A GAME BASED SIMULATION OF NEGOTIATION OVER TRANSBOUNDARY RIVER-AQUIFER

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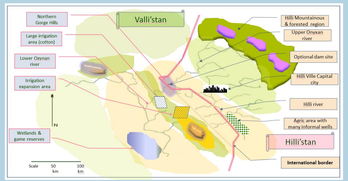
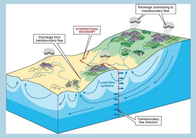
Abstract

This webinar was a simulation of negotiations between two 'countries' over their transboundary river-aquifer system. The simulations were carried out by highly qualified lawyers and hydrologists, drawing on their knowledge on transboundary water resources and international water law.
The Issue: The upstream country (Hilli'stan) wishes to draw on the resources in the aquifers for urgent public supply needs. The downstream country (Valli'stan) is using a large amount of water for irrigation (which could be impacted by the new wellfields) and wants to expand irrigation – but needs the upstream neighbor to undertake either a dam construction or modify its groundwater use.

A river-aquifer system is shared by two countries in this simulation exercise. The transboundary groundwater-surface water system is partially interconnected; some groundwater flow is 'local' but regional flow in the aquifer by-passes some of the rivers and constitutes a 'regional flow' system. Details shown on Figures A & B will enable the negotiating parties to come to an agreement on river / aquifer resources use. However, they will need to agree to seek additional data through mutual discussions and cooperation.





Introduction

An interconnected transboundary aquifer-river system underlies two countries in a semi-arid region. The upstream country (Hilli'stan) wishes to draw on the resources in the aquifers for urgent public supply needs. The downstream country (Valli'stan) is using a large amount of water for irrigation (which could be impacted by the new wellfields) and wants to expand irrigation – but needs the upstream neighbour to undertake either a dam construction or modify its groundwater use.
Both countries have national legislation on water resources. They are not signatory to any of the international water conventions, though both are familiar with them. Inter country relations are cordial, though in the past there were conflicts over territory. Both countries conduct international trade and are signatory to the WTO – there is no mutual trade agreement between them – though a significant amount of informal cross boundary trade takes place. In this simulation, the two countries will conduct negotiation over the transboundary ground and surface waters, based on the BRIEFING NOTES that follow. The year is 2005.
Timeline: 1990 - 1st round of discussions held but did not lead to any formal agreement – rather a presentation of mutual positions – with no formal plan to continue dialogue – but informal science community contacts have continued.
1990's – (mid to late)

- Hilli'stan population increase at 1.2 % per an; within the farming area >300 unregulated wells; deep oil exploration well drilled; (1965 - territory in Hilli river basin lost to Valli'stan)
- Hilliville increasing water demand for municipal needs – 50MCM/y required
- Valli'stan – extensive irrigation developed between 1980 – 1990; for mid 1990's major increase is proposed (35 MCM/y)- so Valli'stan is looking to seek cooperation with Hilli'stan

2000 – mathematical model simulation studies – sponsored by Valli'stan…. situation in both countries getting quite critical …
2005 – a new round of discussions
Hilli'stan's needs – new wellfield producing 50 MCM/y – however this is at the risk from increased well productions in Valli'stan's irrigation area; the dam site at North Gorge could regulate the river water for increased irrigation;
Vallistan's needs – irrigation demand of additional 35 MCM/y to be taken from river, or new well fields or conjunctive use of river / aquifer.

Methodology

The hydrogeology of the transboundary river-aquifer system

The following information has been collated 'from desk study of publications issued independently by the scientists and engineers from the two countries' – and the linguistic and nomenclature differences have been unified, as far as possible, to enable both sides to conduct their negotiations. The aquifer / river system is shown on the block diagram – and a map of the area can be found on page 4, below.

Geomorphology & climate
The topography of the region is dominated by highlands in the east and northeast (1000m above sea level), grading westwards into a peneplain region (250m asl), which is interspersed with some hilly areas. The drainage systems consist of the Upper and the Lower Onyxan transboundary river system which rises in the mountainous east of Hilli'stan and passes into Valli'stan through the Northern Gorge Hills. There is also the smaller transboundary Hilli river system which drains the flanks of the Central Uplands located in Valli'stan. The climate is semi-arid.

Geology
The sequence of the rock formations is from Palaeozoic through to the late Mezozoic, lying across the territories of both Hilli'stan and Valli'stan. The Palaeozoic shales are massive and have thickness of over 700m, outcropping in the Hilli Mountain ranges. These are overlain by a partially conformable Mesozoic sandstone sequence, which consists of quarzitic consolidated layers interspersed with the occasional more shaley sequences. This formation is generally coarse in the east grading to finer fractions westwards. This formation has thickness of 500m. The Quaternary superficial formations are a sequence of partially consolidated to unconsolidated sands, loams, silts and in places, clays. These surface formations have variable thickness and range from a few meters thickness in the east to 200m in the west.

Hydrology and transboundary river flow
The Upper Onyxan River rises in the Hilli mountains, and at the border between Hilli'stan and Valli'stan, at Northern Gorge Hills, has an annual flow of 150MCM/y. It is joined by the Valli river within Valli'stan, and the joint flow of the river is 200MCM/y at the wetland marshes – though almost all the river flow is used up in irrigation demand. The smaller Hilli river basin has limited annual flows of around 25MCM/y, but is underlain by the productive aquifers, which produce spring flow discharges. The spring flows have been reducing due to the production wells that have been constructed and pumped for irrigation. Further to the west, within Valli'stan, a wetland fed by regional groundwater flow, supports a game reserve and the local indigenous population, who rely on the resources of the wetland.

Hydrogeology
The Palaeozoic shales have a very low hydraulic conductivity and broadly form the base of overlying aquifers.
The Mesozoic sandstones are a dual porosity system – with high hydraulic conductivity in the more fractured parts and lower values in the more consolidate sections. The specific yield of the aquifers is 0.03. In places where the shale content in the sequence is higher, there are local sub artesian conditions.

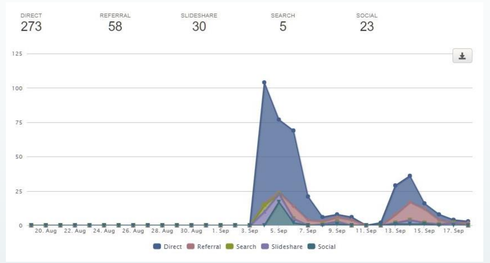
Recharge takes place primarily from the high rainfall in the east where the sandstone outcrops. Westwards, with the declining rainfall, recharge to the sandstones occurs directly where they are exposed, or via infiltration through the overlying sandy sequence.

The water quality in the Mesozoic sandstones has a low TDS in the east (600 mg/l), increasing somewhat westwards, reaching to 1000mg/l. The quality is suitable for irrigation and municipal needs

Transboundary Aquifer flow system
The conceptual flow system of the transboundary aquifer is summarised in the 3D block diagram (Fig B).
Prior to 1980, there were few well records, but by the 1990's considerably more data has been collected, though sporadically. After an interpretation of the data, the aquifer flow system has been defined as shown in the accompanying block diagram. The conceptual flow system has been modelled in the year 2000, in a mathematical model and the groundwater flow balances confirm the general concept of the hydro dynamics.

Results

Survey of participants in the training webinar



Number of webinar participants, downloading the background PowerPoint for the 'transboundary game – Round 1'

- The webinar aroused a huge amount of interest and was highly anticipated, as indicated by the number of time the background PowerPoint was downloaded from ;SlideShare' website; there were nearly 450 registrations and over 270 downloads
- Participants of this exercise were scientists and engineers, from the academia and government sectors. 60% of participants indicated limited experience and knowledge about transboundary water issues. The majority have either general or limited knowledge on transboundary water conventions and related international laws and were involved to some extent in this arena. More than 80% of participant are interested in attending on-line courses on transboundary water resources.
- Participants indicated that bi lateral and trilateral negotiations are more important that international laws and conventions
- On the progress of SDG's on transboundary aquifers, the participants stated that the management and advanced know how of transboundary water is lagging behind, and this should aim to foster cooperation, data and information sharing, institutional and capacity development.
- In case of ccompeting demands on water use, countries should initiate negotiations and agreements that would come up with reasonable, equitable and fair use for the additional domestic uses.
- They noted that key requirement for negotiations is an adequate understanding of the overall water situation including inputs to the system (rainfall and transboundary inflows), outputs including aquifer abstraction, river flows, wetland needs and all domestic and agricultural uses at both regional and local scales. Knowledge gaps should be filled by monitoring and field measurements. This would entail regulation of informal uses and abstractions.
- It is important that Countries work together during the development of the up to date conceptual models taking into account climate change impacts. "Do it better if we work together"
- Any key infrastructure, like construction of regulating a dam, should be jointly approved. It should provide joint benefits that may include trade-offs of water and electricity. This would also require guarantees related to safety of both countries due to the construction of the dam.
- Eliminating financial risks from transboundary issues is crucial for the donor support to Hilli'stan to construct the dam and for active private sector financing for the expansion in cotton production in Valli'stan

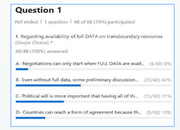
The "negotiators" and lines of negotiations – Round 1 & 2

- In preparation for the webinar. The "negotiators" had conducted a 'dry run' just to make sure that the various points of discussion would smoothly.
- In the 1st Round of negotiations, one party opened with stating that in their view insufficient data and information was available and that as a result they proposed an MoU under which they would further study the river-aquifer system jointly, towards which they proposed an MoU. The other party agreed to this in principle, but stated that before further actions they wished to reach a formal form of agreement in which the principle of reasonable and equitable use and related obligations would be explicitly stated, including the cessation of any withdrawals that might be deemed to be 'unreasonable'. This lead to an impasse.

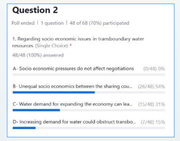
Conclusion

Findings from the questionnaires in the course of the webinar

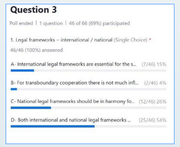
Regarding the availability of full data on transboundary resources:
42% of participants agreed that Even without full data, some preliminary discussions can be started on the key issues While **31%** agreed that Political will is more important that having all of the data.



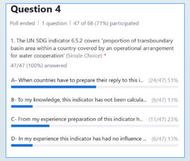
Regarding socio economic issues in transboundary water resources:
52% agreed that unequal socio economics between the sharing countries affect negotiations while **31%** agreed that water demand for expanding the economy can lead to more transboundary cooperation.



On legal frameworks – international / national:
54% agreed that both international and national legal frameworks must be in place for successful negotiations, **26%** agreed that national legal frameworks should be in harmony for transboundary negotiations to be successful and **15%** agreed that international legal frameworks are essential for the success of transboundary negotiations.



The UN SDG indicator 6.5.2 covers 'proportion of transboundary basin area within a country covered by an operational arrangement for water cooperation'"
51% agreed that When countries have to prepare their reply to this indicator, they become more aware of their transboundary river basin / aquifer, **23%** agreed that from their own experience preparation of this indicator has raised awareness of transboundary waters, **13%** indicated that this indicator has not been calculated for the area they are working with and **13%** indicated that this indicator has had no influence on transboundary cooperation



The webinar has been an excellent learning tool – both as regards the negotiations and the priority and approach – as well as the interest and the responsiveness of the very large audience

Acknowledgements

The concept behind the 'game' has been developed by Shammy Puri © , – the detailed background technical text setting out the hydrology. Hydrogeology and the legal-social concept is accompanied and the accompanying power point presentation has been in use since 2001 the simulation game has been played by Parliamentarians from Caucuses countries, post graduate students from Oxford University, participants of a NATO supported training course in Bulgaria; and in a webinar held under the MEWF in Sept 2021; the text in this exercise is based on modified instruction given to students at the University of New South Wales, Australia. While the concept and the game may be freely used & replicated, full acknowledgement is requested.
The MEWF provided the technical backup and the webinar facilities, as well as the running of the on line polls.