Full Proposal Submission

Section 1: General Project Information

Project Title: Open and collaborative science (OCS); a tool for the conservation and development of local ecosystems
Duration of Project: two years
Countries included in this project: Lebanon
Regions included in this project: Middle East
Research Themes: THEME 1 (T1): MOTIVATIONS (INCENTIVES AND IDEOLOGIES), THEME 2 (T2): INFRASTRUCTURES & TECHNOLOGIES, THEME 3 (T3): COMMUNITIES OF PRACTICE IN OPEN AND COLLABORATIVE SCIENCE and THEME 4 (T4): POTENTIAL IMPACTS (POSITIVE AND NEGATIVE) OF OPEN AND COLLABORATIVE SCIENCE
Justification of Research Themes: This proposal helps to evaluate the best scientific approach (T2) to share and translate with the communities the use of technology to assess local environmental concerns (T1). It is also concerned with the understanding of the understanding and appreciation of local communities to the open and collaborative science (OCS) (T3) as well as the evaluation of the impact of OCS on the development of local communities and the ability to extend such strategy to global challenges such as water scarcity and climate change (T4).

Total Budget Cost (CAD): $80,200

Section 3: Proposed Study Information

Research Project Abstract

WORD LIMIT: 250.

The team at the American University of Beirut – Nature Conservation Center (AUB-NCC) has experienced the benefits of the open and collaborative methodology to develop a village "Green Map" database. With this approach the advantages and limitations of the method for stock taking of baseline information for landscape planning was evaluated and significant sustainable management systems of communal lands and their spatial associations in relation to the mapped landscape components were identified.

Considering the success of the developed model and the trust that was built between the Center and the communities, we are proposing to continue to build the local "Green Map" database by adding two new components; air and water pollution. Results will be overlaid on the spatial maps in consecutive phases, starting with people's perception and identification of pollution sources, the scientific measurements including data collection, scientific validation and interpretation and at the last stage people's proposed solutions

based on the village community constraints and advantages as well as presented technologies and case studies.

This methodology contributes to a shift from conventional centralized policy to:

i. A more community-based environmental planning strategy,

ii. The decrease in data basing costs,

iii. Empowering locals to adopt meaningful conservation practices by their own initiatives and

iv. Contributing significantly to the bottom-up dynamics of policy-making.

We believe that this Open and Collaborative Science (OCS) micro-scale methodology is able to shape the complex multilevel coordination to address global issues such as climate change and loss of natural resources in the MENA region and beyond.

Research Problem, Significant and Justification

WORD LIMIT: 1,000. Please provide a brief overview of relevant literature and highlight the knowledge gaps that this project will address. Indicate the size and scope of the problem, as well as how the problem relates to the purpose and goals of OCSDNet; broader national development priorities, and the research and capacity needs of the countries involved.

In 1946, Lewin wrote: "*Research that produces nothing but books will not suffice*" (Lewin, 1946). With it, Lewin introduced the concept of social management or social engineering based on a public participatory research approach where "*action-research*" leads to "*social action*". Decades later, Walker *et al.* 2009 stated that the process of engaging the community in a participatory research approach "*could transform agreements to instruments **of** change and processes **for** change*" (Walker *et al.* 2009). Throughout history, scientists consider participatory research methodology as the tool for social changes, as it is unique in the collective identification of local issues, the educational process for both researchers and people, knowledge production as well as in its active correlation of knowledge to problem-solving (Arnstein, 1969; Hall, 1981, 1982; Pretty & Hine, 1999; White, 1996; Williams Ntiri, 1998). Still, 70 years after Lewin, we have yet to fully integrate the vision into practice.

One of the most developed and influential models of public participatory approach is the primary health care approach led by the World Health Organization (WHO) and adopted by many health-promoting institutions (i.e. (Davies & Kelly, 1993; Green et al., 1995; Horowitz, Robinson, & Seifer, 2009; Israel, Schulz, Parker, & Becker, 1998; Ramsden, McKay, & Crowe, 2010; Yeich & Levine, 1992). WHO emphasizes the need to strengthen local communities to encourage their ownership and control of their own health system and developments (Mills, Bennett, Bloom, González-Block, & Pathmanathan, 2004). In fact, a change from risk factor reduction to health promotion was observed in Canada in the 1980s after launching the

"*Achieving health for all: A framework for health promotion"* project (Epp, 1986).

In the last decade, participatory research practices have been extended to cover environmental concerns. A better public understanding of issues related to protecting the environment can lead to progress and changes in human behaviors towards the environment (Danielsen et al., 2014) like the successful global responses to acid rain in Europe, the reduction of oils spills and international trades of wildlife (Kanie, 2007). It is also noted that 63% of the monitoring possibilities for the Convention on Biological Diversity "2020" indicators, and those of 11 international environmental agreements can involve community members as "citizen scientists" (Danielsen et al., 2014). Reviews suggest that collaborative efforts between researcher and local stakeholders in monitoring the environment increase awareness among the public and policy makers and entice the public and decision-makers to tackle speedy development actions (i.e. (Danielsen et al., 2014; Shirk et al., 2012; Tidball & Krasny, 2012).

Participatory community based water quality sampling, assessment and monitoring schemes for lakes, streams, rivers, catchments, and reservoirs have been implemented in several locations across the northern hemisphere (Au et al. 2002, Overdevest & Orr 2004, Burgos et al. 2013, USEPA 2014, Latimore & Steen 2014), Australia (Nicholson et al 2002) and, to a lesser extent, in a number of developing countries (Deutsh et al. 2005, Nare et al. 2006, and Nare et al 2011). Various water quality parameters were measured and collected during these campaigns using instruments with varying levels of complexity. Despite a number of challenges (such as funding, sustainability, reliability of data, demonstrable application of results, impact on water resource management decisions on the local and national scale) the majority of these campaigns resulted in "synergistic outcomes" which included advancing of freshwater science, public awareness of water resource challenges and concerns, increased levels of "citizen participation" and implementation of "science-based" protection/conservation projects at the local level (Burgos et al. 2013 and Latimore & Steen 2014).

Air sampling was successfully initiated and realistic remedial strategies have been implemented in several locations in the US. The anti-idling campaign at four Cincinnati schools was initiated by academics, researchers, and community partners to reduce exposure to air pollution (Eghbalnia et al., 2013). The resulting decrease in vehicle idling time demonstrates the effectiveness of the campaign and partnership. Several public signs, tools for school program, a website (www.cps-k12. org/) and the review of the current Ohio law regarding school bus idle times in school loading zones (Ohio Administrative Code 3301-83-20) were developed. Air pollution exposure associated with traffic was also assessed by a broader community in Port Richmond (Kondo, Mizes, Lee, & Burstyn, 2014). Actions related to enforcement of anti-idling ordinances, no-truck route designations, and other policy solutions were adopted. "The Los Angeles Collaborative for Environmental Health and Justice (the Collaborative)" (Sadd et al. 2013) study focused on combining scientific evidence and residents' firsthand knowledge about the elevated risk of respiratory illnesses and cancer in areas near major air pollution sources. As a result, the community (scientists and local contributors) developed transparent and scientifically rigorous, relevant and outreach tools to empower the community by highlighting opportunities for regulatory and policy

change.

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 55 villages across Lebanon, the team at NCC has developed a village "Green Map" database. It consists of spatially overlapped aerial photographs and valued (as determined by the community) landscape components through a nationwide public participation GIS process. With this approach the benefits and limitations of the method for stock taking of baseline information for landscape planning was evaluated and significant sustainable management systems of communal lands and their spatial associations in relation to the mapped landscape components were identified. This methodology has built trust between academic institutions and communities, which has decentralized the process of map making and village perception, information generation and made it more relevant to local communities to manage their natural resources.

Considering the success of the Green Map model, we are proposing to add layers of information on water and air pollution for the search of appropriate solutions to increase economic and environmental benefits (CBD, 2010). This Open and Collaborative Science (OCS) model is the first in the region. It helps in building capacity and raise environmental awareness among the general public and policy makers. It also presents a local and responsive approach towards the conservation and development of local micro-ecosystems.

Research Questions and Objectives

WORD LIMIT: 500. Outline your project's central research question(s), sub-questions, and objectives. There must be congruency between the questions, objectives, research design and methods. You should highlight how the study's questions and objectives will contribute to the research themes of the OCSDNet.

Our goal is to study the process by which knowledge generation and scientific evidence is shared with communities so that people may be enabled to take local action in order to effect changes most suited to their needs.

The specific aims are:

- 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.
- Involve community members, organizational representatives and scientists in all aspects of the process, methods, results and interpretation. This requires true collaboration where knowledge is shared horizontally.
- Build local capacity to combine knowledge with taking actions to ensure development of sustainable remedial environmental solutions as suggested by the whole

community.

- 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.

In fact, the work that was undertaken by the AUB-NCC in collaboration with different communities to develop Village Green Maps has alluded to environmental concerns in some of these villages. Data collected during the Green Mapping process will be studied and used to identify two villages that have raised these concerns. These villages will be contacted and the new scientific approach for environmental monitoring will be presented. Local stakeholders in collaboration with scientists will be planning the monitoring process. Workshops to explain the scientific approach will be held before and after every step. Meetings involving the whole community will be used to share the results and discuss interpretations (T1). Generated knowledge will ensure sound proposed sustainable solutions and the development of preventive measures (T4). Obstacles to "Open Science" approach will be evaluated. The process will include our understanding to how communities react to open science practices' legitimization, and identifying and analyzing the tools to overcoming those obstacles (T3). The outcome of the (lack of) legitimization we expect to find will be evident in terms of the resources, infrastructure, support and trust these initiatives get vis a vis conventional science. A set of policy recommendations for different 'environmental monitoring Open Science" forums will be developed in collaboration with the CONICET – CENIT/UNTREF group in Argentina (T4).

Stakeholders

WORD LIMIT: 250. Identify and briefly describe your project's stakeholders. How will your project respond to their needs and interests?

The Open Science and Collaborative Development network involves community members, public and private sector representatives, and researchers in all aspects of the monitoring and evaluation process. The expertise of each partner is highly needed so that the progress of the project leads to the integration of knowledge gained with action.

Each community with its own specific identity will be considered as one major stakeholder in the project. Considering that we will be working with two villages, care will be taken to understand the norms and values of the community, taking in consideration the religious and cultural diversity of villages in Lebanon, as well as the skills and assets of individuals-volunteers who will be committed to the project. This collaborative partnership defines the researchers as equal stakeholders who have to share control over all phases of the research process e.g. problem definition, data collection, interpretation of results, and application of the results to address community concerns ((Israel, Schulz, Parker, & Becker, 1998) and references therein). Other stakeholders include individuals, and representatives from public

and private organization and/or companies and academics available from within and outside the immediate communities we are working with. The role of all stakeholders is to ensure that new understandings emerge as participants reflect on taking actions for the benefit of the community (Petras & Porpora, 1993).

Research Design & Methods

WORD LIMIT: 1,000. In this section, applicants should clearly indicate and justify the proposed study design. You should discuss how you intend to collect the data that you will need to achieve the study's objectives and answer the project's research questions. You should clearly outline how each data collection activity will contribute to the study objectives.

Initial steps include reviewing our village-mapping database that was collected using a public participatory approach for Green Mapping and identify two partners (communities) that expressed concerns over environmental problems. A contact with these communities will be initiated and their participation in the science collaboration project will be solicited via visits to the village and one or more workshops organized with the municipality. The workshop includes a presentation detailing the sources of "hazardous air and water contaminations" and the need to conduct field measurements in order to assess the qualities and sources of water (sewage, fertilizers and/or pesticide contamination or sea water infiltration) and air (combustion sources like traffic, truck idling, diesel generators and others) pollution and their effect on the conservation and development of the village landscape and ecosystem.

Pre-field measurement workshops will result in a volunteering contact list of key community members interested in joining the efforts to conduct the scientific measurements. With the aim of establishing interdependency among partners and to build trust and show commitment, researchers will spend time in the community to document exchanged information and ideas about their perception of pollution indicators, sources of pollution, and their identification of hot pollution spots in order to lay down the foundation for designing the joint field monitoring operation.

Following, several focused workshops will discuss the pollution monitoring process including the sites, training the volunteers on the instrument and the measurement processes. Sessions designed to simulate the data collection for water and air will be conducted. For water, monitoring will include microbiological parameters (thermo- tolerant coliforms and faecal streptococci), physical (turbidity and conductivity) and chemical parameters (total dissolved soluble compounds (TDS), chloride, nitrate, alkalinity and total dissolved oxygen). For air, fine particulate matter (PM) indicators of combustion sources will be monitored using real time PM dust tracks. Several literature references and public links will be consulted and similar approaches in air and water monitoring will be adopted when applicable.

The accuracy and inter-comparability of the data collection and results will be ensured by conducting replicate measurements in each monitoring site. Over the whole monitoring campaign there should be at least 15 collection sites, which amounts to a minimum of 45

data points collected by the community participants. In parallel, there will be measurements at random sites conducted by researchers for comparison purposes. In addition to the measurements of PMs and water pollution indicators, we will collect meteorological conditions and other characteristics of each site like distance to a major pollution source, location of sampler, presence of (and distance to) nearby industrial or point sources (such as bus depots, manufacturing facilities, or construction sites, and open burning or outdoor cooking). Community members will be given maps and walked through the surrounding community with researchers to check the accuracy of site locations.

During air and water field measurements, participants will be equipped with notebooks containing maps, data entry forms, and step-by-step instructions on data collection. Volunteers will be asked to note the location and the surrounding pollution sources as well as the duration of the measurements and any additional observations that they think is relevant to the site.

Post-field measurement discussions between researchers and the community will be documented. It includes result analysis, evaluation of people's perception about pollution indicators, sources, and identification of hot pollution spots and proposed short and long-term intervention processes

Collected data will be downloaded and transferred to the lab and AUB-NCC offices for validation and analysis. In addition to the scientific data both the perception of people about air and water pollution indicators will be assessed. Results will then be shared with the volunteers and then volunteers and researchers will present the findings to the whole community. Remedial solutions will be discussed and mitigation plans will be designed in collaboration with the public and private stakeholders.

In collaboration with the CONICET – CENIT/UNTREF group in Argentina data will also be analyzed to assess the social attitudes towards changes as well as barriers and obstacles of the OCS approach in tackling environmental concerns.

Analysis & Synthesis

WORD LIMIT: 1,000. Describe how you intend to organize, examine and model data to arrive at conclusions and insights.

The objectives set for the Open and Collaborative Scientific approach for Development will be analyzed and assessed based on several indicators as follows:

Form a partnership

The ability of all stakeholders to work together in harmony will be evaluated. This includes the collaboration between the community, researchers, as well as public and private organizations (i.e. (Stokols, Allen, & Bellingham, 1996; Vega, 1992)).

(a) The collaboration with the *community side* is assessed based on the number of

volunteers and their ability and willingness to conduct the project. These include partners with diverse skills, knowledge, expertise and sensitivities to address pollution problems,

(b) The ability of *researchers* to recognize the limitations of their approach and their willingness to merge local knowledge and local theory with the proposed scientific approach. This approach should lead to a more effective action toward the identified pollution problem and to a new research theory grounded by the community based experience.

(c) The capacity of the community to faithfully discuss acquired knowledge and possible solutions with the *private and public representatives*; an outcome that is essential for implementing any change.

Handling and transfer of scientific knowledge

I. The ability of the community to adhere to scientific instructions and specifications will be evaluated based on:

1. Data collection as per agreed instructions and procedures

2. Data logging in the provided and tabulated notebooks including noted observation and description of the sites

3. Data validation that will be cross-checked with controlled measurements conducted by researchers in the field and with the calculations of the reproducibility and repeatability factors.

4. Conventional data quality control may not be applicable given the nature of data sets and so novel methods and approaches will be developed based on every unique situation.

II. The norms, values, skills and assets of volunteers committed to the project in all its steps including the pre-sampling community workshops, sample collection, data analysis and knowledge dissemination, will be monitored and later analyzed in correlation with the level of involvement and the willingness to engage in public participatory scientific campaigns.

The extent at which participants trust the scientific approach and engage in the critique and evaluation of generated results is considered a key for the success of the scientific campaign. This process requires joint analysis sessions that have been developed and adopted by the scientific community to include visual and oral communications of the obtained results, joint scenario and hypothesis formulation as well as well as data processing and hypothesis testing (e.g., (McIntosh et al., 2011; Olsson & Andersson, 2007).

III. The communication of the results between volunteers, researchers and the

community or the feedback loops at different levels will be analyzed. Implemented measures particularly when informed of the impact of measured levels of pollution on ambient air and water quality will demonstrate the effectiveness of the supportive data in the scientific campaign and partnership.

People's perception of pollution sources

Discussion about water and air pollution sources in the village during pre- and post-scientific measurement workshops will be documented. Analysis of people's perception of pollution will be re-evaluated after the results are validated. Since a large group of village citizens will be involved in data collection and analysis, the return rate of people willing to take simple as well as drastic measures to reduce pollution sources are expected.

Use of scientific knowledge to implement changes

The number of volunteers who were engaged in the process will indicate how much people are adopting and accepting the OCS approach. Most importantly, it is the change in people's perception and attitude towards pollution sources that will reflect best the outcomes of the ground monitoring process after presenting and discussing the collected facts. The ultimate change will mark the review of existing policies or the drafting of new policies in relation to air and water quality control and emission. Also, awareness among industry and regulatory officials will open discussions about further and broadened collaborations to measure and mitigate air and water pollution in the neighboring region. Results shared with the community using different tools are hoped to reach to broader community awareness for a more fundamental model of ecosystem services management.

Outcomes & Outputs

WORD LIMIT: 700. Describe the major project outputs and intended outcomes. Your project outputs should creatively reflect the principles of open and collaborative science.

The proposed project will have several outputs and outcomes summarized as follows.

Outputs: Optimize the benefits of workshops that are designed to respond to local needs and identified environmental problems. These workshops will build a trust between researchers and the community and promote scientific dialogues and engagement between different stakeholders. The Open Science approach will also train members on basic concepts in environmental indicators, monitoring and data analysis. By engaging residents in a structured and rigorous collection and validation of the data, the "Open and Collaborative Science" approach helps bridge the gap between technical research, and community knowledge. Generated results will feed into a soft GIS (Geographic Information System) database where environmental and already incorporated cultural components are overlaid over the landscape green maps for a better assessment and pursuit for remedial solutions in ecosystem services and management. Also, results will be documented and disseminated to both the public and scientific communities in joint publications between the

local and scientific communities, phone application (already under preparation), a policy brief, blogs whenever possible and peer reviewed scientific publications.

Outcomes: the "Open and Collaborative Science" approach links environmental monitoring to raising awareness. It empowers community members to explore, verify, and critique collected data and questions the locations of pollution sources in proximity to residential areas. This process enhances community input, building community capacity and identifying and addressing local concerns. Development strategies will result from data analysis and interpretations in such a way that sustainable ideas and problem solving projects like removing and/or eliminating sources of water and air pollution and replacing old by new and green technologies are discussed and implemented. Consequently, people will be enabled to exercise political power in local and national settings. This will be done through improve decision making on air quality regulation and water and land use planning at the municipal and regional levels. Finally this OCS case study can be considered a policy recommendation approach for policy makers to adopt in order to derive recommendations and propose new communal initiatives.

Knowledge Translation & Dissemination

WORD LIMIT: 700. Describe how you will disseminate your outputs. To ensure that the results of your study are applied to address development challenges, explain how you intend to package, disseminate and promote the application of your findings amongst relevant stakeholder groups.

Data Documentation: The Open Science and Collaborative methodology will be documented and presented in workshops, manuals notebooks and at the AUB-NCC website. All basic information regarding the environmental indicators, their sources, their national and international quality standards and health impact will also be made available to people in pamphlets and posters displayed at the municipality or any hall meeting accessible to most people in the village. These publications, which will be developed in the local language and in a way that is easily understood by most people, will link environmental monitoring to awareness raising. All collected information in regards to social behaviors and attitudes towards engaging in the scientific campaign, the collection of data, interpretation of the results and results evaluation will be documented. Changes in pollution perception before and after the scientific campaign will be crucial to assess the usefulness and value of this campaign.

Data Translation: Findings and knowledge will be written and translated (if needed) in a language that is understandable by all partners. It is important to ensure that ownership of knowledge is acknowledged (Davies & Kelly, 1993; Singer, 1994; Wall, 1995). Prior to submission or release of any materials for publication, researchers consult with participants, acknowledge their contributions and, as appropriate, develop co-authored publications. All compiled information will also be presented at local and international workshops and conferences and in scientific publications in journals, which promote the public participatory approach. Social attitudes, changes and impacts will be studied with the help of our

colleagues from CENIT-Argentina.

Data Dissemination: Communicating the data and use of results with the community, public and private stakeholders are important to propose informed action (Fetterman, Kaftarian, & Wandersman, 1996). Meetings to present the results and the main sources of pollution that were deduced from the results will be held with all stakeholders. Solutions based on the constraints, source of funding and resources will be evaluated. Mitigation measures ranging from minimal to major interventions will be presented. We also hope we could offer a monitoring tool that will allow the community to learn more about the effect of the interventions after the project ends. Available models will be consulted to explore possible ways of collaboration.

Network Connections & Interactions

WORD LIMIT: 500. Illustrate how you will contribute to the overall OCSDNet framework and themes. Draw on other initiatives and approaches discussed at the OCSDNet workshop, if applicable.

Our network and collaboration with OCSDnet extends beyond the duration and objectives of this proposal. In its mission, AUB NCC emphasizes the role of people being the guardians of their nature. An open public participatory and decentralized approach has been at the core of our efforts towards nature conservation and the development of local ecosystems. Such a strategy relies on overlays of information of landscape, perception, sources of pollution, open knowledge, cultural practices and beliefs and other information that is compiled based on a soft Geographic Information System methodology. The mission of AUB-NCC is only achieved by learning from the expertise of all colleagues in the consortium. In particular, our collaboration with CATIE, the University of Central Asia, CAMP Alatoo, the Natural Justice in South Africa and the group in Thailand lead by Suvaluck will focus on the understanding of the effects of open science on environmental conservation approaches. This collaboration can be initiated by creating links to each others websites, exchanging visits between the different centers, organizing a common event (day, time, theme) to all centers, setting a common drive among other possibilities. Also, adopting the process developed by CRIA in Brazil facilitates the exchange and dissemination of information and the monitoring of biodiversity, the advanced knowledge in science exchange via social media can only be learned from the group in Quebec lead by Piron, and understanding the drives for social and political changes based on the open science and collaboration methodology will be acquired from the work of the two groups in Argentina, one group in Brazil (ibicit) and one group in India. In fact, one common objective along with the CENIT group in Argentinas was developed in this proposal. Economical and viable ideas and applications towards nature conservation can be promoted and protected through the work that is undertaken by the group at the Scinnovent Center and the engagement of the scientific research approaches in OCSD are tested and encouraged through the MOBIOL laboratory and Collaborative Disaster Preparedness models.

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