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Mega Integration of Water Cycle and Socio-economics of India

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Key Issues

1) Decrease in groundwater infiltration – Some Causes
2) Groundwater Pollution – Destroying what's left?
3) Remedial Actions
4) Artificial Recharge – Its Status and Need in India
5) Policy Recommendations – Setting the Priorities

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The Context

Current Population – 1338 Milliion

2050 Population – 1600Million

Groundwater provides for

60% of total water for Irrigation

80% of total water for human & animal consumption

64% Groundwater blocks in India over-exploited (CGWB, 2016)

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Key Arguments

1) Greater focus needed on integrating India's water cycle with its socio-economic conditions in a community-driven manner with effective monitoring mechanisms at the local and national levels.

2) Need to cover the supply side issues in groundwater depletion, i.e. decrease in groundwater infiltration due to destructive practices across regions.

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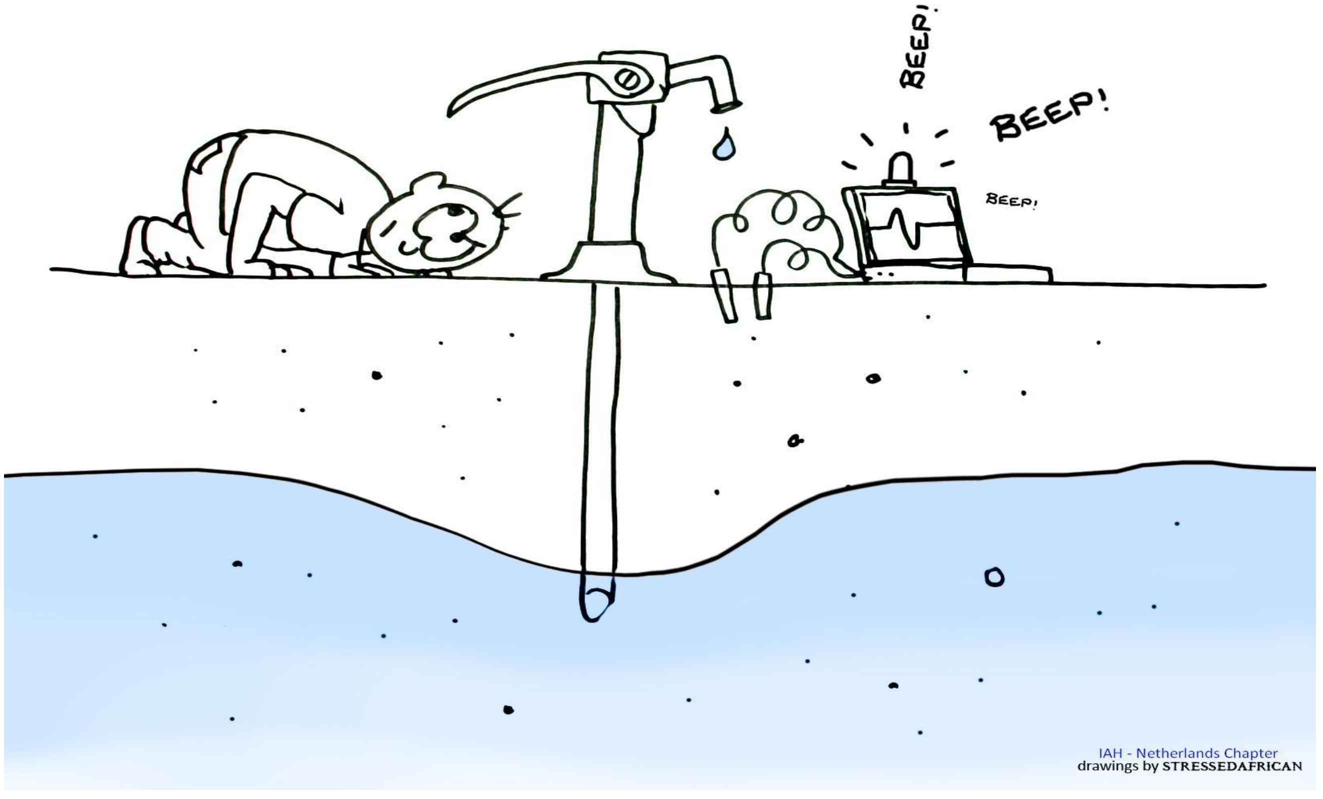
Decrease in Groundwater Infiltration – Some Causes



Land-use changes in the Northern Hills

37% of natural springs in Uttarakhand drying up

Land-use changes in Almora district over 30 years affected natural springs & streams – 33% natural springs and 736 km length of streams dried up (Tiwari & Joshi, 2014)

Negative impacts on availability of water, biomass, livelihood, food, as well as health & overall quality of life – out-migration of youth increased

Growing population & tourism, deforestation for agricultural as well as infrastructural development main drivers

Spread of Chir Pine – now covers 16% of total forests in Uttarakhand – reduces infiltration into ground, increases soil acidity, pine needles burn easily

4000 ha of forest cover destroyed in 2016 from fires – Native Himalayan broadleaf forests, that prevent erosion and increase groundwater recharge, are shrinking

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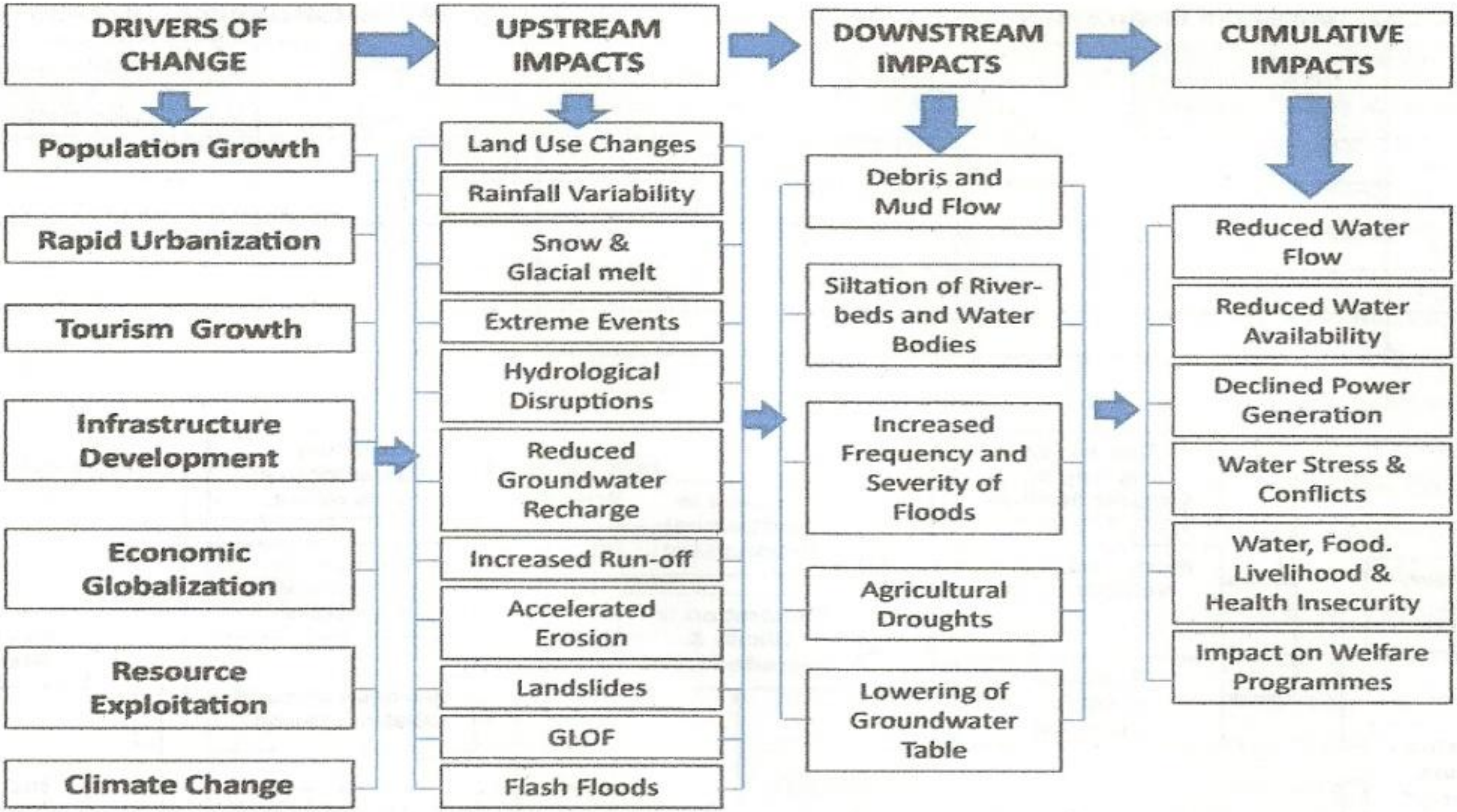
Environmental Changes in Himalayas: Upstream and Downstream Impacts (Tiwari & Joshi, 2014)



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Rapid Urbanisation

High rates of GW extraction – 50% of urban water requirement met through borewells (Suhag, 2016)

States like Haryana, Punjab & Delhi have more than 100% GW development i.e. annual GW consumption exceeds recharge

Rapidly developing urban centres with paved surfaces – roads, buildings, etc. – low rates of groundwater recharge

Urban wetlands dying – 232 out of 629 water bodies in Delhi dead, water bodies in Bengaluru reduced from 207 to 93 during 1973-2010

Decrease in Groundwater Infiltration

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Ingress of sea water in coastal areas

Groundwater overuse in some coastal areas leads to ingress of sea water into inland aquifers, streams and wells

Out of 152 block panchayats in Kerala, 50 have more than 70% GW development while 22 are "semi-critical" (The Hindu, 2017)

In the Sundarbans delta, fresh water flow and sediment supply has decreased on the Indian side while 12400 ha of mangroves have been eroded during 1986-2012 (Singh, 2017)

Local ecosystem services in coastal areas are being affected, also there is significant decline in groundwater recharge and quality of groundwater

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Overdependence on Groundwater for Irrigation

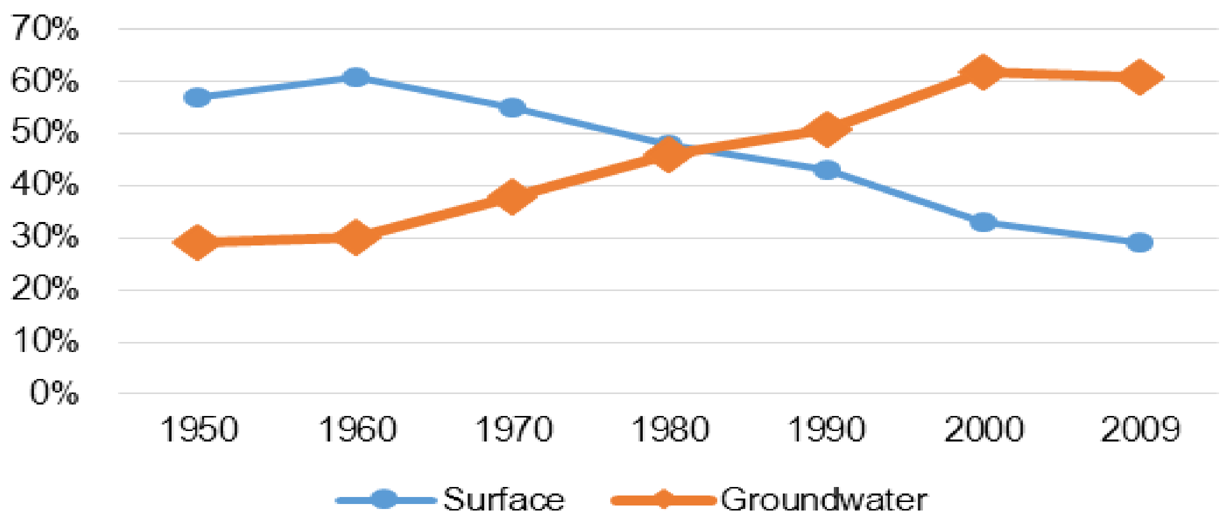
Main thrust for use of groundwater for irrigation came after the North Indian drought of 1967-68 and import of high-yield water-intensive wheat seeds

Second major thrust came in the 1990s when subsidized water and electricity led to double cropping in Punjab, Haryana, and Western UP

This has gone on unchecked leading to increased groundwater use for irrigation even as recharge as well as use of surface water has been decreasing

Groundwater use for irrigation as of now – 222 BCM against groundwater resources of 431 BCM i.e., more than 50% (Ambast, 2017)

Increase in ground water utilization for irrigation (Suhag, 2016)



Status and Projections for water resource development in India (Tyagi, 2017)

Item	Level of development (BCM)		
	2000 (Ultimate)	2010	2050
Surface water	360 (690)	404	647
Groundwater	210 (396)	260	396

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Groundwater Pollution – Destroying what's left?

Glaciers and glacial lakes being polluted due to increase in tourist influx – more waste being produced in higher reaches of the Himalayas

About 37% of groundwater in South Asia contains arsenic at toxic concentrations (MacDonald et al, 2016)

Improper waste disposal – Total waste generated in cities (57233 MLD) is more than treatment capacity of STPs (21478 MLD) - Deficit flows into rivers and aquifers untreated (CPCB, 2015)

90% of Delhi's municipal waste dumped at landfills - pollutes the groundwater in surrounding areas due to percolation of leachate

Rural waste now increasingly inorganic due to use of agro-chemicals and pesticides – pollutes groundwater and is a health hazard – e.g. Bathinda cancer epidemic

Studies show groundwater pollution near mines – Rat-hole mining in Meghalaya banned by NGT in 2014 due to water and soil contamination (CPCB, 2015)

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Remedial Actions

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Better watershed management and monitoring of upstream forests is needed in the Hills – Terracing and gully plugging, used earlier by farmers and forest department but discontinued due to change in forest composition, should be brought back

Comprehensive land-use and water-use policy required for the Himalayas to restore ecological services and attain community sustainability – growing of medicinal plants, fruits, vegetables and processing units should be encouraged in such areas

Tourist inflow to ecologically and geologically sensitive regions should be regulated without compromising on livelihood opportunities for the locals – Road networks should have more tunnels to avoid maintenance and fuel costs

Desalinization has become cheaper – can be used in the coastal areas for urban and industrial use and to discourage groundwater overuse

Waste disposal needs massive investment – objective should be to deal with various types of waste differently to produce usable water for biogas, manure, electricity, etc. – this would require skilled/qualified people in local-level organizations

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Operational holdings and farmer collectives (40 ha area) should be encouraged – such collectives of small land holders have come up in Punjab and Maharashtra, and have been able to use water more efficiently while cutting input costs through consensus-based decisions on cropping, machinery, etc.

Investment in food processing by state, centre, and private sector is set to increase to enhance processing capacity for 90% of produce against the current 10% – this would help in decreasing agricultural waste

To improve water-use efficiency, relevant crops and water allocation should be on agro-climatic soil zone basis taking into account surface-, rain- and ground-water

Average water foot prints of crops in India (Tyagi, 2017)

Crops	**Global average water foot prints, (m^3/t)**	**Average water foot print in India (m^3/t)**
Paddy	1673	2070
Wheat	1827	2100
Maize	1222	2537
Potatoes	287	291
Sugarcane	3048	6026
Rapeseed	2271	3398
Seed cotton	4029	9321

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Artificial Groundwater Recharge

Three plans for artificial recharge till date –in 1996, 2002, and the latest in 2013

Under the 2013 plan, 11 million structures were proposed for rural and urban areas to be constructed over 10 years

Based on assessment of groundwater development levels, most overexploited regions were found in Punjab, Haryana, Delhi, West UP, Rajasthan, Gujarat, Karnataka, Andhra Pradesh, and Tamil Nadu

According to CGWB, during 2009-2011, the number of over-exploited units rose from 802 out of 5842 total assessed units (13.7%) to 1071 out of 6607 (16.2%)

In August 2015, then MoS (Water) revealed in Lok Sabha that only 399 out of the total proposed structures had been constructed under the central sector scheme

According to a parliamentary committee report from December 2016, only six states took up construction activities

Artificial Recharge – Case Studies

Moti Rayan and Bhujpur Area, Kutch District, Gujarat
“18 Check dams, 3 percolation ponds, two recharge wells and one sub surface dam with four recharge wells were constructed in this area to augment groundwater recharge. During the year 1994, in spite of low rainfall ground water could be recharged through water harvesting structures.” (CGWB, 2000)

Recharge structures in Jaipur and Alwar, Rajasthan (Pernod Ricard India CSR)
Micro-watersheds were constructed with storage capacity of 64000 cubic metre in Phagi area of Jaipur district. While the water level before the project was either 10-15 mbgl or dry, there was significant improvement afterwards. In Behror area of Alwar, recharge wells were constructed dovetailing with Mukhyamantri Jal Swavalamban Yojana. Estimated recharge potential of these structures ranged from 30000-40000 cubic metre per annum.

Gujra Sub-Watershed, Durg, Chhattisgarh
“23 masonry stop dams, 12 percolation tanks, 25 boulder check dams, and 13 nala bunds were constructed while 28 ponds were de-silted under the project. Eight observation wells were also built that recorded increased water levels. The dug wells in the area, which were rendered useless prior to the implementation of the project, got revived resulting in improved soil moisture conditions and agricultural production.” (CGWB, 2011)

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Policy Recommendations – Setting the Priorities

Conversion of all types of waste into useful products such as potable water, electricity, etc. should be taken up with urgency as it not only has adverse health impacts but also affects economic empowerment of the underprivileged

Subsidies for use of energy and water in agriculture should be removed – such populist moves encourage overuse of groundwater

Assessment of actual land use and water availability from 1975 to 2015 should be undertaken – projections for land and water use incorporating climate change impacts and increase in actual use for the next 30 years are also needed

New and cheaper technologies are now available for desalinization of brackish water on land – these should be invested in heavily as part of immediate steps

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Thank You