



UNITED NATIONS
UNIVERSITY
UNU-EHS

Institute for Environment
and Human Security

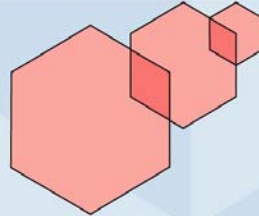


UNESCO / IHP
Division of Water Sciences



UNITED NATIONS
UNIVERSITY

UNU-INWEH



Groundwater and Human Security – Case Studies (GWAHS-CS)

Results from the Kick-Off Workshop

by Fabrice Renaud

Jose Luis Martin-Bordes & Brigitte Schuster

Working Paper No. 4/2008

Bonn

TABLE OF CONTENTS

1. Introduction to the project and workshop.....	3
2. Outcomes of the workshop	5
2.1. Threats and vulnerability factors	5
2.2. Research steps and conceptual factors	6
2.3. More specific (but still preliminary) activities.....	7
2.4. Next steps	8
3. Conclusions	10
Annex 1.....	11
Annex 2.....	14
Annex 3.....	16
Annex 4.....	18

1. Introduction to the Project and Workshop

In 2006, UNESCO-IHP (the International Hydrological Programme of UNESCO) and UNU (United Nations University) decided to develop jointly a programme addressing, through research, capacity development and networking, the interlinkages between groundwater resources and human security. This followed a kick-off meeting organised in Bonn in January 2006 where experts dealing with groundwater resources but coming from a wide range of disciplines identified the above research theme as an important one that should be addressed by both international organisations and their networks of scientists and experts worldwide. A report on this January 2006 meeting is available for download at <http://www.ehs.unu.edu/file.php?id=146>. The programme is called Quo Vadis Aquifers? (or QVA) and has since been integrated in the work plans of UNESCO-IHP and UNU-EHS (UNU's Institute for Environment and Human Security) for the coming years.

QVA is an umbrella programme that will host a variety of research and capacity development projects. The first such project is the **Groundwater and Human Security – Case Studies** project (or GWAHS-CS). The GWAHS-CS project is a collaboration between three international organisations/institutes (UNESCO-IHP, UNU-EHS and UNU-INWEH) and some of their network partners (Fars Research Center for Agriculture and Natural Resources, I.R. Iran; University of Alexandria, Egypt; Mekong Delta Research and Development Institute, Can Tho University, Vietnam; and Division of Hydrogeology and Engineering Geology for the South of Viet Nam, Vietnam). Additional partners will also be involved in the project (e.g. International Groundwater Resources Assessment Centre (IGRAC), The Netherlands; Kochi University of Technology, Japan and others) and additional case studies could be included in the future depending on funding. Funding for the project as it stands now comes from the three international institutions as well as from UNU Headquarters in Japan.

The objectives of GWAHS-CS are multiple:

Overall Objective:

To address the threats to human security and well-being currently posed by water scarcity and water quality degradation in developing countries and the role of groundwater management and protection in alleviating such threats.

Research Objectives:

1. To adapt existing vulnerability assessment frameworks and concepts to the issues of water scarcity and water quality degradation and with consideration of the management and protection of groundwater resources
2. To determine methods for the assessment of groundwater vulnerability and groundwater degradation as both a hazard to communities and as a contributor to the overall vulnerability of communities facing other natural hazards (droughts, floods, earthquakes, tsunamis, etc.)
3. To develop a set of socio-environmental indicators of vulnerability due to natural hazards and water availability and quality. Ground water degradation will be considered as one of the natural hazards.
4. To characterise the vulnerability of selected communities facing various types of hazards and their access to safe groundwater resources. Again groundwater degradation will be considered as one of the hazards but also as one element of coping when discussing other hazards.

Capacity Development Objectives:

5. To train scientists or experts in the use of vulnerability assessment methodologies that are adapted to the local and/or regional contexts (should this be required)
6. To encourage South-South Cooperation between case study experts and institutions

Policy Objective:

To work systematically with relevant research and government institutions to prove the relevance of the approach, which can then be replicated locally in other relevant areas in the countries and in their region.

These objectives will be considered in four case study areas:

Vietnam: 2 Sites

Site one in Vietnam will be near Trà Cú in Trà Vinh Province in the Mekong Delta. This region regularly experiences droughts and groundwater resources are used for both domestic consumption and agricultural purposes. Increasing pressure is put on the resource through pollution and through salinity intrusion.

Site two in Vietnam will be in Binh Thuan Province (South-East of the country) which suffers from water scarcity problems. A UNESCO-Italian project in the region aims at augmenting groundwater resources by artificial recharge to supply fresh water to the local communities.

Egypt: 1 Site

The Egyptian site is located at Wadi Natrun which is a depression on the western side of the Nile delta (80 km north-west of Cairo). It is characterized by its salty water bodies, and fresh groundwater aquifer which is used for drinking, agriculture, and industries. It faces over-exploitation problems and pollution from sewage.

I.R. Iran: 1 Site

The site in Iran (Gareh Bygone Plain) is located 200 km south-east of Shiraz within the 192 km² Bisheh Zard Basin. Groundwater is extracted for drinking and irrigation purposes on the plain, and in the nearby city. The use of agrochemicals in the region has led to high concentrations of nitrates in the water. Techniques to enhance groundwater recharge and the removal of pollutants are being studied at this site.

The project will be implemented over the period 01/2008 – 12/2009.

Following proposal preparation, securing funding and network finalisation, it was important to organise a kick-off workshop for the project as rapidly as possible. The workshop was co-organised by UNESCO-IHP, UNU-EHS and UNU-INWEH and hosted by UNU-EHS in Bonn, Germany over the period 24-25 January 2008. The objectives for the workshop were (1) for the network partners to get to know each-other; (2) to present relevant information on project concept and case study areas; and (3) to prepare in detail a workplan, procedure plan, and agree on methodologies for the execution of the project. The pre-workshop concept note is presented in Annex 1, the agenda of the workshop in Annex 2 and the list of participants in Annex 3.

The workshop had two main components. The first component consisted in formal presentations from the participants to describe case study areas, description of concepts and description of relevant activities. A brief summary of the presentations is provided in Annex 4. The second component consisted on brainstorming activities on three themes: (1) vulnerability assessment for the case studies / coupled socio-ecological systems; (2) specific activities to be implemented in each case study areas / joint activities enabling comparative studies; and (3) methods, concepts and activities linked to vulnerability assessment; timetable. The next section of this report provides an overview of the workshop's outcomes.

2. Outcomes of the Workshop

Following the presentations of case study areas, three brainstorming sessions were organised for activity and administrative planning purposes. The results of the discussions are presented below and consist of (1) a preliminary list of vulnerability factors and threats for each case study area, (2) a list of research steps and conceptual factors which was derived from the research-related discussions, (3) a more general list of specific activities, and (4) the next steps to be taken by all partners for the duration of the project.

2.1. Threats and Vulnerability Factors

- **Egypt case study site**
 - **Groundwater issues:** quality and quantity
 - **Drivers:** economic development (linked to agricultural activities and demographics)
 - **Pressures:** overexploitation and lack of waste water treatment and sanitation system
 - **Impacts:** depletion of groundwater, salinisation, reduced water quality and health problems
 - **Features of vulnerability:** health, local population and poverty, agriculture, no water allocation system, habitat fragmentation, development projects, recreation/tourism, awareness
 - **Data availability:** mortality rates detailed data not accessible
 - **Response:** city Strategic Plan under development (involving local authorities and population)
 - **Recommendations regarding scale:** Level of village
- **Iran case study site**
 - **Groundwater issues:** quality and quantity
 - **Drivers:** economic development and climate change
 - **Pressures:** over-exploitation and irrational fertiliser usage
 - **Impacts:** health impacts (related to nitrate concentration during droughts)
 - **Features of vulnerability:** health, expansion of recharge areas needed, agricultural activity
 - **Data availability:** reliable data not available, data for flooding available
 - **Response:** national artificial recharge plan, technical measures for flood control, increase awareness on fertiliser usage (recommended)
 - **Recommendations regarding scale:** regional level (for upscaling)
- **Vietnam case study site - Mekong Delta**
 - **Groundwater issues:** coastal zones, salinity intrusion
 - **Drivers:** economic development and climate change
 - **Pressures:** livestock, shrimp production and processing, vegetable production
 - **Impacts:** salinity intrusion from sea and fossil saline water upconing, land subsidence, chemicals, groundwater levels decline, arsenic and iron pollution in some areas
 - **Features of vulnerability:** ethnic minorities, children, gender/women,
 - **Data availability:** groundwater monitoring system for levels and quality (5000 boreholes)

- **Response:** regulations mechanisms at provincial level, reporting mechanism related to regulations
- **Recommendations regarding scale:** regional level
- Vietnam case study site - Bin Thuan Province
 - **Groundwater issues:** quality and quantity
 - **Drivers:** economic development
 - **Pressures:** fast development of tourism, shrimp production, mining of titan, deforestation
 - **Features of vulnerability:** used as drinking water by local communities
 - **Data availability:** ground water monitoring system for levels and quality (5000 boreholes)
 - **Response:** masterplan under development (funded by Italian Cooperation), artificial aquifer recharge for drinking water supply to local communities, capturing untapped spring water
 - **Recommendations regarding scale:** watershed

2.2. Research Steps and Conceptual Factors

The main objective of GWAHS-CS is to address threats to human security and well-being posed by water scarcity and quality degradation. It also aims to investigate how improved groundwater management can increase human security. The following questions and steps were identified and will be addressed by the project partners:

- What is the environmental (groundwater) problem?
 - This needs to be addressed in terms of quality, quantity, and/or both
- Who/what is threatened (multiples possible)?
 - Areas of study (rural, peri-urban, urban)
 - Different social groups, age/gender differentials
 - Economic sectors
 - Provision of environmental services (question of dependency with respect to the resource)
 - Other environmental compartments
- Need to assess the vulnerability and coping capacities of people (three dimensions: social, economic & environmental). Questions/steps:
 - What should be the most appropriate scale (multiple, superimposed scales)?
 - What are the observed past trends in groundwater degradation/improvement - such as MAR – Managed Aquifer Recharge; urbanisation; agricultural development, etc?
 - What other hazards should be considered?
 - What legislation is in place or is lacking?
 - Who are the stakeholders? (including final target audiences)
 - Start with what is known (Meta-data):
 - Desk-based studies on hydrogeology
 - Desk-based study on socio-economic factors/sectors (e.g. existing census information)
 - Known environmental impacts and disruption of ecosystem services
 - Review existing policies relevant to the problem at hand

- **Methods and tools:**
 - The methodology needs to be incorporated within, or made compatible with a vulnerability assessment framework (Research Objective 1). If a framework needs to be adapted, UNU will address the issue. Frameworks that can be considered are the BBC framework (from UNU-EHS) or frameworks dealing directly with coupled socio-ecological systems such as the Turner model.
 - Methodological aspects (will vary greatly with what is assessed). Research Objective 2 – iterative process.
 - Rapid Rural Appraisals
 - Participatory Appraisals (including semi-structured questionnaires, group discussions)
 - Stakeholder interviews
 - Anthropologic approaches
 - Answering the What? and the Who? Related questions above will guide the group as to what to be measured (new data generation) and leads to:
 - Development of indicators (Research Objective 3). This needs to be captured at the beginning and refined through the vulnerability assessment process. Two sets of indicators:
 - Common set of indicators (e.g. to be finalised by next meeting)
 - Case study – specific sets of indicators (e.g. to be finalised by next meeting). Also,
 - Indicators need to capture the three dimensions (social, economic and environmental as well as coping mechanisms).
- Team structures needs to be multidisciplinary as multiple dimensions of vulnerability need to be captured.
- Vulnerability assessment per se:
 - Using indicators
 - Synthesis of various data (old and new to give a broader picture)
 - New, complementary surveys will probably be necessary.

2.3. More Specific (but still preliminary) Activities

During the brainstorming session some preliminary ideas on activities in the case study sites were compiled:

- **Egypt case study site**
 - The preferred approach to collect socio-economic data is through an anthropological approach and by involving all relevant stakeholder groups.
 - Surveys should also assess existing ground water management strategies, as these should provide the basis for future interventions.
 - For the vulnerability assessment the use of integrated scenarios in order to project e.g. evolution of water demands, urbanization trends etc., was recommended.
 - Hydro geological modelling was proposed as an approach to gain more information and a better understanding of hydro geological aspects at the case study site.
- **Iran case study site**
 - The proposed scale of the case study is at watershed and aquifer (200 km²) levels.
 - A need for enhanced agro-chemical monitoring was identified with a focus on regular assessments of the amount of fertilizers and pesticides used.

- Farmers should be the main stakeholder group involved in the survey.
- The proposed interdisciplinary research team includes sociologists, economists, hydrologists, who are all based at the same research centre. Additional specialist expertise by UNU or UNESCO might be needed.
- **Vietnam case study site - Mekong Delta**
 - Desktop analysis should focus on compiling available information including
 - Hydro geological studies in the Mekong Delta available through existing databases in the Department of Geology and Minerals of Vietnam, Division of Hydrogeology;
 - Annual statistical survey of socio-economics, available at provincial and local level (commune).
 - Surveys should focus on improving the understanding of the relation between agriculture and groundwater and compiling information on social networks.
 - The following stakeholders should be involved in the survey:
 - Department of Environment and Natural Resources Management;
 - Water supply companies;
 - Farmers;
 - Women associations;
 - Minority groups (Khmer);
 - District and village people committees.

2.4. Next Steps

Diagnostic/identification:

- Case Study Partners (thereafter called CSP) will provide preliminary but detailed answers to the questions raised in Section 2.1., particularly the scale of application/effect, hazards, trends and stakeholder questions **(End March)**
- CSP and UN will prioritise factors generating hazards (e.g. pollution by agrichemicals; sewage; etc) **(End March)**
- UN and CSP will create a logical framework **(End March)**
- CSP and UN will iterate on important factors to consider in vulnerability assessment as well as on specific tools **(End April)**
 - Need to have a preliminary idea of data availability and gaps (in a general sense) **(End April)**

Work-plan preparation – Contractual arrangement (End April)

Execution

- Preliminary synthesis - iterative **(End of August)**
- UN to support in framing the parameters within a conceptual vulnerability assessment framework **(End August)**
- CSP and UN to iterate on indicators (possibly finalise list by next meeting) **(End October - Alexandria)**
- National workshops **(October)**
- CSP to finalise assessment (synthesis) **(August 2009)**
- Synthesis document for policy-makers (with translation) **(November 2009)**
- Interaction with policy & decision-makers (from stakeholder, workshop) **(Nov - Dec 2009)**

Tentative meetings/conferences

- End of October 2008 – Alexandria, Egypt

- End April 2009 – I.R. Iran
- September 2009 – HCMC, Vietnam
- World Water Forum 2009? Session, individual contribution?

3. Conclusions

The three objectives of the workshop were fulfilled. Partners coming from different networks met for the first time and very constructive and lively discussions took place enabling the refinement of the project's concept and execution plan. The four case study areas offer a diversity of socio-cultural and economic settings, geographical locations and climatic conditions and different problematic with respect to groundwater resources (over-exploitation, pollution, but also recharge potential). This diversity will give the opportunity to the project partners to develop a robust vulnerability assessment methodology but will also be a challenge in the sense that the methodology will need to be flexible enough to enable to capture the diversities mentioned above. However, the differences of situations represented in the four case study areas (which was a conscious choice from the beginning) will make the results of this research project more relevant to other areas around the world and more likely to be upscalable and reproducible.

The available timeframe for the execution of the project affords the partners the time of reflection in terms of methodology development and execution. However, careful planning will be required by all so that a smooth project operation will prevail and that results of scientific contents can be presented at each of the meetings that are planned in each case study countries. Adequate execution of the GWAHS-CS project is particularly important as it is the first project within the collaborative Quo Vadis Aquifers programme and will therefore set a precedent for other projects envisaged under this programme.

Annex 1

Concept Note

A bit of history

In 2005, the United Nations University Institute for Environment and Human Security (UNU-EHS) and the International Hydrological Programme of UNESCO (UNESCO-IHP) discussed possibilities of working jointly on issues relating groundwater resources and human security. These discussions led to the joint organisation of a brainstorming workshop in Bonn Germany in January 2006. There, some 20 experts from around the world met to discuss whether a programme addressing the links between groundwater protection and management and human security was warranted and if so in which form. In a nutshell, it was agreed that an umbrella programme made up of several individual but interlinked projects should be implemented jointly by UNU (including not only UNU-EHS but also other interested UNU Centres or Programmes) and UNESCO-IHP. This programme is called “Quo Vadis Aquifers?” (QVA). The report of the workshop can be downloaded from the UNU-EHS website (<http://www.ehs.unu.edu/file.php?id=146>). Following a series of bilateral meetings, it was decided that UNU-EHS, UNESCO-IHP and UNU-INWEH (International Network for Water Environment and Health) would put some core financial resources to initiate one project, GWAHS-CS, focusing on the development of case studies, which would be part of the QVA programme. A separate document describing the QVA programme and which was presented during workshops in Tokyo and Kyoto in Japan in 2006 will be sent with this concept note as background reading material.

The concept of GWAHS-CS

The project is meant to be the first practical activity under the QVA umbrella programme. The objectives are multiple:

Overall Objective:

To address the threats to human security and well-being currently posed by water scarcity and water quality degradation in developing countries and the role of groundwater management and protection in alleviating such threats.

Research Objectives:

7. To adapt existing vulnerability assessment frameworks and concepts to the issues of water scarcity and water quality degradation and with consideration of the management and protection of groundwater resources
8. To determine methods for the assessments of groundwater vulnerability and groundwater degradation as both a hazard to communities and as a contributor to the overall vulnerability of communities facing other natural hazards (droughts, floods, earthquakes, tsunamis, etc.)
9. To develop a set of socio-environmental indicators of vulnerability due to natural hazards and water availability and quality. Ground water degradation will be considered as one of the natural hazards.
10. To characterise the vulnerability of selected communities facing various types of hazards and their access to safe groundwater resources. Again groundwater degradation will be considered as one of the hazards but also as one element of coping when discussing other hazards.

Capacity Development Objectives:

11. To train scientists or experts in the use of vulnerability assessment methodologies that are adapted to the local and/or regional contexts (should this be required)

12. To encourage South-South Cooperation between case study experts and institutions

Policy Objective:

To work systematically with relevant research and government institutions to prove the relevance of the approach, which can then be replicated locally in other relevant areas in the countries and in their region.

Even though it is anticipated that it will be difficult to compare results from all the different case study areas, achieving the same set of objectives will allow for generalisations on the links between groundwater resources management (including degradation) and human security that will be of importance when a larger-scale follow-up project is developed.

As UNU Programmes and UNESCO-IHP work hand in hand with many institutions and partners worldwide, the project was meant to be executed jointly by partners from existing networks and by scientists working in UNU and UNESCO-IHP, the former having the lead for the case study implementation in their own countries. Partners were thus contacted to check whether there was an interest on their part in engaging in the research proposed within GWAHS-CS. This process led to the identification of four case study areas, one in Egypt, one in Iran and two in Vietnam. All areas exhibit various stressors on groundwater resources and of course, are located in different socio-ecological settings.

Kick-off workshop

The kick-off workshop will enable all key project participants to get to know each other. It has been planned so as to achieve three objectives:

1. Learn more from the case study areas through presentations from scientists from the regions concerned.
2. Learn more about vulnerability and vulnerability assessment through presentations from UNU.
3. Brainstorm so as to plan and prepare all project activities for the lifespan of the project and identify expected outcomes.

Implementation of GWAHS-CS

The first step in the assessment of groundwater vulnerability is to identify conditions and trends regarding resource availability and quality. Since threats to human security posed by the degradation of available groundwater quality and quantity are directly mediated by the nature of groundwater dependence within communities for their livelihoods and well-being, this is the next factor to be considered. It is therefore necessary to examine the prevalent modalities and degrees of human dependence on groundwater. Numerous schemes such as managed artificial recharge provide an effective means of storing water and enabling a better management of available resources. This method may also achieve other purposes, such as flood mitigation, reduced soil erosion or change of land use and it can also impact on the water quality, usually in a beneficial manner. Finally, in addition to the environmental and socio-economic factors already indicated, management capacity and options are a third necessary element for human-groundwater vulnerability assessment. Vulnerability is ultimately greatest in situations where capacity for managing water resources is lacking, while human dependence on groundwater and ongoing resource degradation are both in effect.

Coupled human-environmental systems and their interactions can be best assessed at the local level, where changes and interactions within land-use, water-use and the availability of the groundwater resource are more easily identified and assessed. It is also important to recognize that monitoring the evolution of the quantity and quality of groundwater resources is difficult when only little information and data about the resource are available or are analysed. The scale and extent of the aquifer systems in each of the study sites will be taken

into account in the definition and orientation of the case studies. However, where degradation processes are accelerated through socio-economic transformations, they can threaten human security on a wider regional scale. This project will therefore connect small scale localized case study assessments of groundwater vulnerability to processes and effects occurring across entire regions, such as the Mekong Delta, and the Western Desert of Egypt.

Although an understanding of the ecosystem status is important, data already existing at various scales – including the aquifer scale such as e.g. depth of groundwater table, groundwater quality, land degradation, will be collected, analysed and incorporated into vulnerability assessment schemes. What will be generated through the case studies are socio-economic data and information. This will be achieved through households surveys conducted at each location and through the reanalysis of any statistical data already existing for the areas and at larger scales (e.g. regional statistics).

Building on the existing networks and the existing capacities, project activities in each case study area will consist in:

1. Synthesise available groundwater information and hydrogeological conditions (physical basis such as storage volumes, recharge areas, recharge rates and groundwater quality) at various scales
2. Synthesise existing socio-economic and census data for the specific areas of the case studies
3. Carry out interviews and field surveys to understand:
 - a. all the linkages between groundwater and communities
 - b. the social, economic and other environmental dimensions of vulnerability to groundwater degradation considering management and protection measures
 - c. the existing coping strategies used by the communities
4. Synthesise all the information in a scientifically coherent manner and extract essential elements for policy-makers. Prepare policy guidelines based on the results of the case studies.
5. Identify follow-up activities to be carried out with local communities to create comprehensive assessments of vulnerability and to propose guidelines for the protection of groundwater resources.

In particular, study teams will evaluate:

- Prevalence and degree of dependency amongst local populations on groundwater (e.g. for drinking, household use and economic activities such as irrigation, livestock watering, industrial and other uses)
- Conditions and trends in availability, quality and usage of groundwater resources (including relationship to other available water sources)
- Current recharge of groundwater (and options for artificial recharge), threats from pollutants, and management measures in place
- Scenarios to assess the predicted effects of climate change and climate variability on water availability and quality, access and use (including potential sea level rise, where relevant), under various possible management regimes.

It is intended that all sites be visited by the project partners to visit the socio-geographical setting and to discuss project progress, if funds are sufficient.

Annex 2

Agenda

Thursday, 24 January 2008

09.00 – 09.15	Welcome Prof Janos Bogardi (UNU-EHS)
09.15 – 09.30	Self-Introduction All
09.30 – 09.40	Information on the Workshop Dr Fabrice Renaud (UNU-EHS)
09.40 – 10.00	The idea of the Quo Vadis Aquifers Programme: cooperation between UNU and UNESCO-IHP Dr Jose Luis Martin (UNESCO-IHP)
10.00 – 10.15	The idea of the GWAHS-CS Project Dr Fabrice Renaud (UNU-EHS)
10.15 – 10.30	Discussion
10.30 – 10.50	Coffee Break
10.50 – 11.10	Introduction to the case study in Egypt Prof Boshra Salem (University of Alexandria)
11.10 – 11.20	Discussion
11.20 – 11.40	Introduction to the case study in Iran Dr. Mehrdad Mohammadnia (Fars Research Center for Agriculture and Natural Resources)
11.40 – 11.50	Discussion
11.50 – 12.10	Introduction to the case study in Vietnam – Mekong Delta Dr Nguyen Van Sanh (Mekong Delta Research and Development Institute, Can Tho University)
12.10 – 12.20	Discussion
12.20 – 12.40	Introduction to the case study in Vietnam - Binh Thuan Province Dr Bui Tran Vuong (Division of Hydrogeology and Engineering Geology for the South of Viet Nam)
12.40 – 12.50	Discussion
12.50 – 14.00	Lunch
14.00 – 14.30	Concepts and methods for vulnerability assessment Dr Jörn Birkmann (UNU-EHS)
14.30 – 14.45	Some indicators used in groundwater research Dr Fabrice Renaud (UNU-EHS)
14.45 – 15.00	Discussion
15.00 – 15.30	Brainstorming session I: vulnerability assessment for the case studies / coupled socio-ecological systems Moderator: Dr Jose Luis Martin (UNESCO-IHP)
15.30 – 15.50	Coffee Break
15.50 – 17.30	Brainstorming session I: continued
18.30	Joint Dinner at the Gustav Stresemann Institute

Friday, 25 January 2008

08.45 – 09.00	Summarizing results from first brainstorming session Dr Jose Luis Martin (UNESCO-IHP)
09.15 – 09.30	Groundwater and Human Security in Arsenic Contamination Problems of the Lower Ganges Delta in Bangladesh and India Dr Kazuku Tsuji (Fuji Grouting Engineering Co., Ltd)
09.15 – 09.30	Previous work of UNU-INWEH in arid environments Dr Zafar Adeel (UNU-INWEH)
09.30 – 09.45	Discussion
09.45 – 10.30	Brainstorming session II: specific activities to be implemented in each case study areas / joint activities enabling comparative studies Moderator: Dr Brigitte Schuster (UNU-INWEH)
10.30 – 10.50	Coffee Break
10.50 – 12.30	Brainstorming session II: continued
12.30 – 13.30	Lunch
13.30 – 13.45	Summarizing results from second brainstorming session Dr Brigitte Schuster (UNU-INWEH)
13.45 – 14.00	Discussion
14.00 – 15.00	Brainstorming session III: Methods, concepts and activities linked to vulnerability assessment; Timetable Moderator: Dr Jörn Birkmann (UNU-EHS)
15.30 – 15.50	Coffee Break
15.30 – 17.20	Discussion on all practical aspects including: <ul style="list-style-type: none">• Resources required for the implementation of the project• Procedures, communication, and reporting• Location and format of next meeting• Wrap-up Moderator: Dr Fabrice Renaud (UNU-EHS)
17.20 – 17.30	Final Remarks Dr Zafar Adeel (UNU-INWEH)
17.30	End of Workshop

Annex 3

List of Participants

Name	Affiliation	Email	Comment
Dr Zafar Adeel	UNU-INWEH, Hamilton, Canada	adeelz@inweh.unu.edu	Director of UNU-INWEH
Dr Jörn Birkmann	UNU-EHS, Bonn, Germany	birkmann@ehs.unu.edu	Head of Vulnerability Assessment section
Prof Janos Bogardi	UNU-EHS, Bonn, Germany	bogardi@ehs.unu.edu	Director of UNU-EHS & Vice Rector a.i. of UNU
Ms Janine Halder	UNU-EHS, Bonn, Germany	halder@ehs.unu.edu	Will conduct groundwater research in Vietnam for her MSc thesis
Prof Libor Jansky	UNU-ViE, Bonn, Germany	jansky@vie.unu.edu	Participated in the first brainstorming meeting of Quo Vadis Aquifers
Dr Peter Letitre	International Groundwater Resources Assessment Centre (IGRAC), Utrecht, The Netherlands	peter.letitre@tno.nl	Director of IGRAC. IGRAC participated in the first brainstorming meeting of Quo Vadis Aquifers
Dr José Luis Martin-Bordes	UNESCO-IHP, Paris, France	jl.martin@unesco.org	Coordinator of the Project for UNESCO-IHP
Dr. Mehrdad Mohammadnia	Fars Research Center for Agriculture and Natural Resources, Shiraz, I.R. Iran	mohammadnia@farsagres.ir	Coordinator of case study in I.R. Iran
Dr Fabrice Renaud	UNU-EHS, Bonn, Germany	renaud@ehs.unu.edu	Coordinator of GWAHS-CS
Prof Boshra Salem	University of Alexandria, Alexandria, Egypt	boshra.salem@dr.com	Coordinator of case study in Egypt
Dr Nguyen Van Sanh	Mekong Delta Research and Development Institute, Can Tho University, Can Tho, Vietnam	nvsanh@ctu.edu.vn	Coordinator of case study in Vietnam – Mekong Delta
Dr Brigitte Schuster	UNU-INWEH, Hamilton, Canada	schustb@inweh.unu.edu	Coordinator of the project for UNU-INWEH
Dr Zita Sebesvari	UNU-EHS, Bonn, Germany	sebesvari@ehs.unu.edu	Conducts research in Vietnam on water quality issues

Mr Kazuku Tsuji	Fuji Grouting Engineering Co., Ltd, Japan	k.jack.hime@jcom.home.ne.jp	Close collaborator of Prof Murakami who participated in the first brainstorming meeting of Quo Vadis Aquifers and who is active on the topic
Dr Bui Tran Vuong	Division of Hydrogeology and Engineering Geology for the South of Viet Nam, Ho Chi Minh City, Vietnam	buitranvuong@gmail.com	Coordinator of case study in Vietnam – Binh Thuan Province

Annex 4

Summary of Presentations (brief notes only)

The “Quo Vadis Aquifers?” Programme: A joint Programme Addressing the Links Between Groundwater Degradation and Human Security

Presented by Jose Luis Martin-Bordes (UNESCO-IHP)

Quo Vadis Aquifers? is a joint programme developed and managed jointly by UNESCO-IHP and UNU-EHS that proposes to address, through research and capacity development projects and activities, the links between groundwater resources degradation and human security. Ultimately, the various activities under the programme will:

- Advance the scientific knowledge on methods to capture the relationships between different types of pressures placed on the aquifers and the vulnerability of communities that rely on this resource, and this in a wide range of environments;
- Provide, through research results and effective communication, policy-relevant information to local and national policy-makers that would enable them to take actions to alleviate the pressures on the resources and/or reduce the vulnerability of the communities concerned;
- Through institutional and individual capacity development, provide the means for target countries to effectively address the issue at hand.



Examples of specific outcomes of QVA will be (i) to increase our knowledge on the interrelationship between groundwater degradation and human vulnerability – which will serve as a proxy description of human (in)security; (ii) through vulnerability assessment and working with national and local representatives in selected case study areas, identify solutions to reduce groundwater related vulnerability of communities; and (iii) to provide solutions to the cases of transboundary issues related to groundwater and community vulnerability. The projects will be developed and implemented through the vast network of partners both institutions work with.

GWAHS-CS Project

Presented by Fabrice Renaud (UNU-EHS)

The GWAHS-CS is a scientific project that will be executed jointly by UNU-EHS, UNESCO-IHP, UNU-INWEH, four partners in Egypt, I.R. Iran and Vietnam as well as other interested partners and institutions. The overall objective is to address the threats to human security and well-being currently posed by water scarcity and water quality degradation in developing countries and the role of groundwater management and protection in alleviating such threats. The project has several research, capacity development and policy objectives. It will look at groundwater resources from the risk perspective (e.g. because of pollution or over-exploitation) but also investigate the opportunities brought about by sustainable management of groundwater resources (e.g. artificial recharge). The project will build on existing hydrogeological information and will generate new socio-economic data where appropriate.



Concepts and Methods for Vulnerability Assessment

Presented by Jörn Birkmann (UNU-EHS)

The concept of vulnerability can serve as an important framework to understand and capture human insecurity. Particularly, the degradation of groundwater and water resources does not solely pose a threat to the habitats and the ecosystem, it often implies also severe consequences for land-use in the



region and human well-being. This dependency and the anthropogenic use of groundwater resources within a specific region – such as the Mekong Delta or the Nile Delta – describes part of the vulnerability of human-environmental interactions in the context of groundwater degradation. The presentation gave an outline of different methodological concepts to capture and measure vulnerability. Developing and testing different methods to capture and measure the vulnerability of communities who face freshwater supply problems actually or most likely in the future is an important task and challenge. It is essential to acknowledge that risk is the outcome of the interaction between the physical event – such as groundwater

degradation (quality, quantity) - and the vulnerability of the exposed community. Water is essential for various direct human needs (drinking water) as well as for indirect needs and particularly for livelihoods (agriculture). Thus measuring the socio-economic vulnerability of different social groups exposed as well as capturing the vulnerability of human-environmental interactions is key to examine human security in the context of groundwater degradation. It is something of a shock to realize that, not only is there no single method for assessing vulnerability, but there is not even agreement on the basic term (a relative common definition is shown below). However, it might even be necessary to have slightly different understandings and definitions of vulnerability when dealing with very different elements or regions at risk. One can measure vulnerability as exposure to hazards or as the potential loss to gross domestic product. When dealing with local and sub-national case studies and groundwater degradation it is important to focus on the vulnerability of communities, individuals, economic activities and sectors as well as critical infrastructures – which depend in one way or another on water. Consequently, there can be no single definition of vulnerability without consideration of the context in which the examination is taking place. Although specific vulnerability assessments will need to be developed in and for the case study areas selected some general recommendations on how to capture vulnerability within the context of “Groundwater and Human Security” can be formulated:

- Assessment of the dependency of different land-use forms and stakeholders/livelihoods on groundwater
- Assessment of actual and potential impacts of changing groundwater conditions (quantity and quality)
- Analysis of vulnerability patterns due to changes in groundwater conditions and additional hazards (such as Climate Change)
- Estimation of actual and potential coping and adaptive capacities
- Analysis of the effects of interventions undertaken or planned (at different levels, policy dimension)

The slide is titled 'Vulnerability Definitions'. It contains two definitions of vulnerability. The first definition is from UNDP (2004): '... a human condition or process resulting from physical, social, economic, and environmental factors which determine the likelihood and scale of damage from the impact of a given hazard'. The second definition is from Wisner (2002): '... the likelihood of injury, death, loss, disruption of livelihood or other harm in an extreme event, and/or unusual difficulties in recovering from such effects'. On the left side, there is a vertical text label: 'United Nations University Institute for Environment & Human Security'.

Furthermore, it will be important to address and to answer the following questions when developing a common framework for vulnerability assessment regarding groundwater degradation:

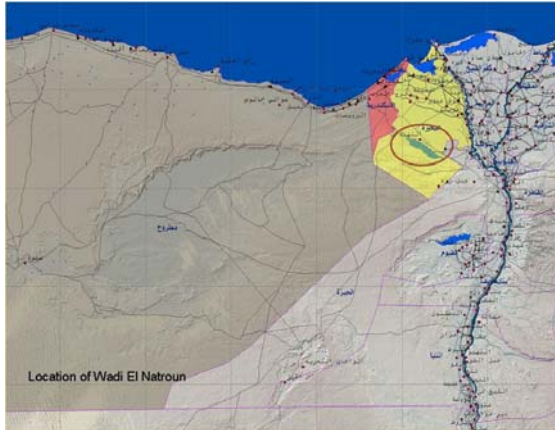
1. What is the appropriate scale to capture the vulnerability of coupled human-environmental interactions?
2. Which are the most relevant socio-economic indicators to assess the vulnerability and what data is actually available?

3. How to ensure that results between the different locations and the various cultural settings can be compared?
4. Are the impacts of the changes in groundwater conditions already visible in statistical data?
5. How to evaluate the different capacities to cope and adapt to potential changes?

Ground Water and Human Security. Case Study: Wadi Natroun - Egypt

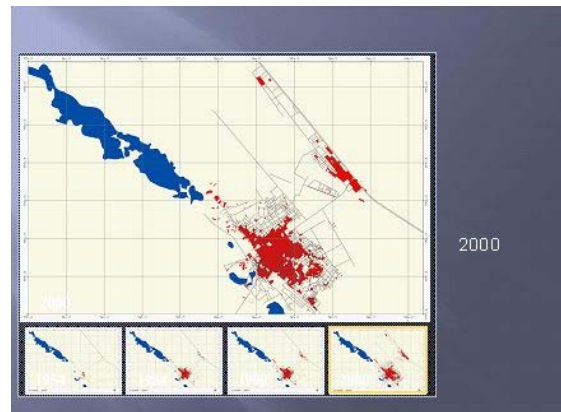
Presented by Boshra Salem (University of Alexandria)

Wadi El Natroun is a part of the Western Desert in Egypt, adjacent to the Nile Delta. It is a narrow depression located approximately 90 km south of Alexandria and 110 km North West of Cairo. It lies 23 m below sea level and is characterized by a series of twenty small disconnected lakes in the bottom of the Wadi, aligned with its general axis in the northwesterly direction for a distance of about 30 km. The region has experienced in the last decades a repaid development through urbanization, development of agriculture and tourism.



Geomorphologically it comprises the Northern gravelly ridge, the Northern marginal slopes, the Central lowland, and the southern slopes. The Nile is the main source of water entering the Wadi. The water infiltrates through the sand and gravel which constitute the main strata separating the Wadi from the river and which forms an easy way for the passage of water through them. There is a hydrostatic connection between the Nile and the depression.

There are 4 aquifers underlying the region: aquifer located in recent sandy deposits, aquifer in the Pleistocene sandy and gravelly deposits, aquifer in the Pliocene deposits, and Miocene aquifer. Groundwater from the different aquifers is used mainly for agricultural (ca. 2,000 wells) and domestic uses. However, pumping rates, distance of wells from the salt lakes, and lithological variations from one area to another influence the groundwater quality, and in turn, its use for different purposes. Exploitation of the aquifers is being increased in parallel with the continued growth of urban areas in the region.



The Gareh-Bygone Plain, proposed case study for the GWAHS-CS in the I.R. Iran

Presented by Mehrdad Mohammadnia (Fars Research Center for Agriculture and Natural Resources, I.R. Iran)

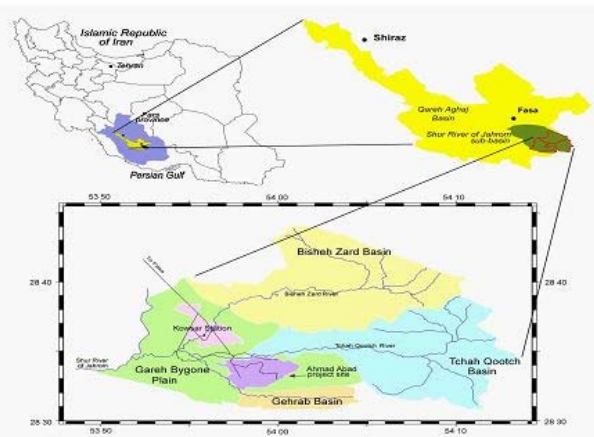
Gareh-Bygone Plain, the proposed study site for GWAHS-CS in the I.R. IRAN



results in reducing city-ward migration.

The study will be implemented at the Kowsar Floodwater Spreading & Aquifer Management Research, Training and Extension Station (28° 38' N, 53° 55' E) 200 km southeast of Shiraz, I.R. Iran on a debris cone and alluvial fan formed by the ephemeral BZR that drains a 192 km² BZB. The climate is characterized by a very low and highly variable rainfall, which is brought in by the clouds originating mostly over the Mediterranean Sea, and the summer dryness. The GBP is an extremely dry place with a MAP of 243 mm, and the Class A pan evaporation of 3200 mm.

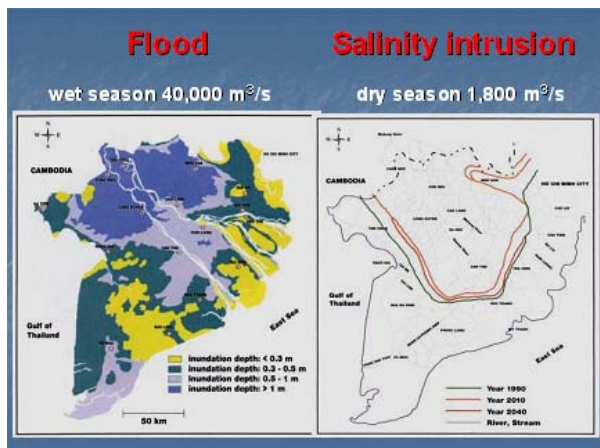
About 60% of the water used in Iran is supplied by groundwater resources and the natural recharge cannot replace the exploitation rates, so the Artificial Recharge of Groundwater (ARG) is actively pursued in this country through Aquifer Management Projects (AMP). Aquifer management (AM) is a nationwide project in Iran which consists in recharging over-exploited and empty aquifers during the wet years (floodwater), and where possible, to optimize the water use for sustainable production and development. The main goal of the AM projects is the control of the desertification through water harvesting and enhancement of environmental quality, which



Groundwater nitrate pollution and removal processes in the GBP Floodwater used in the ARG contains 60.30 mg/L NO₃⁻ on average and may contaminate groundwater. Mechanisms of NO₃⁻ transport and removal processes should be identified to mitigate its hazards on the rural people and environmental quality aspects in that area.

Introduction to the Case Study in VN-Mekong Delta

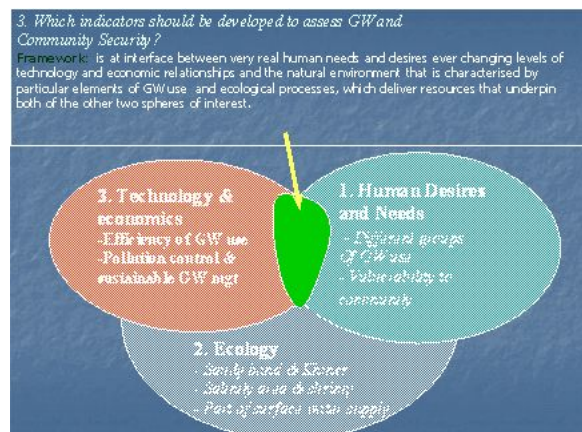
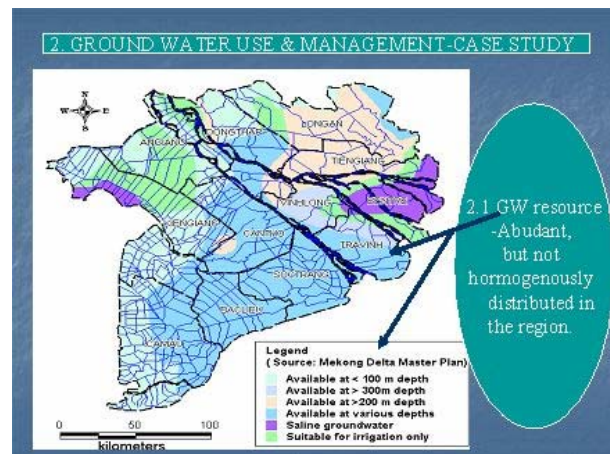
Presented by Nguyen Van Sanh (MDI, Can Tho University)



The Mekong Delta in Vietnam is an extremely diversified environment both from biophysical and social perspectives. The Delta is a very important region for Vietnam particularly in terms of agricultural and thus economic output (paddy rice, fruits and vegetables, fish production). Agricultural production can unfortunately be hampered by degradation of the resource base, notably salinity intrusion in the southern coastal areas (including the Tra Vinh Province which is the location of this case study) and other problems such as acidification of soils, flooding and droughts. In addition, there have been rapid changes in the landscape in the past decades

with first an extensification of cultivated areas followed by an intensification of the cropping systems (shifting in many areas from 1 crop per year to 2 and then 3 crops a year). This in turn generated an increase in agricultural outputs which has benefitted both the region and the nation.

Groundwater resource are fairly abundant in the Delta but their availability varies greatly, notably in Tra Vinh Province. Estimated groundwater resources yields in the region are 1.4 million m^3/d whereas current known use rate is 187,000 m^3/d (mainly for household consumption) with extraction taking place mainly in the dry season during the months of November to April. It is more than likely that pressure of groundwater resources will increase in the future because of intensification of agricultural-related activities and natural demographic increases. Salinity intrusion has already affected many regions of the aquifer rendering water unusable for household consumption. Groundwater is also polluted by excessive amounts of lead and various agrochemicals.



In this case study, the main research question will be “what is the vulnerability of communities who rely on groundwater resources for their every day lives in the short, medium and long terms?”. Specific investigations will address indicator development, a better understanding of water abstraction legislation, and the identification of priority actions particularly targeting poor communities and children.

Fight Against Desertification: Groundwater Artificial Recharge in Vietnam. Case study in the Binh Thuan province

Presented by Bui Tran Vuong, Division of Hydrogeology and Engineering Geology for the South of Vietnam

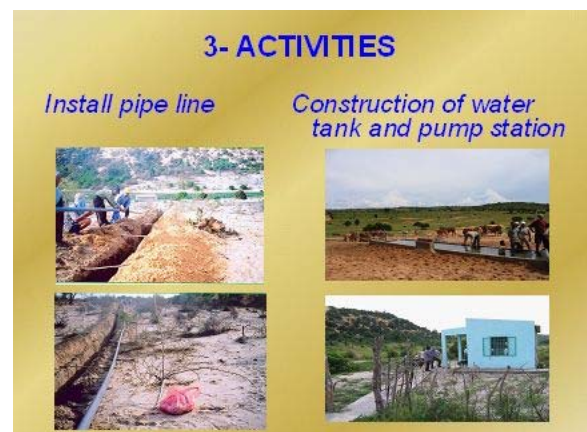
The main objective of this project was to build an experimental pilot project in the sand dune area of Binh Thuan Province, as an example of artificial recharge in Southeast Asia in order to assess methodologies and effectiveness of groundwater management through groundwater recharge



technologies. Another aim of this project was to transfer knowledge and experience of augmenting groundwater resources by artificial recharge to scientists and to inform governments, donors and stakeholders on the role of artificial recharge in water supply and groundwater management. Ultimately, the artificial recharge of the sand dune was to supply with good quality water the communities periodically affected by longstanding droughts.

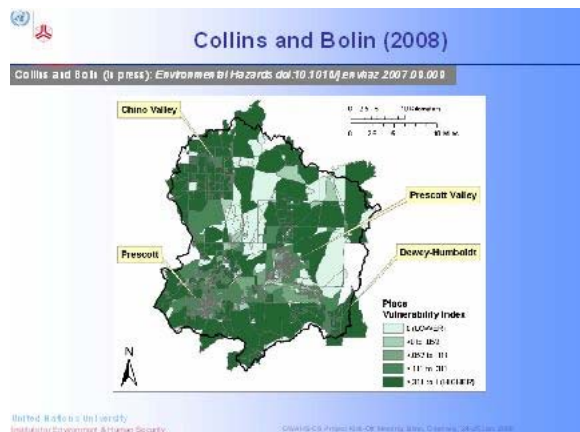
The water demand in Hong Phong was estimated to be 170 m³/d for residents and for livestock and a large amount of water is needed for irrigation. The field site is suitable for groundwater extraction in order to supply water to Hong Phong subdistrict.

There are several opportunities for providing water to Hong Phong including abstraction of the sand dune aquifer adjacent to Bau Trang (AR through bank filtration techniques) then direct to Hong Phong. Water harvesting from roofs in Hong Phong village for storage in tanks or wells is also an alternative to increase water availability. In conclusion, the study is an excellent example of a well-executed hydrogeological study and is an essential foundation for groundwater management which will become increasingly important as Vietnam's economy develops.



Some Indicators Used in Groundwater Research (Coupled Systems)

Presented by Fabrice Renaud (UNU-EHS)

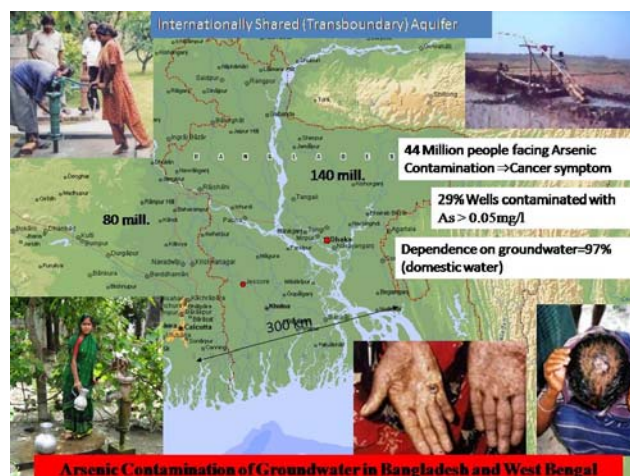


The approach that should be used in GWAHS-CS needs to consider coupled socio-ecological systems and not simply groundwater resources issues and their potential impact on social systems. Various groundwater vulnerability indicators or sets of indices have been developed in the past to capture groundwater vulnerability and vulnerability of people or communities depending on these groundwater resources. Three examples were presented: a recently published approach by Collins and Bolin; an approach by UNEP (not specific to but inclusive of groundwater resources); and the Water Wealth Index which is not specific to groundwater. These examples were used to

illustrate what could be developed in GWAHS-CS knowing that within the project, some degree of flexibility will be required given the variety of groundwater-societal situations being considered. If the project goes in the direction of indicator development then biophysical aspects need to be considered (further degradation of the resource) as well as understanding the socio-economic drivers behind specific exposure to degraded groundwater resources and specific dependencies with respect to the resource. Allocation and user rights, infrastructure development, specific interventions and existing legislation also need to be considered.

Groundwater and Human Security in Arsenic Contamination Problems of the Lower Ganges Delta in Bangladesh and India

Presented by Kazuki Tsuji, Fuji Grouting Engineering Co., Ltd.

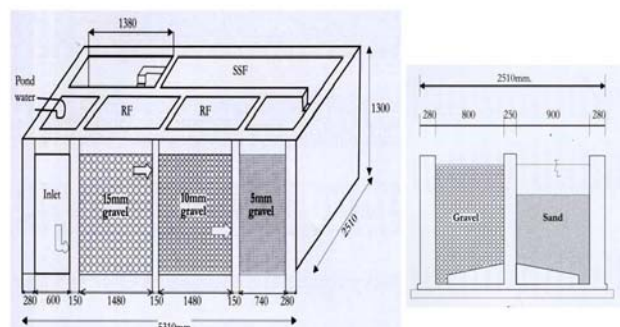


Arsenic contamination of groundwater has been identified as a major concern for human security in the Lower Ganges Delta, in Bangladesh and India. The region is home to about 44 million people, who depend on the use of ground water and are therefore directly affected by the contamination.

There is a concentration of arsenic contaminated areas along the east-westward belt zone of the lower delta and split. The uneven distribution of this contamination hazard resulted from the topographical and geological history - particularly the sea level rise during the last interglacial-glacial transition.

A number of technologies are available to mitigate arsenic contamination of ground water such as pond sand and gravel filters. They are already used in a limited number of villages in the affected region. The technological solutions should be complemented by awareness raising activities in the villages and capacity building activities for local authorities, e.g. on how to maintain filters or monitor water quality.

Brief design of Pond sand filter



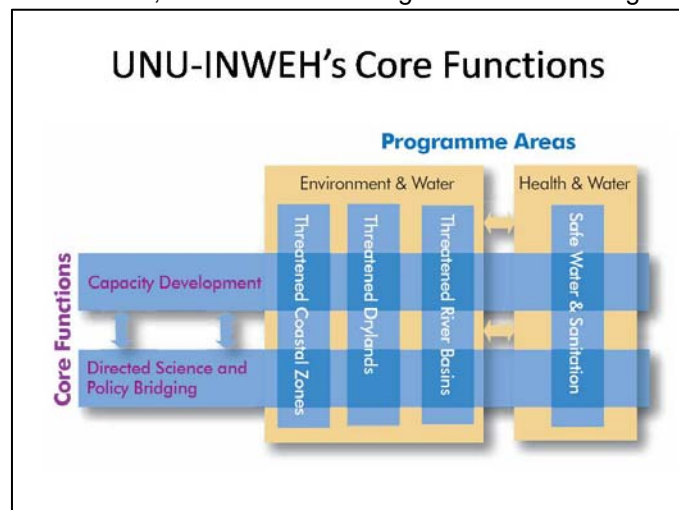
UNU-INWEH's Work in Drylands

Presented by Zafar Adeel, UNU-INWEH

UNU-INWEH's programme is designed to provide applied science and capacity-building initiatives that enable water managers to better address both the root causes and current manifestations of the global water crisis. This is reflected in the four programme areas of UNU-INWEH covering Coastal Zones, Drylands, River Basins and Safe Water & Sanitation (see slide below).

Under UNU's Drylands Programme the longer-term, inter-agency programme KM:Land was designed to strengthen knowledge management in the GEF Land Degradation Focal Area. During its first phase KM:Land intends to develop global- and local-level indicators to demonstrate impacts of GEF investments; establish a learning network to strengthen the exchange of knowledge and practices

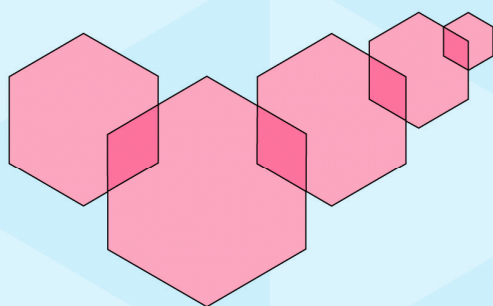
generated in SLM projects; and develop a coordinated and harmonized inter-agency M&E approach. So far, the KM:Land initiative has identified a set of global-level indicators and outlined the basic components of an innovative index to measure human well-being.



Furthermore, Sustainable Management of Marginal Drylands (SUMAMAD) is a joint initiative of UNU-INWEH, UNESCO and ICARDA and is implemented in a number of dryland countries stretching from Northern Africa to China. The focus of SUMAMAD is on improved and alternative livelihoods of dryland dwellers; reduced vulnerability to land degradation in

marginal lands through rehabilitation efforts; and improved productivity through identification of wise practices using both traditional knowledge and scientific expertise. The project uses a harmonised methodological approach for selected study sites involved to enable comparing results and share knowledge.

UNU-INWEH further implemented an initiative addressing both the technical and policy dimension of arsenic groundwater pollution in Asia and has produced a series of publications on this topic. There is also a publication under way on traditional approaches for water management in drylands.



UNITED NATIONS UNIVERSITY
Institute for Environment and Human Security (UNU-EHS)
UN Campus
Hermann-Ehlers-Str. 10
D-53113 Bonn, Germany

Tel: ++49 (0) 228 815-0202
Fax: ++49 (0) 228 815-0299
E-Mail: info@ehs.unu.edu
Website: www.ehs.unu.edu