



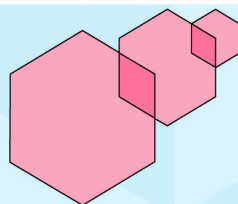
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UNESCO / IHP
Division of Water Sciences



Quo Vadis Aquifers?

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Quo Vadis Aquifer?

**Minutes of the
“Groundwater Resources and Human
Security” Workshop**

23-24 January 2006

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Introduction to the workshop

Groundwater (GW) is an increasingly exploited resource throughout the world. There are therefore many groundwater-related activities and projects carried out throughout the world, whether dealing with exploitation (providing new access to the resource), protection, or research (determining the availability and vulnerability of the resource). As more and more people throughout the world rely on GW and the list of stakeholders grows, increasing attention is being paid to the resource involving not only natural scientists and technical experts, but also social scientists and experts, legislators and politicians. One key question to be addressed is how can GW be exploited in a sustainable way both satisfying as much as possible the increasing demand for fresh water and protecting the resource from overexploitation and pollution?

UNESCO, through its International Hydrologic Programme is a leading organization dealing with GW resources on a global scale. UNU, and particularly UNU-EHS is interested in carrying out research and capacity development activities on the links between resource degradation and human security. Initially UNU-EHS proposed the development of a joint programme between UNU (thus encompassing other UNU research centres interested in the above-mentioned problematic) and UNESCO-IHP which main aim would be to develop research and capacity development activities/projects on the links between GW resource degradation and human security. The proposed umbrella programme would be called “Quo Vadis Aquifer?” (QVA).

UNESCO-IHP and UNU-EHS decided to jointly organise a workshop in Bonn on January 23-24, 2006. The aim of the workshop was to determine whether a collaboration between UNU, UNESCO and other partners on the issue of groundwater and human security was (i) warranted and (ii) desirable and feasible. The scoping paper prepared prior to the workshop is presented in Annex 1 and the agenda in Annex 2. Experts coming from different organizations and professional backgrounds (but involved in groundwater activities) met to discuss these two issues (see Annex 3 for a list of participants).

The workshop was divided into two parts. The first part consisted in brief presentations of various programmes undertaken by the represented institutions. The aim of this section was to give a quick up-to-date overview of the GW-related activities and to highlight the interests in the links between human security and GW degradation. See Annex 4 for a brief summary of the presentations. The second and longer part consisted of a discussion and brainstorming to identify important gaps in research and capacity development under the general themes and interlinkages of human security and GW degradation.

Outcomes of the workshop

General results

After the presentations from the various participants (Annex 4), it became evident that there were important synergies that could be exploited between the various entities represented at the workshop. At the end of the workshop there was a consensus that

- (i) the topic linking GW degradation and human security needed to be addressed globally;
- (ii) that specific projects could be put in place at different time scales (i.e. some projects could be developed rapidly, others would require more time);
- (iii) that all the participants present were interested in cooperating under the umbrella of Quo Vadis Aquifers.

Specific results

The results from the brainstorming activity were immediately summarized by Prof. Uri Shamir, who acted as the moderator of the conference, towards the end of the workshop and are presented in Annex 5. Seven areas for project activities or/and knowledge gaps needed to be addressed were identified:

1. Science (physical, engineering, social, political, economic)
2. Basic Studies (implementation related work)
3. Data and information: collection, analysis, archiving, dissemination, availability
4. Laws, Institutions and Policies
5. Capacity Building, Learning from Experience, Awareness Raising
6. Integrating Studies

What follows is a brief description of the points mentioned above, including other comments and ideas that were discussed during the workshop.

Science (physical, engineering, social, political, economic)

This section deals more with the fundamental, yet multidisciplinary scientific questions that should be addressed by the programme. This covers:

- Uncertainty with respect to GW resources assessments (at various spatial and temporal scales)
- How to determine the linkages between vulnerability of communities, particularly within the context of non-renewable GW resources. Development of social vulnerability indicators at various scales.
- Minimum legal and institutional requirements with regards to risk management for the hazard “GW degradation”. Considering the risks under uncertain conditions
- Integrated water management to reduce human insecurity (how to integrate the management of all freshwater resources)

Basic Studies

This section fleshed out some studies/research activities that would require particular attention when trying to link GW degradation with human security:

- Clarification of definitions. Terminology often means different things to different actors and stakeholders, so a common ground needs to be determined before activities are launched
- Vulnerability assessment (of both human beings in the context of human security and of the resource itself) should be studied for the following interactions:
 - Pollution of GW, particularly but not exclusively in developing countries. Study needs to take into account spatial variations within a catchment and different settings (e.g. rural versus urban or megacities)
 - Vulnerability assessment for communities who rely on GW resources which also sustain important ecosystems
 - Linkages between land management, GW and surface water and implication for vulnerability. Consider also hazards such as floods and underflooding
- Participatory research of responsible local communities and institutions to address the topics above but also to empower communities with respect to GW resources management

Data and information: collection, analysis, archiving, dissemination, availability

This section was dedicated to data requirements, data collection and management, and scale issues:

- Human security maps at various scales and linked to GW resources should be developed using existing data at the global and national scales

- Contribute to the further development of GW databases (quantity, quality, access), but also meta-data on all other aspects linked with GW degradation and human security (including models). Build on IGRAC's expertise in these areas
- Development of tools to assess the vulnerability of communities to GW degradation and for global monitoring of changes in GW. The tools and approaches should be applicable at different scales (local to global)

Laws, Institutions and Policies

The topics under this section covered a wide array of issues. They centre on the interactions between the natural system, and the legislation and policies required to maintain the sustainability of the resource at various scales (from local to transboundary situations). Of particular importance in terms of QVA was the type of tools that are required for the sustainable use of GW resource and monitoring methods to determine whether these tools are effective or not.

Capacity Building, Learning from Experience, Awareness Raising

For QVA activities it is important to take stock of previous lessons learnt when it comes to GW degradation. Then, an important priority for the problematic under study is the transfer of knowledge to and from various stakeholders, i.e. between scientists from different countries and covering different disciplines, awareness raising at the institutional and political levels (both local and national), and capacity development for professionals (through specific training and/or curricula development) . Some specific activities would cover:

- Publication of advocacy papers, books and CDs on the topic
- Develop e-learning modules
- Organisation of workshops

Integrating Studies

In order to achieve some of the scientific and capacity development goals set forth above, it was decided that preliminary work in case study areas should be given a priority in order to determine the feasibility of some activities.

Future steps

Four immediate follow-up activities were agreed upon during the workshop:

1. Meeting of some of the participants during the 4th World Water Forum to be held in Mexico City, Mexico, March 16-22, 2006 to discuss some of the specific activity points detailed above and in Annex 5.
2. Presentation of the initiative (i.e. the Quo Vadis Aquifer programme) during the UNESCO- 17th IHP Intergovernmental Council Meeting in Paris, in July 2006.
3. Round table discussion in Tokyo in August 2006, Japan organized jointly by UNU-ESD and JICA to refine potential project activities within QVA.
4. Link in with ICSU through Prof. Uri Shamir.

At the end of the workshop, preliminary actions to be undertaken by various organizations were suggested (preliminary suggestions and list not exhaustive):

- UNESCO-IHP:
 - Data collection and assembly, creation of databases, methods of data analysis, in collaboration with IGRAC;
 - Link in with member states to create usable methodologies and mechanisms for GW management implementation under local situations;
 - Legal aspects of GW management and Transboundary Aquifers Management (ISARM);
 - Vulnerability mapping including data bases, with IGRAC and UNU, on a regional and local levels.
 - Link with other UNESCO-IHP initiatives such as GWES (Groundwater Resources for Emergency Situations), the WHYMAP Project, the Working Group on Groundwater indicators,
 - Link with UNESCO category 2 centers: ICHARM (International Center for Hazards and Risk Management) in Tsukuba, Japan.
- UNU:
 - Research on human security and the GW-surface water nexus;
 - Development of vulnerability assessment tools;

- Education/Capacity Building in GW management and its relation to Human Security
- Other entities:
 - Research on GW and hazards (particularly ICSU);
 - Consider uncertainty in assessment of the natural resources;
 - Share experiences on failures in management and development of GW;
 - Inventory of human security at country level.

Conclusions

The two main conclusions of the workshop were that:

1. There is a need to look at the links between groundwater degradation and human security
2. This problematic is best tackled through a cooperative, interdisciplinary network of scientists and experts, particularly linking UNU, UNESCO-IHP and other interested institutions

The initiative will be presented at the next UNESCO 17th IHP Intergovernmental Council in Paris 3-7 July.

The activities can be carried out under the umbrella of the Quo Vadis Aquifer programme. Projects with different thematic and with different geographical scopes could then be developed within this programme as long as they contribute to the increase in knowledge and/or capacity development of the main objective which is to address the links between groundwater degradation and human security. The projects should be designed so that the global situation is captured and should encompass both global and local actions.

Annex 1

Scoping Paper

Groundwater Resources and Human Security: Identifying Research and Capacity Development Needs

Objectives of the Workshop

Background

Groundwater: opportunities and threats to human security

Groundwater resources represent as close to 99% of the available freshwater resources and 30% of freshwater use worldwide. It has many attractive characteristics such as limited evapotranspiration losses and availability in large stored volumes for multi-annual flow regulation; protected and less vulnerable from surface induced pollution; and a generally widely accessible resource that can be developed by limited and privately driven investments in close relation to land use and land ownership. It is widely used for drinking water, in industries, and dominantly for agriculture. It is estimated that groundwater supplies 50% of current drinking water and 30% of water for irrigation (UNESCO-WWAP, 2003), with much higher shares in the arid, and drought prone groundwater dependent regions. Large parts of the groundwater resources are transboundary and shared between two or more sovereign states and therefore referable to international and domestic level groundwater management. The past decades have seen an increased exploitation and reliance on groundwater resources which has allowed many people to secure their livelihoods and for regions to develop agricultural production or their industry.

Although groundwater resources are abundant on a global scale, it is, like all other freshwater resources, not homogeneously distributed around the world. Some regions have large aquifers covering an extensive area; others have no or very little groundwater. In many instances, groundwater resources are being overexploited, with withdrawal rates exceeding recharge rates and depleted or polluted by anthropogenic activities such as industrial wastes, urban wastewater, land use changes which affect recharge, and/or agricultural pesticides and fertilisers, and as a consequence the resource will lose its attractive characteristics, as mentioned above. Pollution can be so great that recent press releases from the Chinese

Government¹ mention that 90% of Chinese cities have polluted groundwaters and that this situation is bound to get worse with the continuous economic boom experienced in the country, unless pollution mitigation methods are put in place. In as much that the increased use of groundwater contributes to the achievement of the Millennium Development Goal (MDG) to “halve the proportion of people who are unable to reach or to afford safe drinking water”, these resources should be managed in a sustainable way to support the achievement of the MDGs. Unsustainable groundwater exploitation and the vulnerability of the resource itself to other anthropogenic activities either have direct consequences on populations (e.g. polluted drinking water, land subsidence in mega-cities), or represent a “creeping” threat that will materialise in the long run (sometimes known to decision-makers – e.g. mining of fossil water, sometimes not). In some regions, the consequences of unsustainable groundwater use impact on human livelihoods, human health and food security, three of the seven pillars of the definition of Human Security as defined by UNDP (1994). These impacts are either direct or indirect by compromising the services that can be provided by the environment to communities (e.g. MEA, 2005). Superimposed on this, climate change, by affecting the hydrologic cycle (changes in precipitation patterns and its consequences on the biosphere), could make a difficult situation even worse in the future. However, the IPCC recognised that “...there has been very little research on the potential effects of climate change...” on groundwater resources and that the panel could only present “...a series of hypotheses” in its final report (IPCC, 2001; p 199). Problems in unconfined aquifers linked to recharge (climatic conditions) and sea-level rise are nevertheless mentioned in the report. A complicating factor when it comes to groundwater degradation is the variability in temporal scales of the different processes affecting the resource. For example, groundwater flow is much slower than surface water flow and pollution can either be immediate or take a long time to materialise (depending on many hydro-pedologic factors). It often also takes little time to degrade an aquifer and much longer time periods to reclaim it. The related practical issues include the capacity to clean and apprehend persistent biological and chemical pollutants in the unsaturated and saturated groundwater zones.

Finally, groundwater-related issues can be tackled at various scales: local, national, international; and in connection or isolation of surface waters. The management of transboundary aquifers is perhaps the most challenging. Here a boundary is taken as a dividing line between two distinct political entities and can therefore be between a rural and urban area within one country, between two municipalities, between provinces or regions within one country or, as often implied when using the term “transboundary”, between two or more nations. The importance of international transboundary aquifers has been recognised only recently (relative to that of surface waters) and the lack of legislative framework for the management of these aquifers (Eckstein and Eckstein, 2005) and the lack of information sharing and data homogeneity between countries (Arnold and Buzás, 2005) are now being highlighted. However not much progress will be achieved without establishment of a good level of confidence and active inter-country dialogue and regional socio-economic cooperation, based on real political goals and common socio-economic drives and formalised in inter-country level regional consultation mechanisms at political and technical levels.

Groundwater initiatives

Despite existing initiatives, groundwater resources remain under or suffer from increased pressure worldwide. One of the largest and most recognised hydrological programme on the international scene is the UNESCO-IHP. Groundwater-related activities have been in place for many years now and UNESCO leads the multi-agency initiative ISARM (International Shared transboundary Aquifer Resource Management) launched in 2002 (see Puri and Aureli, 2005).

¹ http://english.gov.cn/2005-12/28/content_140385.htm

UNESCO-IHP also heads the GWES (Groundwater in Emergency Situation) initiative and the GRAPHIC initiative (Groundwater Resources Assessment under the Pressures of Humanity and Climate Change), that tackle groundwater management and protection for emergency situations and future forecasting accounting for anthropogenic and climate change pressures (UNESCO-IHP, nd).

Groundwater is an important issue that should also be addressed by UNU-EHS. The mission statement of UNU-EHS stresses that the institute will address "...challenges to human security due to environmental hazards, creeping deteriorations, and inherent social vulnerability and risks" (UNU-EHS, 2005). Resource depletion and pollution is identified as a "creeping process" that can negatively impact human security and, together with land degradation, groundwater resources degradation is a priority topic to be addressed by the institute. UNU-EHS is therefore in the process of launching in close cooperation with the IHP Programme its groundwater-related programme "Quo Vadis Aquifer" – QVA, with the period 2006-2007 being a preparatory phase for proposal development and submission. This programme will have several objectives: first to increase our knowledge on the interrelationship between groundwater degradation and human vulnerability – which will serve as a description of human in(security); second, 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 third, investigate specifically transboundary issues related to groundwater and community vulnerability. In addition, UNU-EHS will initiate activities in 2006 on vulnerability of rural communities to droughts, the second major activity programme after the one initiated in 2004 on vulnerability of urban communities to floods. This new programme will necessarily touch on the issue of water availability and in many cases on groundwater management issues, and therefore have a direct link with QVA.

More specifically, UNU-EHS proposes to study the link between vulnerability of communities and of groundwater resources, i.e. the reciprocal impacts that dictate how the resource is used and/or how the availability and quality of the resource allows for sustainable living conditions for the communities concerned. To achieve this, the BBC vulnerability analysis framework developed at UNU-EHS for the analysis of vulnerability of communities to floods (Birkmann, 2006) will be adapted for the hazard "groundwater degradation". The information generated through this analysis framework allows to capture the social, economic, and environmental drivers of vulnerability and to then identify some action tools that could be adopted by local or national decision-makers to alleviate identified vulnerabilities. The first objective of QVA will therefore consist on theoretical adaptation of the BBC framework for the new hazard and then test it in selected case study areas, the second objective of the programme. Most of UNU-EHS' research and capacity development activities are carried out jointly with partner organisations worldwide. The same approach will be used for QVA and some preliminary contacts for the identification of case study areas have already been established, notably in Southern Africa, Ghana, Thailand, and Sri Lanka. Because groundwater degradation can take many different forms, case studies will have to reflect different scenarios (e.g. excessive drawdown, diffuse pollution, point source pollution), cover different hydroclimatic settings (arid and humid) and different socio-economic settings (notably rural and urban). Work in case study areas include (not an exhaustive list) vulnerability assessment (which can include e.g. farming system analysis if in a rural setting); precise understanding of the state and quality of the groundwater resources (including identification of all threats); and analysis of all aspects of water management (e.g. technical, socio-political). Some case study areas will also be selected because they offer the opportunity to carry out a vulnerability assessment in transboundary aquifers, within a more complex geopolitical context where conflicts, but also opportunities for increased collaboration could take place (e.g. Jarvis *et al.*, 2005; Weinthal *et al.*, 2005).

UNESCO-IHP is now preparing its 7th phase of activities due to start in 2008. It is evident that there are many synergies to be exploited between the UNESCO-IHP groundwater

programmes and the future research and capacity development components of UNU-EHS' Quo Vadis Aquifer initiative. In addition, QVA will build on activities underway at UNU-INWEH on desertification and at UNU-ESD on hydropolitics. It is necessary to set up a close cooperation between IHP and the UNU entities in order to launch new initiatives, increase capacity, avoid unnecessary duplication, and combine efforts on a subject of increasing importance and relevance for human security.

Objectives of the workshop

1. Investigate the possibilities for UNU-EHS (through QVA) to contribute to the UNESCO-IHP VII phase and set up joint activities and a close coordination mechanism.
2. Investigate the possibilities to collaborate further with UNU-INWEH and UNU-ESD.
3. Initiate the drafting of concrete collaborative projects.
4. Provide inputs, suggestions and comments on Quo Vadis Aquifer as briefly presented above and as will be discussed during the workshop. This should include recommendations for appropriate case study areas.
5. Determine whether human security can be a valuable additional theme to be addressed in UNESCO-IHP VII.
6. Investigate the possibilities for all the parties present at the workshop to jointly propose, develop and carry out projects that relate groundwater degradation (including pollution) to human security by identifying specific areas of collaboration.
7. Determine what additional efforts are required by the scientific community to raise the issue of unsustainable groundwater issue worldwide.
8. Determine the significance of socio-economic and political drivers and of established institutions and mechanisms for effective policy and process and governance intervention to enhance human security
9. Determine what specific contributions Quo Vadis Aquifer could provide to WWAP and the UN Water Decade.

Particular attention should be paid to the following themes:

1. Institutional and legal tools.
2. National and regional capacities.
3. Are there adequate research programmes to provide recommendations to improve groundwater resources management for human security needs? Are we equipped to talk and pass the message to decision makers?
4. Groundwater development sustainability – socio-economic and risk evaluation.
5. Public participation, awareness raising and stakeholder involvement.

Format of the workshop

There will be a lot of ground to cover in order to discuss comprehensively all these objectives. The workshop should be just that, i.e. an opportunity to brainstorm and discuss the topics above. For this purpose, the group of participants has been limited to 17 and Prof. Uri Shamir will moderate the discussions. It is proposed that a minimum of short formal presentations be given, probably one from UNESCO on their current relevant programmes and on from UNU on current initiatives and future plans.

The output of the workshop should be (1) conclusions on all the objectives to be addressed, (2) the identification of the “way forward” for each objective above including the nomination of

individuals and/or institutions taking the lead in that respect, and (3) the identification of dates for potential follow-up workshops.

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Annex 2

Agenda

Sunday, 22nd January

Arrival of participants in Bonn

20.15 Welcome dinner at the Gustav-Stresemann-Institut (GSI), Clubroom I, basement, access from restaurant

Monday, 23rd January

All day meeting at the Gustav-Stresemann-Institut (GSI), Plenary Room S18

09.00 – 09.40 Welcome and introduction by Prof. Bogardi (UNU-EHS) and Dr. Aureli (UNESCO-IHP)

09.40 – 09.50 Words on procedure from the moderator by Prof. Shamir (IUGG)

09.50 – 10.10 Breaking the ice – Self introduction by participants and description of groundwater activities undertaken by their institutes

10.10 – 10.30 Coffee break

10.30 – 10.55 Presentation of on-going groundwater programmes and projects at UNESCO-IHP by (5' each)

- A. Aureli (UNESCO-IHP)
- J. van der Gun (IGRAC)
- S. Puri (ISARM)
- T. Makoto (GRAPHIC)
- J.L. Martin (GWES)

10.55 – 11.15. Presentation of current projects and planned activities on groundwater research and capacity development at UNU:

- Work at UNU-INWEH by Dr. Zafar Adeel (5')
- Work at UNU-ESD by Dr. Libor Jansky (5')
- Aquifer Quo Vadis by Dr. Fabrice Renaud (10')

11.15 – 12.30 Group discussion I (see proposed themes of discussion in the Scoping Paper appended to this Agenda): Identifying potential synergies

12.30 – 13.30 Lunch

13.30 – 15.00 Group discussion I, continuation

15.00 – 15.20 Coffee break

15.20 – 17.00 Group discussion II: Putting in place effective collaborations: how to achieve it?

17.10 Minibus pick-up to Centre for Development Research (ZEF), Walter-Flex-Str. 2, D-53113 Bonn

17.30 – 19.00 Lecture at ZEF by Prof. Das Gupta on Water/groundwater quality

19.15 Minibus pick-up to Restaurant

19.30 Reception and dinner at Restaurant zur Lese, Adenauerallee 37, D-53117 Bonn, phone: + 49 (0) 228 22 33 22

Approx. 21.45 Minibus pick-up to return to Gustav-Stresemann-Institut

Tuesday, 24th January

09.00 – 10.30 Group discussion II: Putting in place effective collaborations: how to achieve it?

10.30 – 10.45 Coffee break

10.45 – 12.30 Group discussion III: Identification of concrete initiatives for collaboration

12.30 – 13.30 Lunch

13.30 – 15.00 Group discussion III: Identification of concrete initiatives for collaborative research projects

15.00 – 15.20 Coffee break

15.20 – 15.45 Conclusions from the workshop activities by Prof. Shamir

15.45 – 16.00 The way forward from the perspective of UNESCO-IHP by Dr. Aureli

16.00 – 16.20 The way forward from the perspective of UNU-EHS & Final words by Prof Bogardi

Depending on the number of participants staying, informal discussions could be carried out until it is time for dinner.

19.30 Dinner at the Gustav-Stresemann-Institut (GSI)

Wednesday, 25th January

09.00 Visit of UNU-EHS

Departure of participants

Annex 3

List of participants

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Annex 4

Summary of presentations (brief notes only)

Welcome words by the chairpersons of the workshop – Prof Bogardi, Dr.Aureli, Prof. Shamir

Dr. Aureli:

99% of fresh water on this planet is
GROUNDWATER

Groundwater is a strategic drinking water reserve for
our future ...
naturally clean, well protected and mostly annually
replenished.

It is our common interest to develop a sound
knowledge of groundwater resources worldwide.

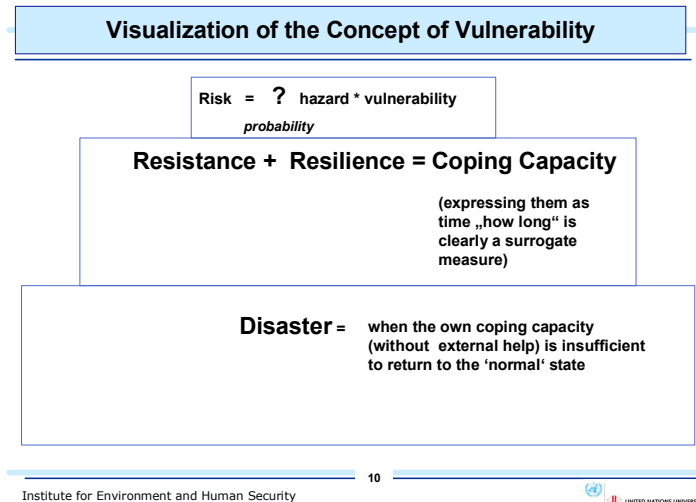
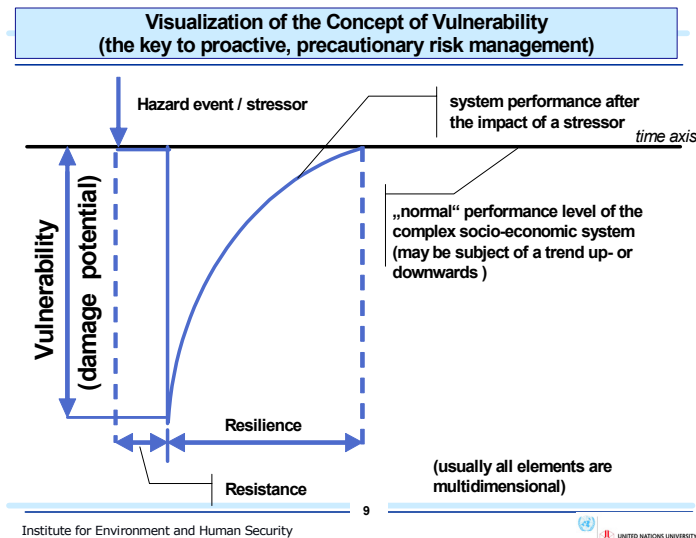
**It also important to recognise that urgent action is
required if we are to sustain groundwater
resources for
generations to come**

This requires:

- ✗ political acknowledgement of the value and
importance of groundwater and
- ✗ significant national and regional financial investment
to establish the physical and social frameworks for
sustainable groundwater management.

Although the science of GW is relatively young, we are all aware of geological, hydrogeological and other natural processes and there has already been much work done in this area, but we need another hydrological approach. Where are the world's aquifers? How much is available for use? Today we know that there are aquifers on all continents, highly productive, but in the interest of future demand they must be mapped and localized. Requirements of sustainable GW use must be better understood. Human security is the best focus to understand this problem, together with adequate funding, political will, and the support of stakeholders. We have to look for conceptual and knowledge gaps.

Prof. Bogardi:





A conceptual framework of what vulnerability is was presented. It was also stressed that GW degradation is one of the most important problems worldwide but little attention is paid to it at the moment. Degradation processes can be fairly rapid, but rehabilitation of the resource takes much more time.

UNU-EHS concentrates on issues of Environmental Human Security. If we apply this to the problematic of GW degradation, it is apparent that activities under the umbrella programme Quo Vadis Aquifers (QVA) needs to be multidisciplinary in nature. The synergies between UNU and UNESCO-IHP were emphasized and the representativeness of the group present at the workshop (in terms of disciplines covered) was recognized. Expected outcome: a matrix of activities to be implemented within QVA, follow-up programme, and an issue paper that should tell us how to move forward and how to link our efforts.

Prof. Shamir:

GW use goes back millennia. As moderator, Prof Shamir explained “the rules of the game”. He also emphasized that we should not make the mistake of looking at GW in isolation of surface water bodies and that populations should be the target concern.

Summary of presentations

<i>Name of the representative</i>	<i>Activities</i>
<p>Dr. Alice Aureli</p>  <p>Current International Framework shaping UNESCO-IHP's actions</p> <p>Millennium Development Goals</p> <ul style="list-style-type: none"> ✓ Poverty reduction, sustainable environment, water supply goal <p>Johannesburg Plan of Implementation (WSSD, 2002)</p> <ul style="list-style-type: none"> ✓ Emphasizes water and sanitation goals, national water management strategies <p>Water for Life Decade (2005-2015)</p>  <p>IHP-VII: Water Dependencies: Systems under Stress and Societal Responses</p> <p>Education, transfer of knowledge and capacity building</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>THEME I: Global Change, Watershed & Aquifers</p> </div> <div style="text-align: center;"> <p>THEME II: Governance & Socio-Economics</p> </div> <div style="text-align: center;"> <p>THEME III: Ecohydrology & Environmental Sustainability</p> </div> <div style="text-align: center;"> <p>THEME IV: Water quality, Human Health & Food Security</p> </div> </div> <p>Cross Cutting Programmes FRIEND — HELP</p> <p><u>UNESCO/UNU-EHS</u> <u>Quo Vadis Aquifer</u></p> <p>What do we need to define minimum requirements to meet Human security?</p> <ul style="list-style-type: none"> a) Drinking water supply (quantity and quality) b) Environmental needs <ol style="list-style-type: none"> 1. Resource evaluation 2. Risks evaluation and costs 3. Alternative development strategies 4. Preparedness and capacity for social transformation 	<p>UNESCO International Hydrological Programme (IHP):</p> <p>IHP is the only global intergovernmental scientific programme on water resources of the UN system.</p> <p><u>Main areas in phase VI (2002-2007)</u></p> <ol style="list-style-type: none"> 1) Global changes and water resources 2) Integrated watershed and aquifer dynamics 3) Land habitat hydrology 4) Water and society 5) Water education and training <p><u>Some of GW issues by UNESCO-IHP</u></p> <p>GW submarine discharge; GW and land subsidence; coastal aquifers management (saline intrusion); GW and climate change; GW-hydrological extremes and emergency situations etc.</p> <p><u>Topics for IHP strategic planning of the 7th phase (2008–2013):</u></p> <ul style="list-style-type: none"> • Global Change, Watershed & Aquifers • Governance & Socio-Economics • Ecohydrology & Environmental Sustainability • Water quality, Human Health & Food Security <p>The minimum requirements in terms of human security need to be defined, such as quality and quantity of drinking water supply and environmental needs.</p>

UNESCO-IHP gaps

- ◆ Surface-Groundwater Conjunctive use
- ◆ Precautionary approaches
- ◆ Remediation measures
- ◆ Monitoring requirements for groundwater
- ◆ Groundwater pricing and ownership
- ◆ Groundwater infrastructure maintenance
- ◆ Groundwater socio-economic and risk evaluation
- ◆ University CVs for education programmes on groundwater
- ◆ Public participation and stakeholder participation
- ◆ Good governance

Outcomes of the workshop and future development of Quo Vadis Aquifer should be presented at the IHP Council in July 2006.

Dr. Jac van der Gun

igrac International Groundwater Resources Assessment Centre

IGRAC's activities

Global Groundwater Information System (GGIS):

- 'Groundwater in a nutshell' (Global Overview)
- Selective thematic/spatial detail
- Meta Information System (MiM)
- Collaborative platform

Guidelines & Protocols (G&P):

- Inventories
- Database
- International working groups for new guidelines



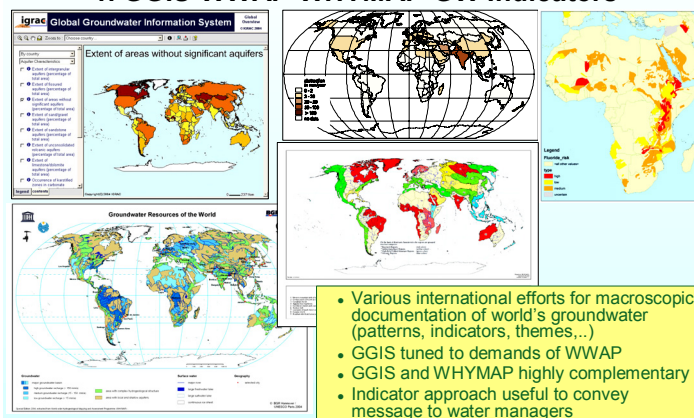
Participation in international projects and working groups:

- WHYMAP: Groundwater Resources Map of the World
- WWAP: 'Groundwater section' WWDR-2, Ch. 4 (Water Resources)
- AQUASTRESS: EU project on drought- & water quality management
- ISARM: information management transboundary groundwater
- GEF/ IW:LEARN: exchange of experience transboundary groundwater
- GRAPHIC: change in groundwater under human and climatic pressures
- Several other projects and working groups

igrac International Groundwater Resources Assessment Centre

IGRAC's focal areas:

1. GGIS-WWAP-WHYMAP-GW Indicators



International Ground Water Resources Assessment Center (IGRAC):

Objectives: To collect and provide information to support adequate GW development management (GW in wide range of its' functions)

IGRAC is cooperating not only with global centers (GRDC, Koblenz, GPPC, Offenbach, etc), international institutions (WWAP, WHYMAP, Non-renewable Groundwater etc) but also with the Netherland governmental and non-governmental institutions.

Activities:

- Global Groundwater Information System (GGIS);
- Guidelines & Protocols (G&P);
- Participation in international projects and working groups;

Focal areas:

1. GGIS-WWAP-WHYMAP-GW Indicators (transferring the collected information into simple indicators)
2. Transboundary aquifers (cooperation, support, sharing the information)
3. Global change regarding groundwater (To monitor the global change-

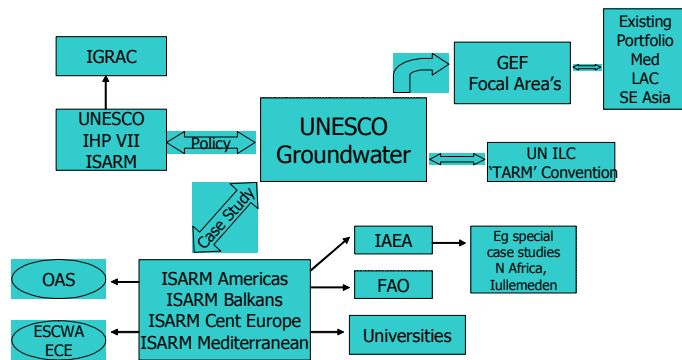
information about time series on change in GW; define priorities in GW, world-wide cover of parameters; well documented zones should be covered)

4. Meta-Information regarding groundwater

(to manage resource development it is important to organize and put all the data together (publications, maps) and further to present them in the internet).

Dr. Shamminder Puri

UNESCO-ISARM mosaic



Bonn Jan '06

International Shared Aquifer Resource Management (ISARM):

Network system between UNESCO Ground Water and ISARM, map of the global ground water resources regions with political boundaries, river basins and non recharged aquifers is presented.

The problems of GW have to be studied in a wider thematic fashion.

The question on GW problems must be discussed in order to know how to present it to governments.

Dr. Makoto Taniguchi

Groundwater Resources Assessment under the Pressures of Humanity and Climate Change Research (GRAPHIC)

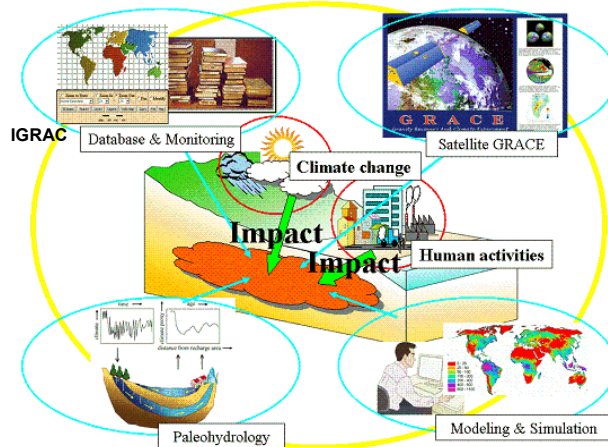
Objectives:

- Evaluation of changes in ground water storage and fluxes;
- Evaluation of GW quality;
- Assessment of human activities and climate change influence on ground water change.

Subjects:

- 1) GW recharge
- 2) GW discharge

Four Methods



- 3) GW storage
- 4) GW quality
- 5) GW management

Methods used:

- 1) Database and monitoring;
- 2) Satellite GRACE;
- 3) Paleohydrology;
- 4) Modeling and simulation;

Dr. Jose Luis Martin



GWES – Activities and outcomes

- International working group formed by UNESCO and IAEA representatives and experts from different regions of the world,
- International seminars and workshops in cooperation with UNESCO Regional Offices – OAS, ESCAP, OSS, SADC – cooperation with PWRI will be established,
- Methodological guidelines based on case studies and workshops proceedings,
- GWES project duration will be from 2005 to 2008



UNESCO future action

Preparation of a Groundwater for Emergency Situations « GIS-oriented » **WORLD MAP** to highlight risk hot spots, linking the existing maps on natural hazards (earthquakes, floods,...) with aquifer systems characteristics maps

Ground Water for Emergency Situations (GWES)

Objectives:

- To consider natural and man induced catastrophes that may influence human health or environment;
- To elaborate effective methodologies against extreme and catastrophic events;
- To introduce suitable hydrogeological and isotope-hydrological techniques;
- To elaborate an inventory of resistant aquifers in selected pilot regions and present case studies;
- To elaborate and publish a guide to be used for emergency situations

Activities:

Workshops organization with further methodological guidelines worked out; working group organisation consisting of the experts from different regions of the world;

Future action:

To highlight hot spots and link existing maps on natural hazards

Ongoing & Planned Groundwater

Dr. Zafar Adeel



Traditional Water Management Technologies in Drylands

- Goal: Understand traditional water stewardship in dry regions, develop local research capacity and raise public awareness of traditional water management technologies
- Projects completed:
 - **Syria:** Restoration of **Qanats** in Syria
 - **Oman:** Traditional Water Distribution in **Aflaj** Irrigation Systems of Oman
 - **Tunisia:** Traditional versus new water harvesting techniques in the dry areas of Tunisia: Complement or conflict?
 - **Pakistan:** Zarh **Karez** - A traditional water management system striving against drought, increasing population, and technological change
 - **Yemen:** Traditional water harvesting in the mountain terraces of Yemen
 - **Morocco:** **Khattara** and organization of water users
- On-going:
 - **China:** **Karez System** in Turpan and its conservation
 - Publication of Findings as a Peer-Reviewed Book

Initiatives at UNU-INWEH

Activities:

- Capacity development;
- Science and policy bridging through applied research;

Focus:

- Arsenic Groundwater Pollution in Asia
- Traditional Water Management Technologies in Drylands
- Improved Septic Systems for Peri-Urban Areas
- Middle East Groundwater Remediation Initiative

Prof. Libor Jansky



**Trans-boundary Aquifers
Potential Partners & Donors**

- Global Environment Facility
 - Focal Area - International Waters
 - OP8 Waterbody-based OP
 - OP9 Integrated Land and Water Multiple Focal Area
 - OP10 Contaminant-Based OP
- EU Joint Research Center,...
- Governments
- Foundations
- NGOs
- etc.

Activites at UNU-ESD:

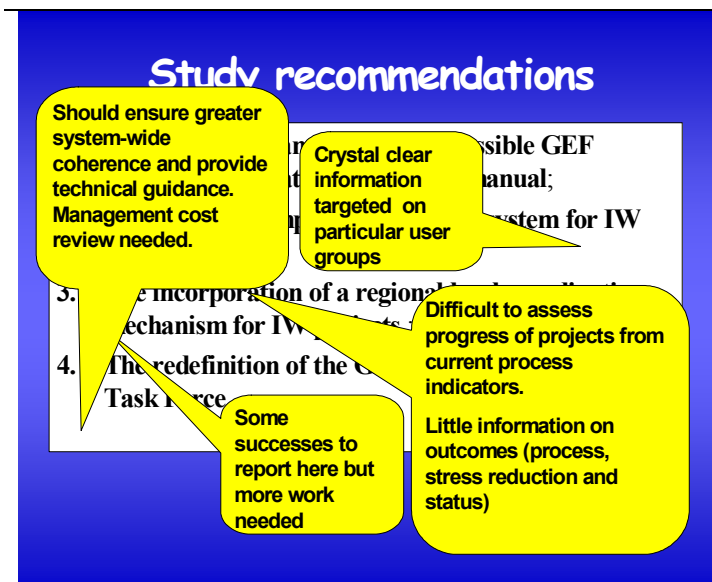
Objectives:

- Sustainable Urbanization;
- Managing Fragile Eco Systems;
- Solutions to Water Crisis;
- Environmental Governance and Information;

Activities:

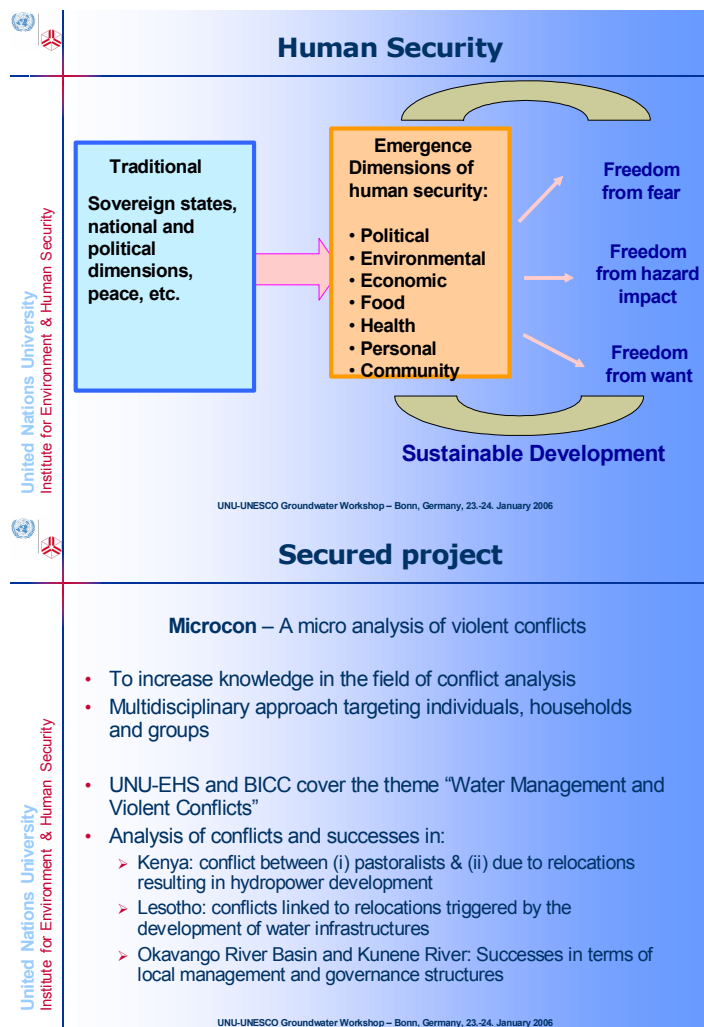
International water system comparative studies in the basin countries to reduce risks for potential conflict and increase chances for co-operation

- Past studies in: the Aral Sea, the Caspian Sea, the Ganges River, the Jordan River, the Danube River, the La Plata, the Nile River and the Zambezi River)
 - Present studies in: Euphrates-Tigris River Basin, Yali Falls Dam project between Vietnam and Cambodia, Trans-boundary Aquifers in South Africa.
 - GEF as a funding partner. ESD has good experience in attracting
-



GEF funding.

Dr. Fabrice Renaud





Objectives:

- Link between degradation of the resource, vulnerability of communities, conflicts, and cooperation
 - groundwater use & degradation;
- Understanding these vulnerabilities for improved cooperation → joint development of shared GW resources to the benefit of all stakeholders
 - aspects of transboundary groundwater;
- Contribute to protection and preservation of groundwater resources, i.e. its sustainable use
 - solutions on vulnerability alleviation; risk assessment for communities;
 - groundwater as one of the component of vulnerability assessment;
 - vulnerability of groundwater resource itself

Activities:

- Assessment of social vulnerability, risk and human security due to natural hazards;
- From 2006, assessments of rural

 United Nations University Institute for Environment & Human Security	<h3 style="text-align: center;">Outlook</h3> <ul style="list-style-type: none"> • We are only at the beginning! • Next biennium (2006-2007): <ul style="list-style-type: none"> ➢ Refine overall strategy ➢ Launch specific new projects • Approach groundwater issues from the remit of our institute: groundwater degradation and human security • Use our strengths, particularly in terms of research <p style="text-align: center;"><small>UNU-UNESCO Groundwater Workshop – Bonn, Germany, 23-24. January 2006</small></p>	
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Dr.Marcella Nanni

OTHER IMPORTANT ISSUES

- Relationship with surface water
- Inter-state/province relations in federal countries
 - Need to define institutional mechanisms for aquifer & risk management agreeable to state/provincial governments
- Transboundary issues (no gw-specific legal framework)
 - Need to define and agree upon the issues which are of a transboundary nature
 - Need to agree on institutional mechanisms for cooperation and scope (& functions + powers) thereof
 - Perhaps a phased approach is advisable

Groundwater risk management: legal and institutional aspects.

- Aspects of drought, flood, earthquakes, landslides etc have to be classified and prone areas should be mapped;
- Develop GW management policies, strategies and plans at different territorial levels;
- Assess GW availability and quality to satisfy basic needs;
- Plan land uses and measures for protection against hazards, etc.

Summary:

The legal aspects have to be considered everywhere, responsibilities of institutions involved

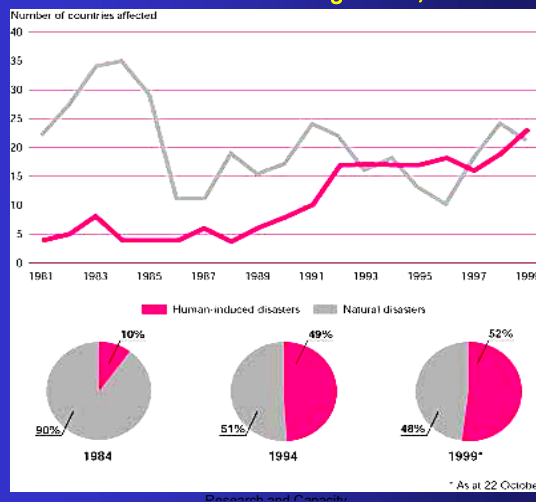
at the various levels of administration have to be defined, requirements and procedures for resource management plans and programs that take disaster into account have to be designed.

Other issues:

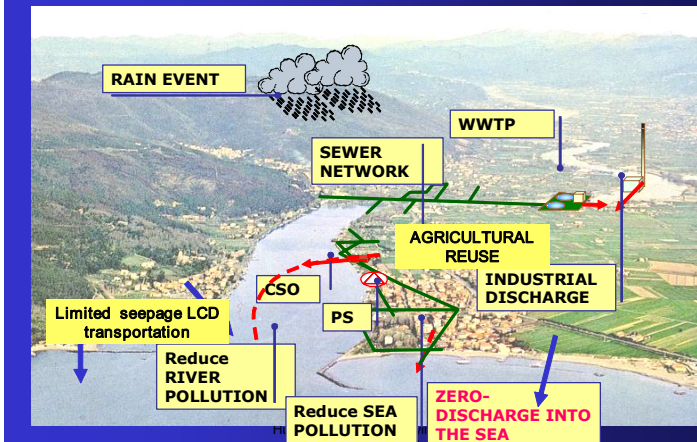
- Relationship with surface water
- Inter-state/province relations in federal countries
- Transboundary issues (no GW-specific legal framework)

Dr. Bo Appelgreen

Trends in causes of food emergencies, 1981-1999



LBC – Zero-Discharge re-use/AR management systems



Proposal for a joint UNU-UNESCO Research Project

Objectives:

- Wetlands and marine water bodies;
- Aquifer and outflow area;
- Integrated development and use systems driven by social and economic processes and expected synergies and multi-benefits at user level;

Activities:

- Basic research to advance science in water resources and hydrology science and technology;
- Data collection and management for baseline coverage, spatial and time-series continuity and enhanced data access and exchange;
- Demand-driven normative research/capacity building on global, regional and domestic policy, institutional and governance issues to enable sustainable development for human welfare and security; social and environmental change and linkages with social priorities, including poverty alleviation, economic growth and sustainability and life-supporting socio-economic and ecosystems

Annex 5

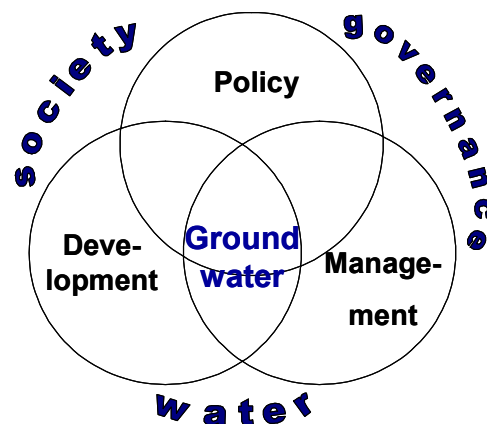
Results of brainstorming activity

Study topics contributed by participants for Quo Vadis Aquifer

- 1 **Science** (physical, engineering, social, political, economic)
 - 1.1 Quantify the uncertainty in assessment of GW resources quantity and quality, and its effect on resource evaluation, on management, and on policy ("what do we want to measure and how should we measure it")
 - 1.2 Vulnerability and rational utilization of non-renewable GW resources. A book is in preparation
 - 1.3 Survey/inventory of legal provisions for risk management, and identification of the minimum level that should be adopted by all countries
 - 1.4 Institutional arrangements for risk management: survey, analysis and recommendations
 - 1.5 Development of GW indicators relevant to human security
 - 1.6 Treatment options for pollutants in GW for various GW uses
 - 1.7 Integrated management of GW and other water resources (SW, reclaimed wastewater, desalination)
 - 1.8 Addressing risk under high uncertainty
- 2 **Basic Studies**
 - 2.1 Operational definitions of threats, hazards, and vulnerability of the GW resource, of human communities, of institutions, and of rational policies and actions to cope with them. Definition and perceptions of risk and hazards to humans. Identify and recognize preventive actions in all domains
 - 2.2 Empowerment of communities to access and benefit from locally available GW
 - 2.3 Control of pollution from non-point sources in developing countries
 - 2.4 Vulnerability of communities that depend on sustainable GW systems which support ecosystems (i.e., GW dependent ecosystems)
 - 2.5 Floods and GW

- 2.6 All linkages between GW resources and natural systems: summarize, then study the effects in both directions
 - 2.7 Management of aquifers as reservoirs (and all the other characteristics that make them special) or just a source
 - 2.8 Global tools and methodologies adapted to local conditions
 - 2.9 Difference between SW and GW: the latter are connected with the land over it
 - 2.10 Upstream-downstream in GW flow and pollution
 - 2.11 Are we dealing with vulnerability of all aspects (physical, human, social)
 - 2.12 GW in megacities, primarily for serving the peri-urban areas
 - 2.13 Study of natural recharge and land use activities effect on recharge
 - 2.14 Integrate-merge: integrated human well-being assessment of GW
- 3 **Data and information: collection, analysis, archiving, dissemination, availability**
- 3.1 Vulnerability maps and data bases of various hazards at various spatial and temporal scales
 - 3.2 Inventory of human security at the national scale
 - 3.3 Data bases of GW quantity and quality at [to be determined] appropriate spatial scale
 - 3.4 Meta-Information on physical and other relevant data (e.g., institutions): creation and accessibility, including IGRAC's role
 - 3.5 Use of the IGRAC system to provide meta-information on projects in progress on an ongoing basis
 - 3.6 Tools to be adapted or developed in order to carry out the assessments
 - 3.7 Methodologies for global monitoring of change of GW – new methodologies (including up-scaling and use of proxy information), using human networks of reporters
 - 3.8 A meta data on models, at all levels of modelling, with instructions and cautions on use
- 4 **Laws, Institutions and Policies**
- 4.1 Traditional water management institutions and technologies and their relevance to current situations
 - 4.2 The connections between Policy-Development-Management, with GW at the center

- 4.3 Imbalance between knowledge of the physical aspects and the social aspects; therefore: stakeholder and user involvement – investigate, identify processes and procedures which are most compatible with the situation. Emphasize the social components of hazards, risk and coping with them.
- 4.4) Recommended procedures and methodologies for dealing with hazards and risk (including remediation capacity, legal and institutional capacity)
- 4.5 Methodology to determine the impact of new policies and legislation on human security (especially in countries in transition)
- 4.6 Understanding the mutual effects of actions in one place and time on others and the relevance to creating institutions
- 4.7 Procedures for development and use of models used on international aquifers



5 **Capacity Building, Learning from Experience, Awareness Raising**

- 5.1 Learning from experiences in GW development and management: causes, consequences, interpretation. Case studies of failures
- 5.2 Lessons (successes and failures) of trans-boundary SW and GW management cases
- 5.3 Foster and improve communication among the scientists, practitioners, stakeholders and decision makers, common language – implementation in a local situation
- 5.4 GW governance: capacity building of professionals and institutions to develop a tool kit, and develop a policy oriented approach
- 5.5 Evaluate curricula for training GW experts, with the objective of creating capacity in DCs (UNU+UNESCO)
- 5.6 Transfer of expertise and knowledge of methodologies, i.e. capacity building
- 5.7 Pre-proposal on an e-Learning modules of hydrology and integrated water resources management
- 5.8 Publish a policy brief and then a series of publications "Managing GW and Transboundary Aquifers for Human Security"

- 5.9 Knowledge book for GW advocacy, (looking at the history of public opposition to dams) and the positive and negative aspects + interactive CD
- 5.10 Round-Table for GW in Japan, 2nd part of August 2006

6 **Integrating Studies**

- 6.1 Middle East Initiative as a carrier/construct for examining national and regional cooperative plans and actions (for UNESCO and UNU, already under development, has a good chance of being funded)
- 6.2 Pilot study (UNU+UNESCO): how GW is important to human vulnerability and capacity building
- 6.3 Integrate with the environmental sector, for the sake of effectiveness
- 6.4 Case studies where the indicators and methodologies are demonstrated and where they are tested for improvements

7 **Other**

- 7.1 Underflooding when GW is close to you
- 7.2 Global assessment of financial needs in the context of meeting the MDGs global needs for utilization of GW;
- 7.3 Global assessment of capacity needs and institutional strength to meet MDGs in the domain of GW
- 7.4 Cooperation with other disciplines on hydrological studies
- 7.5 Development and use of win-win and benefit-sharing mechanisms for trans-boundary aquifers

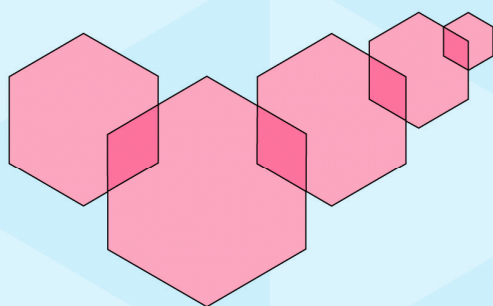
Additional Points

- 1. Linkages of GW to other types of natural hazards (e.g., landslides, earthquakes, volcanic eruptions) (into 2.6)
- 2. Follow up on 1 to identify national and international agencies interested in these aspects, for collaboration and funding
- 3. Add an introduction to final document that emphasizes:
 - a. Human security
 - b. Poverty
 - c. Environment
 - d. Ethics
 - e. Solidarity
- 4. Awareness raising:

- a. Media outreach
 - b. Link with other relevant events
- 5. Donor coordination and fund raising
- 6. Link with the ICSU programme on hazards

Recorded and organized by Uri Shamir

Bonn, 23-24 January 2006



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