

**Flow Alternation &  
Specific Environmental Impacts  
in Ganga Basin**

# Overview

- **Current & future Drivers of water abstraction in Ganga Basin:**
  - Population Growth, Urbanisation, Industrialization
  - irrigation/agro-systems
  - groundwater use
  - Hydropower
  - Water Supply: Domestic, commercial, industrial
    - Har Ghar Jal
  - Anthropocene and Climate Change
  - Livelihood, Cultural (Kumbh, others), recreational services
  - Other challenges: Pollution, Waterways/ dredging, other infrastructure (e.g. Char Dham Highway)
  - Governance, mindset
- **Flow-ecology relationships for the Ganga river**
  - Known relationships
  - Unknown relationships: Improving understanding now and in future

# River Flow elements

- Ganga Basin involves Tibet (China), Nepal, Bangladesh, besides India
- Define the River: What is Ganga, without creating new caste system among the rivers: not just main stem or U/s of Devprayag
- Water: Quantum, Quality
- Silt (along the river, at Delta/ estuary)
- Nutrients
- Aquatic, terrestrial Biodiversity: flora, fauna
- Variations: Daily, Seasonal, larger cycles
- Flood Plain, River zone regulation: Define the space for Rivers and pathways for the streams.
- Connectivity: Longitudinal, Latitudinal, vertical
- Catchment: River flow reflects the health of the catchments: Snow fed and non snow fed rivers
- Credible cumulative impact assessment, carrying capacity studies, through a transparent, participatory process. WII study for Upper Ganga basin has set a good example for this.

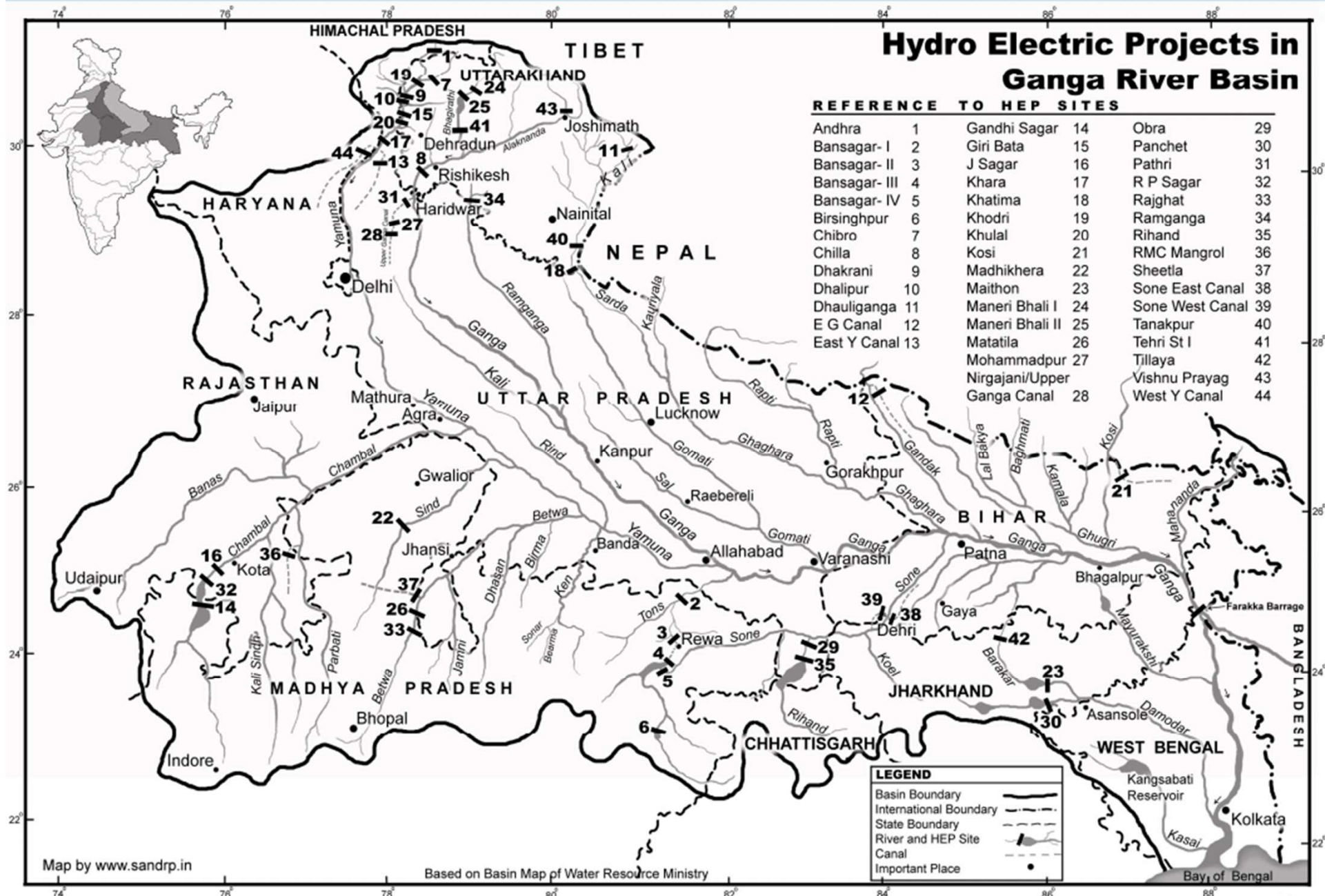
# Hydro Electric Projects in Ganga River Basin

## REFERENCE TO HEP SITES

Andhra	1	Gandhi Sagar	14	Obra	29
Bansagar- I	2	Giri Bata	15	Panchet	30
Bansagar- II	3	J Sagar	16	Pathri	31
Bansagar- III	4	Khara	17	R P Sagar	32
Bansagar- IV	5	Khatima	18	Rajghat	33
Birsinghpur	6	Khodri	19	Ramganga	34
Chibro	7	Khulal	20	Rihand	35
Chilla	8	Kosi	21	RMC Mangrol	36
Dhakrani	9	Madhikhera	22	Sheetla	37
Dhalipur	10	Maithon	23	Sone East Canal	38
Dhauliganga	11	Maneri Bhali I	24	Sone West Canal	39
E G Canal	12	Maneri Bhali II	25	Tanakpur	40
East Y Canal	13	Matatila	26	Tehri St I	41
		Mohammadpur	27	Tillaya	42
		Nirgajani/Upper Ganga Canal	28	Vishnu Prayag	43
				West Y Canal	44

## LEGEND

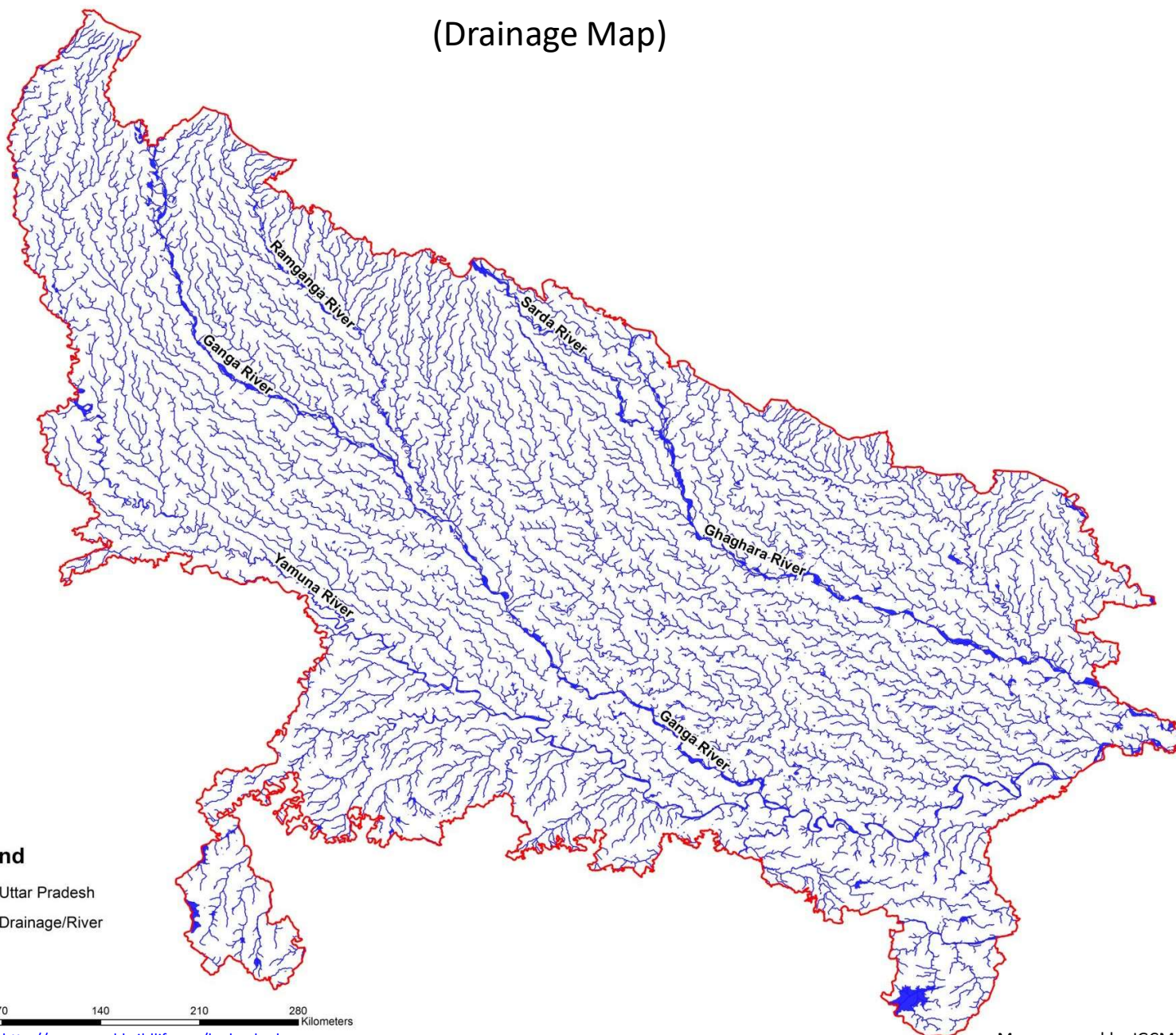
Basin Boundary	—
International Boundary	- - -
State Boundary	- . - .
River and HEP Site	—●—
Canal	- - -
Important Place	●





# UTTAR PRADESH

(Drainage Map)



## Legend

-  Uttar Pradesh
-  Drainage/River

0 35 70 140 210 280  
Kilometers

Data source: <http://www.worldwildlife.org/hydrosheds>

Map prepared by: IGCMC, WWF-India, 2016

# Impacts on Fish

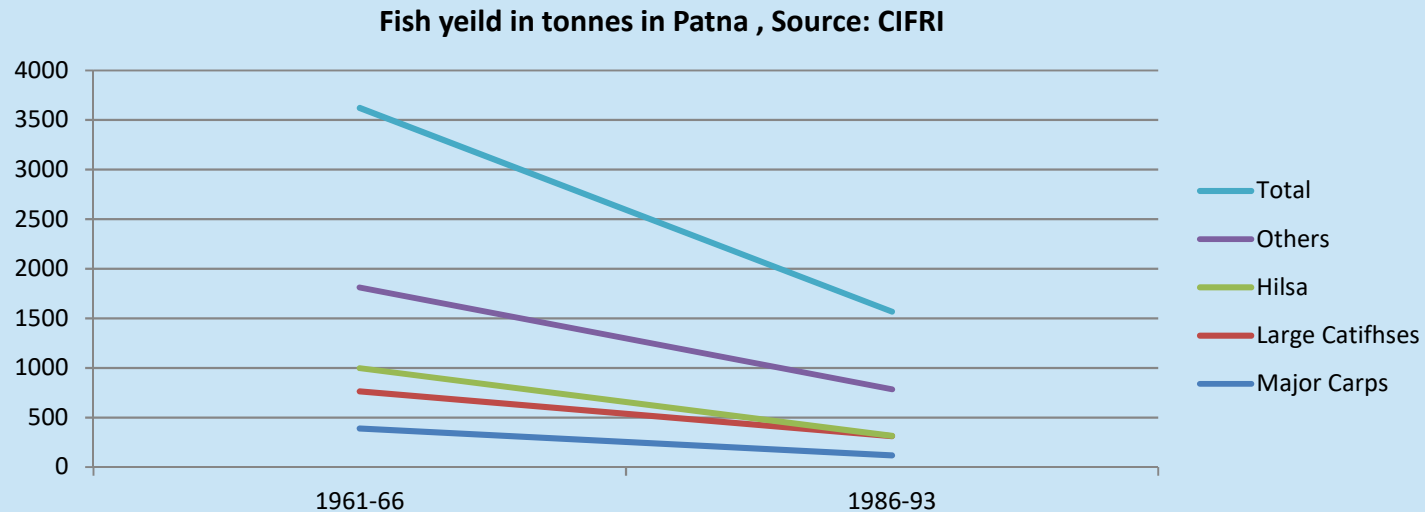


Most large HEPs under construction or planning involve high dams and no credible impact assessment or no provision for fish ladder/ fish passes has been made.

The only mitigation measure for existing and planned dams is hatchery or fish farms, which generally raise Indian Major Carps or exotic species, not addressing issues with native fish diversity or loss of livelihoods due to fisheries.

More than 10.8 million Indians depend on riverine fisheries for livelihood and nutritional needs

# Declining Fisheries in Ganga



- Ganga is the lifeline of **7-10 million** informal, subsistence fisher folk in Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh and West Bengal (Fisheries Development in India: Political economy of unsustainable Development, Kornadi 2008)
- Fisheries in Ganga on a steep decline due to obstacles, hydrological changes and various other changes associated with large scale water diversions through Upper Ganga, Middle Ganga and Lower Ganga Barrages and canals
- According to 10<sup>th</sup> Five Year Plan document, “The average yield of major carps in river Ganga has declined from **26.62 to 2.55 kg/ha/year during last four decades**. The biologically and economically desirable fish species have started giving way to the low value species, exhibiting an alarming swing in the population structure.”

Period	Major Carps	Large catfishes	Hilsa	Exotics	others	Total
1961-68	424.91	201.35	97.17	null	211.96	935.39
1972-80	135.17	98.55	9.66	null	197.86	441.25
1981-90	155.73	99.40	4.31	null	247.59	507.03
1991-00	28.91	62.74	4.51	null	178.20	274.36
2001-06	38.58	40.56	1.20	64.27	223.41	368.01

- At Allahabad, the yield came down from 935 Kg/km in sixties to 368 kg/k in 2001-06. (Pathak et al, Riverine Ecology and Fisheries, vis a vis hydrodynamic alterations: Impacts and Remedial measures, CIFRI, 2010)
- In this, contribution of major carps and large catfish imp commercial species is drastically low, **exotics increased sharply** as they prefer lower and more stagnant water levels which cannot be tolerated by the carps.
- ***The importance of water levels for fisheries is illustrated by the fact that fisheries improve considerably after Allahabad where a number of tributaries meet Ganga, bringing freshwater and sediments with them.***





Ganga at Devprayag at risk due to Kotli Bhel 1A, 1B and 2 Hydropower Projects - Photo by Pansul Mehta

*"The damaged HEP seemed to sum up and typify all that I had seen all through my travels up the Beas, Bhagirathi and Alaknanda. Severely damaged hydropower projects, poor conception, toothless regulation, non-existent monitoring, and entirely unmindful of the consequences to the rivers, and to all life dependent on them"*

*"I felt I was in an Occupied territory: Even as you drive up from the plains up the first rise of the mountain roads, you are greeted by large signboards put up by Hydro-power Companies. They 'welcome' you into the state, like owners and they tell you how many hydro-power projects you will encounter, the mileage to each one of them, and all the major towns enroute. Not the Highways Authority, but private hydropower companies, Government hydropower companies, cement companies, and companies that conveniently do both cement and hydropower. Roads ripped wide, giant transport vehicles crawling up with either fly-ash for cement, or building material and towering machinery for hydropower plants hogging the highway. Wreckage of trashed earth-movers with rusted tank-treads, and twisted trucks abandoned by the side of roads as if in a battlefield. There are billboards that tell you that entry is restricted to the entire road even though there are many villages upstream, and this is the only public access to entire valleys. Near every hydropower installation, your vehicle will be stopped and you will be questioned by armed men in uniform. And you are being constantly watched. On a mountain highway, of all places."*



# Headwater Extinctions

Hydropower projects in the Himalayan reaches of the Ganga and the Beas:

A closer look at impacts on fish and river ecosystems

Emmanuel Theophilus



November 2014

# Ganga Fish Primer

- Published by SANDRP in [2014](#).
- **Around 10-13 million people in the Gangetic floodplains are estimated to be dependent on fish resources for their livelihoods, directly or indirectly.** However, accurate estimates of active traditional and non-traditional fisher populations are still wanting.



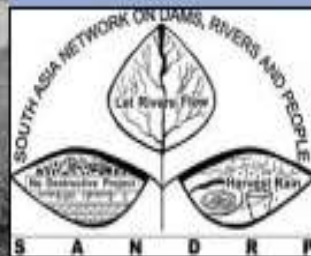


May 2014

## Shrinking and Sinking Deltas: Major role of Dams in delta subsidence and Effective Sea Level Rise



Parineeta Dandekar,  
Himanshu Thakkar  
SANDRP,  
South Asia Network on Dams  
Rivers and People  
<http://sandrp.in/>,  
<http://sandrp.wordpress.com/>



# Evolution of E flows Understanding

- Some key milestones of E flows evolution in India.
- WII report on Upper Ganga: Biodiversity Approach; Drop projects; Leave few tributaries undammed
- WWF report that includes Cultural services
- 2014: 1<sup>st</sup> India Rivers Week: River Health Index
- 2015 Joint report from MoEF-MoWR: Methodology to assess E flows rather than % thumb rules that are devoid of science
- 2016 Ganga Notification: Where is science? Or consistency? Or Credible process? Or even definition as to what constitutes Ganga.
- 2018: Death of Prof G D Agarwal
- Oct 2018 E flows notification/ Sept 2019 amendment
- EAC functioning/ CWC mindset
- Key missing link: Who governs the river?



# 2015 E-flows report from MWR-MoEF

- Key features:
- First ever joint report by the two ministries on E-flows, Draft submitted in March 2015. It talks about River Health Regime and Minimum Env Requirement in the first place.
- The report provides methodology for arriving at eflows, not only about Ganga but all rivers.
- E flows assessment based on: Depth of water required at riffles site for keystone species in normal and spawning season; longitudinal connectivity; 18 days of lateral connectivity with floodplains in monsoon; accepts that e-flows is not just about water but also flow of sediments, nutrients and biota.
- Unfortunately, it has remained in draft form, but continues to provide excellent assessment tool for E-flows.

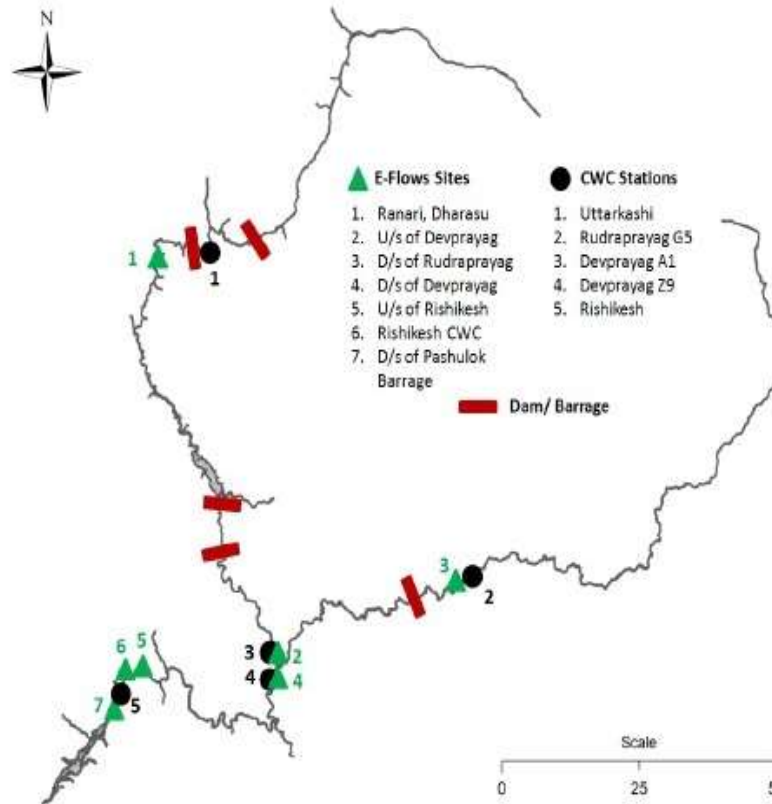


Figure 5.3: Location Map of Flow Monitoring Stations and E-Flows Sites



Riffle and Pool Locations in Longitudinal River Profile

River Cross-Section at E-Flow Site

$D_1$  – Depth of water required for mobility of keystone species during lean period.  
 $D_2$  – Depth of water required for mobility of keystone species during spawning period.  
 $D_3$  – Depth of water required to inundate some riparian vegetation for 18 days/year.

Figure 5.4: E-Flows Assessment – Conceptual Diagram

#### A. E-Flows at Site 1: Ranari, Dharasu (Lat 30°43'02"N, Long 78°21'17"E):

**Geomorphic Attributes:** Confined, incised river channel with coarse bed material in degradational regime in Himalayan steep valley.

#### Cross-Section at Site:



Figure 5.5: River Cross-section at Ranari, Dharasu

Keystone Species	Required Depths for E-flows		
	$D_1$	$D_2$	$D_3$
Snow Trout ( <i>Schizothorax richardsonii</i> )	0.5 m	0.8 m	3.41 m
Golden Mahseer ( <i>Tor putitora</i> )			

# WII study on Upper Ganga Basin

- Assessed/ ranked each of the 18 sub-basins for biodiversity values on the basis of a comprehensive matrix that included aquatic and terrestrial biodiversity. The values were based on six criteria: species richness, Rare Endangered and Threatened Species (RET), endemism, breeding and congregation habitats, migratory habitats, and habitats of biodiversity value.
- On the potential impacts of hydropower projects on aquatic biodiversity and their habitats, WII analysed for major changes in the river due to hydropower projects: 1 habitat modification & loss, 2 barrier effects & fragmentation, 3 changes in flow volumes and rhythms of water, 4 changes in sediment and nutrient flows.
- IIT Roorkee or WAPCOS being asked to do any EIA or CIA is clearly in conflict of interest. Same is the case about any other agency involved in working for hydro projects.



## **CIFRI Report on Nyamjangchu Eflows**

- CIFRI has been a consultant to private dam group Bhilwara Energy Limited proposing to construct the 780 MW Nyamjangchu HP in Tawang region, ArP
- Monpa tribes here worship the trouts in the river and do not hunt these
- CIFRI's study was biased towards the developer, it used wrong methodologies, deviated from its TOR and recommended very low water release from the dam as eflows. (flows 39% lower than the lowest experienced by the river)
- CIFRI has assessed flows for its target species of snow trout (0.45 cumecs), but eflows recommended are even less! (0.36 cumecs, (5.2 Recommendation, Page 47))
- This study has been criticized by a number of groups including WWF, SANDRP
- Local population has gone to the NGT against EC granted to this project
- WII report subsequently (following NGT directions) showed that project is not viable, people are opposed and also because the project will destroy the riverine winter habitat of Black Necked Crane.



# Challenge: NOT Water Abstraction drivers

- Its not the justifiable needs that is as much of a challenge as the mindset and governance model about how to fulfil the needs.
- Groundwater is India's water lifeline for at least 4 decades and will remain so in foreseeable future.
- National Water Policy, programs, plans and institutions need to acknowledge this reality and make sustenance of GW focal point. Sustenance of Rivers, streams, wetlands, forests, catchments than become important for Sustainable GW.
- Water storage is important, but there are a lot of storage options beginning with soil moisture to aquifers, local water systems, wetlands, among others.
- We thus need bottom up governance system, which will take care most of the needs while ensuring sustenance of Rivers. It will help achieve appropriate cropping pattern, water conserving and cost effective cropping methods like SRI, among others.
- It's a long way from where we now are!

## **Rivers can hope to have better future without big dams?**

- Hydropower: The b/g note talks about “significant increase” in expansion of hydropower facilities, but this seems a bit misleading. Big Hydro was so far pushed without inclusion of social or environmental costs. Now big hydro is even economically unviable. Better power options exist.
- Big Dams: 97% of Indian dams are basically irrigation projects. But big surface irrigation projects are no longer delivering additional benefits. Instead of helping sustain GW lifeline, they are adversely affecting GW recharge systems, including rivers and catchments.
- Similarly, ILR projects aren't viable, optimum or justifiable.
- Shockingly, in case of Yamuna, we are told that the river can have e flows only when there are more dams!

# The Groundwater challenge

- Sustaining Groundwater levels also required for Sustaining rivers.
- Key steps for Groundwater sustenance: Acknowledge it is lifeline; make its sustenance focus of NWP, plans, programs; Understand resource and how the recharge happens; protect recharge systems, enhance recharge from them; create more recharge systems; artificial recharge where necessary.
- Most importantly, regulating groundwater use. It has to happen at aquifer or decentralised level, bottom up way.
- If capacity of local communities is increased and they are sufficiently empowered, they can also, in the process, help solve the most untraceable problem: Fix cropping pattern according to water availability.



- FLOW FLUCTUATION DURING HYDRO PEAK OPERATION: Lower Demwe on Lohit
- The level fluctuations in lean season will be 2-3 m 100 km downstream the dam site!
- Flows will vary from 70 cumecs for 10-22 hrs to 1729 cumecs for 2-4 hrs in a single day, every single day in lean season
- Downstream areas include Dibru Saikhowa National Park, a proposed Ramsar site and IBA, habitat of Bengal Florican, Gangetic Dolphin and some species new to science



© darin mcquoid



# Flow-ecology relationships for Ganga river

- Known relationships
  - Snow Trout: Below 1,600 m altitude in streams with low temperatures
  - Mahseer: Warmer waters; lower altitude rivers
  - Hilsa: Before and After Farakka
  - Dolphins, India's National Aquatic animal: Vikramshila Dolphins Sanctuary
  - Ghariyal: Ken Gharial Sanctuary (Ken Betwa Prjct); Sone Gharial Sanctuary
  - National Chambal Sanctuary
  - Turtles:
  - Pancheshwar: Impact on Flora and Fauna

## **Flow-ecology relationships for Ganga river-2**

- Unknown relationships:
  - Improving understanding now
  - Improving Understanding in future
- We urgently need a credible report about state of ecology related to rivers in Ganga basin, on the lines of the WII report for Upper Ganga Basin.
- If we have rigorous EIA and Eflow studies by credible agencies for projects that come before MoEF, that can help improve our understanding.
- Further studies: Credible independent researchers to study specific stretches and species and their requirements.

# **E-flows: not just how much, but how?**

- How is the e-flows to be released from the dam would decide if the flow will serve the purpose it is expected to serve: flow continuity, connectivity, silt and biota also flow up and down.
- The e-flows wont serve this purpose if it flows through a dam tow power house as is recommended by MoEF's EAC.
- We have YET to achieve E flows (Even the ad-hoc, unscientific thump rule low eflows that official agencies recommend) for ANY RIVER IN INDIA. We won't achieve that as long as we do not have credible compliance agency. CWC is certainly NOT a candidate for that.

# Fish Ladders: Do they work?

- Fish ladder at Kuri Chhu HEP in Bhutan:  
<https://sandrp.in/2014/02/02/fish-ladder-at-kurichhu-hydropower-project-bhutan-some-thoughts/>
- No studies available with dam authorities if Fish use it. They sometime stop water in the ladder and see some small fish in the boxes.
- Larji Fish ladder, Himachal Pradesh:  
<https://sandrp.in/2014/12/17/larji-dam-fishladder-an-unlovely-trinket-a-deceptive-ornament/>
- The fish ladder itself was found to be in a state of disrepair.
- Narora Barrage Fish pass:  
<https://sandrp.in/2016/11/24/narora-barrage-fish-ladder-ganga-and-memories/>
- We were told it does work.



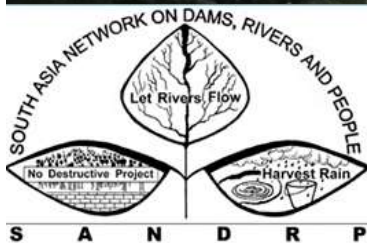


# Short & Long Term steps to achieve e-flows

- E-Flows is NOT a luxury: It is possible to provide justifiable water needs while also sustaining the river and its services
- Create successful pilots of river governance.
- Livelihoods, Biodiversity Criteria
- Informed decision making about everything that affects the river
- Participatory, Democratic Framework
- Credible Monitoring
- Accountable, confidence inspiring Compliance involving independent track record, ensuring there is no conflict of interest
- We are far away from achieving most of this!

# Thank You!

"The concern for man and his destiny should always be the chief interest of all technical effort. Never forget it amongst diagrams and equations"- Albert Einstein



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October 21-22, 2019, at Claridges Hotel, Delhi

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