

Critical Issues on Groundwater in India

インドにおける地下水の重要問題

DEVESH SHARMA

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Water Budget (水収支)

Geographical Area - 328 m sq. km

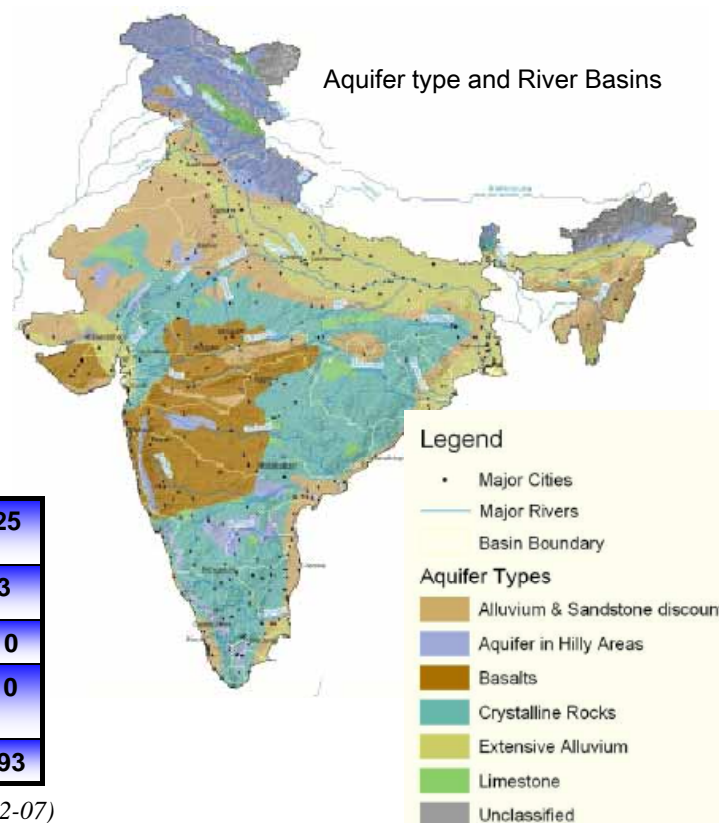
Water Availability (in BCM)

Total rainfall	4000
Total Water Availability	1869
Total Utilizable Water	
Surface water	690
Ground water	432
Total	1122

Water Demand (in BCM)

	2000	2010	2025
Domestic	42	56	73
Irrigation	541	688	910
Industrial, Energy & others	51	69	110
Total	634	813	1093

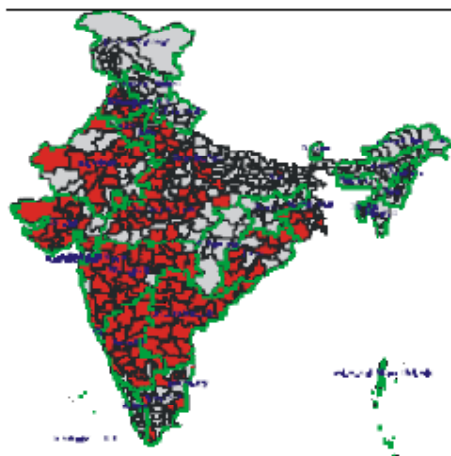
Source: Report of 10th Five Year Plan (2002-07)



Groundwater Situation (地下水の現状)

- Largest user of ground water in the world – approximately 230 BCM/year (*amounts to more than a quarter of the global total groundwater usage*)
- Groundwater supports approximately 60 percent of irrigated agriculture and more than 80 percent of rural and urban water supplies (**World Bank 2010**)
- Around 29 percent (*1615 out of 5723*) of groundwater blocks are semi-critical, critical or overexploited: *Almost 54% of groundwater blocks in the six states of Gujarat, Haryana, Maharashtra, Punjab, Rajasthan and Tamil Nadu are nearly depleted.*
- 60 percent of the aquifers will be in critical condition within the next 20 years
- Groundwater pumping with electricity and diesel accounts for an estimated 16-25 million mt of carbon emission (*Shah, 2009*)
- Groundwater problems and their impacts are heterogeneous across the country
- Immediate actions are required for the sustainable development of groundwater resources

Groundwater Situation (地下水の現状)



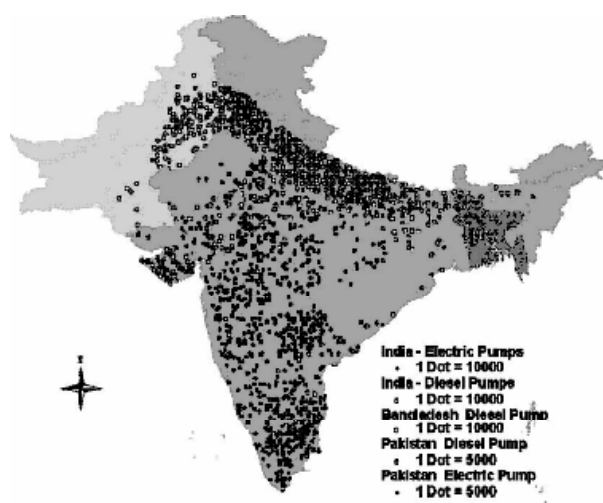
Areas where groundwater levels have fallen by more than 4 metres (>20cm/year) during 1981-2000.

Source: India Assessment 2002, Water Supply and Sanitation, Planning Commission, Govt. of India

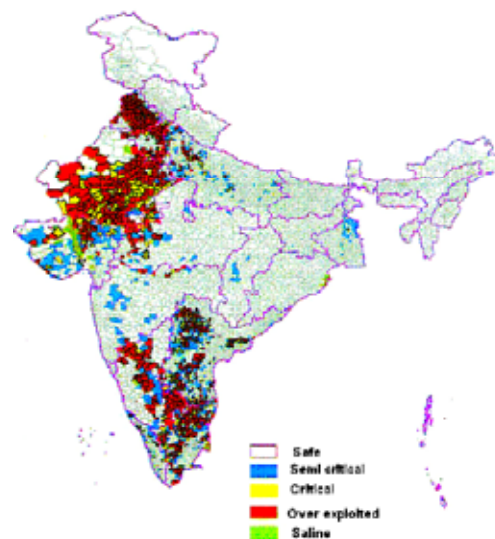
Groundwater Quality:

- Fluoride (>1.5 ppm) – 14 states affecting a total of 69 districts
- Salinity - 73 districts and three blocks of Delhi.
- Iron (>0.3 ppm) - 23 districts from 4 states
- Arsenic (>50 ppb) - alluvial plains of Ganges covering six districts of West Bengal.
- Presence of heavy metals - 40 districts from 13 states
- Non-point pollution caused by fertilizers and pesticides
- Nitrate (> 45 ppm) – 95 districts from 11 states

Groundwater Situation (地下水の現状)



Distribution of electric and diesel pumpsets in South Asia (Shah, 2009)



Groundwater-stressed areas of India. (Planning Commission, 2007)

Groundwater Management - Issues

(地下水管理の課題)

➤ Groundwater Quantity

- Increase in demand
- Irrational and illegal use
- Poor availability of surface water
- Flexibility and timeliness of groundwater
- Electricity subsidies

➤ Groundwater Quality

- Groundwater contamination and pollutant (fluoride, arsenic, nitrate, salinity, etc.)
- Impact of waste effluents into river (river-aquifer interaction)

➤ Seawater Intrusion

- Over exploitation of freshwater from coastal aquifer
- Sea level rise

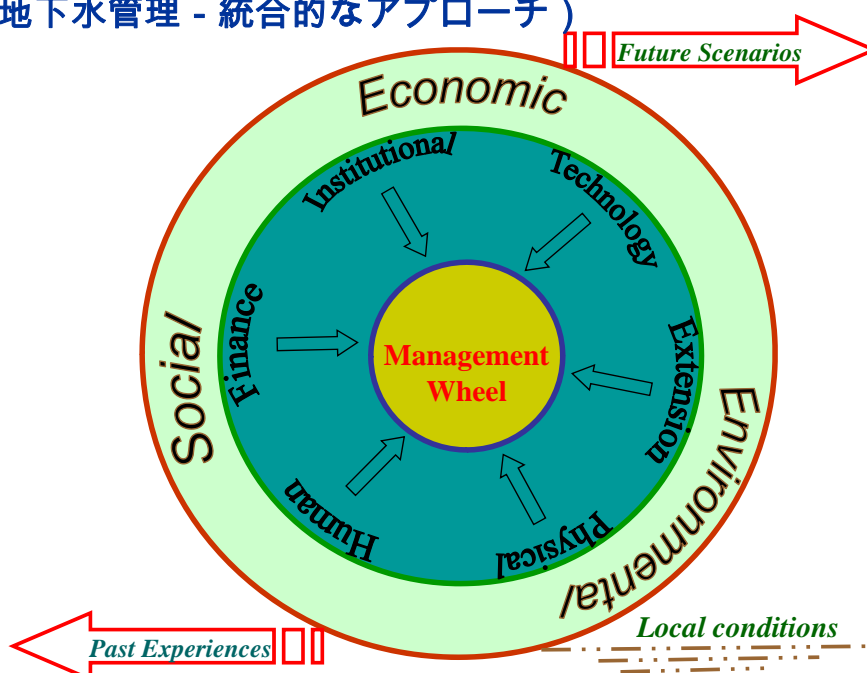
Groundwater Management - Issues

(地下水の現状)

- Groundwater policies are not in line with ground realities (less emphasis on scarcity, depletion and quality of groundwater)
- Deficiencies in groundwater development, use, and contamination control legislation
- Weak Enforcement of laws and administrative regulations: Issue of implementation: *Water is a state subject, Groundwater is considered as an easement of land, low water charges and subsidized energy cost for irrigation, existing local and public institutions are weak*
- Inefficient monitoring of groundwater quality and quantity
- Roles and responsibilities of related agencies and coordination
- Lack of awareness and knowledge among public and water users
- Possible Impacts of climate change on groundwater

Groundwater Management – Integrated Approach

(地下水管理 - 統合的なアプローチ)





Groundwater Management – Approach

地下水管理—アプローチ



- **Need to understand the drivers of groundwater use and degradation**
- **Aquifer management** – *periodic assessment of groundwater potential (quantity & quality) and consumption pattern specific to the aquifer system, prevention of over-exploitation of groundwater near coast (setting of pumping limit), control of groundwater pollution (identification of source and extent of pollution, restriction on subsurface disposal of waste, enforcement of remedial measures*
- **Role and involvement of public and private sectors in groundwater economy**
- **Community groundwater management** – *Promoting government–stakeholder interaction, Promotion of knowledge and public awareness, self-regulation (example-Andhra Pradesh)*



Groundwater Management – Approach

地下水管理—アプローチ



- **Effective regulations and pricing mechanism** - *installation of meters, necessity of well registration, incentives for 4R (reduce, recycle, reuse and recharge of water), effective price mechanism (concerns of equity and affordability to the poor), groundwater use within safe yield, regular monitoring and enforcement of rules, Land use regulation (restricting use of chemical fertilizer and pesticides, etc.)*
- **Recharge of groundwater** – *augmenting existing water resources, artificial recharge and rainwater harvesting (technical and economical aspects)*
- **Demand management** – *water saving activities (leakage management in domestic and industrial sectors, changing cropping patter), management of energy-groundwater nexus*



Groundwater Management – Approach



地下水管理—アプローチ

- **Groundwater Database System** - *Improvement and maintenance of monitoring and information system, sharing of database and information, database quality and consistency, research activities*
- **Building capacity at all levels** – *water is state need to strengthen the capacity at state level to make it proactive*
- **Integrated development of groundwater and surface water** – *conjunctive use to promote sustainable use of groundwater*
- **Impact of Climate change on groundwater** - *Change in temperature and precipitation, change in recharge and evapotranspiration, sea level rise*



TERI's Project on Groundwater Management



TERIの地下水管理に関するプロジェクト

1. Hydrological and hydrochemical studies of Najafgarh catchment (Delhi) & its impact on river Yamuna
2. Independent Third Party Water Resources Assessment
3. Ground water vulnerability assessment at a river basin level in India using DRASTIC approach
4. Designing a model for water recycling and reuse on 'Maintenance lines' for Indian Railways: a pilot project for New Delhi Railway Station
5. Conducting a diagnostic study for assessing availability, quality, treatment and discharge of water, and implementation of suitable solutions to address community concerns
6. Rejuvenation of traditional water harvesting systems
7. Development, Rehabilitation and Outreach Project (DROP) on integrated watersheds (Nelamangala)
8. Conducting a GIS based diagnostic study for assessing availability and quality of water resources to address watershed wide concerns using a watershed approach.



TERI's Project on Groundwater Management

TERIの地下水管理に関するプロジェクト

9. Perspective Water Vision 2030 Arunachal Pradesh, India
10. Impact Evaluation Study (IES) of Watersheds treated during tenth five year plan under NWDPRA
11. HighNoon: adaptation to changing water resources availability in northern India with Himalayan glacier retreat and changing monsoon pattern
12. Preservation of Fresh water ecosystems in Navi Mumbai for sustainable resource utilization
13. Heavy metal assessment of Yamuna River Water
14. Coastal vulnerability assessment and strategies for better preparedness towards impacts of climate change and sea level rise: State of West Bengal
15. Fluoride Contamination in Groundwater (Karnataka, India): A Community Effort in Cost-Affective Treatment and Management
16. Assessing Climate Change Vulnerability and Adaptation Strategies for Maharashtra State, India
17. Assessment of Groundwater Contamination from Polluted Yamuna River near Delhi (proposal submitted)



TERI: Regional Knowledge Hub for Water and Climate Change Adaptation in South Asia

TERI:南アジアにおける水と気候変動アダプテーションのための地域ナレッジハブ

- 💧 Officially launched on 4 Feb, 2010 during DSDS 2010

VISION

- 💧 To ensure equitable and sustainable access to safe water for all

MISSION

- 💧 To facilitate prudent and effective water management in South Asia - a region threatened by water and livelihoods insecurity due to climate change
- 💧 The launch of website of knowledge hub, www.waterknowledgehub.org



TERI: Regional Knowledge Hub for Water and Climate Change Adaptation in South Asia

TERI:南アジアにおける水と気候変動アダプテーションのための地域ナレッジハブ

- ◆ Agriculture
- ◆ Climate change
- ◆ Economics
- ◆ Hydrological & hydro-geological modelling
- ◆ Glaciology
- ◆ Governance & management of water resources
- ◆ IWRM
- ◆ Lake Management
- ◆ River basin Management
- ◆ Transboundary Issues
- ◆ Water Conservation and harvesting
- ◆ Water in Industries
- ◆ Water Quality and Treatment
- ◆ Water Supply and Sanitation
- ◆ Watershed Management
- ◆ Wetland Management

THANK YOU

“Save water, Save Life”