POST-TEHRI DAM IRRIGATION SERVICE AND MODERNIZATION OF UPPER GANGA CANAL SYSTEM

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ABSTRACT

Multiple uses of Upper Ganga Canal (UGC) water- serving thirsty towns, major water feeder to Agra irrigation canals (of Yamuna basin), producing power at many UGC drops, presently irrigating an average 0.6 million ha against cultivable command area of 0.9 mha, generating water benefits @ US$ 1500/ha cropped area at the annual working cost of US $ 20/ha (2007-08) and revenue realized @ US $ 6/ha (based on irrigation rate of 1995) having cost of water @ US$ 0.10/m^3 justifies its capacity modernization from existing 297 m^3/s to 400 m^3/s as a result of additional water 113 m^3/s available post Tehri dam for water distribution in Kharif (wet season): 3 weeks on, one week off and in Rabi(dry season): 2 weeks on and two weeks off.

Based on the ecological flow requirement for a specific reach of the river Ganga, the bare optimal flow need has been estimated as 72% for upper and 45 to 47% of mean annual run off natural for middle reaches respectively.

SUMMARY & CONCLUSIONS

The Ganges River, like most Indian rivers is highly degraded and regulated with over-abstraction of water posing a threat to its many river sub-basins. The combined effect of low flow and discharge of polluting effluent into River Ganga has caused severe deterioration in the quality of water. Vulnerability of 5 million people livelihoods and biota to climate change calls for prioritization of adaptation strategies.

Three key questions are to be addressed: what impact does flow have on water quality? What impact does water quality changes have on biota; and what impact does water quality changes have on cultural and social aspects?

To establish a framework for sustainable energy and water resources management in Upper Ganga river basin, it is concluded that dilution of pollution by releasing additional water from Tehri dam is not advisable at the cost of irrigation and hydropower generation which is another scarcer resource. It is recommended to promote and advocate measures for water and energy co-management in agriculture so that potential base flows are available down stream of diversion structures for the sustainable flow in the river Ganga. Water balance study suggests that in upper reaches catchment contribution from Tehri to Haridwar is always positive, between Haridwar to Narora is often negative during lean flow months (up to 55% of flows) and Narora down stream to Allahabad is again highly negative due to

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unbalance use of surface and groundwater resources in the middle reach of Ganga river. Therefore, the impact of releasing additional water from Tehri Dam, Bhimgoda barrage, Ramganga feeder (Kalagarh dam) and Narora barrage particularly during lean flow months (December–March) to augment river flows at Har ki Paudi (Haridwar) and at Allahabad for Kumbh bath by million pilgrims, even at the cost of irrigation water seems to be unattractive. The better option to raise water level at Allahabad appears to be closing of nearby lift pump canals existing between Kanpur & Raebareli (sum of capacity 34 m^3/s) and escaping Sarda Sahayak canal water from Bhadri escape into the Ganga River (11 m^3/s)only as compared to 71 m^3/s water released from Narora and Haridwar respectively from long distances 600 to 1100 km upstream and that in turn 300 to 400 m^3/s water released from Tehri dam hindering hydropower generation during summer. The other option may be construction of barrages at suitable places.

PROCEDURE AND METHOD

To map irrigation services of Upper Ganga Canal, ten steps of MASSCOTTE was applied at workshop held on Meerut jointly by FAO and Irrigation department, Uttar Pradesh to finalize the modernization options by participating field engineers including the opinion expressed by farmers during field visits.

Water balance study was conducted by the author using long term gauge-discharge data available with SWaRA, Irrigation department, Uttar Pradesh and Upper Ganga Basin Organisation, Lucknow, Central Water Commission, GOI.

Environmental Flow Requirement (EFR) study conducted by WWF-India under HSBC Living Ganga Climate Partnership with expert's help from IWMI, UNESCO-IHE, IITs (New Delhi and Kanpur), PSI Dehradoon, and SWaRA , using Building Block Methodology.

1.0 BACKGROUND

1.1 The Upper Ganga Canal system is about 160 years old. It receives water through a head works at Mayapur diverting flow at Bhimgoda barrage across the river Ganga. The main canal is 290 km long with a network of 115 distributaries. The command area of UGC is located between 27^0N to 30^0N latitude and $77^0$15'E to $78^0$40'E longitude. The modernization of old control structures was taken up by end of twentieth century at estimated cost of US$ 200 million.

1.2 Planned withdrawals from Ganges by canal systems are 1217.79 m^3/s in monsoon (Kharif) and 538.09 m^3/s in non-monsoon (Rabi) crop seasons. Total about 27.3 BCM per year water diversion in Uttar Pradesh that forms about 60% of mean annual runoff for Ganga up to Allahabad. Environmentalists and even Courts are questioning huge river water diversions for irrigation against ecological needs of river Ganga.

1.3 Dependence on ground water irrigation in Ganges canal command (UGC, EGC, PUGC, MGC-I & MGC-II, LGC, PLGC) area from Haridwar to Narora has increased from 1.67 BCM pre Tehri, Kotlibhel, Utyasu and post Ramganga dam to 4.71 BCM post Tehri, Kotlibhel, Utyasu and post Ramganga dam due to reduced water available for surface diversion from 16.81 BCM to 13.78 BCM on 75% dependability for the monsoon period (1st June to 31st October)[1].

1.4 Due to lowering of groundwater tables lateral seepage from the boundary streams has gone up as consequence regenerated flows in river down stream is reduced. Study of river losses in Ganga by the author between Haridwar and Narora and analysis of river water levels at gauge-sites of Ganga downstream Narora to Allahabad during December 2009 to May 2010 confirms this happening.

1.5 The Madhya Ganga Canal (MGC) project (monsoon channel) conceived for increasing groundwater recharge and also feeds water to UGC system in its tail reach. The benefits of groundwater recharge due to seepage from canal system and irrigated fields in Kharif season of Lakhaoti branch "148 to 197 mm depth that nearly matches the recharge due to rainfall" is well documented by Chawla[2] (2005), Goel and Jain (2005)[3]. However, due to rise in water table "lateral seepage from the boundary streams goes down that corresponds to 45 to 23 mm over the study area".

1.6 The major intervention with river Ganga came in the form of the 260.5 m high Tehri dam-the fifth highest rock fill dam of the world (live storage 2.61 BCM and gross storage 3.54 BCM). The dam started filling since 2005 in stages and commissioned in 2007 to generate 1000 MW hydropower in first stage. The reservoir water level are MWL 835 m, FSL 830 m and dead stock level 740 m, beyond which no power generation can be made. This reservoir has reduced flow variability from 76 to 34.

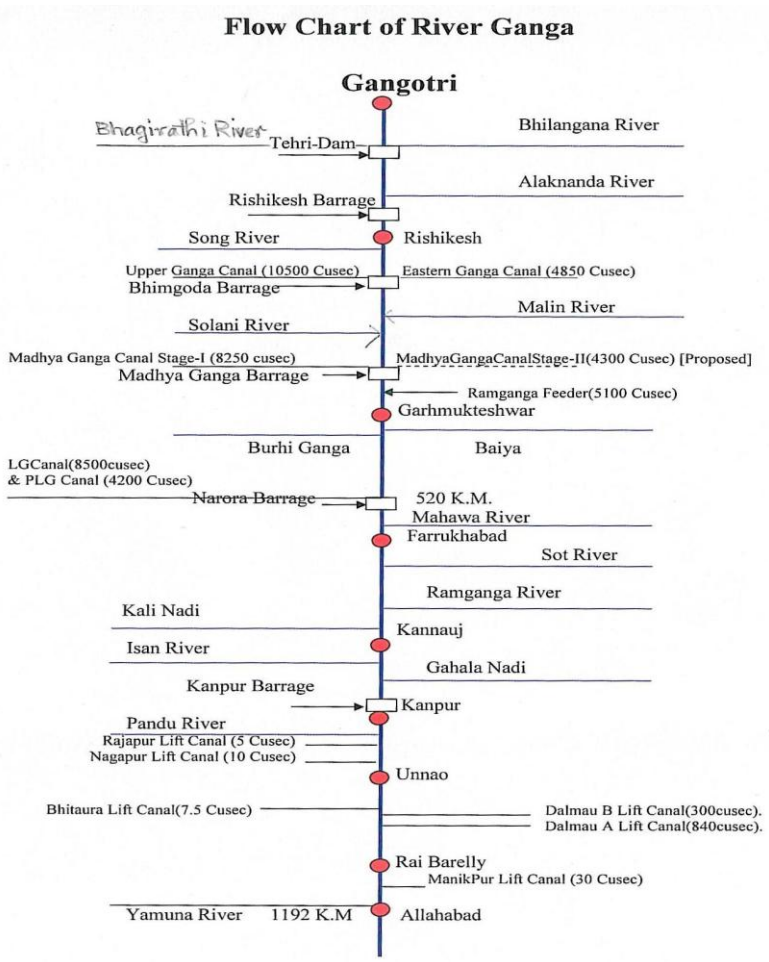

Figure 1: Line Diagram of Ganga River System Showing Canal Withdrawals and rivers Inflows.

1.7 After construction of dams at Tehri, and barrages for diversion of water at Haridwar (UGC & EGC), Bijnore (MGC-I & proposed MGC-II), Narora (LGC & PLGC) and Kanpur barrage (to supply city water), the Ganga flows down 1200 km to Allahabad where lean flow remains unsatisfactory and quality is not even fit for bath. Though sufficiently large quantity of water has been released from Tehri dam to meet the bathing needs of pilgrims at Haridwar during Mahakubh bath festival at Har ki Paudi in the current year of 2010 (wherein 30 million pilgrims took holy dip in Ganges), leaving less water in reservoir for power generation during summer, hardly 40% generation possible during May, 2010.

1.8 Post Tehri dam, Uttar Pradesh state is getting 113.28 m^3/s additional water at Bhimgoda barrage (Haridwar) for the purposes of augmenting existing Ganges canal systems to irrigate 270,000 ha of land and drinking water needs 14 m^3/s for New Delhi etc. The Upper Ganga Canal (UGC) which off-takes from right bank of Ganga river from Bhimgoda barrage, has been increasingly modernized for higher capacity now for 382.32 m^3/s (2007-08) from 297.33 m^3/s (1951-52), 191.16 m^3/s (1938) with original 185 m^3/s (1855) capacity to serve agricultural, industrial and drinking water needs in Ganga-Yamuna doab. Flow chart of river Ganga: canal withdrawals and major tributaries inflows at diversion sites, has been shown in Figure-1.

2. 0 PRE CANAL AND PRE-TEHRI GANGES NATURAL FLOWS AT HARIDWAR

2..1 Col. P.T. Cautley (1842)[4] measured the discharge of the Ganges river just above Hardwar (Raiwala weir), the supply of which in the month of January and December, which might be considered minimum at that point was equal to 226.56 m^3/s - an amount that did not differ in any great degree from that which was formerly given by Capt. Herbert about ten years before, the lowest in driest season of the year was measured at Haridwar 202.95 m^3/s and Garhmukteshwar 245.97 m^3/s on 1st March, 1842 respectively. Maj. Abott of the Engineers Committee considered that 'in abstracting 191.16 m^3/s from the Ganges at Kunkul, the navigation of this river will not be injured below Kanpur'.

2.2 The average river flows in the Ganga near Haridwar in monsoon season (July to September) range between 2000 to 3000 m^3/s and the lean flows are about 10 m^3/s. Average annual flow of Ganga is 23.90 BCM at Haridwar, 31.40 BCM at Narora, 58.9 BCM at Kanpur and 152.00 BCM at Allahabad after confluence with Yamuna river 92 BCM water.

2.3 Post Ramganga dam & Post Madhyaganga barrage Hydrological Data Analysis at Haridwar, Bijnor and Narora barrage: Based on 1935-36 to 1973-74 measured data at Bhimgoda and Raiwala, the values of annual yield, time based yield i.e. Kharif (April to September) and Rabi (October to March) at 75% & 50% dependable flow is given in Table-1.

Table-1 Yield of river Ganga at different places in BCM

Sl. No	Period/Time base	At Bhimgoda with dependability		At MGC Barrage with dependability		At Narora with dependability	
		75%	50%	75%	50%	75%	50%
1	Annual	23.17	26.70	25,48	28.67	26.72	32.01
2	Kharif (Apr to Sep)	18.98	21.13	20.02	22.45	20.93	25.70
3	Rabi(Oct to Mar)	4.19	5.57	5.46	6.22	5.79	6.31

Source: WAPCOS study on Modernization of UGC project[5], Uttar Pradesh Irrigation Department

2.4 Flow Variability: Pre & Post Tehri Dam

The discharge variability of the river systems could be assessed through the ratio between the Qmax and Qmin daily discharges to gauge the intensity of floods in the Ganga River. An idea of monthly flows in Ganga at Haridwar and Qmax/Qmin ratio pre and post Tehri suggests that the flood flow of the Ganga has been modified from maximum 76 times to lean flow in 1995 (Pre Tehri) to 26 to 34 times Post Tehri as shown in Table 2. By way of comparison, it may be noted that this figure is only 4 for river Amazon. The Ganga River is perennial but the variation of flow is further accentuated by its diversion for various purposes, in particular, irrigation.

Table-2 Flood flow to lean flow ratio of Ganga at Haridwar

Year	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Qmax/Qmin	35.56	55.11	51.32	76.03	29.32	71.63	43.09	30.57
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Qmax/Qmin	35.27	30.26	37.46	33.73	34.77	49.20	26.16	33.68

Source: Irrigation department, Uttar Pradesh

The monthly flow variability is shown in Figure-2.

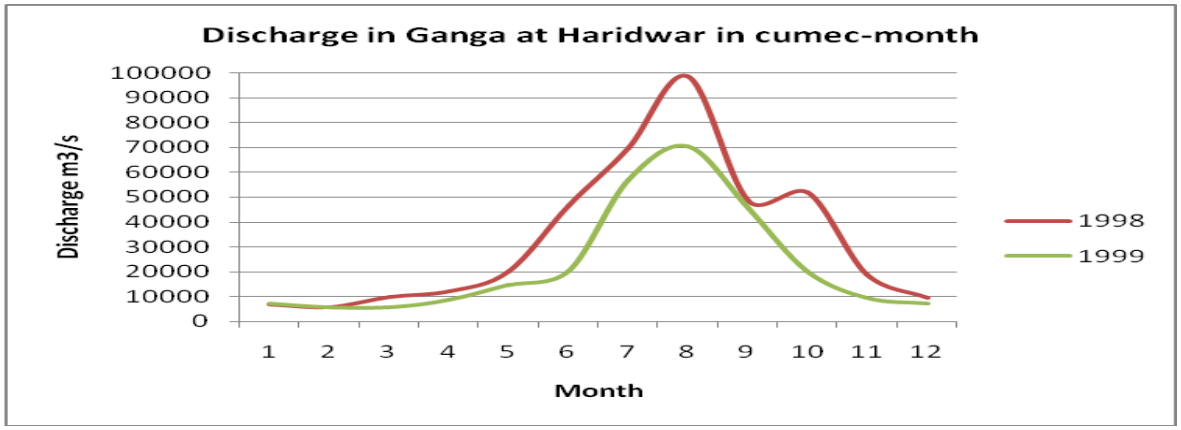

Figure 2 Monthly river Ganga Flows at Haridwar

2.5 Commitments of Commissioned & Ongoing Irrigation Projects

The barrage at Bhimgoda diverts water into UGC & EGC whose authorized discharges beyond silt ejector are 297.33 m^3/s & 137.40 m^3/s respectively. UGC is perennial canal whereas EGC is stipulated to run from 11 June to 20 Oct. MGC barrage feeds MGC Stage-1 with authorized discharge 234.46 m^3/s during kharif and MGC- Stage-II with authorized discharge 121.8 m^3/s is also proposed from left bank of the regulator of this barrage. Narora barrage on river Ganga-LGC with authorized discharge 240.69 m^3/s and PLGC with authorized discharge 118.93 m^3/s take off. The former canal runs both in Kharif & Rabi while the later runs only in Kharif. LGC is also augmented from Ramganga project through Ramganga feeder which outfalls in river Ganga near Sherkot in district J.P.Nagar. The combined discharge capacity of all these six canals is 1150.61 m^3/s.

2.6 **Water availability in Ganga river and Ganges Canal System (2009-10)**

Monthly water released from Tehri dam and its availability at Bhimgoda barrage (Haridwar) and allocations in various canal systems is tabulated in Table-3. The upper Ganga Canal water balance for kharif, rabi and zaid is shown in Figure-3.

2.7 **Mapping System and Services of UGC**

UGC is designed for Kharif 66% of CCA (April to September) & Rabi 40% of CCA (November to March), scheduling at distributaries level is based on availability of water during previous year and roster practiced is KHARIF : 3 weeks ON 1 week OFF - RABI 2 weeks ON 2 weeks OFF. Service to farmers: Proportional system: Deliveries of discharge in distributaries (based on ratio of land) and proportional sharing along distributaries and minors.

Table-3 Water availability in Ganga river and allocation to Canals(2009-10) in m^3/s

Month	Releases from Tehri Dam	Water availability at Haridwar	Water allocated to UGC	Water allocated to EGC	Water allocated to MGC#
1	2	3	4	5	6
June	6074	15354	10409	683	2674
July	4097	28396	10546	2432	7432
August	3637	35576	10521	3032	6343
September	3037	44147	8795	2153	4961
October	4132	14434	874	60	200
November	4026	8650	7191	83	0
December	5015	9850	7099	129	0
January	7380	11209	7070	0	0
February	7628	10615	7923	0	0
March	8122	11145	9200	68	0
April	6957	9171	7522	0	0
May	5085	11435	8159	0	0
Total	65190	209982	95309	8640	21610

Note: Colum 3 of Table-3 gives contribution of rivers Bhgirathi , Alaknanda and tributary joining Ganga above Hridwar. # MGC System is downstream Haridwar and off-takes at Rawaliwala (Bijnore) and feeds UGC in tail reaches.

To map irrigation services of Upper Ganga Canal, ten steps of MASSCOTTE was applied at workshop held on Sept 15 to October 15, 2008 at Meerut jointly by FAO and Irrigation department, Uttar Pradesh to finalize the modernization options by participating field engineers including the opinion expressed by farmers during field visits. It was observed that

1. Allocation: Sufficient during kharif , Insufficient for rabi
2. Out put per cropped area US$ 1500/ha
3. Out put per unit irrigation supply US$ 0.10/m^3
4. Recovery of Revenue: the cost of service comes to about US$ 20/ha (INR 929) against recovery from farmers of US$ 6/ha (INR 299) for the year 2007-08 Meerut division, Ganga Canal.
5. Water balance: For UGC system water balance is shown in figure-3.

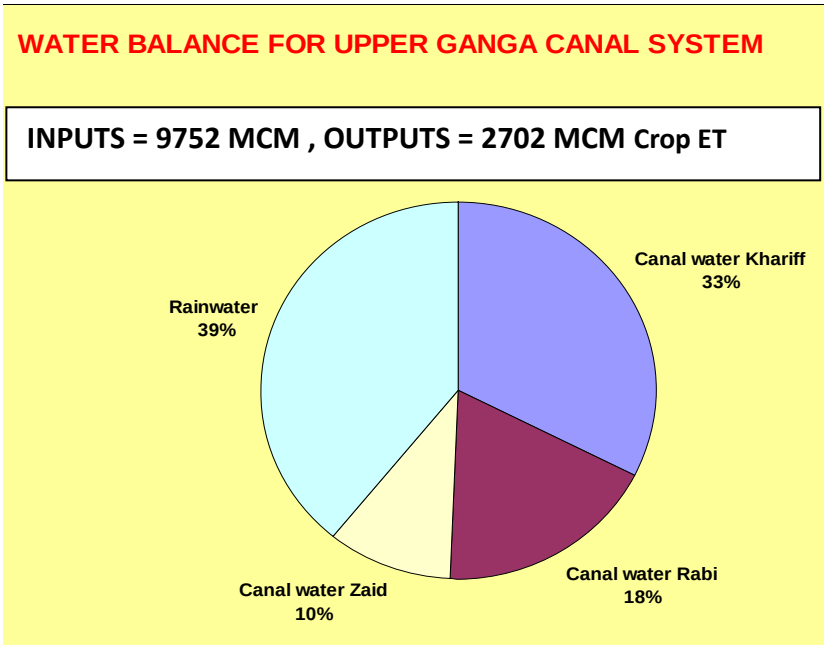

Figure-3 Water Balance for Upper Ganga Canal

2.8 Irrigation service of Lower Ganga Canal System

Lower Ganga Canal (LGC) was commissioned in 1878. The LGC off-take from Narora, 500 km downstream Tehri Dam. The canal roster planned on the basis of average water availability in the river Ganga. For the period April to December 2009 and January to June 2010 data as shown in Table -4 , LGC is actually running 83% of the planned roster in recent years. Not only this, committed water to Panki Power plant at Kanpur supplied through Kanpur branch and water supply to Gas Authority of India through Etawah branch of LGC at a time became difficult to do so because of water released downstream Narora for Kumbh bath at Allahabad to avoid contempt of Court Order.

Table-4 Roster and Actual water availability in LGC system in cumec month at Narora Head

Year/Month	Roaster	Actual	Running days
Apr-09	906	760	7
May-09	4200	2375	31
Jun-09	6968	3939	30
Nov-09	4662	2714	30
Dec-09	2431	1878	31
Jan-10	3415	3362	31
Feb-10	2597	3553	28
Mar-10	923	2981	31
Apr-10	827	840	7
May-10	2409	2148	31
June-10	1573	1121	15
Total	30911	25671	272
Average per day	113.64	94.38	83%

Source: CE, Ram Ganga Organisation, Irrigation Department, Uttar Pradesh

3.0 WATER BALANCE STUDY AT NARORA: POST TEHRI SCENARIO

3.1 Due to meandering tendency the river dugs new channels and tries to flow in many such channels and deposits sediment at the other place. With the increasing sedimentation load in Ganges, it is difficult to maintain the water depths in active channel the desired for bathing or navigation.

3.2 Water availability on 12th June,2010 at Narora u/s was 101.95 m^3/s, out of which 70.80 m^3/s released for Sangam Snan, leaves 31.15 m^3/s against LGC designed capacity at head 240.69 m^3/s. These releases from Narora including 56.64 m^3/s from Haridwar may provide temporary relief at the cost of irrigation water (about 0.16 million ha would remain un irrigated of 12 districts in Rabi), but is an effort to solve greater problem of hydraulic integrity of the river.

3.3 Losses in Ganga River Course: Haridwar To Narora

Water appear as regenerated flows in river downstream (the under- current which percolates the gravelly bed, together with the drainage of the intermediate country), sometimes positive and in some stretches negative balance (as a consequence reduced flow is observed). Water released from Bhimgoda barrage and Ramganga feeder in Ganga river and actual water received at Narora barrage during lean flow months, the difference in terms of gain/loss in percent is given in Table-5. These losses are due to evaporation in river water and groundwater recharge by river. The excessive groundwater pumping for agriculture in the catchment area Haridwar to Narora hardly allow to appear regeneration flows in the river during pre monsoon period whereas the catchment contribution Tehri to Haridwar has been found positive through out the year.

Table-5 : Water losses in River Ganga between Haridwar to Narora Lean Flow Months

Month/ Year	2006			2007			2008		
	Rel.	Recd.	Losses %	Rel.	Recd.	Losses %	Rel.	Recd.	Losses %
DEC	3055	4551	-49	4949	3815	23	7212	4644	36
JAN	4388	5079	-16	5989	5393	10	9451	6828	28
FEB	4276	3299	23	5899	3551	40	10011	4742	53
MAR	4558	4391	4	6680	5684	15	5356	4980	7
APR	2433	2311	5	4096	3946	4	5099	4734	7
MAY	8139	4966	39	6254	4569	27	7611	5207	32
JUN	10842	7961	27	15522	8479	45	21252	21383	-1

Month/ Year	2009			2010		
	Rel.	Recd.	Losses %	Rel.	Recd.	Losses %
DEC	8764	7212	18	3898	3147	19
JAN	10024	6996	30	5289	5238	1
FEB	7437	4742	36	2552	3066	-20
MAR	3723	3775	-1	3203	3911	-22
APR	2895	2881	0	2736	2664	3
MAY	4666	4341	7	3101	2423	22
JUN	6669	4353	35	6939	3147	55

Note: Rel.= Sum of releases made from Bhimgauda Barrage and Kalagarh Dam through Ramganga Feeder, Recd= Water reached up stream of Narora Barrage.
Source: Irrigation Dept.

3.4 **Releases of water from Narora for Kumbh bath at Allahabad**

70.80 m^3/s water from Narora is released since 16th December till January and 42.48 m^3/s per day in general. Impact in rise of water levels at various gauge sites of Ganga downstream Narora due to releases made for Allahabad Kumbh bath has been studied for Narora downstream, Kachlabridge, Fatehgarh, Kannauj, Ankinghat, Bhitaura, Dalmau, Shahzadpur, Phaphamau, Sangam and Chhatnag and shown in Figure-4 for Dec 2009 to May 2010.

It is seen from Figure 4 that immediate rise in water level is visible up to Fatehgarh and ripple effect after due travel time is seen further downstream and declining trend is observed with passage of time during lean period.

It is clear from Figure 5 that a release of 0.64 m down stream Narora generates effective rise in water level along the river in general, 0.48 m at Kachlabridge, 0.41 m at Fatehgarh but of lower magnitude, simply 0.10 m at Kannauj and 0.5 m at Ankinghat and with similar trend at Kanpur.

The presence of a barrage at Kanpur modify rise in water level 0.16 m down stream at Shuklaganj gauge site (Kanpur) that further decline to 0.09 m at Bhitaura, 0.08 at Shahzadpur with exception of 0.11 m at Dalmau (the site of lift pump canal when closed). Highest rise in water level 0.20 m at Phaphamau is resultant of closing lift pump canal Dalmau A & B and Sharda Shahayak canal water releases made from Bhadri escape into Ganga river up stream Phaphamau that tends to decline at Sangam. The high rise in water level at Chhatnag is due to confluence of Yamuna river with Ganga river down stream of Sangam. Monitoring of water levels at various gauge sites corresponding to releases made from Narora reveals only small rise in water level (0.10 to 0.05 m) occurring due to water losses in the catchment along the course of the river down stream Narora to Allahabad as found in the reach of Haridwar and Narora (please see Table-5).

3.5 Historical Discharge Characteristic in Ganga at Shahzadpur Cross Section, 40 km u/s.

All the canal abstraction from Ganga river between Kanpur and Allahabad are situated up stream of Shahzadpur, 40 km up stream Allahabad, which is G-D sites of Central Water Commission. Fifty years gauge discharge data analized for (1960-2010) maximum, minimum and average monthly flows. The monthly flows for the year 2006-07 and 2009-10 as compared to long term monthly average is shown in Figure 7. It is clearly visible that 2006-07 flows are far below average flow but after February due to occurrence of winter rainfall in up stream catchment, the river discharge is more than average during the summer months March-April and May. The current year flows 2009-10 have been equal to average figures during lean flow months (Nov. to Feb.) but low discharges for summer months. Therefore, in the year 2006-07 it appears genuine to file Public Interest Litigation (PIL) in High Court of Allahabad asking for more releases of water in Ganga from reservoirs but the similar demand during the year 2009-10 does not appear to have technical ground except cultural/religious ground. The 50 years average water level at Shahzadpur during winter (Jan-Feb) month and summer month (Mar-Apl) trend do not show declining trend (please see Figure-8).

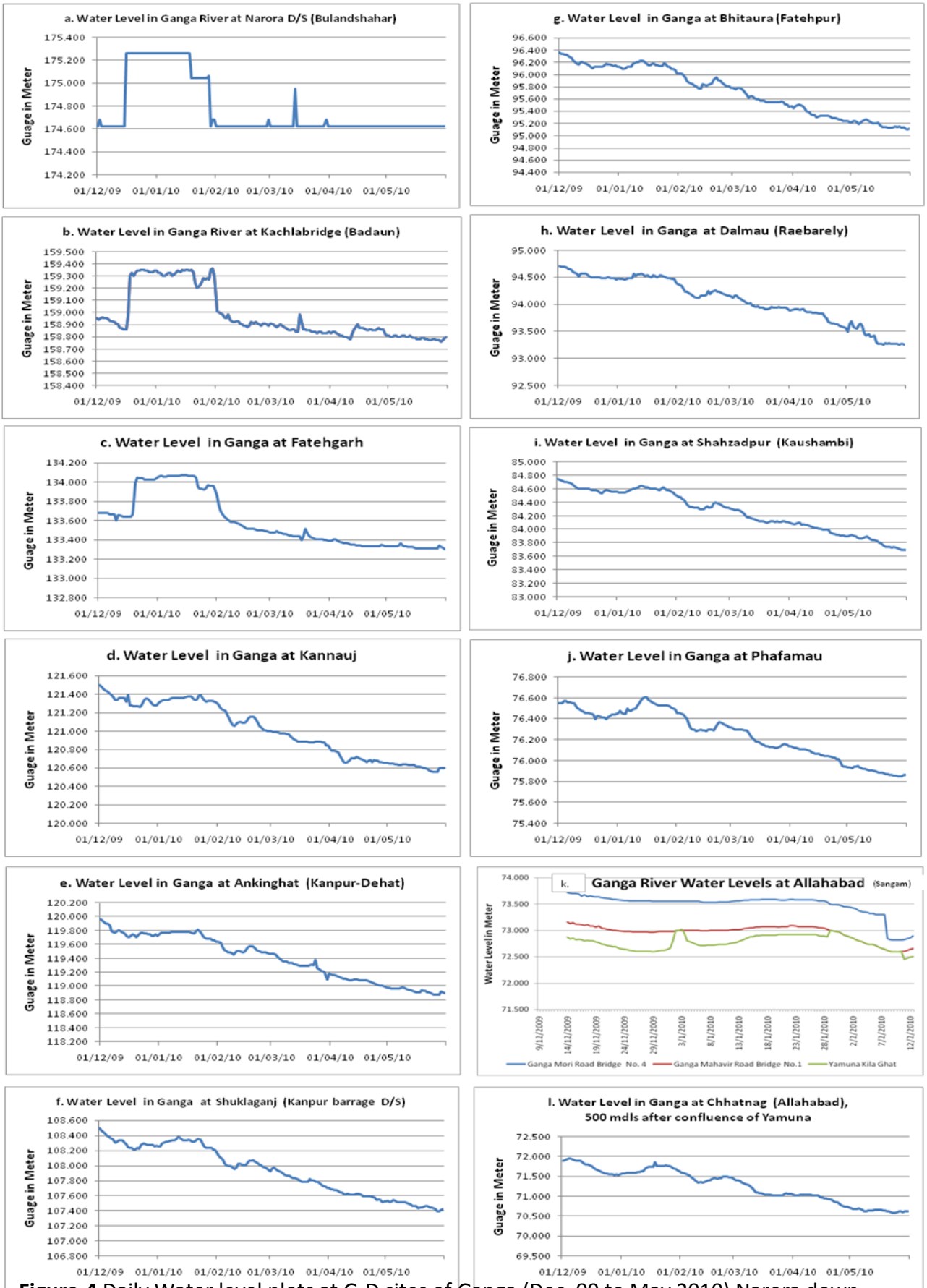

Figure-4 Daily Water level plots at G-D sites of Ganga (Dec. 09 to May 2010) Narora down.

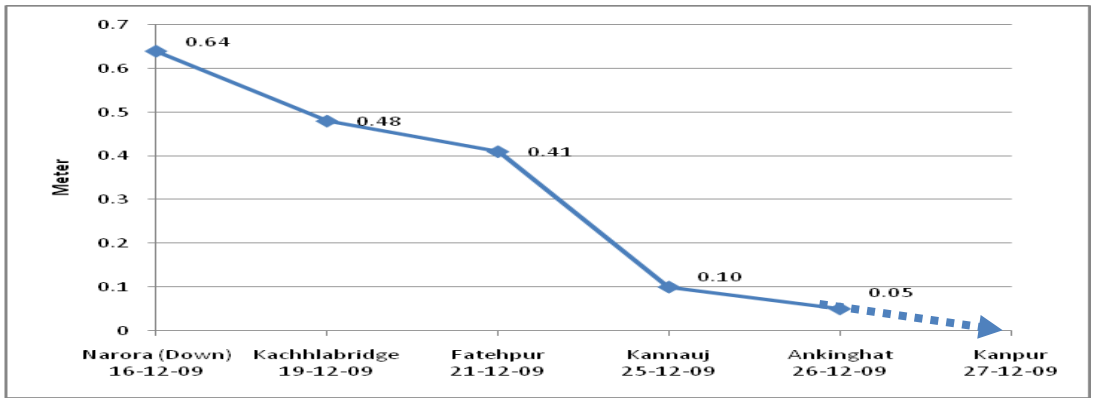

Figure-5 Rise in Water Level Due to Additional Releases in Ganga during 16-31 Dec. 2009

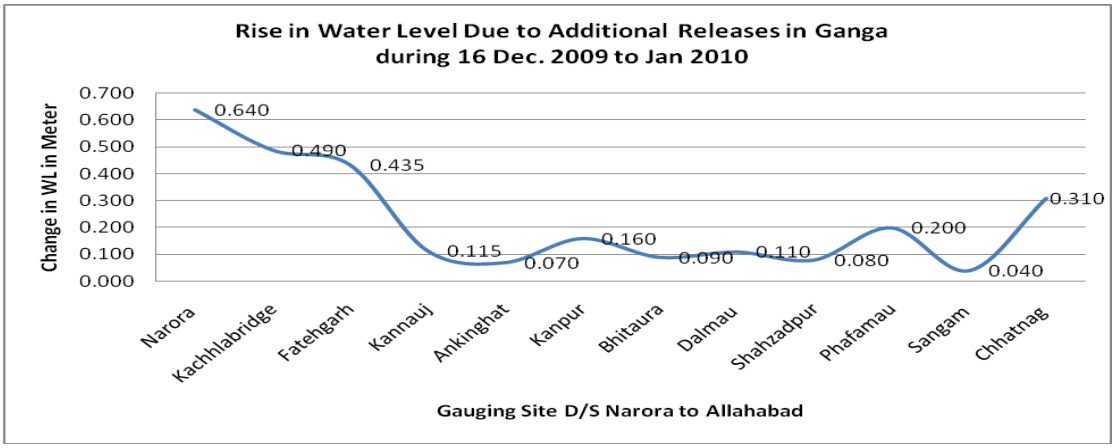

Figure 6. Rise in water level after closing Dalmau Lift pump canal and releasing canal water down stream Shazadpur.

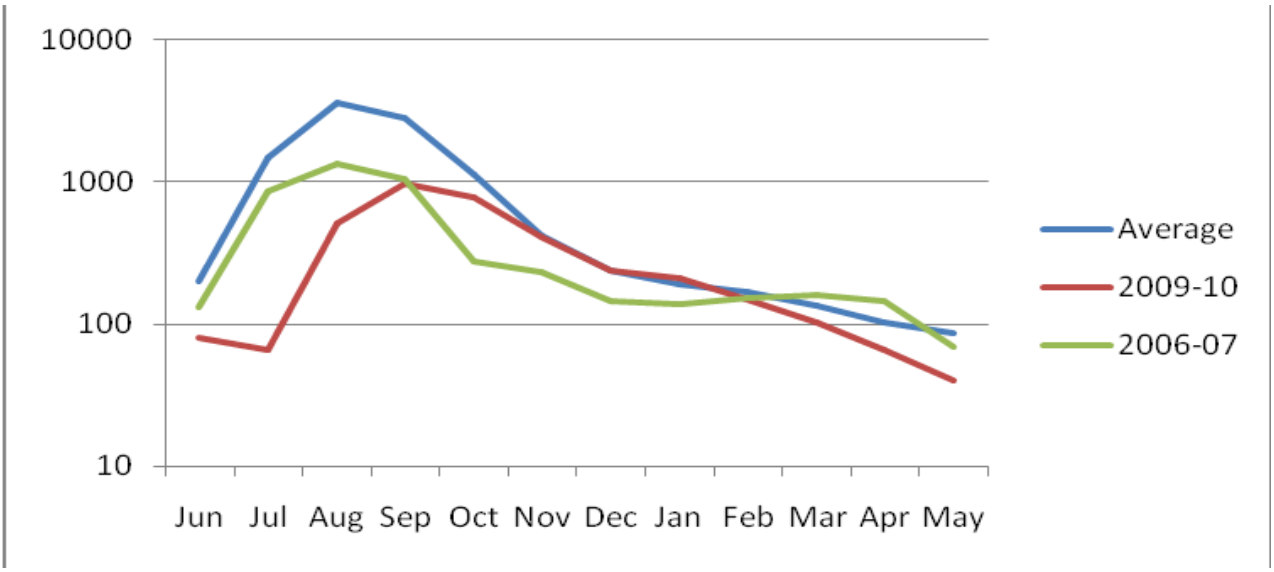

Figure 7 Average flow Vs Year 2006 & 2009 flows in river Ganga at Shahazadpur

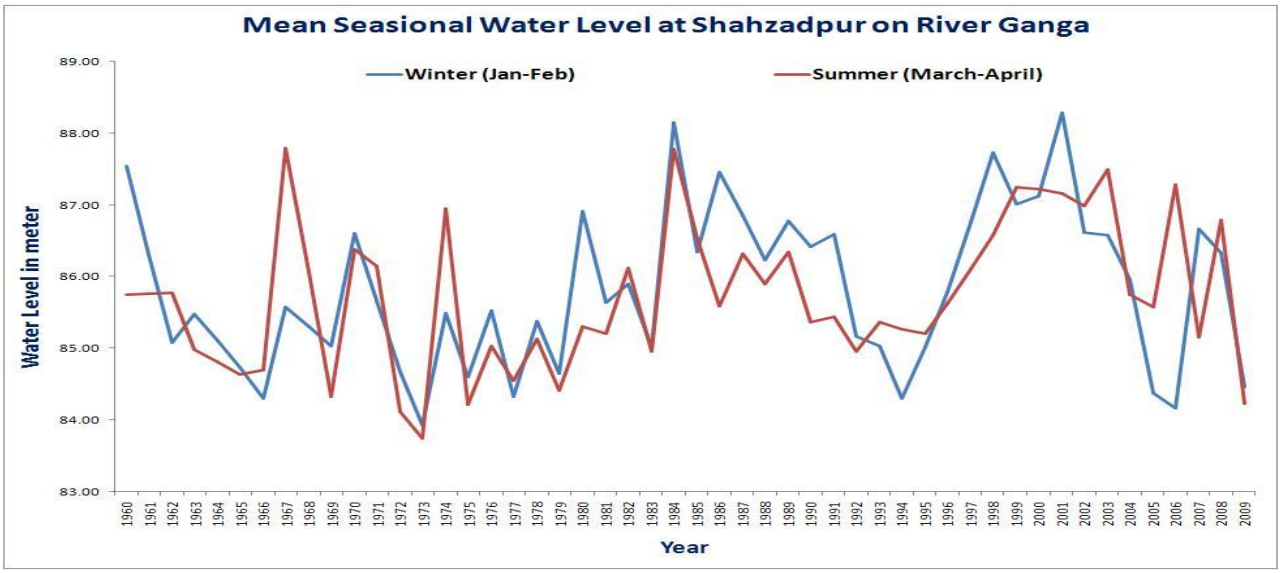

Figure-8 Long term average water level trend during winter(Jan-Feb) and summer months (Mar-Apl) at Shahazadur, Ganga.

Adequate depth required for bathing 3-4 m is available in 200 m wide channel at Shahazadpur as shown in Figure-9. It is again stressed here that present cross section (2009) can only be completely submerged at FSL level of 9/9/ 1978 which corresponds to highest flood year. Figure 9 also depicts changes in cross section as result of sedimentation load during post monsoon as compared to pre-monsoon.

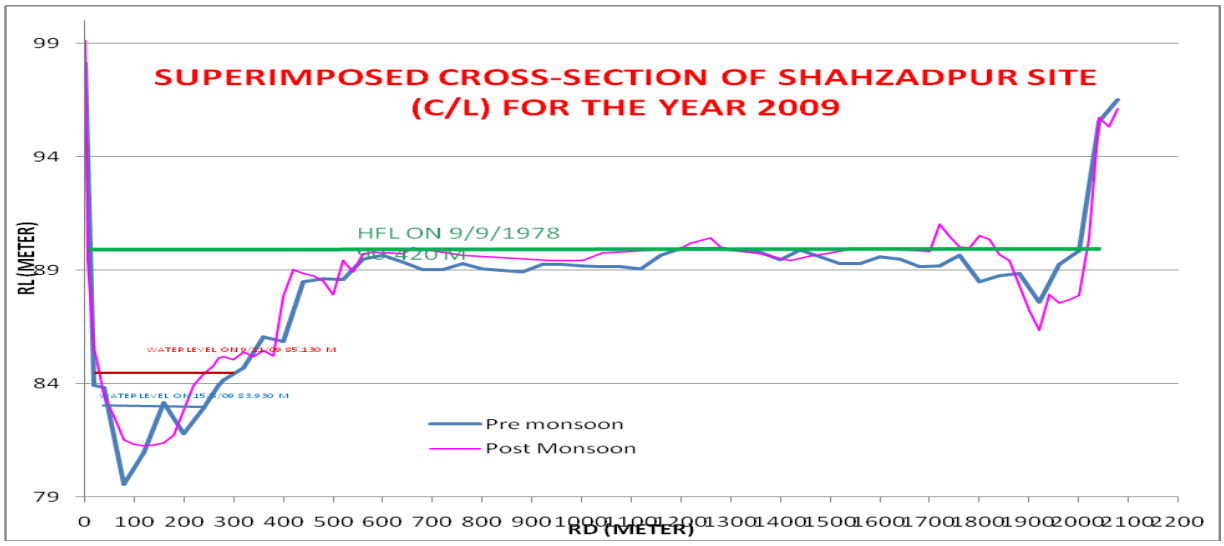

Figure-9 Cross Section and Water Level in Ganga at Shahzadpur Source: Courtsey, Upper Ganga Basin Organisation, CWC, Lucknow.

4.0 SUSTAINABLE FLOW REQUIREMENTS FOR THE UPPER AND MIDDLE REACHES OF GANGA RIVER

There is link between river cross section, habitat, fluvial geomorphology and biodiversity with various flows. In order to plan a detailed monitoring programme to enable identification of the most sensitive zones with respect to the biodiversity homogeneous zones, the Ganga has been divided in four zones: Himalayan (Gangotri to Rishikesh), reference (Rishikesh to Narora) and Middle zones (Narora to Farrukhabad) and (Kannauj to

Kanpur). The flow requirement for cultural/spiritual, livelihoods, sports, habitat/nutrients, depth for biodiversity, velocity for sedimentation transport, refill and pools sequencing for the maintenance year, drought year and flood year for the month of lean (January) and wet (August) was considered.

Based on the above requirements for a specific reach, the bare optimal flow need has been estimated as 72% for upper and 45 to 47% of mean annual run off natural for middle reaches respectively. Confidence level corresponding to simulated flows needs validation by field observed data.

5.0 CONCLUSIONS

- Modernization of UGC system 297 to about 400 m^3/s capacity at head in post Tehri scenario is justifiable.
- Dependence on ground water irrigation in Ganges canal command has increased lateral seepage from the boundary streams.
- Monsoon channels such as MGC-I, EGC and PLGC could recharge groundwater, save energy for pumping groundwater by reduced lift by way of raising water table in addition to the benefits accrued from the increased productivity from irrigated areas.
- Water transfer from long distance through rivers face huge water losses as compared to beneficial losses in canal system.
- Releasing additional water from Tehri dam, Haridwar and Narora barrage for Kumbh bath festival at Allahabad wherein 20-30 million take dip in river Ganga-the holy mother river of India on cultural/spiritual/ecological count at the cost of irrigation is no more attractive option due to huge water losses in river course.
- The alternative and better option is to close nearby lift canals and releases made from Bhadri escape of Sarda Sahayak canal system into river Ganga to ensure adequate water depth for bathing in active channel of Ganga.
- Preliminary assessment of ecological flow requirement in upper reach (at Kaudiyala, 30 km up stream Rishikesh) is estimated by a team of experts is 72% MAR and for middle reaches at Kichlabridge (Badayun) 45% and at Bithoor(Kanpur) 47% MAR natural of river Ganga.
- Below Narora there are major problems in terms of water quality and quantity in the lean season. People should realize that water quality and ecological flows are two different things.
- Committed river water diversions have to be partially compensated by catchment treatment and thereby ensuring base flows to appear in rivers as regenerated flow in river Ganga so that it may remain continuously flowing with its assimilative capacity.
- Monsoon channels are one of the several options to use flood water in recharging groundwater and reducing lateral seepage from the boundary streams.

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