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WELCOME

Hydrology and Water Quality Scenario of Bagmati River

Presented By

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Bagmati River Basin Hydrology

- River Basin selected for Demonstration Project of AWCII activities in Nepal.
- Medium size River Basin with C.A. 3700 sq.km up to Indo-Nepal Boarder.
- Total C.A. is 14384 sq.km. up to outlet point at Khormaghat in North India with Koshi River
- Geographically it extends between $20^{\circ} 42'$ to $27^{\circ} 50'$ north latitude and $85^{\circ} 02'$ to $85^{\circ} 58'$ east longitude

Bagmati River Basin

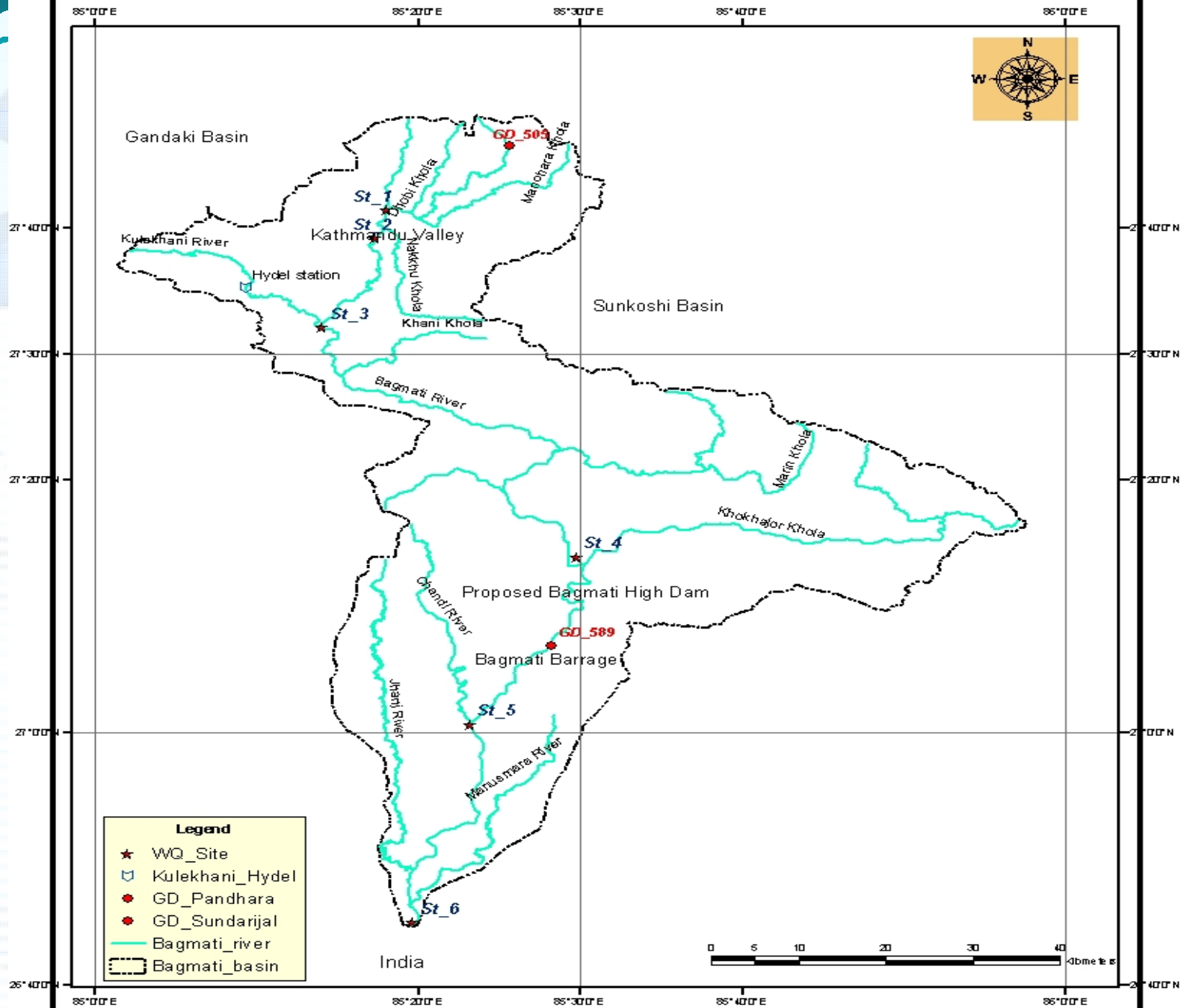
Hydrology

- It originates from Shivapuri Hill (2731 m amsl) and flows down south into plain (75 m amsl)
- Major tributaries of Bagmati River are Manohara, Bhishnumati, Kulekhani, Khokhajor, Marin, Chandi, Jhanj and Manushmara
- Climate condition – quite variable due to intricate topography. Temperature decreases with elevation.

Bagmati River Basin Hydrology

- Rainfall is influenced by mainly south-west monsoon which lasts between months of June and September. Orographic effect is pronounced and governs rainfall pattern
- Avg.annual rainfall in southern part of basin is 1500mm whereas in northern part – 2000 mm.
- Basin is divided into five significant sub basins

Bagmati River Basin



Prepared By: KK Shrestha

AWCI Demostration Project (Nepal)

Sub Basin Characteristics

Sub Basin	Area (Sq.km)	Drainage Length (km)	No Rain gauge	Drainage Density	Gauge Density
1	574.50	1909.435	18	3.324	1 in 31.92
2	306.62	1437.258	3	4.803	1 in 102.2
3	782.40	3402.05	1	4.348	1 in 782.4
4	1036.48	4126.244	0	3.981	-
5	1000.00	1032.242	4	1.032	1 in 250

Drainage Hierarchy Length

SN	Drainage Hierarchy	Drainage Length (km)
1	First Order	863.692
2	Second Order	291.234
3	Third Order	260.678
4	Fourth Order	113.555

Gauge Discharge site

GD Site	Area sq. km	Max River L (m)	Avg. Slop (%)	BF (basin factor)	Avg. Elv. m	PI _{ann} mm	PI _{mon} mm
505	17	5	13	1.16	2060	2174	1828
589	2922	113	11	1.59	1058	1749	1426

Gauge Discharge Site

- Long term average monthly and annual flow (m³/s)

GD	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Anu
<u>505</u>	0.33	0.27	0.25	0.25	0.31	0.92	2.74	3.88	3.14	1.38	0.66	0.44	1.23
589	20.4	15.6	12.5	12.6	28.3	110	415	416	351	121	43.9	26.3	135

- Flows Availability Assessment

GD Site	Flows for specified probability of Exceedence (m ³ /s)							
	0%	5%	20%	40%	60%	80%	95%	100%
505	5.90	4.18	2.58	0.75	0.406	0.234	0.160	0.073
589	1018	473	284	66.2	27	16.2	10.8	6.75

- Observed instantaneous peak flood – 16000 m³/s at GD site 589 (July 21, 1993)

Flood Estimation using Frequency Analysis

(three best fit distributions)

GD Site	Log Pearson III			Gen. Extreme Value			Log Normal		
	2 yr	10 yr	100 yr	2 yr	10 yr	100 yr	2 yr	10 yr	100 yr
GD 505	9.98	34.2	149	9.77	35.3	197	10.2	35.1	112
GD 589	3824	8798	22043	3782	8458	21614	4170	8518	15249

Bagmati River Basin

Water Quality

- Water Quality problem in Bagmati River is very acute
- Tributaries like Manohara, Bishnumati, Nakkhu, Ddhobi Khola are highly polluted
- Municipal wastage and industrial effluents are directly discharged into river. Out of total 4271 water polluting industries of Nepal, 2174 are operating in upper Bagmati sub basin
- Water is black and emanates a foul odor, no aquatic life in the Bagmati river along Kathmandu Valley.

Bagmati River Basin Water Quality

- Several studies have been carried to assess the quality of water of Bagmati River focused mainly within upper reach.
- All studies have reported that the water quality of Bagmati River in the Kathmandu valley is of very poor quality, chemically and bacteriologically, unfit for freshwater flora and fauna.
- Studies have reported that water quality is improved during rainy season due to increase of assimilative capacity of river

Water Quality parameters along Bagmati River (June 2007)

St. No.	PH	Conduc tivity $\mu\text{mos/cm}$	TDS mg/l	NH ₃ mg/l	NO ₃ mg/l	DO mg/l	COD mg/l	BOD mg/l
St-1	7.29	1460	825	84.52	0.38	0	770	420
St-2	7.48	874	468	45.64	0.32	1.50	390	195
St-3	7.88	662	345	23.18	5.03	6.90	37.50	16.50
St-4	7.26	246	154	4.73	0.11	6.30	82.50	34.0
St-5	8.36	446	254	0.07	<0.02	6.30	8.00	1.40
St-6	7.89	234	172	0.14	<0.02	6.00	26.00	7.00

Bagmati River Basin

Water Quality

- The water quality of Bagmati river is found of better quality as it moves down to Indian boarder.
- DO content in river water is critical and is found to be extremely low in Kathmandu Valley
- The condition is improved after mixing Kulekhani Khola with Bagmati River.
- As River traverses, the DO is found to increase

Bagmati River Basin Water Quality

- Reported that only 40% of daily generated BOD₅ in Kathmandu valley is drained out and remaining is retained in the valley which is major source of land and GW pollution

Bagmati River Basin

Water Quality

- PH is found not critical, suitable for irrigation purpose
- Other water quality parameters such as conductivity, total dissolved solids, NH_3 , BOD, COD and NO_3 are found to be very high in river water within Kathmandu as compared to river water outside valley.
- Ammonia (NH_3) is found improving as river moves down
- Two studies show that the water quality of Bagmati river is in declining trend

Bagmati River Basin Water Quality

➤ Mitigation Measures suggested

- Setting effluent standard
- Setting ambient river water quality standard
- Construction waste water treatment plant in Kathmandu valley
- On-site Sanitation
- Effective solid waste management
- Ban on river bed sand mining in the upper Bagmati sub-basin; and
- Increase assimilative capacity of the river in the upper Bagmati subbasin

Tributary – Dhobi Khola in Dry season



Bagmati Barrage during Flood



Kulekhani Reservoir



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Thank you