water futures and solutions

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Scenario Focus Group Workshop Report

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Water Futures and Solutions Initiative
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About Water Futures and Solutions

Water Futures and Solutions is a cross-sector, collaborative global initiative which develops scientific evidence and applies systems analysis to help identify water-related policies and management practices that work together consistently across scales and sectors with the aim to improve human well-being through enhanced water security. A stakeholder informed, scenario-based assessment of water resources and water demand, employing ensembles of state-of-the-art socio-economic and hydrological models, will test the feasibility, sustainability and robustness of portfolios of options that can be implemented today and can be sustainable and robust across a range of possible futures and associated uncertainties we face. The Initiative includes case studies to zoom in on particular issues and regions, and knowledge sharing networks to share policy, management, and technical solutions that have been effective in the bio-physical and socio-economic contexts to which they have been applied, so they can be assessed for application in similar conditions in other regions.

Report Contents

About the Scenario Focus Group

The Scenario Focus Group (SFG) is comprised of water policy and planning decision makers at the national and international level who collaborate within the Water Futures and Solutions Initiative, primarily by identifying key water management challenges, priorities, trends, options, and trade-offs within their regions and advising on where further systems analysis and investigation would be most helpful for understanding externalities and guiding planning decisions. The SFG guides the development of relevant and plausible scenarios across which the sustainability and robustness of potential solution options can be tested.

Goals and Expectations

Goals for the meeting

- Developing sets of possible sustainable water security future pathways leading to the "The Future We Want", where basic human needs are satisfied in harmony with the natural world.
- Exploring solutions to close the gaps between "*where we are today*" and "*sustainability*" futures as well as trade-offs and co-benefits between them.

Expectations: issues to explore during the meeting

Scale	Spatial: Local, Regional, River Basin, National, Global Temporal: 2030? 2050?
Quantitative vs Qualitative	Modeling of supply and demand vs changes in technologies, governance and social behavioral change
SDGs	… and their relation to water scenarios Water Social Goals Ecosystems
Getting things done	Making modeling results compelling to stakeholders Inducing policy change and good governance Capacity Building
Financing	How to get funding for achieving water goals? Investments in information, institutions and infrastructure
Stakeholders	Widening engagement

Adopted stakeholder recommendations from Paris meeting:

- Focus strongly on the sustainability scenario by dividing it further into a few distinct pathways that should provide realistic options for policy development.
- Main focus of scenarios should be water.
- Identify trade-offs and synergies and explore them through the pathways.
- Specific measures depending on local conditions.

Limits to the current capacity of global water modeling:

- Impact of feedback of water constraints and climate damage on GDP and Population calculations.
- Governance and social issues.
- Difference between technologies development and adoption.
- Full spatial water availability-demand calculations based on agriculture and energy production and reflecting water reuse.
- Water allocation conflicts and mechanisms.
- Water quality and environmental flows.

Agenda

Goals review	Goals for the initiative and the meeting
Introductory presentations	Review of the SFG Paris meeting results Review of the sustainability background: Sustainable Development Goals, Agenda 2030, COP 21 Review of the Water Futures and Solutions fast-track results Sustainable Water Security Pathways – introducing concepts Solution Options for Water Security
Water sustainability pathway development for the selected river basins (Zambezi, Indus, Yellow River)	Characterizing current situation and setting desirable goals Identifying tradeoffs Selection of solutions Building sustainable water pathways
Getting out of the water box - water in different sectors	What are the main challenges in the sector? What are the most important inter-linkages between water and the specific sector? - Water and Economy - Water and Food - Water and Energy - Water and Health - Water and Ecosystems
Water, disruptive technologies and surprises	What future technologies can emerge that can strongly affect availability of solutions to close the water gap?

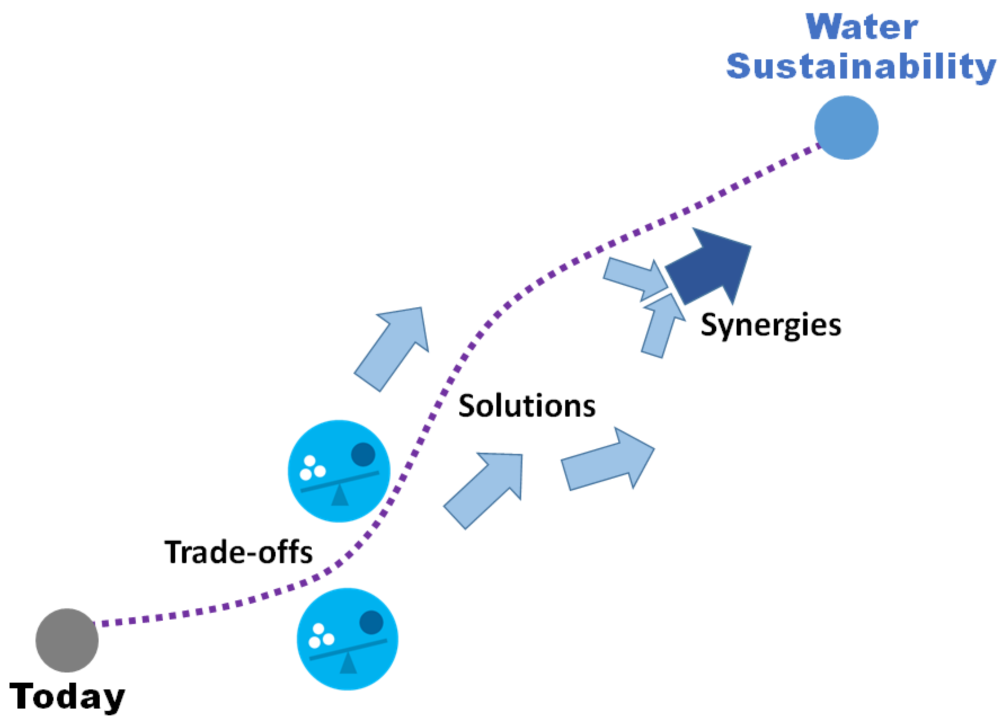
Water Sustainability Pathways

Pathways were constructed within the sustainability narrative as described by the macro-drivers of Shared Socio-economic Pathway 1 of IPCC. This scenario has been described in summary as follows:

“The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural, and economic costs of environmental degradation and inequality drive this shift. Management of the global commons slowly improves, facilitated by increasingly effective and persistent cooperation and collaboration of local, national, and international organizations and institutions, the private sector, and civil society.”

In keeping with this, the regional concentration pathway that was used in the fast-track analysis was the stabilization pathway (RCP 4.5) in which total radiative forcing is stabilized before 2100 through the use of technologies and strategies for reducing greenhouse gas emissions. Up to 2050 there is little difference in the impact on the SSP1 water scenario between that for keeping temperature levels below 2C (as decided at COP21) and that of RCP4.5.

Thus in designing solution option pathways the starting point is to recognize that the environment assumed in SSP1 is one in which there is slowly improving but increasingly effective and persistent cooperation and collaboration of local, national, and international organizations and institutions, the private sector, and civil society.



INDUS RIVER

Participants:

Ismail Serageldin (Egypt), Nadezhda Gaponenko (Russia), Ashfaq Mahmood (Pakistan), Mihir Shah (India), Alberto Palombo (Venezuela), Fernando J. Gonzales Villareal (Mexico), Eva Hizsnyik (IIASA).

Basin characteristics	Drought and flood (to manage) High population density high, high population growth Irrigation 80% Groundwater extraction high Large population already under stress Dependency on Himalaya glaciers Lots of open defecation Transboundary conflicts Low share of wastewater treated Low water use efficiency Hydro power potential (small vs big dams - analysis needed) Glacier and rain; wide range of annual precipitation (100-1000 mm) Precious ecosystems downstream
Goals by 2050	Zero open defecation (provision of toilets) Improve agricultural water use efficiency Sustainable regulation of groundwater and surface water use Increase water treatment and reuse (domestic/industrial) Sustainable groundwater use Storage dams (critical comment: dams created more floods; better solution: leave room for the river)
Critical gaps to overcome current situation	Increase storage capacity to regulate seasonal extreme events and hydropower generation Improve data quality, timeliness and access to information - transparency and accountability Improve legal framework (participation, governance, institutional capacity, equity) Generate political will and funding resources Irrigation system maintenance Low treatment capacity Capacity of individual farmers Geotechnical problems Archeological constraints

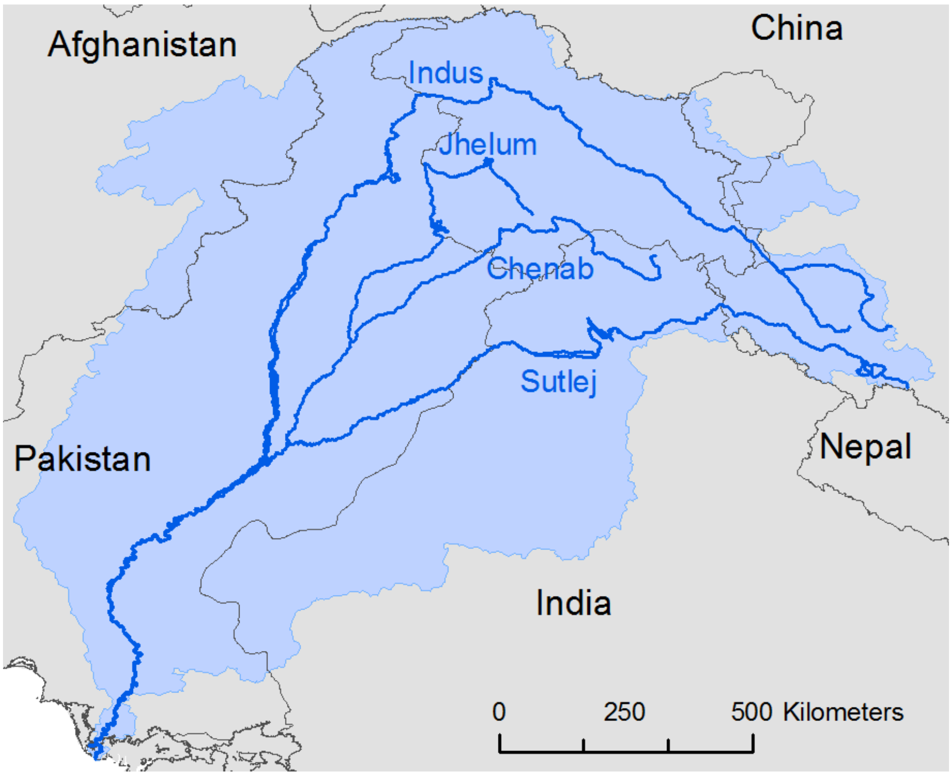
Other comments	Legal aspect of groundwater: who owns the land owns the water under it

Trade-offs	Huge hydropower vs. ecosystem protection Water storage vs. social and environmental effects Use of groundwater vs surface water, Water use for irrigation vs. environmental flows Building dams vs land rights and legal background (displacing people is easier in China than in India) Sustainability (long-term) vs immediate improvements (short-term) e.g. groundwater use
Other comments	Free energy for farmers in India is not good for water table (pumping groundwater is very cheap); would be better to separate power lines for domestic and agricultural use. Free or subsidized energy can cause overdraft of groundwater.

Solutions	*Solution 1*	*Solution 2*	*Solution 3*	*Solution 4*
Critical Gap	Storage gap & hydropower	Improved data quality & timeliness accountability	Improved legal framework	Political will, awareness building & funding
Solution	Select small rather than big dams	Agreement for all riparian and shared information systems	Participation and inclusion	Convincing scenarios
Major steps	Stakeholder consensus	Technology	Governance and institutional capacity	Good communication to target audiences, including media for wide awareness
	Funding	Management of shared information systems	Better framework for groundwater and surface water	Stakeholder involvement and consensus building
		Updated technology	Better policies on energy subsidies	Good science for designs and funding
Timing	Plan: 3 years Implement: 10 years	Agreement: 2 years Implement: ongoing and continued improvement	Start in 1 year Target: 5 years	
Other comments	Climatic variability, precipitation extremes → solution: increase storage capacity			

Knowledge gaps and uncertainties	Aquifer characteristics (recharge, boundaries) Basin baseline data including environmental flows Development and adoption of new technologies Climate change variability including monsoon frequency Political will and consensus building (how long?)

	Not enough knowledge about environmental flows Tipping points in ecosystems and their representation and assessment in ecosystems models Lack of knowledge on social-economic impacts of certain policies Migration – can be temporary, need people to adapt (e.g. 2000 and 2010 floods) Sediment behavior largely unknown (not linear, soil granularity has big impact, etc.)
General comments	Insurance : hurricane and flood maps are used (elevated houses as a potential solution to lower high insurance fees) Adequate flood protection → infrastructure needed Big dams vs small dams → studies needed, cost-benefit, displacement and environmental costs one argument: big dam always costs more and takes longer than planned River: by diverting 30-35% of mean annual flow can be used, with dam 85% Sometimes bureaucratic problems – water does not reach farmers Data quality; improving, update technology Legal framework, governance Good science for policy support; media, educating people Politics; convince first



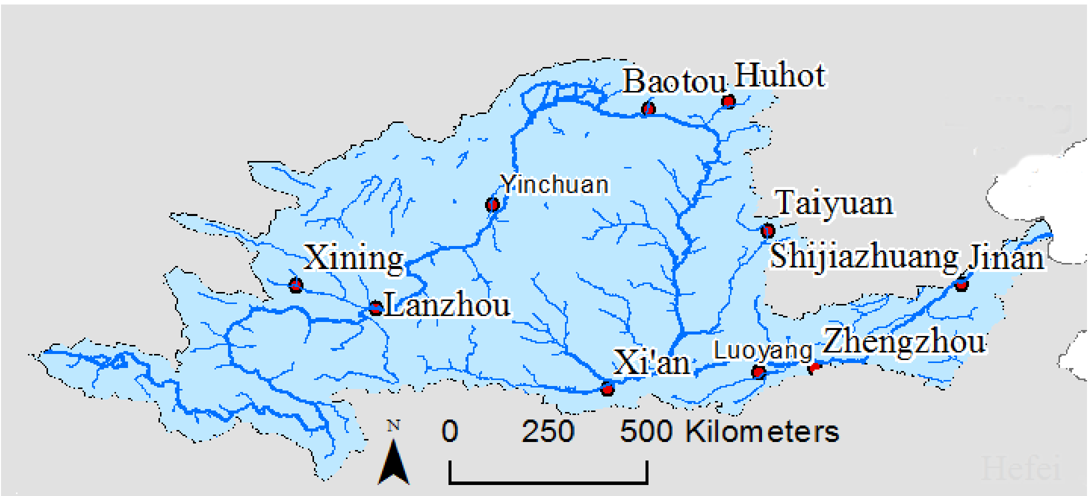
YELLOW RIVER

Participants:

Jinxia Wang (China); Jinnan Wang (China), Anoulak Kittikhoun (Laos); Quamrul Chowdhury (Bangladesh); Sylvia Tramberend (IIASA); input from: Rudolph Cleveringa (GWP) and Bill Cosgrove (IIASA)

Basin characteristics	Need to improve Integrated Water Management - Yellow River Commission – coordination and water allocation; Final decision by Ministry of Water Resources Irrigation efficiency currently low (< 45 %) Downstream water pollution issues (Industry, Agriculture) Drought both upstream and downstream has become more serious
Goals by 2050	SDG goal 6.3 to 6.6 all relevant Improve water quality Improve water use efficiency Develop integrated water management (water quality & quantity; upstream & downstream) Give more authority (power) to the Yellow River Commission (YRC) Improve water governance at the local level Protection of ecosystems
Critical gaps to overcome current situation	Institutions & Policy Finance for both maintenance of current infrastructure and new investments / developments Water saving technologies
Trade-offs	Agriculture versus Industry Upstream (western China, industry, coal energy) versus Downstream (agriculture, industry) Economic development versus ecosystems Regional governance versus river basin governance Water use efficiency improvements versus farmers income Water pricing (favored by parts of government) versus farmers income Higher water efficiency in agriculture increases energy use (drip, sprinkler irrigation has a higher energy needs compared to current simple distribution via canal systems) Local government has no incentive to install volumetric water measurements (because this may result in restricting them in their water use, which results in lower farm income)

Solutions	
Institutions	Improved institutions that govern water rights, water markets, and water allocation
Policies	Water pricing, polluter pays principle, and others Revenues of water pricing should go to local governments, which can use these revenues for investments
Integrated Water Management	Harmonize legal frameworks – In China as many as nine institutions are involved in water related governance (“9 dragons manage water”). Examples include the Water pollution act issued by the Ministry of Environment, the Water Ministry of water resources, and Agriculture Ministry for irrigation development
Lower GHG emissions	Seek win-win solutions with GHG emissions (e.g. less coal mining, less pollution, less GHG emissions)
General comments	Past 10 years have seen major improvement in sanitation and drinking water. Today, tensions about water use are especially between the agricultural and industrial sector. A key question is ‘how to best allocate scarce water resources between these two sectors’. In pilot regions, a water trading mechanism has been set up. Wastewater treatment is currently high in urban areas (> 80%) but low in rural areas (about 15 %). There is a saying: “Negative impacts (harm) travel both upstream and downstream.” Once the downstream area develops, opportunities for upstream areas are closing. There is a discussion about the real impact of implementation of water saving technologies, in particular regarding irrigation efficiency improvements as they may lead to even higher consumptive water use. It has been stressed that solutions to water challenges should consider the consumer perspective, i.e. demand-side drivers. Don’t neglect the rest of the economy. Try speaking about ‘Water for development’, i.e. phrase it positive as opposed to discussing water scarcity



ZAMBEZI RIVER

Participants:

Michael Mutale (Zambia), Mike Muller (South Africa), Florence Adongo (Uganda), Khaled AbuZeid (Egypt), Edward Byers (IIASA).

Basin characteristics	
Key issue: Underutilization	Problem in the basin is not one of scarcity but under-utilization; not lack of resource availability, or efficient use, but the ability to capture and use the resource. Does not make sense to ’increase efficiency’ when water is not even being used, when there are hardly any water services being provided. SDG talks about increasing water efficiency, but in Africa most of the water is not even utilized. Agreement that there is massive potential to increase water utilization. High evaporation losses. 85% loss from reservoirs evaporation Only approximately 1.4% used for irrigation – very low conversion rate Dams not designed to be multipurpose – hence very high losses as water is not being used.
SDG 6 perspective	Water sanitation and supply is very low. Less than 50% water supply (SDG 6.1) and sanitation access (SDG 6.2) Water quality (SDG 6.3) – not a big issue now but likely to become one; potential threats: mining, diseases. Low efficiencies can be improved (SDG 6.4) IWRM needs strengthening (SDG 6.5)
Common management perspective	Water should be protected and controlled Not viewed as a resource to be utilized for purposes such as development and empowerment This perspective generates problems and needs to be changed
Malawi	Malawi is the only water stressed-country in the basin. Upstream country Migration is a big issue – jobs availability attracts people
Other comments	Stakeholder interests very important – dependent on population resident in the basin. Discussion (disagreement) regarding the use of the words ‘consumption’ for the terms evaporation and ET instead of ‘losses’

Goals by 2050 & critical gaps

Huge potential for water to help meet other SDGs too; water can be a driver of development.

Integrated water and river management

Need to have a water resource management goal that is multi-sectoral and inclusive. Multi sectoral water management plan needs to be addressed within the framework of a basin strategic plan.

World Bank Multi-Sectoral Investment Opportunities Analysis (MSIOA). Great analysis but the findings need adoption needed by the member states followed by specified investments.

Underutilization

Gap between water availability (large) and water use (small) needs to be addressed. There is a need to exploit this potential by increase water storage capacity.

Energy and Hydropower

Energy is definitely a big priority and hydropower can play a huge role. Since 1980s there were ministerial priorities to develop hydropower but not much was done.

Irrigation

Agriculture is key for people's livelihoods – there is a pressing need to develop irrigation (from dams). Irrigation is underutilized but it may help to deal with variability and climate change. It can also address poverty. Supplement irrigation from dams using groundwater to smooth out variability issues. However, if water is taken upstream, there may be not enough downstream for hydropower.

Land use

Land use change not likely to be substantial – more significant is the likely intensification of agriculture on existing land

Groundwater

Groundwater management needs attention as often neglected and poorly understood. Groundwater can be effective in rural areas and provide water access in places far from the rivers.

Water Quality and Pollution

Reduction of pollution required. Low flows also have impacts on water quality. Water quality impacts during floods should be addressed.

Critical Gaps

Biggest gap is the potential and the underutilization of supply

Investment in infrastructure to increase water use is needed.

Even if there is infrastructure, is there the capacity to use all the water productively? Challenge: mobilizing the economy to use water – this way water in the Zambezi can contribute to meeting the other SDGs.

Now, with the Southern African Power Pool (SAPP), all SAPP countries can contribute their energy (often from hydropower). This way, some countries are tapping the water resources of other countries, through power.

Political economy problem in the region concerning local elites and private sector projects development. Donor funding is not going to build hydro-dams any more, especially when operated by private companies for profit. However, these dams serve multiple public purposes such as flood protection and environmental flows.

For political security governments look to multi-lateral development banks for funding also to leverage additional private sector investment.

More widespread use of public-private-partnerships (PPP) is urged

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Trade-offs

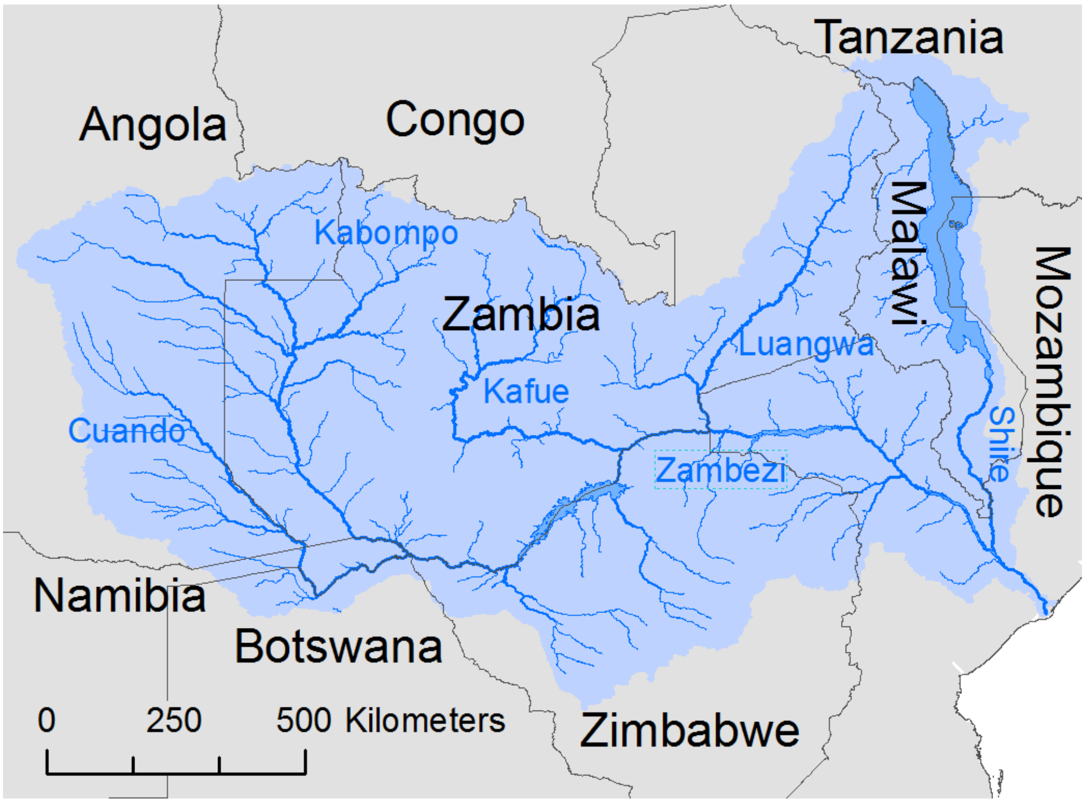
Less trade-offs in this basin since actually there is plenty of water.

Upstream vs downstream

Key trade-off is between the upstream and downstream operations, particularly for irrigation

Water use in different sectors	agricultural irrigation (upstream) hydro-operation (middle reaches) environmental flows (lower stretches and estuary); current operations do not meet environmental flows requirements
Inter-basin vs local use	Between local supply and exploring inter-basin transfers. 2nd city of Zimbabwe is always looking for water, hoping South Africa will pay.
Irrigation vs environment	Development of tourism opportunities in national parks vs irrigated agriculture. National park in middle/upper parts of basin used for tourism – this area could also be used for agriculture. However – this probably saves and protects the watershed. Big question – is there a shortage of irrigable land? Is there actually a trade-off? Is there enough water to irrigate the current agricultural land, let alone potential expansion into the national parks – needs to be answered (depends on water intensity of crops and supplementary irrigation from groundwater).
Storage vs evaporation	Increasing hydropower and storage potential vs increased losses from evaporation
Solutions	*"An integrated approach to develop the potential of the Zambezi river for hydropower, irrigation and domestic water supply, while ensuring the sustainability of the ecosystems in place, using PPP models."*
Key solution	**Key solution to close the gap: adoption of the MSIOA investment plan as laid out by the World Bank. Needs adoption by the member states.**
Capacity building – required at all levels	At high levels – understanding the complexity of river basin management issues with a view to long term sustainability. Also, greater understanding of leveraging appropriate financing mechanisms for development. At lower levels – project development, engineering and construction of infrastructure, roll-out of programs and day-today sustainable management of the basin. Key to making water stewardship work is helping water stakeholders to understand the inter-relationships between sectors. Understanding that not just environmental flows are important, but "integrated flows" for all society. Sufficient downstream flows needed both for development and environment.
Balancing and multiple use of water	Balancing irrigation and hydropower upstream in Zambia to ensure continuation of flows downstream. If not enough water flows downstream, Mozambique will use all for irrigation to the detriment of the estuary. Development of hydropower is of primary importance, both to ensure water flows down the river, but also to drive economic development. Multiple use reservoirs needed, to contribute to local socioeconomic development.
PPP financing models	Previously, there has been expenditures on water supply and services, but not on other water use areas Funding challenges also include providing long term stability and certainty – something that is often lacking. Investment is key but due to uncertainty return on investment has to be very short, i.e. 5 years – which makes it difficult to invest in large infrastructure projects.

	Water is a long term low profit business, historically financed by public sector. With increasingly private sector involvement, delivering profitable infrastructure projects is unfeasible without public financing. Partnership is needed – companies such as Coca Cola are starting to understand this. Selling off land to finance public infrastructure projects?
Knowledge gaps and uncertainties	Big knowledge gap in the ecosystems services assessment – required for sustainable management of the basin and assessment of project and development impacts How to increase the willingness of private sector to invest and be involved in potentially risky development projects? How to reduce project risks and improve project stability? Transboundary and joint operation of hydropower dams for the sustainability of the basin – and keeping all parties happy



Water, technologies and surprises

Likely to be developed	Data available for modelling Satellite and mobile sensing Mobile technologies Social media Desalinization -- very low price Conscious consumer patterns Higher degrees of aquaculture Alternative protein sources Cheap solar energy from space Low cost intermittent renewables More water efficient plants Nanosensors Nanofilters for drinking water Small scale nuclear power plant offshore Water education Largescale land degradation reversal Soil fertility Rainwater harvesting Valuing resources “No water loss” pipes
Should be done / Desirable	Remote sensing for streamflow Alternatives to water-borne sewage 2-3 months water forecasting tool Better water governance (allocation) Surface water meters Nanotechnologies water treatment Reliable data on water use Computerized model of global system (IIASA) CO2 capture coupled with nanotube production Seaweed agriculture Salt-tolerant crops Arid alluvial aquifers

Outlook

Many scenarios have been prepared over the past decades describing what the world would be like in the future if it continues its current practices (often called ‘business as usual’) or how it would be if a variety of technological advances, economic policy changes or behavioral change are implemented. However, national decision-makers have decided where they want to be. Scenarios must now become a tool that can be used to identify pathways that could be followed that will lead us to the achievement of the SDGs quickly, by 2030 if possible. Building scenarios to reach a desired goal from the present situation is called ‘back-casting’.

Maintaining a global perspective, while providing necessary regional detail that recognizes and takes into account the current spatial diversity of water-related challenges and possible future developments, is the key for water scenario development. However, applying different scenario assumptions at every location would produce unjustifiable complexity and make results hard to interpret in a meaningful way. The quantitative scenario assessment here goes beyond globally uniform assumptions of important scenario drivers by developing a classification system for countries and watersheds describing different conditions pertaining to water security, water insecurity, and related challenges. Countries or watersheds facing similar water security challenges and with similar development capacity are assumed to experience similar rates of change in development, although each will still have its own unique path based on its own current development trends.

In order to develop IIASA quantitative scenarios we will continue to use (and to improve) the hydro-economic classification that was presented and discussed during the Paris SFG meeting. The case studies analyzed during the Laxenburg meeting will inform the hydro-economic analysis needed for pathways development. IIASA Water Program team, in collaboration with other IIASA programs (Ecosystem Services and Management Program, Energy Program, Risk and Resilience Program) as well as our international scientific partners will develop a next generation of water scenarios exploring solutions to close the gaps between “where we are today” and “sustainability” futures as well as trade-offs and co-benefits between them (known as backcasting). The “solutions” will become increasingly important, as well as supporting it with economic analysis of related costs and benefits. Other IIASA projects will provide an opportunity to apply the analysis in river basin case studies, building the bridge between global and regional scales. We hope that members of the SFG will be engaged as stakeholders in finding sustainable pathways in the specific river basins and regions where they are involved.

Annex 1: List of Attendees

SFG Members:

Name	Nationality	Position	Institutions/Initiatives/Departments
Dr. Ismail Serageldin	Egypt	Director	Library of Alexandria Bibliotheca Alexandrina
Mr. Michael Mutale	Zambia	Expert - Water resources	Zambezi basin
Dr. Nadezhda Gaponenko	Russia	Head of Department	The Institute for the Study of Science of the Russian Academy of Sciences (ISS RAS)
Mr. Ashfaq Mahmood	Pakistan	Ex Federal Secretary	Government of Pakistan
Dr. Mohamed Ait Kadi	Morocco	President Chair	General Council of Agricultural Development Global Water Partnership Technical Committee
Prof. Arnold Michael Muller	South Africa	Commissioner Professor	National Planning Commission, South Africa University of the Witwatersrand
Dr. Mihir Shah	India	Expert Until 2014 Member of the Planning Commission	Government of India, Water Resources, Rural Development and Decentralised Governance
Mr. Quamrul Chowdhury	Bangladesh	Secretary General	WWFJ
Dr. Khaled AbuZeid	Egypt	Senior Regional Water Resources Program Manager	Center for Environment and Development for the Arab Region and Europe (CEDARE)
Professor Jinxia Wang	China	Professor	Peking University School of Advanced Agricultural Sciences
Dr. Jinnan Wang	China	Vice President and Chief Engineer	Chinese Academy of Environmental Planning
Dr. Anoulak Kittikhoun	Laos	Program Coordinator	Mekong River Commission Secretariat
Mr. Alberto Palombo	Venezuela	Secretary and Executive Director	Inter-American Water Resources Network (IWRN)
Dr. Fernando J. Gonzales Villareal	Mexico	Professor	Instituto de Ingeniería UNAM
Ms. Florence Adongo	Uganda	Director of Water Resource Mgt (DWRM)	Ministry of Water and Environment Water Resource Mgt (DWRM)
Ms. Oyun Sanjaasuren	Mongolia	New Chair to be of GWP Technical Committee	Global Water Partnership

Non-SFG Participants:

Name	Nationality	Position	Institutions/Initiatives/Departments
Klaus Leroch	ADA		
Robert Burtscher	ADA		
Mr. Robert A. Pietrowsky	USA	Supervisory Civil Engineer Director of IWR	IWR Executive Office U.S. Army Corps of Engineers Institute for Water Resources (IWR)
Dr Rudolph Cleveringa	GWP		
IIASA			
Bill Cosgrove	IIASA	Senior Research Scholar	Water Program
Piotr Magnuszewski	IIASA	Research Scholar	Water Program
Simon Langan	IIASA	Director	Water Program
Angelika Scherzer	IIASA	Program Assistant	Water Program
Eva Hizsnyik	IIASA	Research Scholar	Water Program
Yusuke Satoh	IIASA	Research Scholar	Water Program
Taher Kahil	IIASA	Research Scholar	Water Program
Gunther Fischer	IIASA	Research Scholar	Water Program
Sylvia Tramberend	IIASA	Research Scholar	Water Program
Edward Byers	IIASA	Research Scholar	Energy Program