### HYDROLOGICAL MODELLING OF SON AND TON RIVER BASIN USING SWAT

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#### × River Ganges

- + 2510 km long; 907,000 sq.km
- + About 40% (400 million) of India's population live in Ganges (450/sq.km)

# GeoSpatial Database



# GRBEMP

- × Ganga River Basin Environmental Management Plan.
- Consortium of seven IITs to form a management plan for restoring river Ganga
- The role of water management group in this project is to predict the discharge for the current and future scenarios of development

Note : GRBEMP has different group with different functions, *Water management group* is one among them.

# IITM STUDY AREA IN GANGA BASIN



It was not possible to simulate Son as a single basin in SWAT hence it was devided into two basins.

# **162 UNIQUE SOIL CLASSES**



# LANDUSE/LANDCOVER DATA

- × NRSA Bhoosampada
  - + 56 meter resolution
  - Only crop seasons are identified; but crop is not specified
- IWMI (International water management Institute)
  - + 500 meter resolution
  - Irrigated areas identified from this and integrated with NRSA

#### **Sources of Landuse data**



# LAND USE LAND COVER MAP



### **District wise LULC**

GIS overlay
 + District + landuse

#### Statewise Agricultural Crop Distribution

State Name	Rice	Wheat	Maize	Other cereals	Pulses		
Bihar	49.6%	30.5%	10.1%	0.7%	9.0%		
Chattisgarh	73.0%	1.8%	1.9%	4.5%	18.7%		
Delhi	20.4%	49.7%	0.2%	29.0%	0.6%		
Haryana	24.2%	53.5%	0.4%	17.4%	4.5%		
Himachal Pradesh	9.9%	44.9%	36.6%	4.5%	4.1%		
Jharkhand							
Madhya Pradesh	14.4%	31.9%	7.2%	9.9%	36.5%		
Rajasthan	0.9%	16.9%	8.0%	46.3%	27.9%		
Uttar Pradesh	28.2%	46.5%	4.1%	7.3%	13.9%		
Uttarakhand							
West Bengal							
	National Agricultural Statistics						



National Food Security Mission (District level data)

Ħ	crop : Table								
	OBJECTID	ICNUM	CPNM	IDC	CROPNAME	BIO_E	HVSTI	BLAI	FRGR
	949	949 E	3065	4	Double/Triple Conjunctive in District Panipat	22	0.5	5	
	950	950 A	4066	4	Rainfed in District Rewari	33.5	0.45	3	
	951	951 E	E066	6	Current fallow in District Rewari	34	0.9	2.5	
	952	952 J	J066	7	Plantation/orchard in District Rewari	15	0.1	4	
	953	953 I	066	5	Kharif Surface Irrigation in District Rewari	35	0.42	4	
	954	954 H	1066	5	Kharif Ground water in District Rewari	35	0.42	4	
	955	955 (	G066	5	Kharif Conjunctive Use in District Rewari	35	0.42	4	
	956	956 N	1066	5	Rabi Surface Irrigation in District Rewari	35	0.42	4	
	957	957 N	V066	5	Rabi Ground water in District Rewari	35	0.42	4	
	958	958 L	_066	5	Rabi Conjunctive Use in District Rewari	35	0.42	4	
	959	959 F	P066	5	Zaid Surface Irrigation in District Rewari	35	0.42	4	
	960	960 0	D066	5	Zaid Ground water in District Rewari	35	0.42	4	
	961	961 F	-066	5	Zaid Conjunctive Use in District Rewari	35	0.42	4	
	962	962 E	D066	4	Double/Triple Surface Irri in District Rewari	22	0.5	5	
	963	963 0	2066	4	Double/Triple Ground water in District Rewari	22	0.5	5	
	964	964 E	3066	4	Double/Triple Conjunctive in District Rewari	22	0.5	5	
	965	965 A	4067	4	Rainfed in District Rohtak	33.5	0.45	3	
	966	966 E	E067	6	Current fallow in District Rohtak	34	0.9	2.5	
	967	967 J	J067	7	Plantation/orchard in District Rohtak	15	0.1	4	
	968	968 I	067	5	Kharif Surface Irrigation in District Rohtak	35	0.42	4	
	969	969 H	H067	5	Kharif Ground water in District Rohtak	35	0.42	4	
	970	970 (	G067	5	Kharif Conjunctive Use in District Rohtak	35	0.42	4	
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#### Son Basin Delineated with CWC Station at Kuldah Bridge as Outlet

Size: 1,71,884 Sqkm

Waterbodeis: 20

Artificial reservoirs: 12/20

Lakes : 8/20

Major Crop: Paddy, Wheat, Maize, Jowar, Barley, Bajra, Urad, Moong and Sugarcane.





#### Ban sagar Dam

- × Drainage area of Ban sagar Dam
  - + 18,648 sq.km
- × Drainage area at Kuldah Bridge CWC station
  - + 23,270 sq.km
- × Landuse
  - + Forest 50%
  - + Agriculture 40%
    - × Mostly rainfed
  - + Other 10%

Flow Duration Curve (FAO soils data)



Flow Duration Curve (WISE/NRCS soil data)



Kuldah Bridge (without Ban Sagar Dam)



#### Water balance

#### FAO soil data PRECIP = 1081.7 MM SURFACE RUNOFF Q = 255.59 MMET = 683.2 MM

#### NRCS/WISE soil data PRECIP = 1081.7 MMSURFACE RUNOFF Q = 50.11 MMET = 1021.0 MM

### **Diagnosis of soil data**



NBSS&LUP soil map With attributes from WISE/NRCS

13 unique soils



FAO soils

3 unique soils

#### × WISE/NRCS attributes

SNAM	NLAYERS	HYDGRP	SOL-ZMX	TEXTURE	SOL-Z1	SOL-BD1	SOL-AWC	SOL-K1	SOL-CBN1
NRCS-07N0784	7	С	1590	L	70	1.648	0.129	24.142	0.198
NRCS-93P0083	7	С	2100	L	160	1.625	0.111	12.976	0.154

#### × FAO

SNAM	NLAYERS	HYDGRP	SOL-ZMX	TEXTURE	SOL-Z1	SOL-BD1	SOL-AWC	SOL-K1	SOL-CBN1
Vc21-3a-3859	2	D	1000	С	300	1.353	0.128	0.862	0.800
I-bc-3735	2	D	1000	L	300	1.529	0.133	8.282	1.000

Table 7-1Criteria for assignment of hydrologic soil groups when a water impermeable layer exists at a depth between 50<br/>and 100 centimeters [20 and 40 inches]

Soil property	Hydrologic soil group A	Hydrologic soil group B	Hydrologic soil group C	Hydrologic soil group D
Saturated hydraulic conductivity of the least transmissive layer	>40.0 µm/s (>5.67 in/h)	$\leq 40.0 \text{ to } > 10.0 \mu \text{m/s}$ ( $\leq 5.67 \text{ to } > 1.42 \text{ in/h}$ )	$\leq 10.0 \text{ to } > 1.0 \mu \text{m/s}$ ( $\leq 1.42 \text{ to } > 0.14 \text{ in/h}$ )	≤1.0 µm/s (≤0.14 in/h)
	and	and	and	and/or
Depth to water imper- meable layer	50 to 100 cm [20 to 40 in]	50 to 100 cm [20 to 40 in]	50 to 100 cm [20 to 40 in]	<50 cm [<20 in]
	and	and	and	and/or
Depth to high water table	60 to 100 cm [24 to 40 in]	60 to 100 cm [24 to 40 in]	60 to 100 cm [24 to 40 in]	<60 cm [<24 in]

 Table 7-2
 Criteria for assignment of hydrologic soil groups when any water impermeable layer exists at a depth greater than 100 centimeters [40 inches]

Soil property	Hydrologic soil group A	Hydrologic soil group B	Hydrologic soil group C	Hydrologic soil group D
Saturated hydraulic conductivity of the least transmissive layer	>10 µm/s (>1.42 in/h)	≤10.0 to >4.0 µm/s (≤1.42 to >57 in/h)	≤4.0 to >0.40 µm/s (≤0.57 to >0.06 in/h)	≤0.40 μm/s (≤0.06 in/h)
	and	and	and	and/or
Depth to water imper- meable layer	>100 cm [>40 in]	>100 cm [>40 in]	>100 cm [>40 in]	>100 cm [>40 in]
	and	and	and	and/or
Depth to high water table	>100 cm [>40 in]	>100 cm [>40 in]	>100 cm [>40 in]	>100 cm [>40 in]

#### **Analysis for environmental flows**

Example

### FLOW DURATION CURVE SON<sub>cwc</sub> AT ITS VIRGIN STATE



### FLOW DURATION CURVE SON<sub>cwc</sub> MODELED WITH ITS RESERVOIR



