**IWA Webinar**

**“Groundwater: protecting tomorrow’s resources”**

**Q&A Report – 23/03/2022**

Webinar available at: <https://iwa-network.org/learn/groundwater-protecting-tomorrows-resources/>

**Questions received from participants during registration:**

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| # | Questions | Speaker | Answer |
| 1 | Are coastal groundwater resources threatened by sea level rise? If so, what adaptive measures can be taken? |  |  |
| 2 | How to avoid produced leachate from contaminating groundwater |  |  |
| 3 | Groundwater is being pumped at a higher rates as opposed to recharge rates, how do we sustainably manage this? |  |  |
| 4 | How is it possible to include scientific knowledge on the protection of groundwater in public policies? |  |  |
| 5 | How to we treat ground water for drinking purpose. | Julia Gathu | Various water treatment technologies exist depending on the contaminant and associated costs. The most common however is the Reverse Osmosis technology which is removes most contaminants found in groundwater. |
| 6 | What are the criteria for selection of proper groundwater recharge structures |  |  |
| 7 | What is the geostrategic risk on water resource management? |  |  |
| 8 | What tools/ methods can be used to assess the groundwater? |  |  |

**Questions received from participants via the Q&A:**

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| # | Questions | Speaker | Answer |
| 1 | How exactly does urbanization increase the groundwater recharge? Is the effect of recharge from sewerage and other sources more than the recharge being limited as a result of increased impervious surfaces? |  | Correct ! In most settings urbanisation increases recharge. |
| 2 | Hello sir please once again explain it Rural management |  |  |
| 3 | What can we do when there is no reliable data on groundwater governance? |  |  |
| 4 | How can the nitrate, nitrite and ammonia contamination can be removed from underground water? |  | In some geochemical conditions natural denitrification can occur, but this is the exception and it normally has to be handled by water-supply mixing and/or treatment at high cost. |
| 5 | Urban groudnwater use results in subsidence. In addition to associated flooding losses, does subsidence cause additional loss to storm sewers, water supply lines and sewer systems? Does it lead to breakage of the pipes due to gradual subsidence of the land? or Is it subjected to flexural breakage due to differential subsidence? |  | Subsidence only results from groundwater extraction in certain hydrogeological conditions, not universally. But where it occurs, and especially where the thickness of alluvial deposits varies abruptly along fault lines, serious differential subsidence does occur and can impact the sewer lines in particular. |
| 6 | To Stephen: Any existing regulations you know on regulating emerging pollutants (e.g., microplastics, pharmaceuticals, PFAS, etc.) that may reach urban groundwater? | Stephen Foster | No, these emerging pollutants are of considerable concern, and are largely unmonitored in groundwater. |
| 7 | How has the great success of condiminial sewerage in urban Brazil (e.g. Brasilia; Salvador) affected groundwater quality in thse cities? | Ricardo Hirata | There is no doubt that sewage mains effectively reduce urban contaminant loads affecting aquifer quality in cities. It is evident when we compare towns with and without sewers coverage. However, it must be recognized that the lack of maintenance of old sewer networks leaks and contaminates unconfined aquifers extensively. Detailed studies in several cities in the State of São Paulo (southern Brazil) showed that the mains with the most leaks were those built before 1990, when plastic was not the standard material. Contamination is significantly reduced when the modern sewage network is built before the urban occupation. |
| 8 | Does any evidence exist that shows groundwater aquifers are equally exploited no matter it is a porous or hard rock matrix based? |  |  |
| 9 | Hello panelists, does the climate of the region influence recharge rates? i.e. does recharge occur faster in tropical climes then temperate climes? |  | There is a good deal of uncertainty about the effect of climate-change on groundwater recharge -- where rainfall intensities increase recharge is likely to increase, despite overall reductions in annual rainfall. |
| 10 | How to sustainably solve groundwater rise in costal urban areas especially if pumping requires alot of pumps and large discharge rates (not very effective) ? | Ricardo Hirata | It must be recognized that the exploitation of coastal aquifers has limitations. Thus, a study to recognize the aquifer's potential, followed by monitoring, will make it possible to define safe exploitations. Furthermore, artificial recharge of aquifers can reduce the advance of saline intrusion and management of exploitation. |
| 11 | Considering the migration of contaimants, what do you think of data sharing/management on pollutants? And is it realistic to have a model which essemble various factors on a global perspective? |  |  |
| 12 | To Ricardo: how come the Cabo aquifer does not experience salinization (despite proximity to coast) and even contamination ? | Ricardo Hirata | Cabo Aquifer in the Recife region (NE Brazil) is confined by clayey-silty sediments (aquitard) at the top and the bottom by Precambrian granitic rocks. The recharge area occurs in the west and the crystalline basement at topographic elevations > 20 masl. Discharge takes place in the Atlantic Ocean. However, 14 km from the shoreline, a structural elevation blocks (reduces) this groundwater discharge to the sea (discharge occurs through aquitard).  The waters of the Cabo aquifer are at shoreline ages greater than 8 kybp (14C technique) |
| 13 | How many Modelling studies have been carried out by you till date. Though you mentioned about scarcity of data your modelling study shows that you are able to accesss enough data for Modelling studies. How did the Govt. ban extraction of water in some areas of Brazil ? Based on what kind of data ? | Ricardo Hirata | Our group at USP has developed numerous numerical flow models at various scales to meet multiple objectives. Sometimes the models are more assertive; other times, they are approximations. But even in this case, the models help us make a decision (which must be accompanied by the monitoring wells to confirm the results). In studies of aquifer contamination (in small areas with a high density of monitoring wells), the authorities follow the model results more. In regional studies, less. Everything will depend on the importance of the resource and the strength of the stakeholders. |
| 14 | Can you share some experiences of developed world example - City of London : How it has addressed GW fall ( and continous rise of groundwater that now impacts urban developments incl. underground tube as city water is dependent on alternative sources of water supply) - Big cities like Delhi are facing and reporing similar issues of rising water table flooding basements .. |  |  |
| 15 | Respected sir, I am. Pallavi from India. Thank you for providing the clear vision on ground water aspects in Indian region. Sir I wanted to know about ground water measurements, can we simulate it from a hydrological model and can use the simulated GW further for our any extremes event analysis. Or do we need validate those modelled Gw, as measuring GW is difficult at an academic scale. |  | Hi Pallavi, groundwater modelling remains a key tool to manage groundwater, specially when we need to project future and management scenarios. There are multiple studies on the same. However, any model is as good as data and validating the model is definitely needed and can be done. |
| 16 | hello panelist  as told by Mr foster groundwater recharge is higher in urban area. however in India the recharge is quite low due to higher dependence on GW for water supply.  the rate of declining of water level is also high in deeper aquifers, as water is extracted from there is more than shallow aquifers. |  | In India although urbanisation has increased groundwater recharge rates, the abstraction has increased even more resulting in falling water-tables. |
| 17 | What mechanisms or tools have you used to increase public knowledge or perception on groundwater? |  |  |
| 18 | Hello panelists, Thanks for the great presentation. Do you think the sulfur related compounds like sulfide or sulfate are important parameters for groundwater quality? |  | Indeed. On our wellfields we use sulfate as an indicator of the sustainability of our groundwater abstraction. If we abstract to much we get high concentrations of sulfate due to oxidization. Usually we see the high concentration in our abstraction wells with a delay - usually years. |
| 19 | How GW extraction is responsible for the land subsidence ..? |  |  |
| 20 | To Stephen: Can you share some experiences of developed world example - City of London : How it has addressed GW fall ( and continous rise of groundwater that now impacts urban developments incl. underground tube as city water is dependent on alternative sources of water supply) - Big cities like Delhi are facing and reporing similar issues of rising water table flooding basements .. | Stephen Foster | The main London aquifer (the Chalk) is very deep. It's groundwater levels have been rising now for many decades after reduced demand from industry and water-utilities in the central urban area, but when the long-term implications of this were realised there was an effort to encourage use and the situation is now under control. |
| 21 | How should private & illicit groundwater wells be addressed? Does it solely depend on making legal frameworks? |  |  |
| 22 | To Stephen: what are the differences in groundwater statuses in cities dominated by septic tanks VS cities underlain by connected sewage system? | Stephen Foster | In-situ sanitation at high density poses a bigger threat to groundwater than sewered sanitation, which if not properly managed can create some serious issues downstream. |
| 23 | To Faiz Alam: do those MAR facilities also able to mitigate flooding that occurs during monsoon seasons in India ? | Faiz Alam | Hi, MAR could be used for mitigating flooding. Please find the link to the report https://www.iwmi.cgiar.org/2020/09/underground-transfer-of-floods-for-irrigation-utfi-exploring-potential-at-the-global-scale/ where we introduce the concept and do some assessment of the same. However, on field implementation of the same is much more challenging requiring social-institutional support |
| 24 | To Faiz Alam: Given the differences in resiliency between hard rock aquifers vs alluvial/porous aquifers, how will their management strategies differ then? | Faiz Alam | Thanks Jayson for this question. The differences should dictate what we want and could achieve in hard rock vs alluvial aquifers. In alluvial aquifers with large storage, mitigating long term declining trend and protecting water quality is critical. I think in hard rock, it is importance to first take a better stock of storage and recharge which is relatively more difficult and which should set the limits on how much the same can support. At shallow levels, more critical to manage the short term/inter-annual storage. |
| 25 | How is salt intrusion being controlled? What are also the mitigations when salt intrusion is already present? |  |  |
| 26 | Good morning. Taking up Jayson Gabriel Pinza's question, there is something about the contamination with elements typical of the region that are found in these overexploited water wells, such as arsenic or phosphorus. |  |  |
| 27 | Does Indian suburban areas follow any legislative control on groundwater exploitation in general? |  | Hi Vasudevan, large industrial users do need NOC from groundwater authority. But for individual users, I am not sure of any. In cities, I think private wells are restricted but depends on enforcement. |
| 28 | Hello panelists. I have a more general question: in your opinion, what are the main competences (technical and/or other) future hydrogeologists or water managers should acquire to promote more sustainable use of groundwater? |  |  |
| 29 | Is chlorination able to be avoided because of the localized/decentralized drinking water systems? There is not as much storage or potential contact time with contaminants? | Troels Bjerre | In Denmark chlorination of drinking water isn’t necessary since the groundwater ressources used for drinking water purposes are well protected against microbial pollution. See alson the answer to question no. 31 |
| 30 | To Julia: are the aquifers in East Africa are likely to be fossil and thus not regularly recharged by current hydrological regime? What managed aquifer recharge (MAR) techniques might still work on such situation? | Julia Gathu | The most practised MAR technique in Africa is sand dams. The aquifers are different types. Volcanic rock aquifers, weathered crystalline basements, major unconsolidated formations and consolidated sedimentary rocks are the main aquifers in Sub-Saharan Africa. Most African countries with little groundwater storage have high annual rainfall. Conversely, many African countries with low rainfall have considerable groundwater storage |
| 31 | To Stephen and Troels: what about the microbiology? Are there emerging concerns about the microbial contamination of the ground water, in addition to pesticides, micropollutants etc.? | Stephen Foster & Troels Bjerre | Dear Maria - I can only answer for Denmark, we have that fortunate situation that the groundwater abstracted for drinking water is without microbiology issues as it is abstracted from areas without surfacewater contact, and no oxygen present. So if we keep the system "closed" we are good on microbiology. That is also the reason we are so focused on leakage reduction, as this is important for the water quality to ensure a low leakage lewel |
| 32 | What is the IWA doing to enhance cooperation between utilities with proper groundwater management mechanisms and those without in a quest to help countries achieve SDG6? |  |  |
| 33 | Addressed to Ms.Julia Gathu from Africa As Groundwater supports economic and social upliftment of African countries please throw some light on Groundwater resource availability and data on disposition of aquifers in general | Julia Gathu | Total groundwater storage in Africa is about 0.66m km3 and exists in various aquifers such as volcanic rocks, weathered crystalline basements, major unconsolidated formations and consolidated sedimentary rocks |
| 34 | To Troels Bjerre: What kind of forests do you establish in Denmark? | Troels Bjerre | In our afforestation projects we plant mainly native deciduous treas (oak, beech, birch etc.). We only use coniferous trees to a small extent since they have a high interception loss causing a decrease in the groundwater recharge. |
| 35 | Denmark presentation: How strong is the pushback from farmers in view of the additional competition for land surface by the water utilities? How to manage this issue / the relationships with farmers? (In Germany this has caused friction...) | Troels Bjerre | The pushback from farmers are varied, but there is a significant wish to make sure that the farmer compensation scheme is as high as possible (they must be fully compensated for not using pesticides, but the term fully has proven to be very elastic...latest it has been possible to buy/own land as water operators, that has not been possible earlier, so now we are hopefully getting the true value for the land in the equation.  In VCS Denmark our afforestation projects have been realised through land consolidation. That has resulted in less friction. |
| 36 | To Troels: can you elaborate more on afforestation being context-specific? What can be an alternate if afforestation will not work on a certain area? | Troels Bjerre | You can consider afforestation as an example of a nature based solution. There are other kinds of nature based solution that also might have a positive effect on groundwater quality. It depends on the geological setting, the climate and the present land use etc. I can imagine that rewilding, grass land, organic farming, restoration of wetlands, sustainable forest management (without clear-cutting) etc. could be relevant measures as well. |
| 37 | To Faiz Alam: Would putting a tax on private groundwater abstraction be a helpful tool to reduce water abstraction in India? (especially if this tax is being used in order to fund measures needed for advancing centralized and sustainable groundwater management) | Faiz Alam | Hi Maria, Any tax is difficult to implement given we have ~ 25 million pumps. Also water is politically sensitive (given agriculture directly/indirectly employs > 50 %) so any tax remains a difficult prospect politically. I think effective policies to incentivise efficient water use and climate appropriate crops hold the key |
| 38 | To Troels: can you elaborate more on afforestation being context-specific? What can be an alternate if afforestation will not work in your study area (Denmark)? | Troels Bjerre | See answer to question no. 36. |
| 39 | This is to add Faiz Alam's reply to Dorte Skraem In India data on Deeper aquifer Monitoring is still scarce which needs further strentheneing | Faiz Alam | Thanks Anandha for this, I agree. And I think more dense network of monitoring wells (even for shallow wells) is still a need in many states. |
| 40 | Urbanisation is many parts of Africa is characterised by grey cities that leave minimal space for ground water recharge. taking cases of Cameroon, where we notice a drop in water table and characteristics Dunes runoff with high level of flooding. what measures and actions can be taken to ensure a balance between urbanisation and ground water Sustainability? Given that ground water pollution continuons to increase over time Fonyuy Carlos |  | In my view, this is really where water utilities come in to help better manage groundwater sources and create protection zones to reduce groundwater pollution |
| 41 | I want to highlight the relevancy of salt water intrusion in coastal aquifers due to sea level rise and the importance of using models e.g the GALDIT method to assess the vulnerability of aquifers to sea level rise annd to have a pririority and focus on the groundwater quality monitoring area in coastal zones and islands |  |  |
| 42 | To Troels Bjerre: how do you achieve the good quality of groundwater you are aiming for, with having so much agriculture at the same time? Do you have a lot of extensive agriculture? (or a lot of organic farming?) | Troels Bjerre | No. We have a lot of intensive agriculture in the catchment on our wellfields. And our aquifers a contaminated with pesticides as I showed in my presentation. We are working on protecting the vulnerable areas in the catchment of our wellfields of strategic importance through afforestation and land-use agreements. |
| 43 | Does urbanisation increase or decrease ground water recharge?  I am a bit lost as I know urbanisation increase amount of runoff reduce space for water infiltration  change Manning coefficient of water couple with reclaimation of wetlands for construction purposes. So how do we secure the risk to water associated with urbanisation? |  | In some geochemical conditions natural denitrification can occur, but this is the exception and it normally has to be handled by water-supply mixing and/or treatment at high cost. |
| 44 | Any examples of what type of GW use is / was encouraged - does it feed to supply network of water utilities or alternate non potable bulk usage. |  | Subsidence only results from groundwater extraction in certain hydrogeological conditions, not universally. But where it occurs, and especially where the thickness of alluvial deposits varies abruptly along fault lines, serious differential subsidence does occur and can impact the sewer lines in particular. |
| 45 | Faiz, can you kindly highlight what the Indian government is doing to address the Punjab groundwater crisis because there is the potential for same challenge here in Nigeria. For example over abstraction is contributing to the salinisation of the coastal aquifers of Lagos. | Faiz Alam |  |