage citizens in identifying and deciding on water sources to be tested.
Producing water quality fact sheets	These fact sheets educated citizens about water

	quality parameters and their testing techniques.
Winter water quality measurement campaigns	This activity aimed to train local citizens on the different procedures conducted during water sampling and water quality measurements to build local water quality monitoring capacity.
Dissemination of initial findings	This activity aimed to disseminate the results to the wider community and established an open exchange of information platform between the team members and different stakeholders.
Summer campaign	Same as winter quality measurement campaigns.
Drafting of a citizen guide to evaluate and treat water contamination problems	This guide contained facts and instructions on water quality, water quality monitoring and water treatment techniques. It served as a quick action guide for community members willing to take part in water quality monitoring and treatment.
Project closing action-oriented workshop	During this workshop the overall findings of the water testing campaigns were disseminated, possible solutions were discussed and a community committee responsible of continuing the water monitoring activities was formed. Thus this workshop served in laying the foundation for independent community-based water quality monitoring activities.

Any Future Activities Planned?	
Type of Activity	*How does this activity relate to your research and OCSDNet's objectives*
Enhance the water quality citizen guide to serve villages on the national scale (might develop it to a mobile application)	This activity relates to the sustainable development objectives that are set by the *OCSDNet*

5. Project Outputs and Dissemination

Describe project outputs and dissemination strategies:

After each water quality measurement the results were posted on a board in the gathering room. At the end of each campaign (summer and winter), results were disseminated to the public in an open seminar followed by discussions.

Name of workshop	Objectives of workshop	Outcome(s) of workshop	Number of participants present	Any relevant links
Introductory seminar	Project introduction Call for participation	Registration of 46 volunteers	55	
1st winter water quality measurements workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of seven water sources was tested	13	
2nd winter water quality measurements workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of seven water sources was tested	8	
3rd winter water quality measurements workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of eight water sources was tested	8	
Dissemination of results	Disseminate winter campaign results		25	
1st summer water quality measurement workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of six water sources was tested	13	
2nd summer water quality measurement workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of six water sources was tested	8	
3rd summer water quality measurement workshop	Give citizens hands-on training on water quality tests and let them perform the tests	Water quality of six water sources was tested	8	
Project closure workshop	Give an overview of the project and plan for future steps	Treatment techniques were discussed and a committee from municipality members	35	

		and citizens were formed to follow up on water quality issues		

List of relevant publications (February 2015-2017):

Name of Publication	Type (book, journal article, newspaper, blog, etc.)	Authors	Link
Citizen's Water quality Fact sheets	Ten fact sheets about specific water quality parameters and their measurement procedures	Rima Baalbaki Serine Haidar Ahmad	
Citizen's water quality monitoring guide; Recommendations and treatment techniques	Handbook	Rima Baalbaki	
The scientific approach to citizen science	Manuscript (in preparation)	Mahmoud Al Hindi Serine Haidar Ahmad Rima Baalbaki Najat Saliba Salma Talhouk	
Contextualizing openness: A case study in water quality testing in Lebanon	Book chapter	Salma Talhouk Rima Baalbaki Serine Haidar Ahmad Wassim Kays Sammy Kayed Mahmoud Al Hindi Najat Saliba	
Planning an OCS Project in Lebanon Part I	Blog post	Serine Haidar Ahmad	
Planning an OCS Project in Lebanon Part II	Blog post	Serine Haidar Ahmad	

Any other outputs:
Other important links that capture project findings/impact. (Ex: Social Media activity, photo galleries, educational resources, websites used for project dissemination, blogs, etc.)

URL	Content of URL
http://www.aub.edu.lb/units/natureconservatio	

6. Community Building

What tools and methods have you used to reach out to and communicate with relevant communities and potential participants? What do you think worked well and what didn't? Why?

Communicating with citizens: We relied on municipality members to invite the local community to the project introductory seminar. Letters of invitations were sent to NGOs and clubs through the municipality. However, this approach excluded a large group of the community and included only two NGOs lead by women who are affiliated with the two predominant political parties.

Forming a working group after the first workshop: During this first encounter, we solicited participation from attendees and created the participants contact list. 11 women who were members of only one of the NGOs preferred to be contacted by the coordinator of the group. We later learnt that the coordinator did not have the proper means to inform the group to attend the training and the following workshops and so we took the initiative to call the women and other participants by phone and invite them to the testing sessions. We managed later to establish a working group who can be reached by What's App messages and this made our communications much easier.

Invitation to seminars: For results dissemination and discussion of remedial solutions, invitation letters were sent to all local officials and women who participated in the testing were invited by What's App.

Result dissemination: Our work was posted on the NCC website, a guide book was distributed to the community, a chapter in the Open Science in Development was drafted and a manuscript is a work in progress

Relevant communities	*Outreach Method/Tool*
(e.g. policy makers, research/scientific communities, community group, etc.)	ex**:** online platforms (facebook, twitter etc.), word of mouth, email, other networks, conference networking etc.)
Municipality of Der Al Zehrani	Meetings, phone calls
South Lebanon Water Authority	Meetings
Local representatives of the Ministry of Health	Meetings
Water testing community groups	Phone calls, What's App group
Local community	Word of mouth, invite letters

7. Impact

How would you define the impact of your research in relation to your research objectives? *[We purposefully leave open the definition of "impact" and would like you to define it in your own context.]*

This project answered a local call for help in assessing and mitigating a local water pollution problem. The approach was well focused and has attended directly to the needs of the community in question. The work resulted in

- o implementing a remedial solution to one of the contaminated water sources in the village
- o raising awareness and establishing a follow-up committee to test water regularly
- o opening the public well that showed to be safe for domestic use
- o developing a step-by-step guide to follow up with governmental officials on water safety in the village
- o Establishing a working framework for academia-community collaboration

<u>What criteria and indicators did you use to measure and evaluate the impact of your project?</u>

The indicators that can be used to measure the impact of our project are the numbers of participants, the water quality of the wate sources, the number of remedial solutions, and the attitude towards contaminated water in the village.

- The number of participants was high at the initiation phase (around 50 participants). It decreased during the progress of the work (decreased slowly to reach around 8 participants) but went back up to around 30 participants during the final workshop
- All water sources except one showed minor contamination with bacteria (namely total coliforms).
- One solution to one of the water sources was implemented even before the closing of the project. The public well, which was closed by the Ministry of Health, was reopened because it was shown to be safe for domestic use.
- Women who did not know the status of the water prior to testing were empowered to raise their concerns and take part of the water committee.
- The establishment of the water committee, which consisted of five active members from the village.

8. Reflective Learning on Internal Dynamics:

<u>What has been the successes and main challenges of your project (in terms of the way that the project was conducted)?</u>

The successes listed in (7) are function of the transition of our working methodology from traditional science to open and collaborative citizen science and the multidisciplinary approach that the team undertook to implement the project. Collaboration among different disciplines is one of the strengths of NCC. NCC is a platform that has fostered multidisciplinary projects for over 15 years. One of the main challenges was to ensure the sustainability of the project at the village and to initiate in local citizens the drive to demand for clean water.

<u>Does your team have mechanisms in place to capture these lessons and share them internally? If so, which mechanisms and how have they benefited your project?</u>

The internal sharing mechanisms consist of team meetings and documentation via NCC's website, publications and conferences. We understand that there are rooms of improvement in this aspect.

<u>Please reflect on internal project power dynamics and its influence in project development and outcomes. How did you observe power dynamics to play out? How might north-south relations within the project have also played a role?</u>

Our team consists of three faculty members of different disciplines, two part-time research assistants and one community coordinator. Regular meetings were held between the team members to discuss the working plan and the progress of the project. The interdisciplinarity of

the team called for long discussions that served to optimize our approach. It is important to note that the research assistants and the field coordinator who were in close contact with the community played a major role in the success of the work. Being part of the network was essential to understand the social component of the project and to learn from the challenges of others how to deal with local communities.

9. Recommendations (for OCSDNet):

How did you find the (experimental) network model that was used by IDRC to administer the OCSDNet subprojects? What were notable strengths and weaknesses you experienced?

The network model of OCSDnet served as a platform for researchers of different backgrounds and expertise to collaboratively study open science ideologies, methodologies, procedures and challenges. The notable strength of the network was the efforts that were put in team building. The newsletter, blogs, meetings and workshops have all served in promoting better exchange between different network members. Additionally, the ability of the leading team to respond to changes in some projects aims, design, and finances have helped in fostering the success of these projects.

In your experience, how might a culture of shared learning be fostered/improved for future iterations of a network such as OCSDNet?

The network was a platform to discuss open science. It allowed academicians to take local initiatives to test the benefits of open science. In two years (the duration of the project), it is extremely difficult to assess the communal change that emanated from the projects but was enough to create a working force in open science that will continue along this path for many years to come. I suggest that a society of open science is created. The society will hold annual meetings for knowledge exchange and future strategies.

Has feedback from members of the network had an impact on your research? (consider insight from the coordination team, advisors and peers in the network).

Maybe not directly but definitely has broadened the views on determining the indicators for change.

Do you have any other advice/feedback that you would like to provide to OCSDNet or IDRC? (consider modes of communication, evaluation, etc.)

Sustainable development remains a challenge that will only be assessed over a longer period of time. I do hope that funding agencies while receiving yearly reports, plan to fund projects on long term basis. It is the trust that we need to build with the community to show concrete changes that come up every time we secure new funding.