GLOBAL CATCHMENT INITIATIVE CONFERENCE
The Global Dimensions of Change in River Basins.
Threats, Linkages and Adapatation 6-8 December 2010, Bonn, Germany

GLOBAL ASPECTS OF WATER RESEARCH AND MANAGEMENT IN LARGE RIVER BASINS WORKSHOP

17-19 FEBRUARY 2010, BONN, GERMANY

Participant Responses and Perceptions: A Summary and Perspective
by Roland Schulze

Setting the Scene

Following pre-workshop responses by participants to the 10 key research questions that had been presented to them under the 3 GWSP key themes, as well as the presentations at the workshop from the selected basins, the discussions following those and the outcomes of smaller specialized working groups, some key issues came to the fore from the participants. The main issues raised are highlighted below. It should be stressed that most of these issues are neither new, nor are they covered comprehensively, but they were made in the context of the workshop and reflect the exchange of ideas during those three days.

Points of Departure

Points of departure regarding the workshop as well as the Global Catchments Initiative *per se* were distilled by participants as follows:

- The niche / uniqueness of the GCI is that it addresses global perspectives on water which have to be translated to a set of unique basins
  - at a range of management scales and experiences
  - from transboundary basins with international linkages to within-country basins reflecting more national and even local agendas
  - using the insights gained and experiences from selected case study basins
  - from a science based perspective (as against an advocacy based approach)
  - in which detailed interlinkages between *external* drivers (i.e. the more global teleconnections) and *internal* (the more local) drivers are sought.

- It must be appreciated and stressed, that what is acceptable in one country may be a major concern in other countries and, indeed, the world at large.

- The role of water is a strong and central driver as well as the binding factor not only in regard to sustainable water security, but also to sustainable food and energy security, climate change impacts, trade and donor funding to lesser developed countries.

On the River Basin as a Unit: An Assessment and the Role of the GCI

While promoting the importance and essentiality of the river basin to policy makers and water managers as the preferred spatial unit for integrated water resource management (IWRM), the watershed bounded basin is subjected to global and regional factors which challenge its uniqueness as a coherent unit, for example

- climate systems ranging from intra-annual frontal systems to annual monsoons to multi-year phenomena such as the El Niño and La Niña with their hydrological consequences, and the moisture recycling (televapour) associated with these systems, take no cognizance of basin boundaries;
- nor will climate change with its spatially and seasonally realigned temperature and rainfall regimes;
- economic spaces do not necessarily match basin boundaries;
- neither do societal/linguistic boundaries coincide;
- aquifers frequently have different boundaries;
- inter-basin water transfers blur the unity of a basin;
- as do invasive terrestrial and aquatic species; while
- land use practices in one basin may drive feedbacks felt in other basins; and
- rivers may form international boundaries with major 'left bank' and 'right bank' differences, or flow from one country to the next with upstream-downstream consequences in the quantity, quality and distribution of water.

There is relatively little previous experience of inter-basin comparisons of large basins and from socio-political, governance and catchment contexts the GCI thus seeks water related comparisons regarding, i.a.

- different states of economic development, such as
  - developed economies
  - transitional economies and
  - developing economies
- state-centred vs decentralized water management systems
- in countries with different levels of political stability
- in countries with different water development plans

- between countries of greater or lesser regional geopolitical importance
- between countries with different cultural value systems (e.g. in respect of corruption levels, patronage networks)
- transboundary vs within-country basins
- and governance regimes re.
    - levels of implementation of IWRM
    - levels of community based management and stakeholder participation
    - use of the basin as a management entity
    - management of transboundary waters
    - and the status of water related adaptation strategies and plans of action in respect of climate change

From Policy to Practice

1. On Policy and Legislation

A fundamental question arises whether water policy should be hydrological sciences driven, or new insights into hydrological sciences be water policy driven.
Irrespective of the above, what nevertheless remains a problem is the very slow acceptance of research results into policy.
Policy on water, in addition to addressing vital issues on water security, requires an integrative approach with clear coupling to key cross-cutting and interwoven themes such as

- food security (with its high susceptibility to global drivers)
- energy security
- income security and
- environmental security
- land use planning (e.g. in the case of flood policy in the EU's WFD) or
- coastal zone interactions (where rivers discharge).

Furthermore, policy on water also needs to facilitate

- the ability to transcend/cross/link scales of operation from the international to national to provincial to local, as well as
- the merging of 'hard' solutions (e.g. infrastructure development) with 'soft' solutions (e.g. modelling, incentives, land use planning) and
- the ways and means as to how people respond to and cope with political decisions.

Additionally, legislation should set targets (with milestones and timelines) and not only set rules, and ensure that principles (e.g. polluter pays) be adhered to.

At regional level it remains a sad reality that many international political alignments, particularly in lesser developed regions, lack the necessary inter-country buy-in and cross-boundary enforcement on transboundary water matters (as in the case of SADC), and that the gap in infrastructure planning between lesser and more developed countries belonging to regional alliances has not as yet been bridged, as in the case of the EU, for example.

2. On Institutional Arrangements

A lack of coordination is sensed between the

- *global players* within the broader field of water such as the World Water Council, The GWP, the IUCN, global NGOs (e.g. the WWF), UN-Water, the various UN Conventions (and commitments by signatory states to these), or the World Bank, and also the
- *regional players* such as SADC or the EU as well as the Asian and African Development Banks.

In particular the major coordination role of UN-Water was highlighted, not only because of the fragmentation of water programmes within the UN family of institutions, but also because of a perceived lack of links between global water and global food organizations.

Questions arose on whether the initiatives and pronouncements of most of the above institutions

- were impacting at all on actual basin management?
- were in any position to be prescriptive to a basin?
- were actually accessible to basin managers and
- were specific enough for local action?

3. On Vulnerability

Vulnerability at all levels, be it regional or national or local, sadly remains rooted in the level of economic development.

Factors that render populations in lesser developed countries (LDCs) more vulnerable than those in developed countries (DCs) include

- the high sensitivity in their daily lives to daily, intra-seasonal, inter-seasonal and decadal climate fluctuations in regard to water, food and energy security;
- relatively high population increases, but coupled on the one hand with climate fuelled in-migration to urban areas with under-prepared infrastructure/sanitation facilities and, on the other hand, with a high loss of skills through HIV/AIDS;
- being at the receiving end of globalization issues such as production for biofuels (vs food), land grabbing or trade agreements in a globally very interconnected world;
- experiencing less polycentric governance structures than in developed countries (DCs), with poor intra-government linkages;
- a lack of sound governance, especially at local lev-

el, in regard to capacity, management skills and/or monitoring;
- a poor/slow trickle-down and transfer of knowledge from "first world" to "third world" or from central government to local application;
- high levels of rhetoric from essentially sound legislation, but low levels of action and implementation;
- often poor infrastructure which additionally is frequently in a state of retrogression rather than of maintenance and improvement; and
- many LDCs being prone to political turmoil and open conflict which results, inter alia, in poor data collection and a lack of controls (e.g. regarding pollution).

The GCI needs to identify suchlike problems in its inter-basin comparisons on water related issues, especially in the 'hotspots' of concern within basins of the LDCs. These vulnerabilities are likely to be exacerbated by climate change.

4. On Adaptation

Adaptation has to respond to
- *external/global drivers*, which include
  - climate change
  - virtual water trade
  - donor pressure or pressure to implement IWRM from a certain perspective, as well as
- *internal/local drivers* such as
  - demographic change
  - changes in consumption patterns
  - political reform from within or
  - economic reform from within.

Difficult as it already is to adapt to biophysical or societal change, having to adapt to political change can often be very difficult and this adds an additional stressor.

With their generally low resilience to drivers of climate and water, LDCs are 'hot spots' for adaptation because they tend to constitute the 'poor spots' of the world.

Water should be the binding theme in adaptation to environmentally driven change.

- *On national adaptation plans*

National frameworks on adaptation are needed, but their structures should grow bottom up rather than only top down and they should therefore be led by local initiatives rather than donor determined thrusts.

The *value* of national adaptation plans is not entirely clear and still contains numerous imponderables, including whether they should
  - be responsible to update the respective country`s climate science and/or
  - link to international organizations and/or
  - solicit international funds and/or
  - be the springboard for wider and more integrated decision making.

- *On basin scale adaptation plans*

The value of basin scale adaptation plans is important as
  - each basin is unique and is thus subject to its own set of hydro-climatic and socio-political drivers
  - it is at basin scale that water amplifies the effects of changes in climate and displays non-linear responses with land use and
  - it is the scale at which IWRM is implemented.

Basin scale adaptation plans have to be synchronized with national adaptation plans and, where applicable, be aligned to transboundary adaptation plans.

Such plans must operate beyond only water and include land use, agricultural practices, health issues and disaster risk management.

- *On local adaptation plans*

While adaptation frameworks are geared to the national scale, and under certain circumstances even to the basin scale, adaptation on the ground is a local issue.

Challenges to adaptation which need to be factored in are that locals tend to be risk averse, often do not operate to their potential and do not always readily take up new concepts/ideas.

- *On links between migration and adaptation*

In human migration (be it rural – urban within the same country, or as refugees from one country to another), when considered from water resources and disaster management perspectives, the distinction should be made between
  - *voluntary migration*, which is environmentally determined (for example by drought), in which case the migration may be considered a 'failed adaptation' and *forced migration*, for example by inundation resulting from the construction of dams.

In either case, security is the reason for migration.

Migration may be considered a trigger to build new capacity.

5. On Pressures on the Water System

Recurring themes which were identified from the various case study basins and which need the attention of basin management included
- groundwater pollution
- over-extraction of groundwater
- artificial groundwater recharge
- effects of changes in land management (as against simply changes in land cover)
- hydrological responses to changes in crops
- increasing water use efficiency (WUE), and the provision of incentives for improved WUE
- water quality in regard to nutrients, pesticides, sediments,

faecal contamination, water temperature, land degradation and deforestation
- coastal zone management and its links to upstream basin management
- impacts of the water engineered system, especially of large dams, on hydropower production, environmental flow requirements and poverty / disease reduction as well as
- environmental and other impacts of inter-basin water transfers.

Two issues on the above were stressed, viz.
- they have to be assessed across the entire range of relevant scales in the basin studies, and
- *climate change is superimposed on ALL of the above existing water related problems as an additional, over-arching stressor and should not be viewed in isolation.*

6. On Land Use and Basin Responses

The need for integrated land and water management cannot be overstressed, as some examples identified below by participants illustrate.

Do we fully understand the downstream hydrological consequences of upstream intensification and/or extensification of land uses such as
- plantation forests,
- urbanization or
- irrigation?

As these practices may have
- amplification effects on downstream flows or effects that attenuate downstream flows (but by how much? how far downstream?) and
- hydrological consequences which may be of short duration or more permanent.

Agricultural prices tend to be determined in the west and not in developing countries, whereas the latter have a heavy dependence (from both livelihood and economic perspectives) on the land and what it can produce for local consumption and export.

A major emerging land use concern/threat is that of so-called 'hydrological colonialisation' (or 'land grabbing') as a result of foreign companies buying up vast tracts of land in LDCs with foreign monies to set up agricultural monocultures for their own benefit. Many questions on such 'land grabbing' arise, for example:
- have the consequences of vast new monocultures been evaluated in regard to local water resources and downstream impacts?
- can it be regulated?
- is the process transparent?
- has the local population been properly informed of any short and long term implications?

Added to this is the biofuels dilemma, especially as it affects basin water budgets and the LDCs, whose first concern and responsibility of agricultural production should be food security.

7. On Climate Change

Projected climate change (CC) is likely to have substantial effects on broader water linked sectors such as
- tourism,
- shipping trade,
- agriculture (both dryland [e.g. shifts in production areas] and irrigated [e.g. altered crops, water demands]),
- migration patterns and rates (both inter-country and within-country),
- disaster risk management, and thus
- civil society at large.

More directly linked to the water sector are impacts on:
- water quantity (magnitude, inter-annual variability and intra-annual distribution), and thus
- hydropower generation and
- inland navigation,
- water quality (chemical [nitrates, phosphates, heavy metals], physical [sediment yields] and biological [water temperature, faecal contamination]),
- extreme events (frequencies, magnitudes and spatial extents of extreme events),
- the vulnerability of the groundwater component (the amplification effect, the lag),
- the vulnerability of mountainous areas (the 'water towers' of many regions, but with highly uncertain vertical gradient changes), and
- the dynamics between concurrent climate-water-land use changes, environmental demands etc.
- all of which have to be addressed at the basin and sub-basin scale.

In the CC field we have to address simultaneously
- climate scenarios,
- water sector impact scenarios
- social impact scenarios and
- action scenarios.

Despite the high uncertainties still prevalent in the structure and process representations of GCMs, and consequently the output of future climate projections from different GCMs and for different emissions scenarios, coupled with uncertainties involved in downscaling, scientists should nevertheless raise awareness of potential impending water related impacts to
- policy makers,
- water managers,
- other stakeholders, and to

- civil society at large.

Moreover they should undertake sensitivity analyses at basin and sub-basin scales to gauge where and when thresholds of critical change could occur.

Because of its explicit and implicit links with human health, agriculture, coastal zone responses and disaster risk management, water should become the binding theme in CC impacts studies, adaptation strategies and negotiations on climate change, including issues such as carbon credits.

While resilience to CC is required at the global scale, managing its impacts is a local responsibility, where local implies the basin and sub-basin scale.

8. On Virtual Water Trade

In regard to virtual water trade (VWT), many questions remained unanswered to workshop participants. The following were highlighted:

- Is it a realistic option, especially to LDCs which depend largely on dryland agriculture for their food production?
- Or, is it merely a popular water accounting system invented by and for scientists, an overplayed concept, but one which basin practitioners, especially in LDCs, do not take account of?
- Or, should it be factored in now already in basin management plans in order to set new water standards determined by global economic considerations?
- Do basin managers really comprehend the meaning and the consequences of VWT?
- In agriculture, is VWT always built upon sound premises of the locally relevant climate-soil-vegetation-water continuum?
- Is it, in fact, dependent solely on/related solely to agricultural crops? What about forests or natural grazing?
- If VWT was to become a global driver of local water utilization, who would control/regulate it? A new World Food Bank? A new World Water Trade Organisation?

9. On Integrated Water Resource Management

There appear to have been relatively few successes of IWRM, and where they have been successful

- there has been no politicaI meddling in the process,
- it has been linked to incentives for improved management, and
- there is often catchment asymmetry in the sense that upstream–downstream or transboundary issues are at the core of problems needing to be solved.

The failure of IWRM is frequently associated with

- poor accountability and
- poor governance.

The three approaches to water management, viz. the livelihoods approach vs the environmental approach vs the ecosystems services approach have different core interests and there are often conflicts of interests between them because society and nature have different demands on water,

A general consensus was that the concept of IWRM, as promoted at the present time, should be re-visited in light of the realities of water management.

10. On Challenges to the Hydrological Sciences

Some challenges to the hydrological sciences which were identified included

- the coupling of water and solute fluxes at basin scale,
- an improved understanding of ecosystems services from a hydrological perspective,
- attaining a better understanding of the resilience of river systems,
- better understanding scaling problems between global and local drivers of the hydrological system, and
- ensuring that science properly informs issues around climate change impacts, food security, energy security and donor funding (including international development banks).

Where to Now? Questions and Challenges Facing the GCI

The February 2010 workshop posed many questions and challenges to the GCI, including the following:

- What does the water user community demand of the GCI? And who, indeed, are the 'users', our stakeholders and our potential audience? Are they
  - Politicians?
  - Policy makers?
  - Basin managers?
  - Technical advisors to policy makers and/or basin managers?
  - Other practical implementers of policy or fellow scientists?
- Will our insights and findings be useful and meaningful for development issues? And will the findings trickle down to people who make actual decisions?
- Can really meaningful inter-basin comparisons be made in light of the 10 questions posed, when each basin is unique?
- Should the 10 questions be clarified/refined and placed into sharper focus for basin stakeholders to be able to relate to them in a more practical way?
- Does the GCI need a clearer framework within which to function? And is there funding to develop/refine such a framework?

- Will the endeavors and findings of the GCI trigger new paradigms in water management, additional to the already existing ones which have evolved over the past decade or two, or a shift in already existing paradigms?
- Could new paradigms include
  - solutions to crossing spatial scales in basin studies? or
  - merging external (global) with internal (local) drivers of water management? or linking science with policy makers via technical advisors and management experts?

In regard to the December 2010 conference, the science context of the GCI should be relevant, credible and legitimate.

Science relevance includes

- knowing about external (global) and internal (local) processes and what shapes the responses and management in their respective basins,
- defining who our clientele really is,
- involving global water governance institutions (e.g. UN-Water) and donors, on the one hand, and on the other
- opening the dialogue between us as scientists (representing a wide range of disciplines as well as scientific water initiatives), and basin relevant practitioners (who are the ones providing us with reality checks),
- appreciating the challenges faced by individual basins, and
- learning from other basins.

Credibility involves the rigour of information and includes

- involving credible keynote speakers,
- promoting dialogue between science and government,
- highlighting clearly what interdisciplinary science is contributing to better governance and basin management, as well as
- formulating clear policy messages and management messages, and on a practical note
- making certain the conference proceedings are published appropriately.

Legitimacy implies

- clearly defining our expectations, *inter alia*,
- questioning whether the right people are engaged in these discussions,
- getting basin managers to tell *us* scientists what it is that we can provide them with for *them* to make better decisions (and not vice-versa),
- evolving a process whereby we can continue involving basin practitioners once the conference ends, and
- attracting young scientists to express their views, and if it is by way of poster presentations to make certain they get short presentation time slots to showcase their work.
- highlighting clearly what interdisciplinary science is contributing to better governance and basin management, as well as

Roland Schulze
School of Bioresources Engineering & Environmental Hydrology
University of KwaZulu-Natal, South Africa
Contact: schulzer@ukzn.ac.za

From Questions to More Questions: From of the 2nd GCI Workshop to the GCI Conference by Janos Bogardi

The 2nd workshop of the Global Catchment Initiative (GCI) was held on 17-19 February 2010 in Bonn, Germany. Invited participants were challenged in advance to answer a questionnaire classified into 3 subthemes and formatted into 10, sometimes multiple questions. Answers were solicited for large river basins the invited participants were familiar with through professional practice and/or research projects. The set of 10 questions was conceived and formulated by the 1st GCI Workshop held in February 2008. 14 sets of answers from 5 continents were received, relying on information and insights from the following basins or group of similar catchments: Amu Darya, Andean catchments, Danube, Elbe, Huai, Incomati, Jordan, Rhine, Sao Francisco, Tisza, Upper Danube, Volga, Volta, Winnipeg Lake basin. The following summary presents the 3 thematic areas covered and the 10 questions together with an abbreviated quintessence of the answers received to the respective questions.

"Distilled" *Answers* to the Original Set of the 10 Research Questions

GWSP Core Theme 1: What are the magnitudes of anthropogenic and environmental changes in the global water system and what are the key mechanisms by which they are induced?

1. How is global change manifested in particular catchments (at the decadal to century time scales)?

Anthropogenic imprints/influences are more pronounced than global change (governance, pollution, river training, land use, population growth/shrinkage). Floods and droughts seem to have increasing tendencies but much uncertainty remains.

2. How do changes in climate, land cover/use, demography, institutions and consumption patterns and other external factors, affect the characteristics of particular catchments?

Political decisions, instability and changes, reservoir construction and river training, bio fuel production trends and irrigation development outpace climate (change) signals.

3. What are the expected impacts of these changes on society and ecosystems?

Ecosystems deteriorate, invasive species occur, poverty and depopulation, flood/drought extremes will accentuate, passing (or have passed) "tipping points".

GWSP Core Theme 2: What are the main linkages and feedbacks within the earth system arising from changes in the global water system?

4. What meteorological, hydrological or biogeochemical connections from beyond the catchment are observed in specific catchments, why do they occur and which feedbacks do they induce? Interactions with coastal zone and oceans e.g. through reservoirs?

El Niño, la Nina and monsoon effects, changing flow regimes esp. headwater fragility, invasive species, pronounced change of climate drivers, uncertainties.

5. What are the determining factors and the consequences of virtual water trade? How does international trade in food and in other commodities, driven by consumption patterns, production systems and lifestyles, affect the transfer of virtual water within a river basin? Conversely, how does water availability affect trade and terms of trade? What are the institutional settings at different levels as driving forces? What are the effects of virtual water flows on the exporting and importing side (on human well-being, water use, availability, quality and biodiversity in a river basin)?

Virtual water trade is not everywhere considered/recognized or significant as factor. Some catchments "suffer" as donors of virtual water. VW import areas seem to profit, but there are plenty of (hidden) vulnerabilities. Trade liberalization, agriculture lobby, ill-conceived irrigation development and undervalued water in agriculture damage ecosystem ´services. It is expected to become a strong future challenge of water resources management.

6. How do international power relations affect the use of water and other natural resources in catchments? What are the relations between water and other resources (energy)?

Politics, transitions (socioeconomic and political) and conflicts dominate the scene. Hydropower and cooling water versus ecosystem and agricultural water needs competition is likely to increase.

GWSP Core Theme 3: How resilient and adaptable is the global water system to change, and what are sustainable water management strategies?

7. What is an appropriate framework to address vulnerability, resilience and adaptive capacity of water systems in river basins from a global perspective and to integrate across scales to identify and rank factors and their interactions which influence sustainability?

Except presenting existing governance and management frameworks answers remained very general. The multitude and fuzziness of some of the definitions certainly matter in this regard. Suggested by many answers as a prospective area of research for GWSP-GCI.

8. How did and do water governance regimes compare between catchments in their ability to achieve sustainable (environment, social, economic) management of the water resource and to adapt to global change?

Historical development models and trajectories prevail. Much difference is detected between basins or even within basins. Little evidence is reported of adaptation at basin scale to global change.

9. What is the influence of international institutions (e.g. binding UN conventions, global norms) and global actors (e.g. World Bank, GWP, multi-national water companies, NGOs, scientific community) on the resilience of river basins and how can such influence be improved?

Strong differences exist between developed/developing basins. International organisations could champion/assist positive change in management/governance of water.

10. Does sustainable water management improve the balancing of water needs for ecosystems and human activities? Are the concepts of ecosystem services and resilience of social-ecological systems useful performance criteria for sustainability?

Answers, while generally affirmative, revealed much uncertainty and a bit of scepticism over our ability to implement the respective principles and concepts in practice. Areas implied by the questions were recommended as core research foci of GWSP.

No doubt that much uncertainty could be detected even in these "distilled" summaries. This is partially due to the customary time lag between the emergence of new ideas, concepts and techniques

and their full fledged introduction into the praxis of water management. However some answers contain fuzziness as the reflection of imprecise definitions and terminology used, as well as the reference to practically untested concepts in the questions. Further the set of questions confronted by the respondents implied a kind of expected uniformity of and within river basins. As a consequence many answers "threw back the ball" and suggested to GWSP to address those complexities and uncertainties as its future research foci. Answers indicated that, depending on the particular question, size and other features of the basin, there might be more than one single answer. Both the answers to the questionnaire, and even more during the deliberations of the subsequent workshop indicated that some concepts, expected change, trends and priorities in drivers and consequences at basin scale and beyond need to be critically scrutinized. Neither the state of science, nor the state of river basin management praxis warrant to continue "business as usual". Given this backdrop and the results of the mapping just before the workshop make it less than surprising that substantial part of the outcome of the workshop can rather be formulated as a question than a matter of fact style statement. The following list summarises the most pertinent questions emerging from the 2nd workshop of GCI.

Theme 1: What are the magnitudes of anthropogenic and environmental changes in the global water system and what are the key mechanisms by which they are induced?

- Can experience gained and conclusions drawn for a particular large basin be transferred to another one, irrespective of social, political, governance, hydrological and economic differences?
- How far can amplification and/or attenuation effects downstream, due to upstream changes of land uses be considered, regulated and addressed?
- How can land use and water issues be addressed in an integrated manner at basin scale?
- How could climate, social and political change scenarios be formulated and assessed simultaneously?

Theme 2: What are the main linkages and feedbacks within the earth system arising from changes in the global water system?

- How can global players, economic and political events influence the water debate and river basin management/governance?
- Is virtual water trade (VWT) a realistic option, especially to LDCs which depend largely on rainfed agriculture for their food production?
- Is VWT merely an accounting system for scientists, but one which basin practitioners do not take into consideration?
- Should VWT be considered already in basin management plans in order to set new water standards determined by global economic considerations?
- If VWT was to become a global driver of water utilization, who should control/regulate it?
- Are the consequences of large scale "land grabbing" with regard to water have been thought through?
- Should not land and water rights be separated?

Theme 3: How resilient and adaptable is the global water system to change, and what are sustainable water management strategies?

- How could the concept of vulnerability be incorporated into human-centered water resources management at basin scale?
- How can water be defined as a key factor in adaptation to climate change?
- How can be ensured that national frameworks on adaptation incorporate both bottom-up and top-down approaches while being led by local initiatives rather than by donor determined thrusts?
- How these approaches be incorporated in management and governance of large basins?
- How can "water security" be adequately taken into consideration when addressing interrelated and interdependent 'securities' such as food, energy etc.?
- Can migration, induced by the lack of water security be considered as an adaptation strategy or does it reflect the failure to adapt?
- How can science supported water policy transcend/link different scales of consideration from international, national, provincial to local level?
- How can research contribute to transboundary water governance and management?

Answering questions by formulating new ones might be seen as a dissatisfactory result. However we are still at the beginning of a difficult conceptual process –both in science and in practice- to explore links and mutual interactions between scales (global processes vs. basin processes) sectors and concerns (water resources management, climate change and variability, demography, agriculture, industry, trade, cultural and spiritual needs and many more). The 2nd workshop of GCI was conceived as a preparatory step towards an international conference "Global Dimensions of Change" to be held on 6-8 December 2010 in Bonn. The set of questions generated by the 2nd workshop are certainly waiting for answers to be given at the forthcoming conference but also by follow-up reareach and dedicated praxis of river basin management all over the world.

Janos Bogardi
International Project Office
Global Water System Project, Bonn, Germany
Contact: jbogardi@uni-bonn.de