Groundwater Governance

A Global Framework for Action

Fourth Regional Consultation

Asia and Pacific Region

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### Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AIDA</td>
<td>International Association for Water Law</td>
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<tr>
<td>CGS</td>
<td>China Geological Survey</td>
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<td>CAGS</td>
<td>Chinese Academy of Geological Sciences</td>
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<td>ETWatch</td>
<td>Evapotranspiration Watch System</td>
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<td>FA</td>
<td>Framework for Action</td>
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<td>FAO</td>
<td>Food &amp; Agricultural Organization of the United Nations</td>
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<td>GEF</td>
<td>Global Environment Facility</td>
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<td>GWES</td>
<td>Groundwater for Emergency Situations (UNESCO-IHP)</td>
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<tr>
<td>IAH</td>
<td>International Association of Hydrogeologists</td>
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<td>IGES</td>
<td>Institute for Global Environmental Strategies</td>
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<td>ICHARM</td>
<td>International Centre for Water Hazard</td>
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<tr>
<td>IGRAC</td>
<td>International Groundwater Resources Assessment Centre</td>
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<tr>
<td>IHEG</td>
<td>Institute of Hydrogeology and Environmental Geology</td>
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<td>IHP</td>
<td>International Hydrological Programme (UNESCO)</td>
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<td>INBO</td>
<td>International Network of Basin Organizations</td>
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<td>ISARM</td>
<td>International Shared Aquifer Resource Management (UNESCO-IHP)</td>
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<td>ICQHS</td>
<td>International Centre on Qanats and Historic Hydraulic Structures</td>
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<tr>
<td>IRCK</td>
<td>International Research Centre on Karst (UNESCO)</td>
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<td>IW LEARN</td>
<td>International Waters Learning Exchange and Resource Network</td>
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<td>IWMI</td>
<td>International Water Management Institute</td>
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<td>IWRA</td>
<td>International Water Research Association</td>
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<td>IWRM</td>
<td>Integrated Water Resources Management</td>
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<td>MAR</td>
<td>Managed aquifer recharge</td>
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<td>NCGRT</td>
<td>National Centre for Groundwater Research and Training (Australia)</td>
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<td>NGO</td>
<td>Non-governmental Organization</td>
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<td>SIDS</td>
<td>Small Island Developing States</td>
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<td>SPC</td>
<td>Secretariat of the Pacific Community</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<tr>
<td>UNESCAP</td>
<td>United Nations Economic and Social Commission for Asia and the Pacific</td>
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<td>UNESCO</td>
<td>UNESCO United Nations Educational, Scientific and Cultural Organization</td>
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<td>INESCO-IHP</td>
<td>UNESCO International Hydrological Programme</td>
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<td>UNILC</td>
<td>United Nations International Law Commission</td>
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<td>WWDR</td>
<td>World Water Development Report</td>
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Key recommendations from the Asia-Pacific consultation

1. Countries in the Asia-Pacific region need to deploy more resources - money, people and time - and to further develop groundwater governance structures and processes to address shortfalls in the monitoring, implementation and enforcement of groundwater policies and regulations.

2. There are a rich variety of groundwater laws and groundwater governance institutions in the region. While different governance structures and processes suit different locations and conditions, good governance requires effective accountability, responsibility and coordination arrangements.

3. There is scope for increased cooperative action on groundwater governance between regional countries especially in relation to comparative analysis and research, information sharing, policy evaluation and feedback. The UNESCO regional centres related to groundwater governance, including the planned new centre on Groundwater and Climate Change announced at this consultation, make an important contribution to regional cooperation. There is also scope for increased assistance to fragile and vulnerable SIDS and small islands.

4. Acceptable limits for the consumptive uses of groundwater should be set out at various levels (basin, aquifer, city, water use area) striking a balance between current and future consumption. Water use entitlements should only be issued within these limits. Reducing groundwater consumption by managing evapotranspiration merits wider consideration.

5. National policies are needed to encourage conjunctive use and managed aquifer recharge. Coordination between surface water and groundwater plans is essential to ensure efficient spatial and temporal use of water. There should be no double counting of surface water and groundwater resources. Investors need to be assured about the recovery of water stored in aquifers.

6. Groundwater institutional structures, legal frameworks and regulatory mechanisms should be designed to respond to changed knowledge and conditions, including climate change. Groundwater risk assessments and risk reduction measures are needed, including protective groundwater reserves for managing disaster risks.

7. Greater use of incentives could be introduced to manage groundwater use including water pricing and user fees on withdrawals. Pricing of surface water and groundwater should be consistent.

8. Investments in groundwater infrastructure including managed aquifer storage and recharge are needed to improve the security of water supplies.

9. Groundwater governance arrangements should be designed and implemented with the active participation of public and private water users and other stakeholders, taking account of other policies, including land-use planning. Implementation should be devolved to the lowest feasible level.

10. Education and training programs and pilot demonstration projects are needed to improve the awareness and capacity of groundwater managers and consumers. Comprehensive borehole licensing is needed, coupled with improvement of training and accreditation for drillers.
Background for Regional Consultations on Groundwater Governance

Introduction

The international project “Groundwater Governance: A Global Framework for Country Action” focuses on addressing concerns over the depletion and degradation of groundwater resources. The overall project objective is to increase awareness of the importance of sound management of groundwater resources as a means to preventing and reversing the global water crisis. The main drivers of groundwater depletion and degradation include, but are not limited to:

a) Increased utilization of groundwater resources as a result of population growth, increased urbanization and pressure caused by increased climate variability and climate change;
b) Weaknesses of the groundwater governance structure; and
c) Limited knowledge of groundwater science and lack of awareness of groundwater’s role in socioeconomic development.

In this project groundwater governance is defined as “the process through which groundwater is managed through the application of responsibility, participation, information availability, transparency, custom and the rule of law. It is the art of coordinating administrative actions and decision-making between and among different jurisdictional levels, one of which may be global”.

Groundwater governance is the process of deciding what is to be done, as distinct from groundwater management which is about getting things done.

The project will develop a global "Framework of Action" (FA), consisting of a set of effective governance tools: guidelines for policies, legislation, regulations and customary practices. The FA will foster the evaluation of groundwater as a key natural resource, and of the social, economic and ecological opportunities that sustainable groundwater management could provide through an interdisciplinary dialogue.

The Purpose of Regional Consultations

The purpose of the regional consultations is to seek regional perspectives on the practical application of groundwater governance. The specific objectives are:

a) Compile first-hand knowledge provided directly by local sources - groundwater experts, resource managers and actors in different areas – about the main features of the region;
b) Discuss the different issues that derive from the specific characteristics, challenges and priorities of the region based on case studies elaborated by national experts;
c) Build partnerships among cross-sectoral collaborating project agencies, stakeholders, decision-makers and specialists.
The results of the regional consultations will contribute towards the preparation of a “Global Groundwater Governance Diagnostic”, which will serve as a technical basis for the different stages of the process.

Regional consultations are organized as follows:

a. Montevideo, Uruguay, for Latin America and the Caribbean, 18th – 20th April 2012;

b. Nairobi, Kenya, for Sub-Saharan Africa, 29th to 31st May 2012;

c. Amman, Jordan, for Arab Countries, 8th – 10th October 2012;

d. Shijiazhuang City, China, Asia, 3rd-5th December 2012; and

e. The Netherlands for the UNECE region and a roundtable devoted to the private sector, 19-21 March 2013.

The fourth regional consultation, for the Asia-Pacific region, was carried in Shijiazhuang, China from 3 to 5 December, 2012. The consultation was organized through the UNESCO-IHP network and brought together a set of groundwater practitioners and policy makers. Each invitation included a Groundwater Governance Questionnaire for invitees to fill before the workshop. Participants from 17 countries of the region attended the event.

The consultation was hosted by the Institute of Hydrogeology and Environmental Geology (IHEG), Shijiazhuang, China, under the auspices of the Ministry of Land and Resources of the People's Republic of China, with the support of the China Geological Survey (CGS) co-sponsored by the Chinese Academy of Geological Sciences and with the contribution of the National Centre for Groundwater Research and Training (NCGRT) Australia.

Mr Wang Min, Vice-Minister, Ministry of Land and Resources, People's Republic Of China, Mr Zhang Jiehui, Vice Governor -in-Chief of Hebei Province and Mr Shi Jiansheng, President of IHEG welcomed participants and made opening remarks.

The Opening Ceremony was an opportunity for Dr. Shi Jiansheng to express the intention of the IHEG to consider the establishment of a UNESCO Regional Category 2 “Center for Groundwater and Climate Change”.

Representatives from the Global Environment Facility (GEF) (Ivan Zavadsky), World Bank (Liping Jiang), International Association of Hydrogeology (IAH) (Shammy Puri), United Nations Educational, Scientific and Cultural Organisation (UNESCO) Beijing (Jayakumar Ramasamy), United Nations Economic and Social Council for Asia and the Pacific (UNESCAP) (Hongpeng Liu), and the UN Food and Agriculture Organisation (FAO) (Mohamed Bazza) also welcomed participants and gave opening remarks.
Questionnaire on groundwater governance

A questionnaire on groundwater governance that included 13 questions was sent to invited participants in the consultation. There were 37 individual responses from 35 institutions in 16 countries. Federal and state governments were well represented. Responses to the questionnaire are summarised below.

Respondents characterised groundwater governance in the Asia Pacific region as uneven. There is concern about the lack of effective groundwater governance models in much of the region. As one respondent put it, “there is a long way to go”. But there is already cooperation in the region and scope for more. There are also examples like Australia where groundwater governance structures are established and appear to be effective.

Hongpeng Liu (UNESCAP) summed up the general view that:

“We need to share knowledge and experience within the region and provide support for developing and realising local targets, goals and solutions that fit into a regional sustainability objective”.

Key steps towards improving groundwater governance are:

- establish networks of stakeholders at multiple scales and engage all stakeholders in groundwater governance, especially user groups;
- set directions and establish legal frameworks;
- improve enforcement of policies and regulations;
- take incremental steps towards better governance.

A multiplicity of institutions and organisations is involved in groundwater governance in the Asia Pacific region:

- the emphasis should be on achieving better coordination between existing organisations rather than establishing new organisations;
- in many cases further support and capacity building is needed.

Groundwater governance priorities in the region include:

- scientific evaluation, monitoring and assessment;
- water planning;
- management and protection of water quality and water quantity;
- pricing and regulation;
- development of local initiatives;
- pollution control;
- disaster planning and management;
- capacity building;
- public education and engagement.
All countries covered by the questionnaire reported policies and/or legislative frameworks covering groundwater:

- where there is legislation, there is considerable variation in enforcement and its success;
- where policy is not supported by legislation, compliance is even more variable;
- a number of respondents expressed concern about the absence or failure of enforcement, leading to issues of overuse and pollution.

Challenges and barriers to groundwater governance are:

- inadequate integration and implementation of policies;
- water plans do not address needs of all users;
- weak compliance and enforcement;
- lack of public awareness of the fragility and declining availability of resources;
- excessive decentralisation of groundwater management;
- lack of formalisation of groundwater rights;
- non-availability of groundwater data;
- cultural practices and legacies that pose risks to groundwater;
- inadequate education, skills and capabilities for management, regulation and evaluation.

Groundwater quality and quantity is impacted by

- overallocation and unregulated extraction of groundwater;
- failure to understand the meaning of and potential for sustainable groundwater exploitation;
- contamination, e.g. industrial, agricultural & urban;
- impact of droughts on recharge;
- actual and potential impact of sea level rise;
- limited storage in some aquifers e.g. in small islands;
- lack of data of groundwater resources and their interaction with surface water;
- managing groundwater in isolation from surface water;
- land subsidence;
- lack of groundwater management expertise.

Community education and awareness of water is a key to unlocking investment in groundwater. Investment is needed for:

- community education;
- institutional capacity building;
- infrastructure;
- knowledge support for decision making, including better data;
- matching groundwater allocations to actual requirements and supply realities;
- obtaining a balance between economic development and sustainability;
• encouragement of commercial and business innovations in sustainable groundwater use and management.

Sustaining interdisciplinary and intersectoral dialogue requires

• community engagement, and good communication through all stakeholder levels;
• creative use of mainstream and social media.

The following organisations are willing to contribute to a shared regional vision on groundwater governance:

• the National Centre for Groundwater Research and Training (NCGRT), Australia;
• the Centre for Comparative Water Policy and Laws (CCWPL), Australia;
• the China Geological Survey, China;
• the International Research Center on Karst, UNESCO/Institute of Karst Geology, the Chinese Academy of Geological Sciences (CAGS), China;
• the French Embassy, China, International Office for Water, International Network of Basin Organisations;
• the World Wildlife Fund (WWF), China;
• the Advanced Centre for Water Resources Development and Management (ACWADAM), India;
• the South Asia Consortium for Interdisciplinary Water Resources Studies (SaciWATERs), India;
• the International Association for Water Law (AIDA);
• the International Groundwater Resources Assessment Centre (IGRAC), Netherlands;
• the Institute for Global Environment Strategies (IGES), Japan;
• the International Water Management Institute, Lao PDR;
• the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP);
• the World Bank.

Institutional support for problem-solving at the local level:

The main local problems identified by respondents were:

• lack of community awareness about groundwater;
• economic development often takes precedence over environmental management;
• lack of scientific evidence;
• identifying and enforcing responsibility and accountability.

Various institutions consider that they can offer:

• encouragement and support for local initiatives;
• education and awareness;
• multidisciplinary perspectives;
• research to provide evidence for the need for better management of groundwater;
• assistance with relationship building and consultation;
• investment.
Plenary Sessions

Plenary Session 1 – Setting the Scene of the Groundwater Governance

Chair: Andrea Merla; Rapporteur: Majid Labbaf (ICQHS - Iran)

Andrea Merla introduced the session by pointing to the challenges faced in the management of groundwater resources. Groundwater resources are being threatened by both climate change and over-exploitation. The project is focused on how to manage groundwater resources in a more sustainable way.

A video message followed: “From Amman to Shijiazhuang”.

Mohamed Bazza (FAO) introduced the project “Groundwater Governance: A Global Framework for Action”. The project is financed by GEF in cooperation with FAO, UNESCO, IAH and the World Bank (CHECK). Sound groundwater governance is needed to reverse groundwater depletion and degradation and alleviate the impacts of climate variability and change on groundwater resources. Mr Bazza explained the project architecture including papers and consultations leading to a shared vision, global groundwater diagnostic and global framework for action.

Alice Aureli (UNESCO) introduced the Fourth Regional Consultation. Groundwater plays a central role in the Asia-Pacific region for supplying fresh water for human populations and ecosystems. Groundwater is used extensively in India, Pakistan, Bangladesh, China and India, and plays a crucial role in highly vulnerable areas such as low-lying coastal zones and the SIDS. Each regional consultation engages different international and national entities and NGOs. Consultation meetings are organized during three days with participants from relevant organisations. Ms Aureli reported on the outcomes and conclusions from the consultation meetings held in Latin America, Africa (Kenya) and in Middle East (Jordan). Further details are given at http://www.groundwatergovernance.org/.

Hongpeng Liu (UNESCAP) described UNESCAP and their policy, project, research and capacity building activities, especially focused on transboundary issues. He identified major water challenges in Asia, and the countries facing the greatest number of challenges and capacity building needs throughout the region. Increasing groundwater use has followed economic development in Asian cities. Mr Liu detailed the regulatory, economic and other measures to reverse the decline of groundwater resources and environmental degradation in Bangkok. He recommended a package of approaches to be used in the context of intra and intersectoral governance, with regional cooperation on data gathering, information sharing research and development.

Neil Power (Australian National Groundwater Sub Group) presented the Australian water reform framework. Key elements of the reform have included cost recovery and pricing, institutional reform (separating regulators and water service providers), tradable water entitlements, water allocation plans, environmental water allocations, consultation, education and payments to the states when reforms are implemented. Water Reforms (including groundwater) have been effective in Australia, because all levels of government were involved, and major reforms have been carried
out within agreed timetables. Groundwater has been recognised as a major resource requiring specific management measures.

Jie Liu from University of Beijing talked about joint challenges posed by water scarcity and pollution in China. Northern China includes 50% of China’s population but only 19% of water resources. In the North over-pumping of groundwater has led to groundwater depletion, saline water intrusion and subsidence. Groundwater governance is explicitly defined in national laws, and the State Council and local governments have set out regulations and standards at different levels. A range of engineering and technical approaches have been adopted. Further emphasis is needed on socio-economic, political and institutional approaches. Solutions to the water crisis include comprehensive analysis, institutional reforms (coordination between different jurisdictions) national monitoring networks, metering, data publication and information sharing.

Lucilla Minelli (UNESCO-IHP) explained the IW LEARN Project (International Waters Learning Exchange and Resource Network). The project aims to consolidate transboundary waters management by paving the way for portfolio learning and information management amongst GEF IW projects and partners, and by providing a series of services to facilitate this exchange. She introduced the groundwater "community of practice" facilitated by UNESCO-IHP. It provides a forum for project managers of GEF groundwater projects, national experts and policy makers of the relevant ministries of project countries to exchange ideas and experiences about groundwater governance and related issues. She explained a website set up to assist this exchange.

Stefanie Neno (FAO) talked about communication and dissemination of the Groundwater Governance Project. The objectives of communication are to broadcast information about the project (involving stakeholders), disseminate the results, advocate for better groundwater governance and trigger policy change. The target audience is decision and policy makers at all levels. Channels to reach the target audience include web, public media, and international events. Ms Neno outlined media that have been released and events that have occurred. Next steps include the development of dissemination platforms and policy briefs, and further involvement of the media, leading experts and spokespersons. World Water Week, IHP Council, and the International Year of Water Cooperation 2013 provide opportunities for publicising the project.

Plenary Session 2 – Groundwater Governance: Focus on Legislation and Regulation

Chairs: Alfred Duda (UNESCO-IGRAC), Ivan Zavadsky (GEF); Rapporteur: Huade Guan (NCGRT Australia)

Stefano Burchi, International Association of Water Law (AIDA) gave an overview of water legislation in Bhutan, Cambodia, China, India, Indonesia, Kyrgyzstan, Nepal, Philippines, and Taiwan. Groundwater legislation primarily covers groundwater ownership, permits for well drilling and groundwater extraction, pollution control, qualification of professional well drillers, aquifer protection, and artificial recharge. In many countries where groundwater legislation exists the enforcement is lacking. Mr Burchi suggested that two important components are currently missing from the groundwater management and regulation that should be considered in future. They are the
impacts of urban development on groundwater recharge, and ecosystem support function of groundwater.

Himanshu Kulkarni, Advanced Centre for Water Resources Development and Management, Pune, India, suggested integrating science, participation, and legislation into groundwater governance. Domestic, agricultural and industrial water use in India is heavily reliant on groundwater. There has been a shift to groundwater following the widespread supply of cheap electricity through areas. 60% of users now suffer scarcity or contamination issues. Aquifer mapping and participatory groundwater management have been introduced. A modified legislative framework together with water management plans is needed to support decentralised activity and to address free riding.

Saim Suratman, National Hydraulic Research Institute of Malaysia discussed the water legislation at the state level, where the power at the federal level over water sharing between States is very weak. The absence of federal level legislation and authority is a real challenge for effective groundwater governance. However, water related infrastructural development is generally funded by the federal government. Research on the estimation of transboundary aquifers is urgently needed to support legislation on groundwater sharing between States.

Robert Delinom from Indonesian Institute of Sciences provided an interesting example of groundwater management, pricing and regulation in the Greater Jakarta Area. The main threats to groundwater sustainability arise from the steady increase in demand for water and from the increasing use and disposal of chemicals to the land surface. In response the groundwater price was increased by seven times from Rp 650 to Rp 4,400 per cubic metre following one regulation in 1999. Further increases are scheduled but there are ongoing political pressures to restrain price increases.

Discussion

Although river basin management and conjunctive water management are often advocated by international experts, often they are not included in national legislation. Therefore it is difficult to make sure that surface water and groundwater use entitlements are not counted twice.

There is also a general lack of legislation to protect recharge areas, or application of land-use controls in these areas. Policies and regulations that control land uses could be extended to apply to these areas.

In some countries there is fragmentation of regulation amongst many sector ministries/agencies, resulting in overlapping functions, competing interests and lack of data sharing and collaboration between agencies. The lack of national level authority over groundwater governance is a significant challenge.

Although there are weaknesses and gaps in legislation, lack of implementation and/or enforcement generally poses much greater challenges.
Plenary Session 3 Governance of Shared Water Resources: International River Basins and Transboundary Aquifers

Chair Stefano Burchi; Rapporteur Gabriel Eckstein

Han Zaisheng (China Geological Survey – International Shared Aquifers Resources Management, Asia) highlighted the diversity of characteristics and conditions of groundwater in Asia. As groundwater abstractions have increased, falling water tables, land subsidence, and seawater intrusion have occurred. Intervention is now needed to slow down or reverse aquifer depletion through the management of groundwater demand and the conjunctive use of surface water and groundwater. UNESCO and the China Geological Survey are now developing the preliminary inventory of transboundary aquifers in Asia and a Map that now includes 67 transboundary aquifers.

Shammy Puri (International Association of Hydrogeologists) explained that the UN law on transboundary water courses is inadequate to regulate transboundary aquifers because of the different characteristics of transboundary rivers and aquifers. Some alluvial plains in Asia store major transboundary aquifer resources. The science-based foundations for international law on transboundary aquifers are contained in five reports of the UN International Law Commission (UNILC). In late 2008 the UN General Assembly recommended Draft Articles covering measures for protection, preservation and management of transboundary aquifers for consideration by the UN Member States. Key lessons learned from the process of developing the draft articles included the importance of context and timing, good communication using simplified concepts, support from professional bodies, cross boundary scientific collaboration, persistence and patience.

Edouard Boinet (International Network of Basin Organizations- INBO) proposed Integrated Water Resource Management (IWRM) at national and international levels to address the poor distribution, overexploitation and pollution of groundwater. Institutional obstacles to cooperation include: over-centralization of authority, complex bureaucracy; absence of legislative, regulatory, and normative frameworks; and inadequate knowledge, training, education and resources. IWRM at multiple scales may provide a solution, including: integrated information systems; water plans; programs of measures; mobilization of financial resources and public participation. IWRM could be progressed by a network of river basin organisations.

Discussion was postponed until following sessions

Plenary Session 4 - Groundwater Governance: Enhancing Capacity in Groundwater Resources Monitoring, Management of Aquifer Recharge and Conjunctive Uses

Chair: Mohamed Bazza (FAO); Rapporteur: Geert-Jan Nijsten (IGRAC)

Liping Jiang (World Bank Beijing) introduced a novel approach to reduce groundwater overexploitation and increase agricultural incomes in the He Ha Basin, by reducing
evapotranspiration and increasing water use productivity. Water management focuses on reducing non-productive ET and discharge to groundwater while leaving overall water consumption (ET) unchanged. Setting limits to groundwater use (e.g. pre-paid cards for pumps) in combination with training/capacity and agricultural reforms can lead to increases in farmers incomes, while saving water and reducing pollution.

Bingfang Wu (Chinese Academy of Sciences) explained the ETWatch system whereby remote sensing is used to monitor ET on a daily basis and on a detailed (30x30m pixels) as well as basin scale. Monitoring ET through remote sensing can identify potential for water savings by calculating controllable ET for each type of land use. ETWatch is extensively validated using point field measurements in different landscapes and for different land uses.

Peter Dillon (CSIRO Australia and IAH) provided an overview of how demand management coupled with recharge enhancement and alternative water supplies can prolong or sustain groundwater resources, maximise their value and provide water supplies during droughts. Managed aquifer recharge (MAR) without demand management is flawed, at the same time MAR can be an inducement for demand management. The balance is determined by local factors. MAR requires a water sharing plan to set entitlements, allocations and use conditions. Good engagement and communication with stakeholders is required. New institutions and research may assist implementation; e.g. groundwater user groups, water banks and case studies of the economics of MAR. National capacity building for MAR is needed for sustainable operation e.g. http://china-mar.ujn.edu.cn/ and www.ismar8.org.

Richard Evans (SKM Australia and IAH) set out major economic and social reasons to encourage planned conjunctive use. Poverty reduction in irrigation areas is closely linked to water supply efficiency and hence to conjunctive use management. An important part of planned conjunctive use is to establish the true total cost of water resources and the separate cost to individual users. The regulatory settings for water management are an important driver for conjunctive management. Institutional, economic, social and technical challenges need to be addressed at the national scale. Institutional strengthening to promote conjunctive water management is a major challenge in most areas.

Prem Chandra Jha (IHP National Committee, Nepal) described how groundwater potential is underutilized, due to limited knowledge and poor governance. A legal and institutional framework needs to be in place for groundwater governance, including laws, policies, monitoring and enforcement. Subsided access to groundwater for poor people should be considered. Water markets offer a way to manage water use, but legal provisions should be in place before privatising groundwater. More funding is needed for research, assessment and knowledge development.

Jin Menggui (China University of Geosciences) said that coordination and communication between groundwater governance organisations in Zhengzhou needs to be improved, with better communication and exchange between water managers, planners, decision-makers, scientists and water users. Groundwater development should be easy to understand, based on well investigation and consideration of user demand. Water abstraction licensing has been introduced but enforcement is incomplete. Groundwater governance could be improved by new cropping patterns, water saving technologies and water pricing.
Discussion

The market approach to water rights is working in Australia where farmers are used to dealing with world markets, and there is a well-established system of water planning and application, but the assessment of applications for water trading can be difficult and costly. Where legal and institutional arrangements and the experience and sophistication of farmers and other stakeholders are not well developed, the market approach to water rights might not be suitable.

Card systems for managing irrigation water use are accepted when it can be shown that they help farmers to increase income.

There are a range of different situations in different countries that affect conjunctive water management.

- In India the health of groundwater is driven by surface water management practices, and consequent pollution. Managed aquifer recharge is a more urgent priority than developing a market approach to water rights.
- Malaysia has a shortage of groundwater aware leaders and management capacity.
- In the Philippines 60% of urban areas depend on groundwater. Unregulated pumping and groundwater pollution pose substantial problems.
- In Thailand, around Bangkok, water pricing has been introduced to manage demand but there is still substantial pressure on groundwater resources because of lack of surface water storage.

There is tension between the objectives of food security and sustainable groundwater use Dialogue and institutional change is required to develop conjunctive management of strictly managed surface water systems and open access groundwater.

Plenary Session 5: IWRM, Groundwater Governance, Natural Hazards and Climate Change

Chair: Craig Simmons; Rapporteur: John Chilton

Kenzo Hiroki (International Centre for Water Hazard - ICHARM) emphasised that IWRM needs to include land management. He illustrated this by the water cycle, and discussed the degree to which this concept has been implemented, saying that scenario based management strategies were useful. He suggested that integration in the legal/policy framework, planning, information sharing and people's participation is needed for the integrated management of surface water and groundwater. The region should work together through shared discussions, targets, technology and financing.

Upali Imbulana presented on climate change and groundwater governance in Sri Lanka. He first listed the history of policy development in the country from 1965 to 2005, and gave reasons why there had been policy failures. The concerns about climate change had produced an increasing sense of the importance of groundwater due to the increased variability of surface water supplies. There was now widespread recognition of the impacts of climate change on coastal aquifers, and strong political will for measures to adapt to climate change.
Satya Priya reported on experience in a GEF-supported project on participatory groundwater management in Andhra Pradesh. This builds farmer capacity to manage their own systems, including by teaching them about hydrogeology and monitoring of groundwater. The governing principles of participatory management include equal rights, long-term commitment, community management - including all users - and reliable baseline data. Incorporating responses to climate change and developing adaptation measures needs to be done at all scales from the household and farm upwards. He illustrated the difference between the top down and bottom up approaches, and described farmer schools that provide experience-based training during the growing season.

Wenbin Zhou described a pilot project at Shenzhen – the Xikeng reservoir, and illustrated the management of water resources and water recharge in the catchment using best management practices. These practices can effectively remove pollutants such as sediments and nutrients. Planter and bio-boxes are effective techniques to manage pollutants at small scales. The cost of technologies for water harvesting in Shenzhen are US$ 4000 per year per village ie per thousand inhabitants, plus the overall cost to set up the programme.

Jaroslav Vrba provided a summary of the Groundwater for Emergency Situations (GWES) project findings and recommendations, with three case studies from India, China and Japan. Groundwater resources can provide a safe source of water for drinking and other purposes in emergency situations. Aquifers can be temporarily drawn down if there has been prior investigation of regional hydrological and social conditions and community participation. Clear definition of the responsibilities of governments and other stakeholders in emergency situations together with capacity building and community participation are needed to implement effective disaster response.

Discussion

It can be difficult to establish coordination owing to surface water and groundwater responsibilities being in different ministries, or because of disagreements between relevant ministries usually cannot agree. One possibility is to get regional cooperation or informal local regional committees set at levels below the ministry. Often the first step is to share data locally, and then this may occur later between ministries.

Although it is preferable to avoid the depletion of groundwater storage, aquifers may be depleted in the short term during drought crises if the social and economic needs are great enough. Acceptable limits need to be set for aquifer depletion. Natural or managed recharge in the wet season allows increased groundwater use during the dry season.

The cost of technologies for water harvesting, discussed in the Shenzhen case study, may restrict the application of the technology in some countries.

The community based, participatory approach to groundwater management in Andhra Pradesh could have broader applications. Lack of mandate among government institutions can be a constraint. In Andhra Pradesh community based management is a new approach and clear management responsibilities have not yet been defined. A consortium of civil society organisations at the national level is also needed.
Plenary Session 6: Challenges and Opportunities for Groundwater Governance in Pacific Island Countries

Chair: Phil Crawford; Rapporteur Louise Whiting

David Hebblethwaite gave an introduction to the Pacific community, which is made up of 14 countries (plus 8 territories). These Small Island Developing States (SIDS) are small, isolated, vulnerable and short of natural, human and financial resources. All rely on groundwater to a greater or lesser extent. Groundwater governance is not just about legislation, but crucially involves community engagement. The cases of Palau, Marshall Islands, Tuvalu and Fiji illustrate the diversity of groundwater governance issues and settings in the Pacific. In the Marshall Islands protection of the one small section of the atoll - the Laura lens - is a critical buffer against climate change. Marshall Islands experience reveals that effective governance depends on a common and integrated agenda, consistent communications, effective support networks, continuous monitoring and adequate resources. Tuvalu has introduced composting toilets - this has been a very effective strategy to protect groundwater from septic pollution and conserve water. In Fiji exports of groundwater represent 20% of total export earnings.

Reenate Willie spoke about how Kiribati needs to move from disaster response to risk management, although this is constrained by lack of economic resources. Improved monitoring, leakage reduction water tariff reform, legislation review and capacity building are required together with community education and engagement.

Taaniela Kula explained how groundwater resources are threatened by growth in population and pollution and the implications of climate change for Tonga are not clearly understood. There are opportunities for better coordination between stakeholders, better measurement and monitoring and capacity building with external help.

Discussion

Groundwater governance is a lifeline for Pacific island communities in responding to global change. Limited groundwater supplies are being polluted by land-use activities. This pollution is increasing as populations grow.

Climate change impacts are already occurring and the extent of future impacts is not clearly understood. The SIDS need external help for monitoring and capacity building so they can move from disaster response to risk management.

The benefits and risks associated with desalination facilities on Pacific Islands raise many important issues such as economic viability, impact on surrounding reefs and long-term sustainability.

The Pacific SIDS already cooperate actively with one another. Dialogue between the SIDS and other countries which have remote, small islands (e.g. Korea, Malaysia and Indonesia), as well as with SIDS in other regions (e.g. the Caribbean), could be an important learning and capacity building exercise.
Plenary session 7: Groundwater Governance, National and Regional Experiences - Focus on Networking and Capacity Building

Chair: Jiansheng Shi; Rapporteur Louise Whiting

Tadashi Tanaka (University of Tsukuba, Japan) compared groundwater governance regimes in China, Indonesia, Thailand, Vietnam and Japan. Most legislation is setup to overcome groundwater hazards. Groundwater should be defined as a shared natural resource with legislation for sustainable groundwater use. Many overlapping organisations are responsible for groundwater governance, with no coordinating Ministry. Japanese law on the water cycle could be adapted for groundwater governance, with cross ministry policy coordination plus specific local action plans.

Yatsuka Kataoka introduced the Institute for Global Environmental Strategies (the Asia-Pacific knowledge hub on groundwater management) and IGES activities. There has been a lot of talk about IWRM to improve groundwater governance, but not much progress. Further socio-economic and hydrogeological assessment and an apex body to coordinate governance are required. Changing the awareness of stakeholders and policy makers is a key to improve groundwater governance. Future challenges include groundwater-poverty issues, cross country groundwater governance diagnosis in Mekong countries, identifying partners for twinning projects, fostering young talent and creating a one stop online shop to share information and knowledge.

Xu Zhanci spoke about the widespread and growing exploitation of groundwater in Hebei province in China. The provincial government has formulated a strategy to manage groundwater resources including a long-term management plan, water use and drilling permissions, water tariff regulation (farmers don’t pay tariffs), restrictions to prevent further development of groundwater ”funnels”, programs to improve monitoring and public awareness, artificial recharge (which is already being practised), conjunctive use and other water saving technology including saline irrigation.

Lunten Janchivdarj explained that Mongolia suffers from extreme water scarcity especially in the South, and the frequency of droughts is increasing. It is difficult to find groundwater in the South Gobi region and northern permafrost area. Water has deep cultural significance in Mongolia. Herders participation is needed to develop local groundwater governance. The recent re-centralisation of water governance provides an opportunity to improve interagency coordination. There is a need for further research and investigation, especially in the South Gobi region, including the establishment of ecological criteria for guiding use of fossil groundwater.

Dr Do Tien Hung presented five challenges for groundwater governance in Vietnam: completion of the legal system and its implementation, improving data and monitoring network for groundwater management, strengthening coordination with neighbouring countries (such as the joint monitoring network with Cambodia), long-term and short-term planning of water resources and measures, such as groundwater protection zones, to maintain water quality around cities.

Discussion
There are gaps in knowledge and understanding between policymakers and communities. Coordination between high level governments and other stakeholders requires improved communication mechanisms, users need opportunities to talk to decision-makers.

Improved monitoring is needed of the deep aquifer across Vietnam and Cambodia. Collaboration between Vietnam and Cambodia requires cooperation between jurisdictions to manage shared resources that cross borders. Monitoring is being introduced step-by-step with water resource maps at decreasing scales - a joint monitoring network with Cambodia is needed. In future Vietnam wishes to implement a plan about flows from Cambodia to Vietnam.

In Mongolia water privatisation was promoted by mining interests. Privatisation was accompanied by weaker central institutions and the abolition of the Ministry of Water Economy. Currently a revised more centralised structure is being prepared.

**Plenary Session 8: Groundwater Governance: From Local to Regional Visions Focus on Institutions Engaged in Groundwater Governance**

**Chairs: Andrea Merla and Kenzo Hiroki; Rapporteur Craig Simmons**

Tom Soo (IWRA) gave an IWRA perspective on groundwater governance. The IWRA seeks to improve water policy and management through publications, fora, exchanges and networking. There has been a rapid increase in scientific groundwater publications. IWRA publishes the journal Water International, and books and conference proceedings. The World Water Congress has been organised since 1973 - discussions of groundwater quality and hydrology have been popular.

Jiansheng Shi (Director IHEG) explained how precise controls on groundwater use can be implemented with the support of hydrogeological surveys, assessments and monitoring using a network of gauges and information-based platforms. In North China it is advisable to reduce winter wheat, and increase summer plantings to make full use of soil water and cut irrigation use. Agricultural subsidies should be sensitive to water use and emergency groundwater supplies should be established for cities. Action should be taken to reduce pollution from sewage discharge and landfills.

Namsik Park (Dong-A University, Republic of Korea) spoke about the plethora of water related laws across ministries in the Republic of Korea. Despite four groundwater monitoring networks in Korea there is little knowledge of groundwater in upstream or coastal areas. Many small wells are not metered. Only 48 out of 275 local governments implement a groundwater use fee. Local governments do not want to increase monitoring or fees for fear of offending constituents. Farmers who consume 50% of water supplies receive free supplies. Economic instruments are being considered to manage water use.

Anjal Prakash (SaciWATERS India) discussed water supplies in Hyderabad, India. Rapidly growing urban housing settlements are not connected with water services. Traditional supplies from lakes are encroached and polluted. Over 3000 hectares of water bodies lost in the last 10 years. Private water tankers are filled with groundwater pumped from periurban and rural areas. Private water
tankers are not registered. There are no pumping limits and no consideration of water flow or water quality.

Guillermo Tabios (University of the Philippines) discussed groundwater management in the Philippines. Sectoral agencies have retained their functions despite attempts to coordinate policy under a National Water Code and Water Resources Council. Multiple water institutions with overlapping and fragmented roles are operating at different levels of authority and across different sectors and interests. Legitimacy and transparency, public trust and accountability, credibility and participatory decision-making are key principles for water governance.

Labdaf Majid (ICQHS) gave a brief introduction to groundwater management in arid areas in Iran. There has been a shift from traditional qanats to tube wells. Iran has introduced long-term strategies for water resource development, fair water distribution and allocation. A range of measures have been taken at regional level including shutting illegal wells, controlling discharge, limiting agricultural development, changing cropping patterns, increasing public awareness and establishing water shareholders unions. These measures have been successful in reducing overexploitation of groundwater.

Jianhua Cao (IRCK) talked about Karst systems in China - a resource totalling 200 billion cubic meters per year, one quarter of national groundwater resources. A large-scale survey was carried out before drilling wells to improve water supplies in response to drought in south-east China. In some areas eucalypt plantations have reduced spring flows affect Spring flows. Further modelling and monitoring is being undertaken.

Xiangfang Song (CAGS) introduced an assessment of the interaction between groundwater, ecological systems and economic development in the North China plain. The research examined the interaction between agricultural water use, soil types and wetlands, explored the relationship between economic growth and groundwater, and analysed environmental problems (seawater intrusion, land subsidence and soil salination) and the interaction between reclaimed water and groundwater. A groundwater carrying capacity evaluation model has been developed.

Dongguang Wen (CGS) talked about the rapid increase in groundwater abstraction in China during the 1970s and 1980s, and gave an introduction to the activities of the China Geological Society, including hydrogeological investigations (quantity and quality) and surveys. In northern China 65% of domestic water, 50% of industrial water and 33% of irrigation water comes from groundwater resources. More than 400 out of 657 cities in China use groundwater for drinking water.

Owing to the relatively large number of presentations in plenary session 8 there was no opportunity for a concluding discussion.
Working Groups

Working Group 1: Groundwater Governance: Agricultural and the Expanding Food Demand

Facilitator: Satya Priya; Rapporteur Jiang Liping

Working group 1 was asked to consider two questions
A. What elements should be considered to establish good groundwater governance that can contribute to secure the sustainable management of groundwater resources while supporting the growing demand for food and water?
B. What are the challenges and barriers to the establishment of effective groundwater governance?

Current situation - groundwater management

There has been serious groundwater over-exploitation leading to surface subsidence and degradation of ecosystems, such as trees dying, and rivers and lakes drying up. Farmers will have to change to pumps with bigger capacity in order to pump water from deeper aquifers.

Farmer communities do not know how much water is available to consume, or what is actually consumed. Many groundwater wells have not been registered and there are no monitoring instruments or measurement of water use for most of these wells.

In many areas there have been no rules and regulations on use of groundwater. Where rules exist there are no institutional arrangements for enforcement of these rules and regulations.

There are few platforms or institutional mechanisms available for negotiations on water demands among different water use sectors.

There has been insufficient development of irrigation systems (both main systems and on-farm systems) and agricultural extension services. Irrigation water use efficiency is very low.

Current situation - conflicts and barriers

There are conflicts between economic development (industrial, domestic and agricultural water uses) food security and environmental conservation.

There are substantial technical and financial difficulties, and institutional and political barriers

Lessons and Opportunities
It is difficult to regulate the increasing number of wells.

Good experience and knowledge in groundwater management exists, and there are successful precedents for conjunctive water use. While many elements of effective groundwater management have been established, it is too soon to make a final assessment of all of the elements of effective groundwater governance taking into consideration the range of national conditions.

There are opportunities to get support from governments and technical assistance from international organizations to improve groundwater governance. Recent innovations and new technologies are available to support the preparation and implementation of groundwater governance, monitoring and enforcement.

**Recommendations**

The pre-requisite for effective groundwater governance is policy change to establish sustainable groundwater management with groundwater levels maintained by defining maximum admissible draft. There are nine elements of good groundwater governance:

1. The maximum amount of water available for consumptive use (target or cap) should be worked out at various levels (river basin, aquifer, city or water use area) to ensure that the actual consumptive use does not exceed the target;

2. A platform with institutional arrangements should be established to conduct dialogues and negotiations on water allocation among different water use sectors and stakeholders. Agreements should be reached for decision making on conjunctive use and water allocation from the aquifer or river basin level down to a water user level;

3. Related laws, policies and regulations should be established and implemented for groundwater management; for example, participatory groundwater management;

4. Investment programs should not be prepared with a “silo approach” looking groundwater or irrigation systems alone. Equally important measures are required in other sectors such as agriculture;

5. Means or tools for monitoring and evaluation should be in place as part of groundwater governance;

6. Farmer incentives (income increases) should be considered as a very important factor in groundwater governance;

7. Groundwater governance should consider local conditions and cultural differences, and use flexible ways to promote sustainable use of groundwater resources;
8. Increased consultations at every level of decision making within and across the water user groups are necessary to develop the guidelines and to ensure compliance before a framework for actions comes into force.

9. The development and implementation of good groundwater governance can be promoted by:
   - Study tours to visit countries where there are good experiences and lessons in establishing groundwater governance;
   - Training provided to government officials and national experts;
   - Organising international conferences and seminars and inviting government officials and experts to exchange ideas and experience;
   - Cooperation between countries in establishing groundwater governance.

**Working Group 2: Groundwater Governance: Climate Change and Natural Hazards**

**Facilitator:** Wenbin Zhou; **Rapporteur** Jaroslav Vrba

Group discussion concentrated on impacts of climate change on groundwater governance. Recommendations about groundwater governance in response to national disasters also draw on the UNESCO IHP VII project “Groundwater for Emergency Situations (GWES)”. Impacts of climate change and natural hazards on the SIDS are also discussed in WG No 6.

**Current situation**

According to the World Bank (WWDR No 4), the Asia-Pacific region is the most disaster prone in the world. Natural disasters of hydrological and geological origin affect millions of people in the region and their water resources.

Climate variability and extreme weather events are expected to increase and affect the region at a wide-ranging scale and more frequently. Coastal and delta flood-prone areas with high concentration of population and economic activities are particularly vulnerable to climate change.

Specific attention has to be given to the areas where cumulative human impacts (pollution, depletion) and natural impacts (disasters and climate change) on groundwater occur. In several countries approaches to disaster risk reduction and climate change adaptation are integrated and coordinated. However, in many countries weak groundwater governance and lack of political will increase populations’ vulnerability, and reduce their capacity to prevent and cope with the impact of disasters on water supply facilities.

**Lessons and opportunities**

Many countries in the region are experiencing the impact of climate change and natural hazards on coastal aquifers. Droughts and wet seasons are prolonged, there is greater variation in rainfall extremes and changes in seasonal distribution of rainfall, recharge and groundwater availability.
Generally, groundwater is less dependent on climate change and less directly influenced by natural disasters than surface water. A distinction must be made between relatively high risks to vulnerable shallow and coastal aquifers with residence time in days and years, and lesser risks to deep aquifers with renewable groundwater (residence time 000’s of years) and non-renewable groundwater or fossil groundwater (aged more than 10 000 years).

Human impact on groundwater resources (pollution, depletion) in many parts of the region continues to be socially, economically and ecologically more significant than impact of climate and natural disaster related events. Populations’ vulnerability in developing countries is affected by their poverty. Development of deep groundwater resources resistant to disasters and climate change is costly and exceeds the accessible funds of local communities.

**Recommendations related to climate change impacts**

The following proactive, preventive and adaptive approaches are proposed to build groundwater resilience to climate change impacts.

1. Develop regional and national adaptation strategies and an integrated action plan for mitigating climate change risk on groundwater resources. Incorporate climate change impacts on groundwater, and indicators of groundwater variability in national water plans.

2. Develop efficient groundwater risk reduction measures, adaptation plans, diagnostic and risk maps, and statistical methods and models for groundwater dependent areas in low-lying coastal and delta flooding zones. Take immediate protective actions and investments in these areas.

3. Establish and operate integrated climate, surface water and groundwater national monitoring networks to create accessible databases and provide data to predict impacts of climate change on groundwater systems.

4. Increase investments in groundwater infrastructures (artificial recharge, bank infiltration and sub surface dams, hydraulic barriers to reduce salt water intrusion) to improve the security of water supplies threatened by climate change. Disseminate knowledge and experience from the UNESCO IHP MAR programme.

5. Establish training programmes targeted at risk assessment and mitigation of climate change impact on groundwater, and transfer knowledge to water managers.

6. Promote active community participation in developing strategies and responses to climate change impacts on local water supply and sanitation. Community education about economic (price) and environmental values of water helps to build community resilience against disasters.

7. Undertake pilot demonstration studies and projects in hotspot areas where climate change is most likely to impact on groundwater resources.
8. Create an international task force team within UNESCO IHP to address adaptation measures and long-term strategy to mitigate climate change risk and impact on groundwater resources in developing countries and SIDS.

Recommendations related to the natural disasters

1. Establish groundwater protection policy for disaster risk reduction at regional and national scales and coordinate countries' efforts to jointly harmonize and link their activities in this field.

2. Make emergency groundwater resources an integral part of the national water plan, land use planning and groundwater risk management scheme.

3. Define priorities for utilising safe emergency groundwater sources, coordinating diverse or conflicting interests of various sectors.

4. Provide financial and technical support to developing countries for the development of deep and safe emergency groundwater resources in disaster prone areas and the formulation of relevant groundwater governance for emergencies.

5. Build capacity to implement emergency measures as set out in UNESCO IHP VII project “Groundwater for Emergency Situations (GWES)”.

Working Group 3 Groundwater Governance: Construction of Wells and Wellfields: Exploring Relations between the Regulators and the Regulated

Facilitator: Shammy Puri (IAH); Rapporteur John Chilton (IAH)

Current Situation

Experience from China, Thailand and the Philippines (supplemented by the regional experience of the facilitator and rapporteur) suggests that most countries have in place some borehole or well licensing or registration system. Countries have defined depth (15 m in Thailand) or yield (100 l/sec in Philippines) thresholds, so that very shallow or low to medium yields do not need to be licensed. Mostly these licensing systems require no more than notification that the borehole has been constructed, and some basic information about it.

However, in most cases the responsible government agency does not have the technical manpower to ensure that licensing is fully implemented, and systems are probably incomplete and open to misuse. There may be many unlicensed boreholes.

Licensing of the amount of abstracted water is often provided for by regulations, but is difficult to implement as it is difficult to monitor yields. Sometimes abstraction permits are time limited.
Countries also have licensing regulations for borehole drilling contractors. Some of these are time limited with accreditation being renewed e.g. every five years.

In some cases e.g. China, there are national standards for construction of boreholes. However, in most cases there is no supervision of construction (except for the really highest value construction, no government resources to check on quality of construction, and the government agency may only respond to complaints.

Currently driller training is much too short, sometimes only a week.

Lessons and Opportunities

The lesson is that there is legislation but little supervision. Opportunities for improvement are included as recommendations below.

Recommendations

There is a clear need to improve the sustainability and the lifetime of the supply in terms of both the management of the groundwater resource and the construction of the borehole itself.

Firstly available groundwater resources need to be assessed to confirm that they are sufficient for the designed abstraction (especially for large yields), backed up by suitable choice of drilling site. The need for this varies a lot between hydrogeological settings. The ability to do this is greatly improved if borehole licensing schemes require proper information submission from the drillers, which is then available and increases our knowledge of groundwater.

Secondly improved driller training and accreditation backed up by field supervision is required. Where training is available, governments generally pay it. There is a case for drillers to pay for their training if they are going to make profits afterwards.

For both aspects, investment in quality control needs to be proportionate to the total investment in the supply in terms of construction and what also depends on the water pumps, distribution works, and farm installations e.g. small scale rural versus large scale urban schemes. For large rural water supply schemes the cost of each borehole for a hand pump may be relatively low, but if there are many failures in a total programme of hundreds or thousands of such boreholes, then the lost investment can be comparable to fewer, high yielding boreholes.

Can contractors be expected to provide a guarantee of borehole yield and workmanship, and if so, for how long? Guarantees are included in some of the largest contracts, the specification of size, depth and straightness guarantees an operating lifetime of at least 20 years, but this only works with adequate technical supervision. A formal guarantee of a certain operating life may not be realistic, but the purchaser of the borehole (like any other purchaser) is entitled to some degree of confidence in what was being paid for.

While a guaranteed lifespan may be unrealistic, there could be some quality assurance for resources and construction quality at the time of completion.
**Working Group 4: Groundwater Governance and National and Regional Legal Settings**

**Facilitator: Stefano Burchi; Rapporteur Huade Guan**

**Current Situation**

An overview of the current situation mainly in Australia, Philippines, China and Japan suggests that there is some degree of groundwater regulations in most nations at local or national level.

The biggest challenge is to ensure the implementation and enforcement of existing laws

There are also gaps in the existing legislation - few countries appear to have comprehensive regulations addressing the chief concerns related to groundwater management. These include extraction, pollution from point and non-point sources, subsidence, protection of recharge/discharge zones and aquifer dependent ecosystems.

**Recommendations**

1. It is desirable to have one main agency with responsibility for all water management issues for all of the relevant sectors and uses, and this agency should delegate responsibilities.

2. National laws related to management of water resources should enable good groundwater governance.

3. There should be differentiation between and recognition of the existence of both statutory law and customary law.

4. Implementation should be authorized at relevant level of governance and adapted to local conditions through regulations that can change over time. Water managers and other local authorities need to have some decision-making and interpretative flexibility in implementing regulations in response to changing circumstances.

5. A greater range of incentives (including economic incentives) could be introduced to help to implement and enforce laws. These could include incentives for both the implementing agencies and users.

6. Use control measures and disincentives could be used to manage water use, including pricing water and user fees on withdrawals.

7. Land use controls need to be coordinated with groundwater management regulations in order to control pollution and protect recharge areas.

8. Efforts are required to expand the capacity and understanding of groundwater users as well as governments, pursuing a bottom-up rather than a top-down approach.
9. Groundwater user associations should be legally authorized and permitted to take a proactive, participatory role-groundwater management.

Working Group 5: Groundwater Governance: Managed Aquifer Recharge (MAR) and Conjunctive Management of Groundwater and Surface Water

Facilitator: Rick Evans (IAH); Rapporteur: Peter Dillon (IAH)

Current situation

The current applications of Managed Aquifer Recharge (MAR) and planned conjunctive use of surface water and groundwater (CU) are small in comparison with their potential to buffer ecosystems and livelihoods against drought and climate change and reduce evaporative losses from reservoirs.

Examples of MAR and planned conjunctive water use include:

- MAR as a product of rural employment policies in India, stormwater harvesting programs in Australia, and urban flood mitigation programs in Netherlands;
- conjunctive use in the He Ha Basin China has been successfully introduced to eliminate non-beneficial evapotranspiration from the water table. Price is the same for surface water and groundwater;
- coordinated management of surface water and karstic aquifer at Yuntaishan Geopark in China, with park income allocated to pay for recharge and ecosystem protection;
- mixing surface water and groundwater to reduce aquifer drawdown around Jakarta; and
- responses to subsidence in Japan and several other countries.

Reasons why MAR and planned conjunctive uses are not being adopted include:

- no Asia-Pacific country has a specific government program for establishing MAR or CU;
- a lack of unified institutions for managing surface water and groundwater and lack of coordination or information sharing between multiple authorities;
- a large number of unregistered and/or unmonitored wells;
- in some countries surface water is a public good operated by a government agency whereas groundwater is in private ownership;
- supply of subsidised cheap surface water. Also irrigators prefer surface water because they avoid pumping costs, although cheap electricity supply can reverse this preference; and
- evaporative losses from surface water storage are not generally accounted for in determining surface water prices.

Lessons and opportunities

Diverting water from rivers to depressions during flood seasons can mitigate flooding and replenish aquifers directly or through constructed recharge works and is under consideration in China, Vietnam, Thailand and Korea.

Cities such as Beijing are using technologies for recycled water and treated stormwater.

The multiple benefits of MAR need to be taken into account e.g. MAR undertaken to mitigate urban flooding can result in parkland development in urban areas and groundwater replenishment.
Conjunctive management needs a leading agency, clear definition of responsibilities and mechanisms for inter organisation cooperation and information sharing. Links to ecosystem conservation, and water quality protection also need to be made.

**Recommendations**

1. **National policies**
National policies are needed to encourage conjunctive use and managed aquifer recharge. Surface water use should not be approved without assessment of impacts on groundwater, groundwater use should not be approved without assessment of impacts on surface water. Impacts on both consumptive use and water dependent ecosystems should be considered. Where groundwater is privatised its ecosystem support role should be recognised and groundwater redesignated as a public good, or a convergence pathway adopted to align government and private interests.

2. **Consistent pricing**
Consistent pricing of surface water and groundwater is needed to ensure that economic drivers for users’ choice between water sources are consistent with the policy on conjunctive use, and to account for economic and ecosystem service outcomes.

3. **Total costs must be identified**
Evaluation of MAR and CU schemes should be based on “true total costs and benefits“ accounting for economic, environmental and social costs and benefits from a long-term and whole of system view.

4. **Integrated water resources assessment and planning is essential**
Planning needs to be undertaken at an appropriate scale. This will normally be at a large scale, such as river basin scale. Information on surface water and groundwater will be necessary to evaluate potential investments and solutions. Institutional mechanisms to integrate efforts of multiple stakeholder organisations will need to be identified and implemented, and new institutions such as water banks considered for sustaining supplies over the long-term.

5. **MAR requires entitlements to store and recover water**
Investors must be assured of the right to recover stored water, embodied in a credible transferable entitlement. Groundwater users need to adhere to entitlements. Where secure entitlements do not exist or are not adhered to, linking MAR with the piloting of entitlements, or groundwater resource charges, should assist communities with responsible demand management for which there is a tangible benefit.

6. **There should be no double counting of water**
Where groundwater and surface waters are connected withdrawing groundwater also reduces stream flow. Groundwater and surface water entitlements should take this into account and avoid double counting.

7. **Capacity building in MAR and CU is paramount**
Building knowledge of MAR and CU among water policy makers, natural resources managers, health and environmental regulators, water supply and irrigation organisations and water users is essential to achieve to community understanding and support for MAR and CU. Demonstration and documentation of successful MAR and CU projects (including operation and maintenance) will build
confidence among regulators and water users. Pilot projects should be included in scientific, technical and operational training to ensure there is capacity to implement these systems, and to allow research to adapt and improve system design and performance.

**Working Group 6 Small Islands and Groundwater Governance**

**Facilitator:** Al Duda; **Rapporteur** Dave Hebblethwaite.

**Current situation, lessons and opportunities**

The current situation, lessons and opportunities in the SIDS were identified as discussed in plenary session 6. Therefore this working group focused on developing recommendations to improve groundwater governance in the SIDS.

**Recommendations**

1. **Leadership**
   In order to avert pending drinking water shortages, disease and economic crises in many small island states, strong commitment and leadership is needed at all levels of government to build and implement the policies, programs and resources needed for effective groundwater governance.

2. **Investment**
   The long-term viability of small island states relies on the sustainable management of their fragile potable groundwater reserves. This will not be achievable without increased and sustained financial investment from national budgets, the private sector (including tourism) and external partners.

3. **Capacity**
   Small island states have limited capacity to assess, manage and protect their fragile groundwater resources, and increased and sustained efforts are needed to develop, strengthen and maintain this capacity at a regional, national and community level.

4. **Monitoring and Assessment**
   Not enough is known about the potential and sustainability of small island groundwater resources, particularly those that sustain isolated communities, and increased efforts are needed to collect the data and create the knowledge needed to inform good groundwater governance.

5. **Community engagement**
   On small islands, communities, households and particularly women play an important role in the management and protection of fragile groundwater reserves, and should be actively involved in groundwater governance.

6. **Integration**
   The integrated management of water resources is particularly important in small islands, which typically rely on a combination of water sources to meet peoples' daily needs. In these cases effective groundwater governance clearly needs to be based on IWRM principles, and the collaborative efforts of all relevant sectors and stakeholders.
7. Pollution Reduction
The size and fragility of small island groundwater resources leave them highly vulnerable to the impacts of pollution, including those caused by inadequate and inappropriate sanitation facilities and land use practices. The provision and management of appropriate sanitation facilities and sustainable land use practices must be central components of effective groundwater governance.

8. Maintaining Lifelines
Small island states are particularly vulnerable to the impacts of climate variability and climate change, and the development, management, protection and rehabilitation of groundwater reserves should be a key component of efforts to adapt to these impacts.

9. Mitigating Risk
The drinking water resources of small island states are particularly vulnerable to the impacts of natural and human hazards, and groundwater governance should play a key role in anticipating and mitigating the risk of disaster.

10. Knowledge Sharing
Regional and sub-regional sharing of knowledge, technologies and experiences is a proven approach to build capacity and commitment across small island states, and should be supported and replicated as a means of increasing the effectiveness of groundwater governance in small islands and coastal areas globally.

11. Utility Reform
Reforms in utilities, regulations and tariffs are essential to enable sustainable water supply and sanitation services in small island states, including the uptake of innovative technologies that reduce the over-extraction and pollution of scarce potable groundwater reserves.
Plenary Session 9 – Closing Session

Chair: Alice Aureli; Rapporteur Craig Simmons

The final plenary session was divided into three parts: a report on the questionnaires, rapporteurs’ reports on the working groups, and a closing discussion.

Laki Kondylas, from the National Centre for Groundwater Research and Training, Australia presented a summary of the results of the regional questionnaire. Further details are provided on pages 7-9 and in Annex 2.

The rapporteurs presented a summary of the outcomes of the six working groups. Further details are provided on pages 21-31 and in Annex 4.

In the closing discussion Alice Aureli pointed to the goal of developing clear guidance on groundwater governance post 2015. This will be facilitated by a debate among practitioners in the regions. The aim is to bring a proposal based on the five regional consultations to next year’s World Water Forum. This will be followed by the preparation of documents on sustainable groundwater development and the organisation of an E-Forum on the groundwater governance website.

Rick Evans (Australia) suggested that the report on the regional consultation should contain strong recommendations on groundwater governance. International water institutions neglect groundwater governance, but when separate groundwater institutions are established they do not gain traction in international water fora and institutions.

Alice Aureli responded that the report on the regional consultation will be circulated to participants for comment.

Conference closing messages

Mr Shi Jiansheng, President of the IHEG thanked participants and made closing remarks.

Representatives from UNESCO (Alice Aureli), the Global Environment Facility (Ivan Zavadsky), World Bank (Liping Jiang), International Association of Hydrogeology (John Chilton), and the UN Food and Agriculture Organisation (Mohamed Bazza) made closing remarks, thanked their Chinese Hosts and also thanked participants in the consultation for their inputs.