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ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT: PROMOTING SECURITY IN THE MIDDLE EAST AND THE MEDITERRANEAN REGION

Report of the Working Group on Environmental Risk Assessment and Management [1]

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1. Introduction

Risk Assessment and Risk Management are two parts of a process known as Risk Analysis (RA) [1], [2]. This is a complex scientific domain involving different disciplines (e.g. physics, chemistry, toxicology, engineering, law, economics, sociology and political sciences) and inter-disciplines (e.g. ecology and environmental sciences) and addresses difficult technical, environmental, economic and social problems, where hazards may threaten populations or ecological systems. Environmental Risk Analysis (ERA) deals mainly with the evaluation of uncertainties in order to ensure reliability in a broad range of environmental issues, including utilization of natural resources (both in terms of quantity and quality), ecological preservation and public health considerations. In the USA and more recently in Europe, Japan and other developed countries, ERA has rapidly become not only a scientific framework for analysing problems of environmental protection and remediation but also a tool for setting standards and formulating guidelines in modern environmental policies [3], [4].

The main element in ERA is the definition and characterization of the notion of risk. Risk has different connotations and interpretations depending on the historical developments of the specific corresponding scientific disciplines. Engineering risk [5], [6], environmental, ecological or health risks [7] [8] may have different verbal or mathematical expressions. It is generally accepted that risk is a measure or a function of two variables: (1) the frequency or the probability of failure and (2) the consequences of failure. Most of the time, events of a very rare degree of appearance (small

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probability) lead to severe damage (like the devastating tsunami of 26th December 2004 in Indonesia). Frequent occurrences of a random event, like heavy precipitation, may generate only limited damage.

ERA is a general framework providing tools and methods for problem formulation, load-resistance or exposure-response characterization and risk quantification [6]. More important for practical applications is the risk management process, where decision-making may be analysed by evaluating incremental benefits against different degrees of risk [9].

The task of this discussion group was two-fold:

(1) Review recent development in ERA and its importance for promoting environmental security, stability and cooperation in the Middle East and the Mediterranean, and
(2) Investigate effective ways for implementing ERA in the Mediterranean region and especially in the Middle East.

2. Recent advances and importance of ERA for stability and peace

Risk-based assessments have been rapidly developed during the last five decades mostly in the fields of engineering, environmental sciences, chemistry, toxicology and human health. Quantitative Risk Assessments (QRA) and Probabilistic Risk Assessments (PRA) have evolved in civil, nuclear and chemical engineering under heavy regulatory and public pressure [10]. More traditionally, risk of extremes (e.g. floods and droughts) [6] and structural safety under extreme loads (e.g. earthquakes and high speed turbulent flows) were investigated using probabilistic approaches in water, civil and aeronautical engineering.

During the past few decades ERA has benefited greatly from the rapid progress in the science of RA, mainly in the areas of environmental, public health and ecological risks. New scientific tools and methodologies have been developed and well defined regulatory frameworks and directives have been adopted by professional institutions and national agencies, such as the American Society of Civil Engineers (ASCE), the USA-Corps of Engineers (USACE), the US-Environmental Protection Agency (US-EPA) and the European Environmental Agency (EEA). Recently the concepts of *Comparative Risk Analysis (CRA)* [11], *Cumulative Risk Assessment* [12], [13] and *Integrated Risk Management* [14] have been developed, and may be applied to environmental and public health issues in order to reduce risks by implementing new legislation regarding drinking water and food safety [3], [4], [15].

Environmental security is a core element for promoting peace and stability between peoples. This was emphasized at the World Summit on Sustainable Development (WSSD), held in Johannesburg, August - September 2002 [16]. At this summit the international community identified the mutually beneficial management of the world's natural resources and environmental preservation as key factors for peaceful coexistence, cooperation between countries and sustainable development.

WSSD recognized that environmental crises related to non-sustainable utilization of natural resources, water shortages and climate variation could affect every aspect of life from ecosystems to human health, food security, human rights and

cultural heritage. Such crises could significantly affect various levels of economic development, increase the risk of conflicts between countries at various degrees and increase regional political instability. The WSSD plan of implementation recommends integrated environmental management and effective strategies for water use as important tools to promote environmental security, political stability and peace. ERA may be used as a framework for reducing ecological and human health risks and implementing cost-effective measures for sustainable use of natural resources.

In the Mediterranean region and particularly in the Middle East, the semi-arid climate, ethnic conflicts and unstable socio-economic conditions have put natural environmental resources like water, air and soil under severe natural and anthropogenic pressures. Tal and Linkov [17] reviewed the main environmental issues of a transboundary nature in the Middle East and described how CRA may be used as a general framework in order to reduce possible environmental conflicts between countries in the region.

Management of transboundary environmental resources and especially water involves different preventive and curative actions, use of economic instruments, integrated plans for water conservation and demand management, watershed and ecosystem management and wetland conservation [18]. However, in order to effectively address the complexity of real environmental and ecological problems, the use of technical and technological instruments, like monitoring, modelling, risk management and decision analysis, is not sufficient. Effective cooperation between different institutions, involvement of local stakeholders and public mobilization are also very important components for implementing specific action plans [19].

UNESCO has developed two major international programmes for transboundary natural resources management at a regional level. The first is called UNESCO-ISARM (Internationally Shared Aquifer Resources Management) and deals with technical, institutional, economic and social considerations of groundwater management in transboundary regions. The second is the PCCP programme (from Potential Conflict to Cooperation Potential). PCCP focuses on various methodologies, including training and capacity building, in order to prevent and alleviate potential conflicts in sharing transboundary water resources. UNESCO Chair and Network INWEB (International Network of Water–Environment Centres for the Balkans), which is an active regional network in South Eastern Europe (SEE), participated in both programmes. It has recently completed an inventory of internationally shared water resources in the Balkans [20]. The scope and methods for developing such inventories for transboundary groundwater are given as an example in Appendix 1.

The working group recognized the need to examine how the development of an open and broad based partnership of groups and individuals coming from different disciplines could help to implement the ERA framework at a regional level. The main idea was that by combining the expertise and state-of-the-art knowledge of different scientific communities and disciplines, such as engineering, economics, environmental and social sciences, regional partnerships may contribute to the development of new methods and models in order to more efficiently resolve conflicts and controversial issues in the management of transboundary environmental resources.

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3. Developing a regional cooperative ERA network for the Middle East

The main objective of the working group was to set up a network of scientists and institutions, and using ERA as a framework, to address environmental problems in the region. The group discussed a methodology for establishing such a network, which will be called *MEERA-Net (Middle East Environmental Risk Analysis Network).* The following issues were discussed:

3.1 JUSTIFICATION

Traditionally, scientists concerned with risk assessment have worked mainly individually or cooperatively with scientists and institutions within their own country. This is satisfactory for small-scale environmental projects. However, to deal with larger scale projects, it is essential that scientists from various countries within a region work together. Such cooperation may be facilitated and enhanced by a structured regional cooperative network.

Cooperation is particularly difficult in areas such as the Middle East, where countries not enjoying good political relations need to work together to solve environmental problems. The situation is particularly volatile due to the possibility of conflicts, even war between countries, the consequences of which would exacerbate environmental problems. Cooperation is also difficult due to economic and social disparities between countries in the region. Mediation is needed to deal with collecting and sharing data, applying ERA methodologies and alleviating potential conflicts in managing internationally shared natural resources, in particular water resources.

The establishment of MEERA-Net was seen as the best way to provide a sustainable cooperation in order to develop an objective regional database, to effectively implement ERA and to facilitate funding from international organisations.

3.2 SCALE

The MEERA-Net aims to involve scientists from all core countries in the region i.e.: Egypt, Israel, Palestine, Jordan, Syria, Lebanon, Cyprus and Turkey. Main partners should be those of the discussion group willing to join on a voluntary basis. Such a group would be able to tackle regional environmental problems (first level) and exchange experience on ERA. At some point however, a wider cooperation may be necessary, connecting MEERA-Net to other existing regional networks. This would involve a second level of inter-regional cooperation incorporating SEE (Balkans) and Northern Africa. A third level (extra-regional or international) would include networks from the European Union and North America.

3.3 BENEFITS

MEERA-Net aims to improve transboundary cooperation at a regional level. It intends to propose institutional arrangements for effective environmental management and formulate ideas and plans for sustainable use of natural resources. The network aims to further the development of local economies and to promote peace through a

harmonisation of environmental legislation, guidelines, and ERA methodologies. With these goals in mind, it should attract international funding and, by addressing existing national and transboundary environmental problems, benefits will result to all member countries and the region as a whole.

3.4 ISSUES

Firstly inventories indicating the existing situation from environmental and institutional points of view, and mainly in transboundary areas, should be compiled (see the example in Appendix 1). Environmental issues in the region should be evaluated by the network and weighted so as to determine priorities and pilot projects. A topic that will clearly receive priority is *sustainable water management* including issues of supply, demand management, sharing international waters, recycling and re-use, waste-water treatment and disposal, desalination, coastal waters, ecology, biodiversity, and climate change. Another important topic is that of *air pollution* (including issues of transportation and industrial activities). All topics should be considered from multiple perspectives: economical, ecological, social, public health, risk perception, and climate change.

3.5 TOOLS

The tools and methods to achieve the network's objectives were then discussed. It was agreed that MEERA-Net should be an open network that promotes a multi-disciplinary approach to all environmental issues, and involves ERA experts from different fields including science, engineering, economics, law and sociology. It should use new information and communication technologies to reach as wide an audience as possible and to facilitate ease and speed of communication. The network's approach should be flexible so that it can adapt to different areas', countries' and regions' varying cultural, social and legal practices. MEERA-Net will not be a research network in itself, but a means to address existing environmental problems.

MEERA-Net will also be concerned with informing the general public about environmental issues, and sensitising them to the ideas of prevention, protection and preservation. A special initiative to promote environmental awareness at all levels of public education, including primary schools, was seen as an important tool that will promote sound environmental practices.

MEERA-Net will promote joint training projects and the sharing of expertise, and aim to enhance the ease of exchange of knowledge, state of the art information, experience and advice.

3.6 PROCEDURE

Suitable experts from a wide range of disciplines should be identified and invited to join the network. Participants of this working group agreed to be founder members of the network. It was suggested that one representative from each country be chosen as the contact person for that country. Dr. Nava Haruvy was chosen as the contact person

for Israel. Contact people from the other countries in the region still need to be nominated.

Once the network has been established, it will use the following three-step procedure to tackle any environmental problem selected from the list of priority issues previously drawn up.

The first step is to set-up an *information community*. This means acquiring all relevant information and data. It is important to acquire an exhaustive list of information so that no part of a project will be overlooked and to understand the attitudes of scientists from different countries. The means of acquiring data could be broken down as follows:

1.1 Mapping existing data and information
1.2 Data validation through analysis
1.3 Development of inventories
1.4 Monitoring and establishing common monitoring networks
1.5 Reviewing guidelines and standards in affected countries
1.6 Sharing data and information
1.7 Electronic cooperative networks and use of internet for data communication
1.8 Education, training, and capacity building
1.9 Exchange publications and papers

The second step is to convert the information community to a *knowledge community* by analysing and evaluating the data. To structure the information and determine its importance the following list was developed:

2.1 Problem formulation and risk assessment
2.2 Modelling of the environmental situation
2.3 Analysis of past experiences and suggestions for new pilot-studies
2.4 Develop tool boxes for problem resolution
2.5 Organise workshops, exchanges of experiences, and seminars
2.6 Learn from local traditional techniques and craftspeople
2.7 Comparative analysis and "best practices" guidelines

The third step is to convert the knowledge community to a *community of practice*. This step aims to develop useful recommendations and create a plan to implement them. In order to reach a final consensus, mediation is needed between many different groups of people, including:

3.1 Financing and sponsoring organisations
3.2 Decision makers at all levels
3.3 Private and public administrative organisations
3.4 End users
3.5 The general public

4. Conclusion

In order to effectively solve regional environmental problems, countries need to work together. This is best accomplished by creating regional cooperative networks, such as MEERA-Net, to facilitate communication, data sharing and common and joint actions for the mutual benefit of the whole region.

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6. APPENDIX

6.1 SCOPE, METHODS AND TOOLS FOR DEVELOPING AN INVENTORY OF TRANSBOUNDARY AQUIFERS IN THE BALKANS

by

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- AUTh (Aristotle University of Thessaloniki) (Greece)
- Hellenic National Commission for UNESCO (Athens)
- IAH / TARM Commission (International Association of Hydrogeologists / Transboundary Aquifer Resource Management)

In cooperation with

- UNESCO-IHP (International Hydrological Programme)
- UNECE (Economic Commission for Europe: Working Group on Monitoring & Assessment) (Switzerland)
- ESCWA (The Economic and Social Commission for Western Asia) (Lebanon)
- OSS (Observatoire du Sahara et du Sahel) (Tunisia)

6.2 OBJECTIVES

In order to help resolve problems of water use, environmental protection and economic development in SEE and the Mediterranean, there is a need to improve cooperation between countries sharing transboundary aquifers.
The objectives of the programme are:

- to review the available data collected during the first phase of the ISARM Inventory of the Transboundary Aquifers of OSS Mediterranean Countries.
- to learn from the experience gained in the ESCWA region and to coordinate with ESCWA on the preparation of a Mediterranean inventory.
- to compile an inventory of the Balkans region following the ISARM framework document guidelines.
- to identify the key issues for sustainable management of transboundary aquifers in SEE and the Mediterranean area.
- To create an appropriate database at the UNESCO-WMO IGRAC Centre and develop a GIS-based inventory of shared aquifers in the Mediterranean region and SEE. This inventory may serve as a basis for formulating specific local projects for cooperative actions.

6.3 BACKGROUND

The need for international cooperation on the sustainable management of transboundary groundwater resources in the Balkans is particularly acute, and there are many examples where potential conflicts in the use of international groundwaters could arise. Prior to 1992 there were only six international river basins in the Balkans, whereas after

the collapse of the Yugoslav Federation, the number of internationally shared river basins in the area more than doubled. Today in fact there are 13 international shared river basins as well as 4 transboundary lake basins. Institutions dealing with water problems in the region need support to use modern information and communications technologies for monitoring, modelling and water management studies.

The water resources in the semi-arid northern part of the UN-ESCWA region are dominated by groundwater characterized by significant and large shared aquifers located in the Eastern and Southern sections of the Mediterranean basin. UN-ESCWA gives high priority to sustainable development and joint management of transboundary groundwater resources and has carried out important aquifer studies in the region. UN-ESCWA is a partner in the ISARM initiative and is currently concluding two important ISARM case studies on the regional Basalt Aquifer system in Jordan and Syria and on Paleogenic Carbonate Aquifers, which are both represented within the Mediterranean basin.

The work for this project is based on previous programmes and initiatives such as:

- ISARM, UNESCO, IAH, UNECE, FAO (Food and Agriculture Organisation)
- The European Water Initiative
- The Athens Declaration
- The UNECE Guidelines on Monitoring and Assessment of Transboundary Groundwaters
- The OSS programme on arid zones
- The ESCWA findings on legal frameworks.

6.4 METHODOLOGY

ESCWA, UNECE, UNESCO and OSS will compile a draft document presenting the state of knowledge on shared aquifers in the region based on the ISARM questionnaire. Using this information, experts from OSS and SEE will be invited to identify key issues and problems for the sustainable management of aquifers in the region at a three-day workshop in Thessaloniki, Greece. At the workshop they will work together to initiate the preparation of an Atlas of International Aquifers in the Mediterranean Region, to define support mechanisms to improve cooperation for the better use and protection of shared groundwater resources in the region, and to identify tools to help countries better evaluate their groundwater resources.