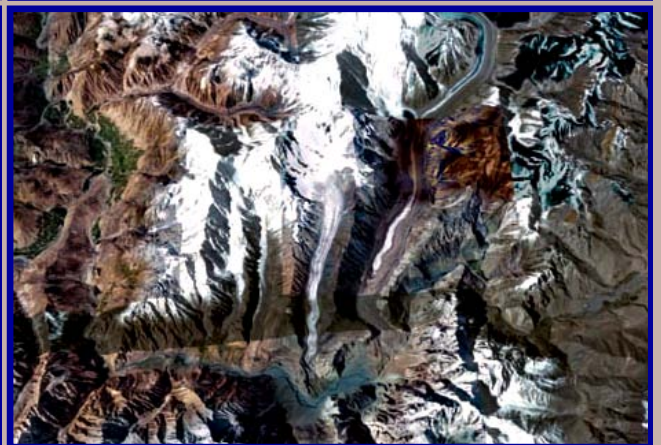


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Beyond Indus Water Treaty: Ground Water and Environmental Management – Policy Issues and Options



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Prepared by:

Dr. Shahid Ahmad

Resource person:

Hamid Sarfraz

BEYOND INDUS WATER TREATY: GROUND WATER AND ENVIRONMENTAL MANAGEMENT – POLICY ISSUES AND OPTIONS

1. THE CONTEXT

1.1. Indo-Gangetic River Basin (IGRB)

Length of the **Indus River** is 3,199 kms. In the Upper Indus Basin, the principal tributaries are Kabul, Swat and Kurram on the right bank and Jhelum, Chenab, Ravi, Beas, and Satluj on the left bank (**Figure 1**). The basin extends over an area of 1.166 million km² and its distribution covers: Pakistan 0.693 km²; Afghanistan and China 0.015 km²; and India 0.321 km². The mean annual flow of the Indus Basin is 187 km³ contributed by runoff, snow- and glacier-melt. Catchment area of the Ganga River falls in India, Nepal, China, and Bangladesh and its length is 2,525 kms. Yamuna is the most important tributary that joins it on the right bank at Allahabad. After confluence with Yamuna, the Ganga River flows eastward and is joined by a number of tributaries.

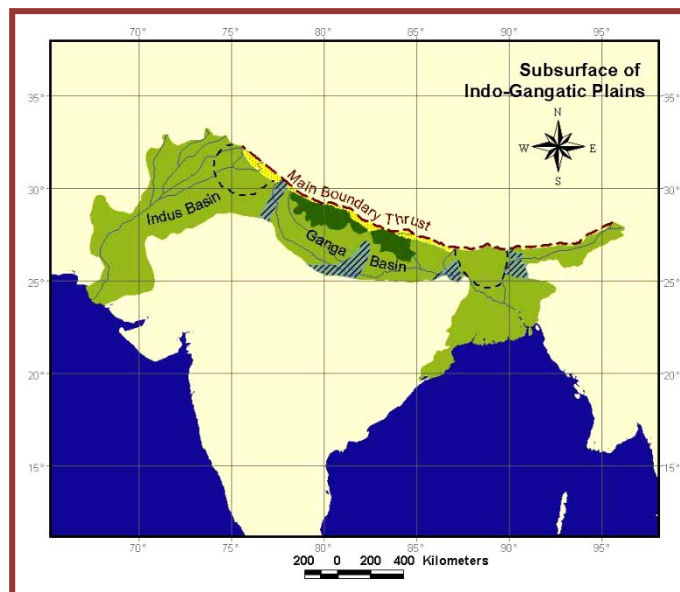


Figure 1. Map of IGRB

1.2. Surface Water Resources in the IGRB

IGRB drains from southern Himalayan and Hindu Kush “Water Tower of Asia” and provides base for economic development for over a billion people. The projected per capita water availability in the Indus-Pakistan and Ganga-India sub-basins by 2025 will be reduced to < 1000 m³ – water scarce sub-basins. The Indus-India sub-basin will be a water stress sub-basin by 2030 having per capita water availability of < 1700 m³. Indus-Pakistan is the most water scarce sub-basin in the IGRB (**Table 1**).

Table 1. Renewable water resources & per capita water availability in IGRB (Sharma et al 2008)¹

IGRB Basin	Total Renewable Water Resources (km ³)	Per Capita Water Availability (m ³ /person)			
		1990	2000	2025	2050
Indus-India	97	2487	2109	1590	1132
Indus-Pakistan	190	1713	1332	761	545
Ganga-India	663	1831	1490	969	773

1.3. Groundwater Resources in the IGRB

¹ Sharma, B. R., U. A. Amarasinghe and A. Sikka. 2008. Indo-Gangetic River Basins: Summary Situation Analysis. International Water Management Institute, New Delhi Office, New Delhi, India. 25 July 2008.

Groundwater in the **IGRB** occurs in porous media below the soil surface and termed as ‘**aquifer**’. It is well developed in deep alluvium having capacity to retain and transmit water and provides reliable source of water on demand. The canal water diversions in the basin states are still managed in a supply side system. Thus, groundwater is premium water for productive and sustainable agriculture. Groundwater resources can be classified as “**static**” and “**dynamic**”. The ‘**static resource**’ is the amount of groundwater available below the zone of water level fluctuations. The “**dynamic resource**” is the amount of groundwater available in the zone of water level fluctuations. **Sustainable groundwater development requires that only dynamic resources are tapped. Abstraction of static groundwater resources could be considered during extreme scarcity, for essential purposes only (Table 2).** Groundwater resources in the Ganga basin are nearly six times that of the Indus basin.

The studies revealed that number of shallow tubewells in India roughly doubled every 4th year during 1951-91. Groundwater users in poorer provinces tend to rely more on diesel. Groundwater irrigated crops generally result in higher yields due to availability of water on demand (Shah et al. 2000²• Singh and Singh 2002³). Overdraft has taken on alarming proportions in several Indian states, and has led to increased competition among water

users. Subsidized energy for groundwater pumping is a major contributor to overdraft in Northern India.

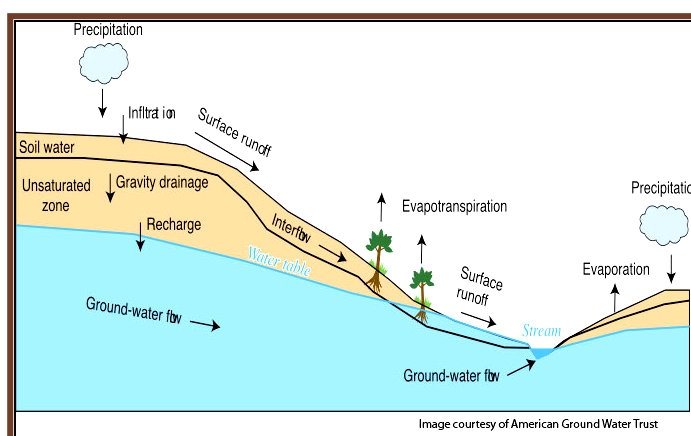


Figure 2. Conceptual framework for groundwater

Table 2. Fresh groundwater resources (km³) in the aquifers of the IGRB¹

River Basin	Alluvium/Unconsolidated Rocks	Hard Rocks	Total
Indus	1,334.9	3.3	1,338.2
Ganga	7,769.1	65	7,834.1

Research conducted by IWMI-TATA revealed that groundwater use has surpassed surface water use in Indian agriculture as the primary source of food production and income generation. The key question for policy makers and planners is how to tap this resource without exhausting the supply. The mind-set and water management skills need to shift from resource development to resource planning and management.

In **Pakistan**, there are now 1.0 million tubewells energized either with electricity (13%) or by diesel (87%). Growth rate is now stagnant due to the rise in price of energy or due to quality concerns. There is no subsidy on diesel. The subsidy on electricity is only for Balochistan for 15262 tubewells (1.5% of total tubewells⁴), which had serious impacts on the lowering of water table and mining of groundwater, rather it resulted in wasteful use of water.

2 Shah, T., D., Molden, R. Sakthivadivel and D. Seckler. 2000. The global groundwater situation: overview of opportunities and challenges. International Water Management Institute, Colombo, Sri Lanka.

3 Singh, D. K. and A. K. Singh. 2002. Groundwater Situation in India: Problems and Perspectives. International Journal of Water Resources Development 18(4): 563–80.

4 GOP. 2009. Agriculture Statics of Pakistan. Economic Wing, Ministry of Food and Agriculture, Government of Pakistan.

1.4. Groundwater and Environmental Management by the Basin States

Over-abstraction of groundwater in Indus-India basin closer to Pakistan's border has serious impacts on the aquifers of Indus-Pakistan – seems an extension of mining of groundwater in Northern India, as rest of the country is not facing groundwater mining. The basic issue is how to address trans-boundary groundwater issues. A Case Study of Excessive Groundwater Abstraction in India conducted by NASA⁵ was analyzed to assess possible impacts on the aquifers of Indus-Pakistan. The Indus Water Treaty does not clearly articulate the environmental concerns. In the catchment areas of the Indus-India, the effluents are being discharged into the rivers due to rapid urbanization and growth in agriculture. The drains entering into Pakistan are also bringing heavy load of wastes – creating environmental implications for human and livestock health. The surface water scarcity in the basin states would ultimately put more pressure on the depleting aquifers. There is a need to look into options of managing aquifers in the basin states – thinking beyond the Treaty.

2. TRANS-BOUNDARY GROUNDWATER ISSUES BETWEEN THE BASIN STATES

In India, 60% of water used in agriculture is contributed by groundwater. Groundwater and environmental issues will further worsen in future. It is imperative for the basin states, to envisage comprehensive development and planning for the optimal use of water. A holistic approach of conjunctive use and management of water has to be adopted. Groundwater needs to be managed as a resource as well as a trust. The resource has to be sustained for the future generations so that they also enjoy the opportunity of affordable pumping. It is essential to jointly set up an organisation with representatives from the basin states, whose functions would entail identifying short- and long-term supply capacity of the basin and its integrated development, setting up of infrastructure and coordinating activities within the respective states.

Integrated development approach is beyond consideration in the current context of relations between the basin states, but all other options will lead to destruction sooner or later. It is only possible with a paradigm shift in the mindset. It will require a complete end to hostilities, both physical and psychological, from both sides.

2.1. Groundwater Abstraction in India – Case Study by NASA

NASA⁶ (National Aeronautics and Space Administration) study highlighted that Indian border states with Pakistan are over abstracting groundwater, which might affect aquifers of Pakistan because of depression created by farmers due to subsidized power policy in India (**Figure 3**). Further, India being located at the upstream may be motivated to exercise environmental management for the movement

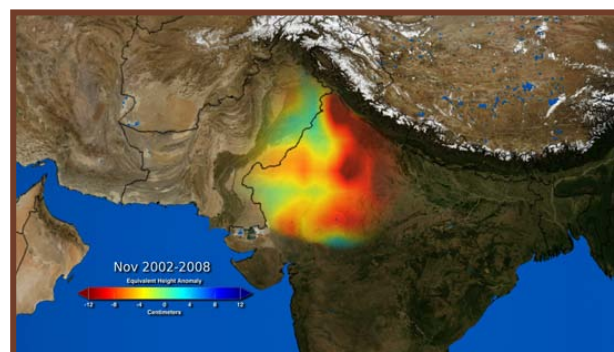


Figure 3. Groundwater vanishing in Northern India⁶

5 Rodell, M., I. Velicogna and J. S. Famiglietti. 2009. Satellite-based estimates of groundwater depletion in India. Nature. 08238.

6 NASA Satellites Unlock Secret to Northern India's Vanishing Water 08.12.09 Gretchen Cook-Anderson NASA Earth Science News Team; NASA Study on "Science Serving Society: Water Management.

of effluents into the rivers flowing to Pakistan. ***There is a need to have clear additions in the Treaty to address the environmental issues more effectively.***

NASA study revealed that groundwater is vanishing in the Northern India⁷ as the groundwater levels in Punjab, Rajasthan, Haryana and Delhi are falling by 0.3 m per year — a trend that could lead to “extensive socio-economic stresses” for the region. A staggering 109 km³ of groundwater has been lost during 2002-08 — a figure twice the capacity of India’s largest surface reservoir of Upper Wainganga and “much more” than government’s estimation, says the paper published in international journal *Nature* by NASA. The study further revealed that the depletion is caused entirely by human activity (irrigation) and not by climatic variability. Groundwater abstraction is more than the recharge.

The finding is based on images from NASA’s Gravity Recovery and Climate Experiment (GRACE), a pair of satellites that sense changes in Earth’s gravity field and associated mass distribution, including water masses stored above or below the Earth’s surface. Study also indicated that in India, depletion is likely to continue until effective measures are taken to curb groundwater demand which could propel severe shortages of potable water, reduced agricultural productivity, conflict and suffering. The climate of Rajasthan, Punjab, Haryana and Delhi is classified as semi-arid to arid. The map, showing groundwater withdrawals as a percentage of groundwater recharge, is based on state-level estimates of annual withdrawals and recharge reported by India’s Ministry of Water Resources (**Figure 4**).

The averaging function (spatial weighting) used to estimate terrestrial water storage changes from GRACE data was mapped in the study conducted by Rodell et al. 2009⁸. Warmer colours indicate greater sensitivity to terrestrial water storage changes (**Figure 5**). Larger image beneath northern India’s irrigated fields of wheat, rice, and barley – beneath its densely populated cities of Jaipur and New Delhi, the groundwater has been disappearing.

The study provided an opportunity to observe groundwater use without any field data. This is critical because in the basin states hydrological data are sparse and hard to access; space-based methods provide perhaps the only opportunity to assess changes in fresh water availability across large regions.

The map shows groundwater changes in India during 2002-08, with losses in red and gains in blue, based on GRACE satellite observations (**Figure 6**). The estimated rate of depletion of groundwater in north-western India is equivalent to a water table decline of 0.33 m per year.

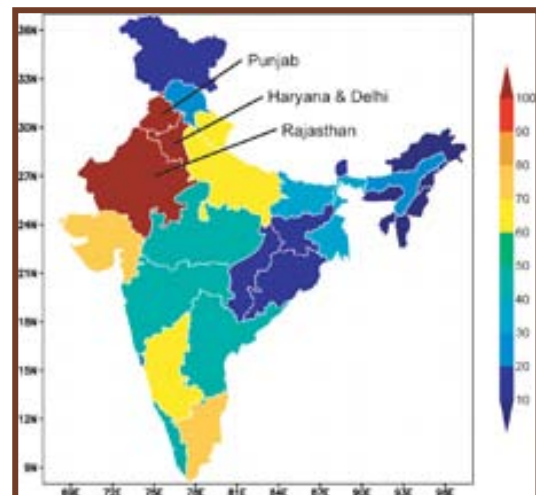


Figure 4. Groundwater abstraction as % of recharge

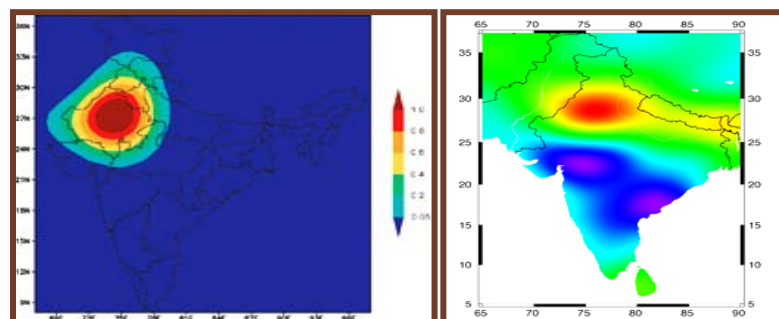


Figure 5. Sensitivity to terrestrial water storage losses in IGRB **Figure 6. Groundwater loss (red) and gains (blue) in IGRB**

7 Groundwater Vanishing in India says NASA. 2009. Online edition of India’s National Newspaper, The Daily News Hindu. Bangalore, Friday, Aug 14, 2009. ePaper, Mobile/PDA Version

8 Rodell, J., T. Schindler, J. Famiglietti and G. C. Anderson. 2009. NASA Satellites Unlock Secret to Northern India’s Vanishing Water. NASA Earth Science News Feature, NASA, USA

There is no excessive abstraction of groundwater in Pakistan, except in a smaller strip along the border, which seems an extended impact of the mining of groundwater in India. Otherwise, there is no region of groundwater depletion in Indus-Pakistan. Even excessive groundwater abstraction in India has affected Nepal from both sides of the Indian border.

Water table does not respond to changes in weather as rapidly as surface water bodies. Therefore, when groundwater is abstracted, recharge to the original water tables can take years. Changes in groundwater masses affect gravity enough to provide a signal, such that changes in gravity can be translated into a measurement of an equivalent change in water. Through the use of GRACE satellite observations, one can observe and monitor water changes in critical areas on temporal and spatial basis without spending time and resources on collection of costly field data.

The study does not provide information regarding absolute volume of water in the Northern Indian aquifers, but it provides strong evidence that current rates of groundwater abstraction are not sustainable. The region has become dependent on irrigation to maximize agricultural productivity, so the authors predicted water crisis in the near future.

The study further revealed that at its core, this dilemma is an age-old cycle of human need and activity – particularly the need for irrigation to produce food," said Bridget Scanlon, a hydrologist at the Jackson School of Geo-sciences at the University of Texas in Austin. "That cycle is now overwhelming fresh water reserves all over the world. ***Even one region's water problem has implications beyond its borders.***"

The study findings raise an issue that how the aquifers of Indus-Pakistan are going to be affected with the excessive abstraction of groundwater on the Indian side. What are the implications on Pakistan side aquifer both in quantity and quality terms is a major question to be addressed? The issue of trans-boundary groundwater with India has to be addressed and an addendum has to be negotiated between basin states for inclusion in the Indus Water Treaty.

2.2. Pollution of Indian Rivers and Environmental Impacts

Shukla (2009)⁹ indicated that most of the Indian rivers are grossly polluted due to the disposal of untreated sewage and industrial effluents into the rivers. It led to environmental disturbance and is a potential source of stress to biotic community. Studies show terrific facts like; death of ghariyals in Chambal sanctuary, pesticide pollution in Yamuna River, etc. He further indicated that though, the CPCB (Central Pollution Control Board) has laid down stringent environmental norms in the form of CREP (Corporate Responsibility for Environmental Protection), but only 45% of the grossly polluting industrial units have installed ETPs (Effluent Treatment Plants). Out of these, over 18% did not function and also did not meet the standards. The NRCD (National River Conservation Directorate) also has no mechanism to ensure that installed ETPs function properly. The contribution to pollution load by various sources was estimated at 75 and 25% for domestic and industrial wastes, respectively.

9 Shukla, K. S. 2009. . Indian river systems and pollution. The Encyclopedia of Earth. //www.eoearth.org/article/ Indian_river_systems_and_pollution. Last Updated November 12th 2009.

Pratyush (2007)¹⁰ indicated that apart from ensuring proper operationalisation of assets created under different schemes, it is needed to strengthen mechanism and the capacity of institutions for effective control of water pollution and waste from point source by emphasizing socio-economic measures at the same time as using law enforcement measures.

Lifelines of India are in dying condition and the threat is coming from the dumping of sewage in to freshwater tributaries. Lack of proper sewage system in most of the cities is main culprit behind the killing of rivers. New Delhi is alone responsible to produces 3.6 billion litres of sewage per day. The city's poor management is unable to treat half of the daily produced sewage. The remaining untreated waste is dumped into the Yamuna River. One can imagine the condition of River Yamuna that is lifeline for Delhiites. This is not the story of Yamuna only the same thing is being happened with almost every river in India (**Figure 7**).



Figure 7. Bathing in streams

In India, there are 300 sewage treatment plants and most of them are underutilized and badly located. Most of the sewage treatment plants partially treat the sewage and throw into rivers. India has a badly structured and poorly managed drainage system. It is in need of repair as more than half of India's drainage system is virtually outmoded. Situation in Pakistan is relatively better due to less population but rest of the things are almost same like of India.

2.2.2. Pollution of Wular Lake and Seepage Losses

Ready and Char (2004)¹¹ identified the environmental issues of Wular Lake located in Jammu and Kashmir and comprising of 17,300 ha (**Figures 8 to 11**). Rashid (2009)¹² indicated that shrinkage in Lake's area and rise in the silt and the chloride contents in waters are the major threats for the Wular Lake. The lake has lost its vast area to agriculture, willow plantation and urbanization. The Wular Integrated Conservation and Development Action Plan (2001-2011) indicated that the lake area was reduced to 79 km² in 1993 whereas it had 200 km² during 1911.



Figures 8 to 11 (Left to right). 8. Overview of Wular Lake. 9. Paddy fields. 10. Pollution from sewage. 11. Pollution by infrastructure.

10 Pratyush. 2007. Poor sewage treatment, drainage system & climate change making Indian rivers 'Dead'. Insta Blogs. Website: <http://pratyush.instablogs.com/entry/poor-sewage-treatment-drainage-system-climate-change-making-indian-rivers-dead/>. June 15 2007.

11 Ready, M. S. and N. V. V. Char. 2004. Management of Lakes in India. Paper prepared by the Formerly Secretary and Commissioner (Eastern Rivers), Ministry of Water Resources, Government of India.

12 Rashid, A. 2009. Wular lake faces threat. Report of the J&K Plus On-line Edition. Saturday, July 18th, 2009, Chandigarh, India.

The lake stores excess water during floods in the valley. “*Massive willow plantation within and around the lake has been acting as a barrier for heavily silted waters to drain out. The lake is thus fast becoming a huge deposit of silts*”. The bio-matter from dead plants and decay adds to the organic content of the lake that further deteriorates water quality. The process of agriculture around the lake has eaten away most of the marshy areas that could otherwise act as an absorption area for harmful components entering the lake. About 3,00,000 people are living in floating residences in Baramulla district. Their sewerage and garbage goes directly into lake and pollutes it. The waste drained directly into the lake has been constantly increasing its chloride content. Any alteration in size, structure and components of the lake body will not only hamper special supplies provided by the lake (fodder, fish, etc.), but also jeopardise livelihood of many fishermen. “*Drudging, de-silting and selective de-weeding of channels and nullahs that are connected with Wular can be of great help in restoring its lost glory*”.

Seepage losses contribute to groundwater and plantations around the Lake are also consuming water. The Wular Lake and Kishenganga Project would further results in feeding the storage and groundwater recharge will be enhanced, which would also cause serious environmental concerns for surrounding areas of the Lake and it will further reduce the flows of Kishenganga River to Pakistan. The pollutants of the Lake will also pollute the flowing water and there will be more pollutants in the water of the Jhelum River flowing to Pakistan.

2.3. International Water Law on Trans-boundary Aquifers

Article #42 of International Water Law deals with trans-boundary aquifers and is composed of six points regarding rules and laws applicable to shared waters apply to aquifers and are relevant to the basin states and may be considered in future while making additions to the Indus Water Treaty¹³. The Law clearly states that the basin states sharing an aquifer shall manage it in its entirety and exchange data at the request of any one of them and cooperate in the collection and analysis of additional information, if needed.

While using the groundwater, the basin states must have due regard for the obligation not to cause significant harm to other basin states and to the obligation to protect aquifer and also cooperate in managing recharge to the aquifer. The basin states shall also refrain from and prevent acts or omissions within their territory that cause significant harm to another basin state having due regard to the right of each basin state to make equitable and reasonable use of the groundwater and management of trans-boundary aquifers.

The pressure on groundwater will increase in future and there are chances that condition of aquifers will be further aggravated. Pakistan may take up the issue of trans-boundary aquifers with India

- 13 a. The Rules applicable to internationally shared waters apply to an aquifer if: a) It is connected to surface waters that are part of an international drainage basin; or b) It is intersected by the boundaries between two or more States even without a connection to surface waters that form an international drainage basin.
- b. Whenever possible and appropriate, basin States sharing an aquifer referred to in paragraph 1 shall manage an aquifer in its entirety.
- c. In managing the waters of an aquifer referred to in paragraph 1, basin States shall consult and exchange information and data at the request of any one of them and shall cooperate in the collection and analyzing additional needed information pertinent to the obligations under these Rules.
- d. Basin States shall cooperate according to the procedures in Chapter XI to set drawdown rates in order to assure the equitable utilization of the waters of an aquifer referred to in paragraph 1, having due regard for the obligation not to cause significant harm to other basin States and to the obligation to protect the aquifer.
- e. Basin States sharing an aquifer referred to in paragraph 1 shall cooperate in managing the recharge of the aquifer.
- f. Basin States sharing an aquifer referred to in paragraph 1 shall refrain from and prevent acts or omissions within their territory that cause significant harm to another basin State, having due regard to the right of each basin State to make equitable and reasonable use of the waters.

before it is too late, as in India aquifers are under heavy depletion. There are also chances that due to pressure on groundwater, India may be tempted to divert waters of Western Rivers to recharge depleted aquifers. The extensive development of hydro-power projects in India would also result into heavy seepage of surface water into the groundwater and ultimately reducing the flows to Pakistan.

3. KEY POLICY ISSUES

Water entitlements of India on the western rivers have created a situation where the basin states are facing conflicts in implementing the Treaty. The issues of depleting aquifers could not be given due consideration, but it is expected that in future such issues will be much more serious to address along with environmental issues. The key issues of rapid abstraction of groundwater in Northern India were identified having impacts on sustainability and inter-generational issues of aquifers in basin states.

3.1. Depletion of Aquifers in Northern India and Impact on Pakistan's Aquifers

Lowering of water table due to over-abstraction of groundwater in the Northern India has serious impacts on the depletion of aquifers on the Pakistan's side. Pakistan is not facing acute depletion of groundwater except on the fringe of the border with India, which seems an extended effect of excessive groundwater depletion in India. Rest of the country is either under hydrological equilibrium or receiving higher recharge in the lower Indus basin. With further scarcity of surface water and prolonged droughts, the pressure on groundwater will increase and there are chances that aquifers will be further depleted and this would have negative impacts on aquifers on the Pakistan side, as there is overwhelming evidence generated under the NASA study.

3.2. Entry of Effluents to Western Rivers

Entry of effluents into freshwater rivers and tributaries feeding the Western Rivers on the Indian side is causing serious environmental implications for Indus-Pakistan. The extensive development of agriculture around the Western Rivers in India, with higher use of fertilizers and pesticides, is a concern for Pakistan. The domestic effluent is also a serious issue due to rapid urbanization around water bodies. Furthermore, the drainage channels from India entering into Pakistan are now flowing with effluents having higher concentration of chemicals and causing environmental impacts on the livelihood of rural population, livestock and groundwater quality. Mortality of livestock has been reported due to the use of drainage water as stockwater. The further growth of chemical agriculture in India would further deteriorate the quality of drainage effluents entering in to Pakistan.

3.3. Growing Demand of Surface Water to Recharge Aquifers of Indus-India

With the depletion of groundwater in northern India, there will also be additional pressure to construct projects where surface waters can be used either for recharging groundwater or supplementing the groundwater use. Pakistan has to oversee all the river flow projects in Indus-India in terms of seepage losses induced due to heading up of stored water and additional diversions to support the shortages of water in India. There are chances of further aggravating water conflicts in the near future.

3.4. Seepage Losses in Lakes and Reservoirs

India has planned construction of number of hydro-power and storage projects with creating large heads of water in the reservoirs, which will induce recharge to groundwater and will ultimately reduce the flow of water to Indus-Pakistan. The heading up of water in the hydro-power dams must also be viewed in terms of seepage losses, which might increase by many-fold due to heading up of water in the reservoir. This is also true for the Wular Lake, Kishenganga, Salal and Baglihar dam projects.

4. POTENTIAL OPTIONS

4.1. Dialogues for Addressing Transboundary Aquifer's Management

Emphasis must be placed on the basin aquifer bordering the basin states in future discussions of the Indus Water Commission. With the scarcity of surface water and persistent drought the pressure on groundwater will increase and there are chances that condition of aquifers will be further aggravated. Pakistan may take up the issue of trans-boundary aquifer with India before it is too late, as in Indus-India aquifer is under heavy depletion.

Initiate dialogues between the basin states for transboundary aquifer management through: a) sharing information on aquifer abstraction; b) ensuring that electric and diesel fuel policies are not encouraging farmers for over-abstraction of groundwater; c) developing capacity of the basin states for the use of remotely sensed data for the assessment of water table and groundwater abstractions; and d) exchange of knowledge and technologies for efficient use of water to reduce dependence on groundwater through the management of water demand for all sub-sectors of water use.

4.2. Managing Groundwater as a Resource as well as Trust

Manage groundwater as a resource, as it is essential to jointly set up an organisation with representatives from the basin states, whose functions would entail identifying short- and long-term supply capacity of the basin and its integrated development, setting up of infrastructure and coordinating activities of different agencies. Furthermore, **groundwater must also be considered as a trust** because in a concept of trusteeship, resource is not only depleted but it is also recharged to manage it on sustainable basis. As in the basin states, surface water schemes are largely being managed on *Warabandi* (fixed-rotation) and water allocations are actually based on rationing of water, therefore groundwater provides water on demand basis and hence it has larger impacts on productivity of irrigated agriculture.

4.3. Support Paradigm Shift in the Mindset of People

Support paradigm shift in the mindset of people of the basin states and it would require a complete end to hostilities, both physical and psychological, from both sides. It will have to be a part of the final settlement in letter and spirit. The integrated development approach is beyond consideration in the current context of relations between the basin states, but all other options will lead to destruction sooner or later. Furthermore, trans-boundary water and aquifers have to be seen in terms of opportunities available to manage water (surface, groundwater and wastewater), while developing future plans for the benefits of the basin states.

4.4. Monitoring of Hydro-power Projects on the Western Rivers

Monitor river flow projects in terms of seepage losses due to heading up of water in the reservoir, where seepage is induced by many-fold. This will be a loss to Pakistan but a gain to India. Therefore, water apportionment to India on the western rivers in terms of storage has to be seen in the context of induced seepage losses. Depletion of groundwater in northern India will pose serious implications for India to try to use surface waters from the western rivers over and above the provisions of the Treaty, being an upper riparian. In addition, the seepage of water from the storage projects can be easily estimated by measuring the inflows and outflows from the reservoir. Ultimately, the Pakistan has to initiate discussions to include the seepage losses as part of water entitlements for India. In addition, there is an urgent need to exchange the data and information so that experts can formulate options for the benefit of the basin states.

5. Way Forward

Who will be the Champions of creating a shift in the mind set of the experts and people to consider environmental concerns and groundwater issues and to formulate detailed provisions on trans-boundary aquifers and environmental pollution so that dialogues can be initiated to address the emerging issues and formulate plans for the benefits of the basin states – on the Indus?



INTERNATIONAL UNION FOR
CONSERVATION OF NATURE

Balochistan Programme Office

Marker Cottage
Zarghoon Road, Quetta
Pakistan

Tel +92 (81) 2840450/51/52

Fax +92 (81) 2820706

cro.pk@iucn.org

www.iucn.org/pakistan