

**“Climate change, water scarcity and food security:
the challenges for the Middle East region
with a focus on Lebanon”**

**Research Proposal for
The Fund for Global Environment and Conflict Resolution**

Simone Sala as focal point of the GEOLab, Geomatics Laboratory
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Cover letter

June 30, 2009

c/o GEOlab, Dipartimento di Produzione Vegetale
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Ms. Josie Lianna Kaye
Assistant Director, Center for International Conflict Resolution, CICR
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420 West, 118th Street, MC 3369
New York, NY 10027

Dear Ms. Kaye,
my name is Simone Sala, and I am a PhD student of the Faculty of Agriculture of the University of Milan. I am writing to you in order to apply to the Call for Proposal of The Fund for Global Environment and Conflict Resolution. I am applying as focal point of the Geomatics and Landscape Ecology Research Laboratory (GEOlab) of the Crop Production Department of my Faculty. GEOlab was founded in 2003; it operates within the Crop Science Department of our Faculty, and it is directed by Professor Stefano Bocchi. The GEOlab activities are focused on Advance Agroecological Habitat modeling/mapping and species conservation science, through a synergistic integration of the research experiences in Geomatics, system modeling, and Landscape Ecology.

After reading the Call for Proposal, our team thought that this Call seems ideal for the experience and research interests of our laboratory, and we would be delighted and honored to contribute. As the CICR we think that producing opportunities for dialogue through systemic problem analysis is essential to contribute towards the resolution of conflicts and for their prevention. In one of our past researches, carried out at a subnational level and applied to the case of Kenya, we focused on the relationships between environmental factors and violence or conflicts. Particularly, our goal was the location of those areas apparently most at risk of suffering negative social effects and their consequences in terms of internal security, using spatial databases to map the various sources of environmental scarcity through geographic information systems. The successful outputs of the research (Bocchi et al, 2006) encourage us to move our work further on this path.

On my specific side, my academic and professional background fully reflects my deep interest in cross-sectorial issues and Development. Through my Master in Information and Communication Technology I have obtained solid training in research and development of solutions to a wide range of technical and development problems. My work at field level in Ghana made me realize the need to focus on the agro-environmental sector as a key for contributing to sustainable development, and for this reason I developed a thesis on the application of information systems and technology to climate change adaptation and natural resources management. This work constituted the starting point of my PhD research, which is currently being carried out with a partnership with the Food and Agriculture Organization of United Nations, particularly within a Communication for Development project applied to Natural Resources Management and Climate Change Adaptation. Working on both technical and socio-environmental issues, I am confident that with my colleagues from the GEOlab we could add a plus in the analysis of the system linkages among climate change, food security and water scarcity.

For all these reasons, I really hope you could find our proposal interesting and in line with your research interests at CICR.

Thank you in advance for your consideration.
Best Regards,
Simone Sala

Research Proposal

I. Executive summary

The wide majority of the international scientific community agrees that climate change is the main challenge humankind has to face nowadays. This is due to the fact that climate change is much more than an environmental issue: the local impacts of this global phenomenon are going to affect the global world security in a cross-cutting and trans-sectorial way. For this reason, the need for scientific assessments of the links between climate change, water scarcity and food security to promote conflict prevention, cooperation, and peace-building today can be considered a priority.

Particularly, in regions where stability is already threatened by an interdependent set of driving forces, climate change can jeopardize the peaceful regional development. This is the case of the Middle East region, which is currently experiencing a series of issues that put its stability under high risk. Among the various regional driving forces there are: a) population growth; b) water scarcity; c) environmental degradation; and d) rapid and often unplanned urbanization.

Due to the strategic importance of this region for the whole World stability, it is needed a serious analysis of the Environment-Security nexus in order to understand the climate change impacts on water resources and food security, as well as to plan timely and adequate responses.

Among the various Middle Eastern countries Lebanon plays a key role in regional peace and stability. For this reason, the proposed research aims at studying the linkages among climate change, water and food security in this country, in close contact with key Lebanese stakeholders in order to identify vulnerabilities, threats, risks and opportunities. The stakeholders will be selected reflecting the range of users concurring in water management and consumption, namely: national and local institutions, universities and research institutes, water user associations and representatives of private and civil society.

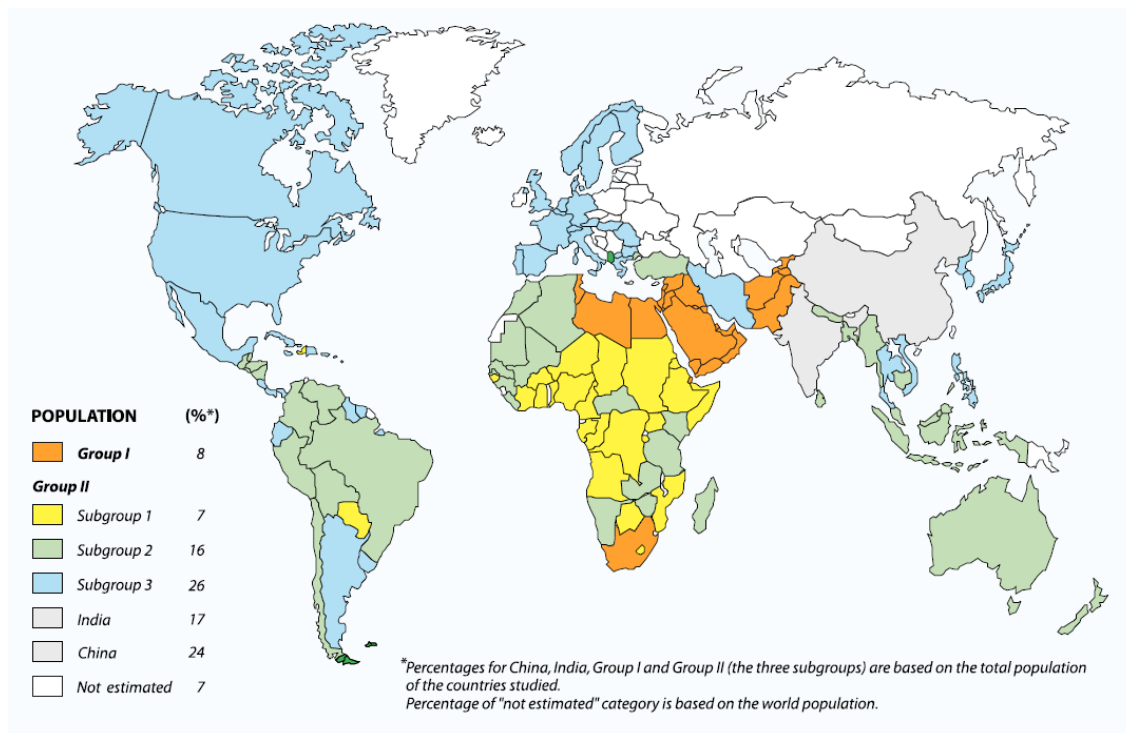
A first preliminary model will be discussed with the stakeholders, leading to the development of an ad hoc Geographic Information System (GIS) which will take into account the stakeholders' perspective and the system analysis. The GIS will serve as a tool for the further analysis of vulnerabilities, threats, risks and opportunities with all the stakeholders, through a Participatory GIS approach in order to foster stakeholders' mutual recognition and dialogue. Finally, the validated model will be framed into the regional system, and the model along with the discussion process will be presented to the main regional stakeholders with the aim of identifying recommendations and a possible way forward.

II. Rationale

Climate change is one of the most complex challenges humankind has to face. As climate change seems to be irreversible, it has become urgent to develop sound adaptation processes to the current and future shifts in the climate system. Particularly, over the next few decades it is likely that the biggest impacts of climate change will be on agricultural and food systems (M. E. Brown, C. C. Funk, 2008). Through the use of crop models some scientists (Lobell et al., 2008) have pointed out that climate change is likely to reduce food availability due to a reduction in the agricultural production. The Intergovernmental Panel for Climate Change (IPCC), a committee of the United Nations that every five years collects and reviews the most important scientific contributions in the climate change field, divided the effects of climate variations in agriculture in two different groups: direct effects, and indirect ones. Particularly, the IPCC put in evidence that higher frequency and diffusion of climate fluctuations is likely to produce more severe and frequent droughts and floods, which already are the main causes of short-term fluctuations in food production in semiarid and sub-humid areas. FAO (2008) stated that in the Middle East the agricultural sector is likely to suffer losses because of high temperature, droughts, floods and soil

degradation threatening the food security of its countries. In addition, the region can be considered at high risk of vulnerability to climate change due to water scarcity, population density and economic activity in flood-prone urban coastal zones, a significant dependence on climate-sensitive agriculture, and the presence of unstable areas in which climate-induced resource scarcity could exacerbate conflicts and socio-political tensions (World Bank, 2009). Moreover, most climate scenarios agree that Middle East will suffer a decrease in water availability, an increase in evapotranspiration and shifts in precipitation patterns. This will heavily affect the crops which highly rely on irrigation (e.g. rice, maize, citrus fruits and sugar beet, among others); in addition, many of the region's irrigation systems are under considerable environmental strain due to salinity, water logging or overexploitation of groundwater (including non-renewable fossil water).

Climate change is going to exacerbate water scarcity in the regions already affected by this issue. A recent study published by the International Water Management Institute (IWMI) reveals that, by 2025, some 25 percent of the world's population (33 percent of the population in developing countries) will live in regions experiencing severe water scarcity, and a total number of one billion of the world's poorest people will be affected. The above map shows how Middle East countries will be included in the area experiencing severe water scarcity (See Group I).



Population affected by water scarcity: scenarios for 2025 (IWMI, 1998)

In regions like the Middle East an other heavy impact of climate change may be on water resources, thus further reducing the resources available for agricultural production and exacerbating water scarcity conditions. Among the various natural resources in Middle East and Mediterranean countries, water is widely considered as the most strategic. In addition, several authors (Cooley 1984, Lowi 1995, Haddadin 2002, Mirkamysov 2006, Pitt 2006) pointed out that a strong link exists between water scarcity and economic, social and security constrains to the development. As a result, competition to access to water resources in the Middle East region may grow up, both on a domestic and regional dimension, increasing the risk of domestic and regional conflicts.

Other than climate change, other driving forces are likely to play a role for determining the regional stability. Among the others the population growth can be considered one of the major issues, as the World Population Prospect of the United Nations projects that the Middle East and North Africa region will shift from 300 million people in 2000 to 600 million by 2050 (UN, 2004).

In addition, the rapid and chaotic urbanization has increased the demand for resources, along with waste management problems (UNEP, 1997). Poverty, health issues and food security, especially in rural areas, can cause the migration of the poor, rural population to urban areas, thus worsening the current situation. For this reason, all these system dynamics have to be taken into account. A good starting point would be represented by a national case study looking at the interfaces with the regional system. Within the Middle East region, Lebanon is an area of central importance due to its strategic geographic location and its agro-environmental and socio-economic peculiarities. The United States special envoy to the Middle East for the Obama administration, Mr. George J. Mitchell Jr., recently stated that Lebanon is key for peace in the Middle East. The complexity of this country makes it a suitable area for a research which employs a systemic approach and innovative research methodologies. Thus, Lebanon can serve as a model for extending the study to other countries in the Middle East region.

Lebanon is going to be heavily affected by climate change. In fact, this country is particularly vulnerable to bioclimatic changes in its humid and cold regions, as well as in its areas already under severe drought conditions. Water is already scarce in Lebanon, and it is highly vulnerable to climate change both in quantity and quality: UNEP estimates that a water deficit will annually grow from 140 to 800 million cubic meters (mcm) by 2015. Competition to access to water resources among the industrial, agricultural and domestic sectors is going to raise, undermining food security at national and local level. The 10 Year Strategic Plan prepared by the Ministry of Energy and Water (MEW) foresees the stocking of 850 Mm³ of water in Dams and collinear lakes to face scarcity of water: the incidence of climate change on the replenishing of these infrastructures will have a decisive impact.

In addition, climate change will produce shifts in the distribution of crops, and some plants will disappear, thus reducing biodiversity. Other threats are related to: a) disappearance of certain vegetation associations, and/or their replacement by others; b) flooding of low-lying areas; c) losses in coastal activities, such as fishery and tourism; d) increase in production costs in the agricultural sector.

III. Project Description

The research project seeks to assess the potential impacts of climate change on water resources and food security in Lebanon, particularly looking at the interaction of the agro-environmental and the socio-economic systems as well as their role within the framework of national and regional security.

The key questions that the study will try to answer are the following:

- What will be the impact of climate change on water resources in Lebanon, basing on the up-to-date climate change scenarios?
- How are the different sectors (agricultural, industrial and domestic) competing for the access to and use of water resources?
- How are the main driving forces (climate change, population growth, food and water consumption) linked to each other and what is the water network efficiency?
- What are the main vulnerabilities and threats that can generate environmental insecurity and/or conflicts for the use of water resources at domestic level and with neighbor countries?
- What are the possible institutional and research pathways to ensure sustainable use of water resources for ensuring food security and minimizing the risk of conflicts?

In order to answer to these questions, first of all the potential conflict for the use of water resources among the different stakeholders of the national system will be analyzed with the problem tree methodology. The data necessary for this study will be obtained from: a) the review of existing experiences in sustainable water management (e.g. the Water Demand Initiative for the Middle East and North Africa, *WaDimena*); and b) the analysis of databases and databanks of

International institutions and research centers, such as United Nations agencies, the Intergovernmental Panel on Climate Change (IPCC), the Earth Institute of Columbia University, the Water Issues group of the School of Oriental and African Studies (SOAS, University of London) and the Millennium Institute, among the others. In addition, data will be gathered from relevant regional and national institutions, such as the Lebanese Ministry of Energy and Water, the American University of Beirut and the Notre Dame University, among the others.

This analysis would lead to a preliminary understanding of the main vulnerabilities and risks that could lead to conflict on a medium term basis. At this stage, a first round of discussion will be set up with key Lebanese stakeholders through a series of technical interviews at field level.

The output of this preliminary discussion would serve as an input to the second, broader analysis of the system. The theory of System Dynamics (J. W. Forrester, 1992) will be used as theoretical basis to model the interaction among the driving forces at both national and regional level at longer term.

The elaboration of such a system will be performed through the development of an ad-hoc Geographic Information System, in order to create a visual map of vulnerabilities, risks and opportunities. The generated maps will be used to validate the model with the above stakeholders, through a one-day workshop to be held in Lebanon at the presence of all the stakeholders. The discussion will employ the Participatory Mapping approach (Rambaldi et al, 2006): this approach can be a powerful mechanism to understand and try to resolve disputes or conflicts, as well as to identify and strengthen conflict management capacity at institutional level.

Finally, the results of the workshop and the process will be disseminated to key stakeholders at regional level, along with a questionnaire and interviews. Their feedback will be particularly helpful to: a) assess the output of the discussion, both in terms of process and results; b) frame the model within the regional scenario, recognizing potential threats and opportunities at regional level; and c) identify knowledge gaps in the Institutional and Research sector, and a possible way forward.

The research will be conducted by Simone Sala as a focal point of the GEOLab laboratory, under the scientific supervision of Professor Bocchi and in peer-to-peer partnerships with the researchers of the laboratory: Dr. Andrea Porro, Crop Production and Agro-Meteorology specialist; Dr. Giancarlo Graci, Geographic Information System and Remote Sensing specialist; and Antonio Monteiro, Remote Sensing for landscape ecology and land use/land cover specialist.

IV. Objectives

The objectives of the research are the following:

- identification of the possible impacts of climate change on water resources and food security in Lebanon;
- definition and characterization of the vulnerabilities, threats and risks for national security due to the pressure on natural resources, as well as their linkages to the regional security;
- development of a geographic information system to be used as a tool for discussing the above impacts with national and regional key stakeholders;
- formulation of recommendations for addressing further research and policy dialogue where the model identifies knowledge gaps and/or ambiguous patterns.

V. Outputs and Outcomes

Through the desk study and the work at field level, the research will produce the following outcome and outputs:

Outcome 1:

Potential impacts of climate change on water resources and food security in Lebanon, including strengths, weaknesses, threats and vulnerability of the national system validated by all relevant stakeholders.

Outcome 2:

Recommendations for a possible way forward identified and validated by the stakeholders at national and regional level.

Output 1:

Reports describing:

- a) the impacts of climate change on water resources and food security in Lebanon;
- b) the system dynamics modeled via Problem Tree and via GIS, including the relationships among the driving forces and among the different actors of the national system, as well as their linkages to the regional security; and
- c) the impact of the discussion process on stakeholders' perceptions and the negotiation process.

Output 2:

A paper with recommendations validated by the local and regional stakeholders that identify potential issues and possible measures to be implemented in order to address the situation at medium-long term.

VI. Challenges

Two main challenges could particularly undermine the successful accomplishment of the research project:

1. Local stakeholders not open and/or interested to share information. This could endanger the assessment of the local and regional situation. A good mitigation strategy would include:
 - a) involvement of the stakeholders from the beginning of the research, keeping them well informed about the process and the results;
 - b) adoption of an appropriated participatory methodology to carry out the workshop discussion; and
 - c) cooperation with professional facilitators in the workshop to assist with participatory decision making and strengthening the ownership of the project.
2. Crisis preventing the organization of the interviews and/or the workshop. The consultative process would be in danger, due to the impossibility to carry out the interviews at field level and/or a lack of stakeholders' participation to the workshop. A good mitigation strategy would require the constant monitoring of the situation, and if required the postponement of interviews and/or workshop dates; the organization of a webinar could be a possible (partial) substitute of the workshop.