World Bosai Forum - Platform on Water and Disaster

Mapping Hydraulic and Physical Characteristics of the Indus Basin for Early Flood Warning System

by

Dr Manzoor Ahmad Malik

Pakistan Council of Research in Water Resources

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Objectives and Methodology

Objectives:

- To determine and map soil hydraulic characteristics of the upper Indus Basin plains.
- To record and map physical and textural profiles of the upper Indus Basin plains

Infiltration rate measurement and data analysis

- Used Double Ring Infiltrometers at three step wise layers of soil at surface, 0.5 m and 1.0 m depths.
- Volume infiltrated recorded by weighing the feeding container through funnel and pipe.
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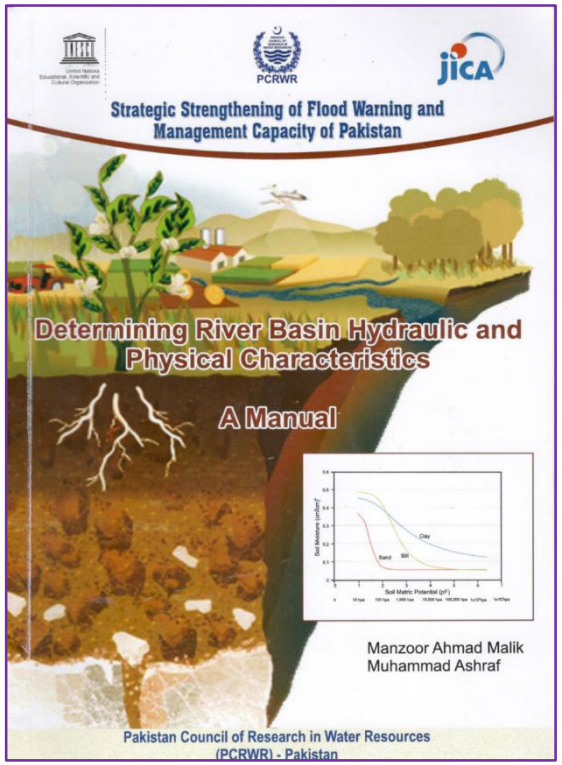
PCRWR Soil Physics Laboratory Apparatus and Lab Manual

- Soil moisture retention
- Soil texture analysis
- Soil saturated extract for chemical analysis
- Infiltration rate and saturated conductivity



PCRWR assembled saturated soil paste extractor

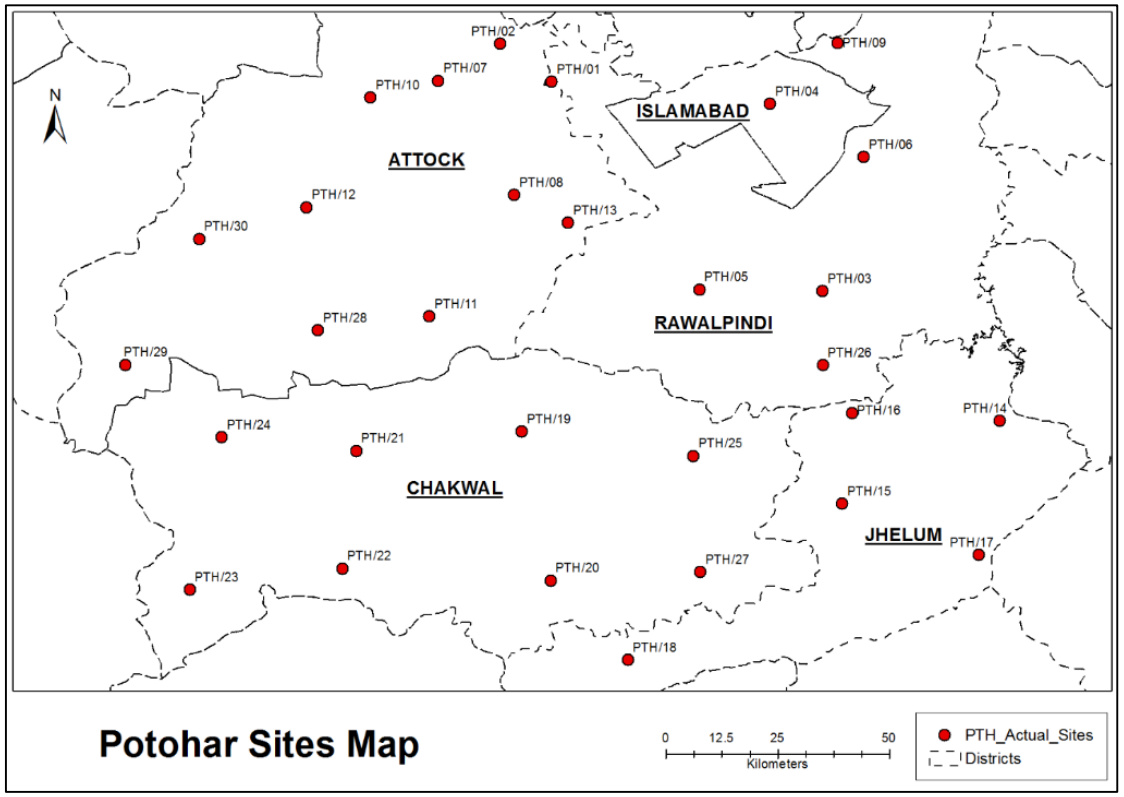
Coverage Pothwar and Doabas

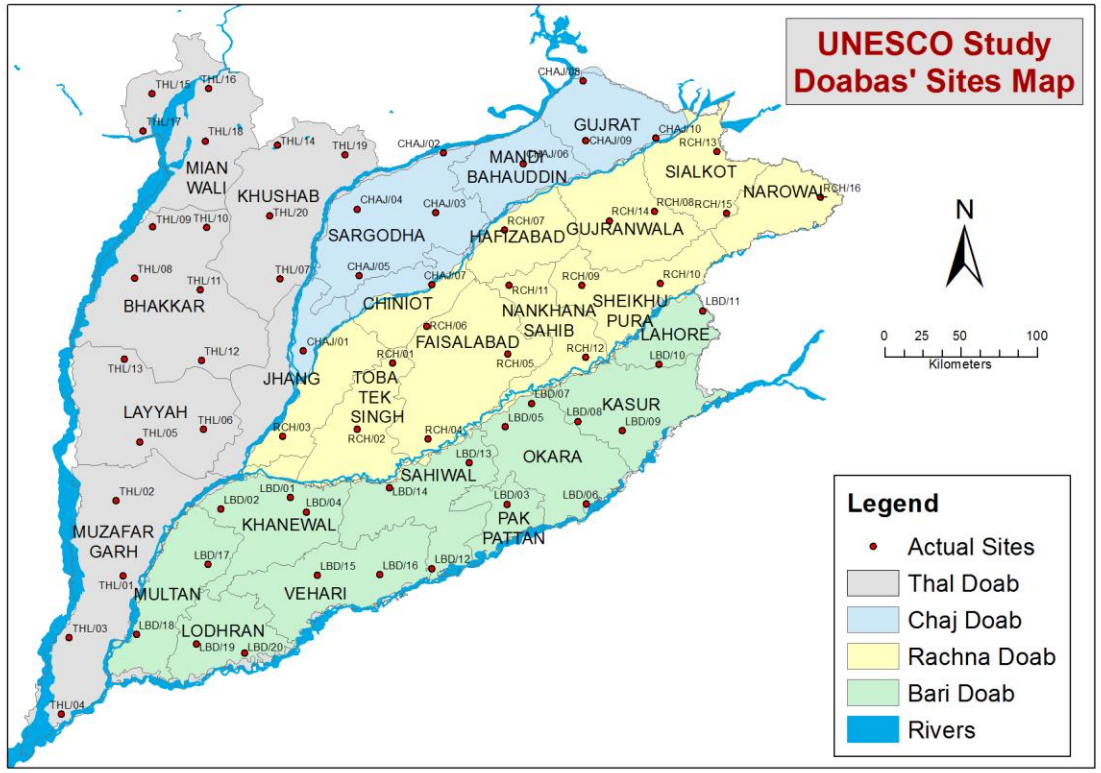
Potohar:

- Geographical area = 22,254 km²
- Coverage per site = 800 km² (28 km X 28 km grid)
- Sites covered: 30

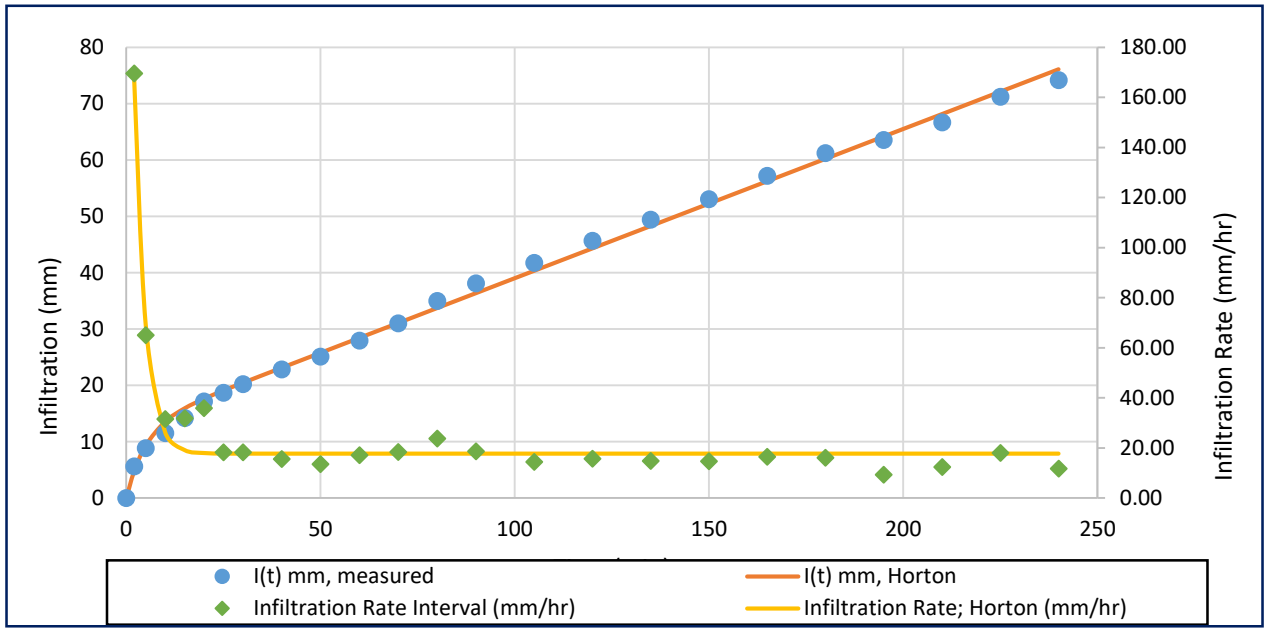
Doabas:

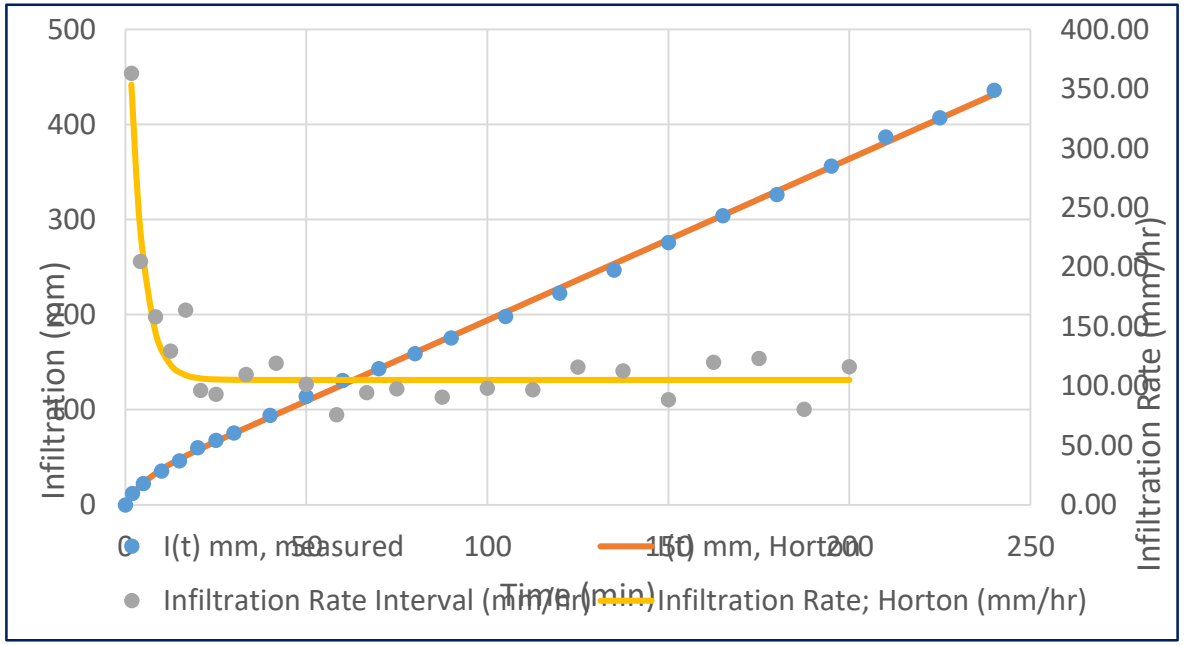
- Geographical area = 113,085 km²
- Coverage per site = 1713 km²
- Sites covered: : 66

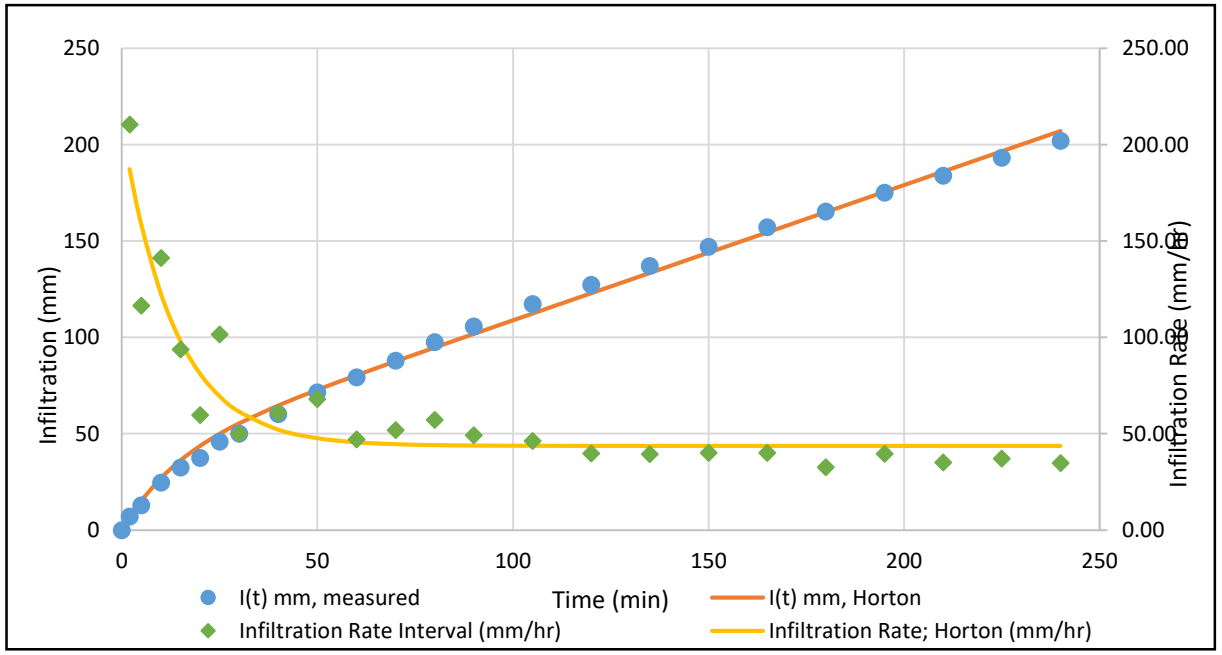




Cumulative Infiltration (mm) and Incremental Infiltration Rate (mm/hr) fitted on Horton equation







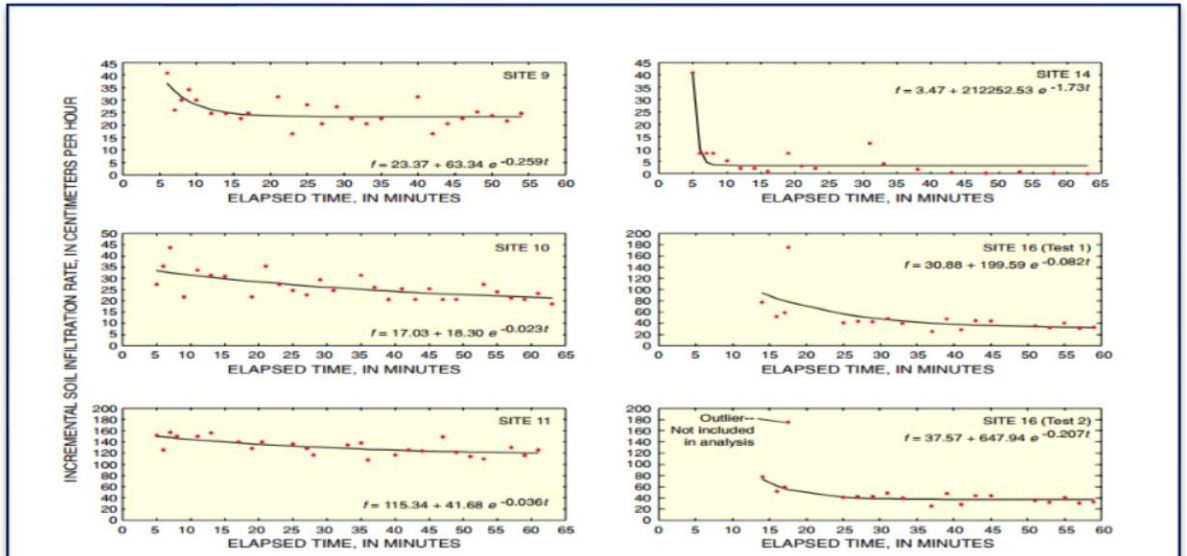
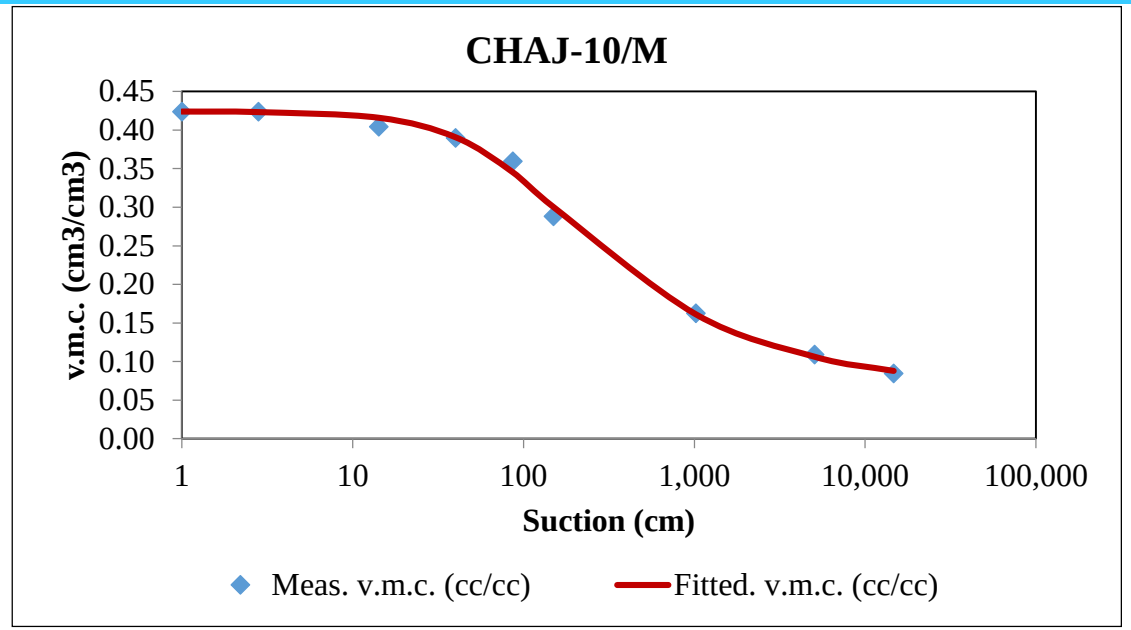
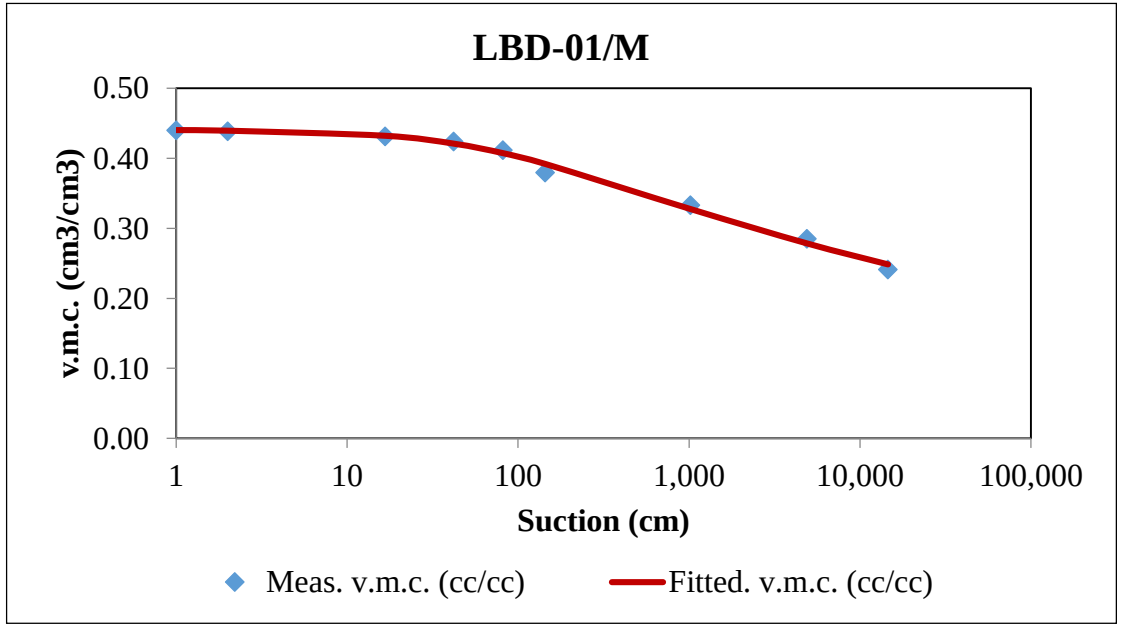


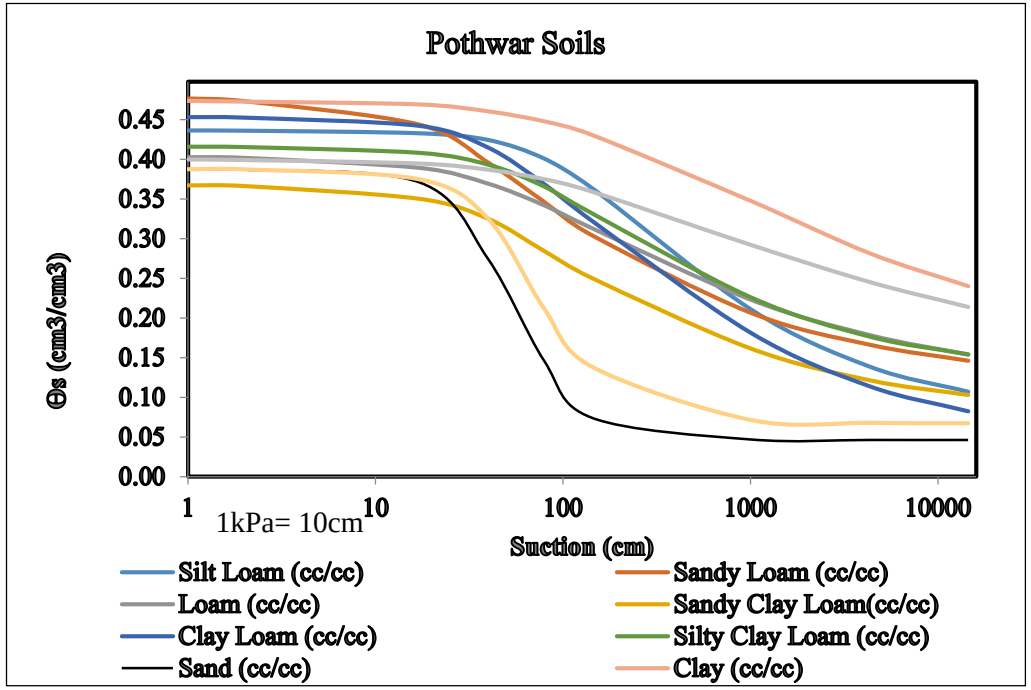
Figure 4. Soil infiltration rate as a function of time for sites fitted to Horton's equation--Continued.

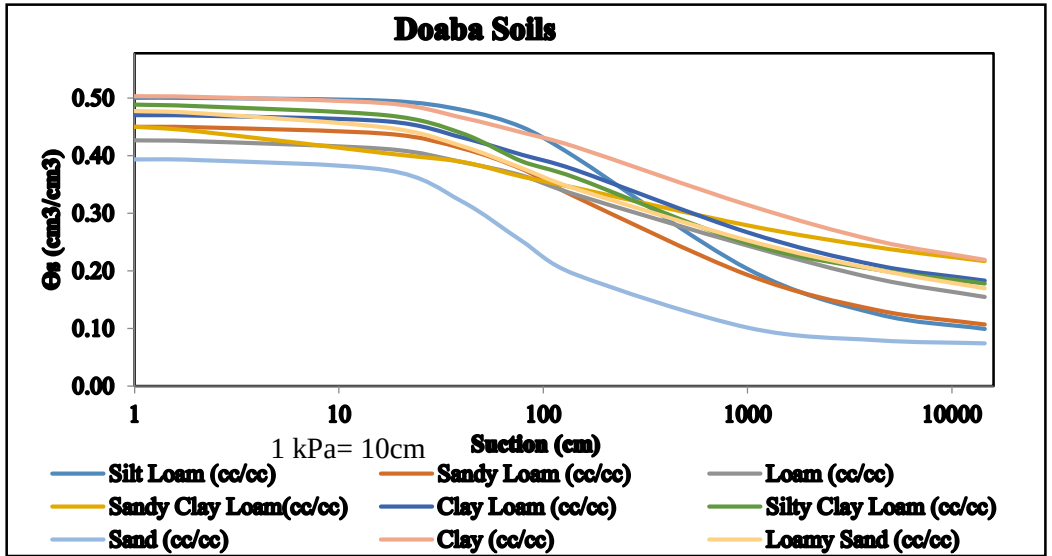
Source: Telis 2001, USGS

Representative Soil Moisture Retention of Pothwar and Doabas

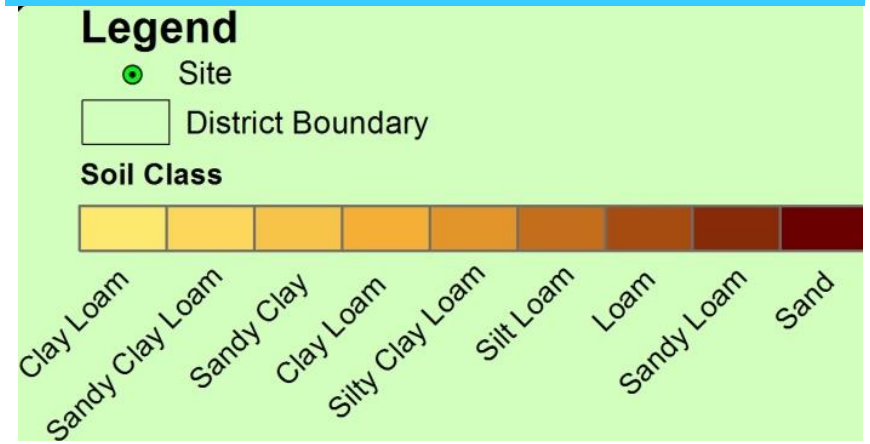


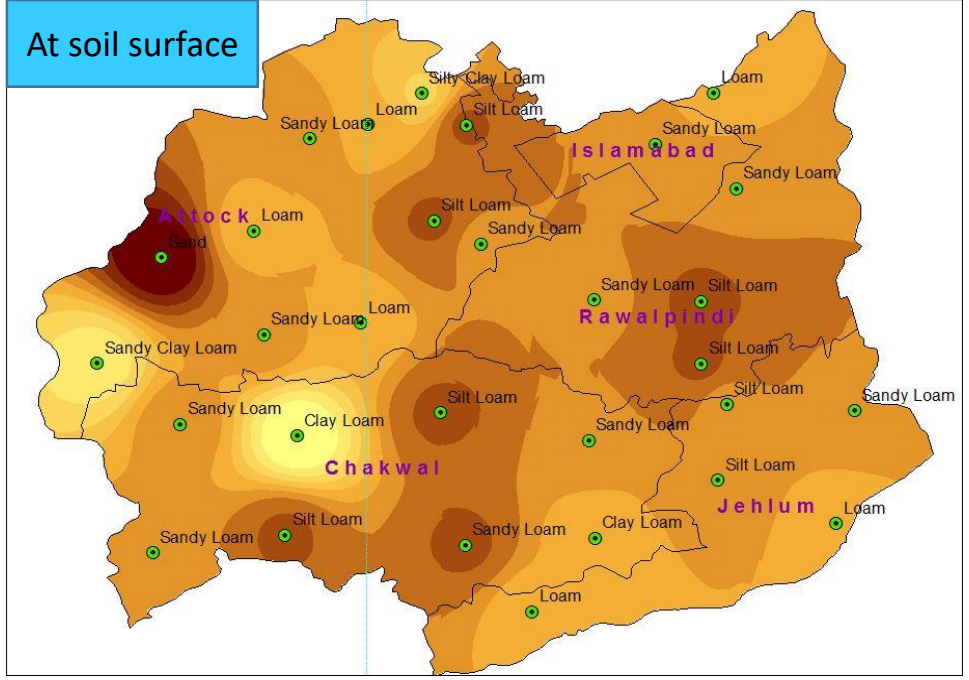


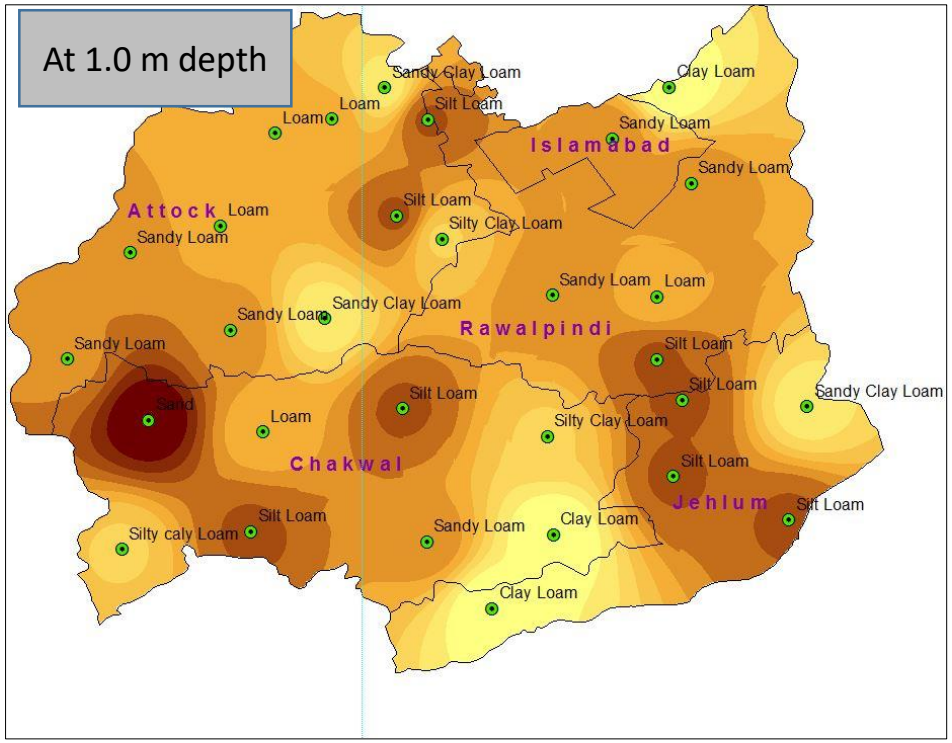


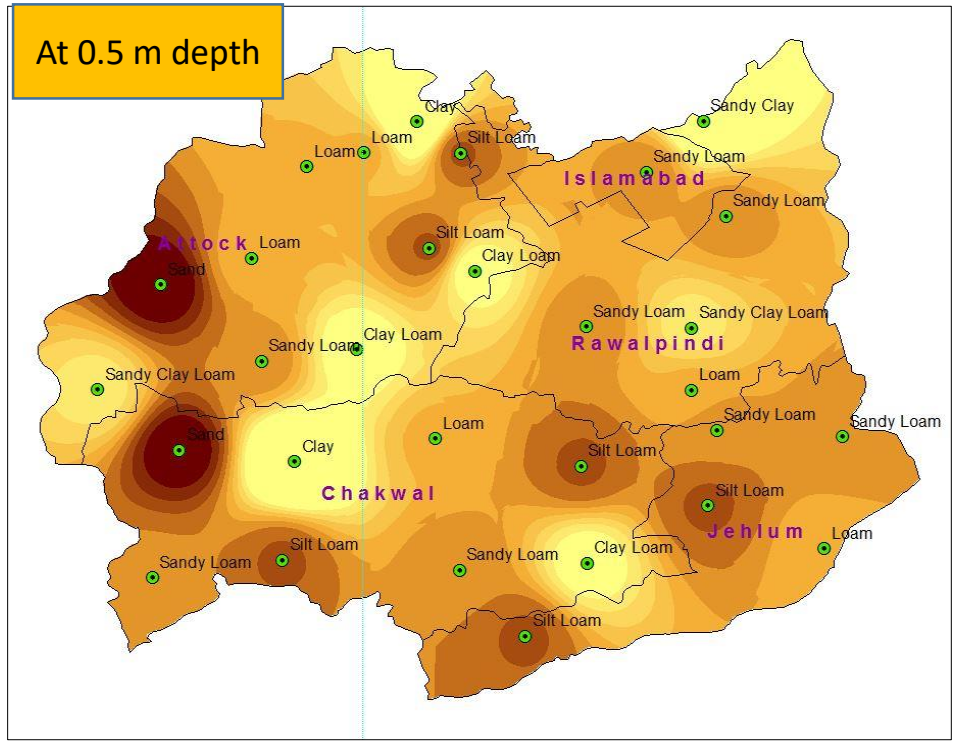


Mapping Soil Textural Classes in Pothwar Region

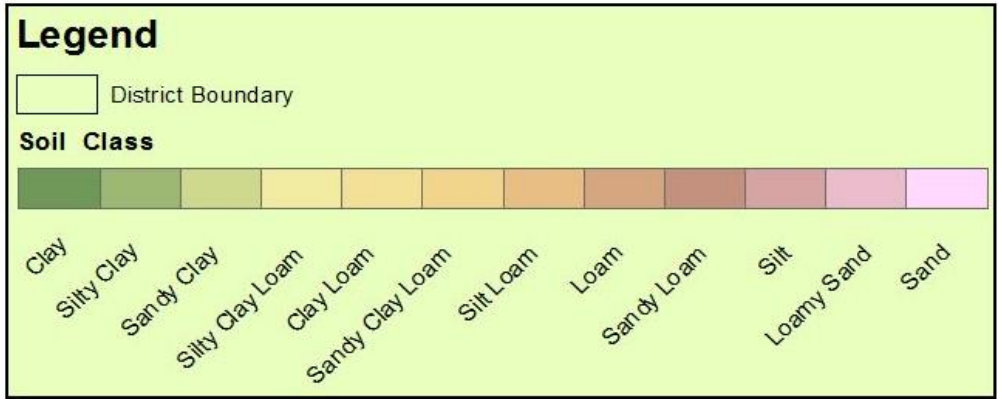


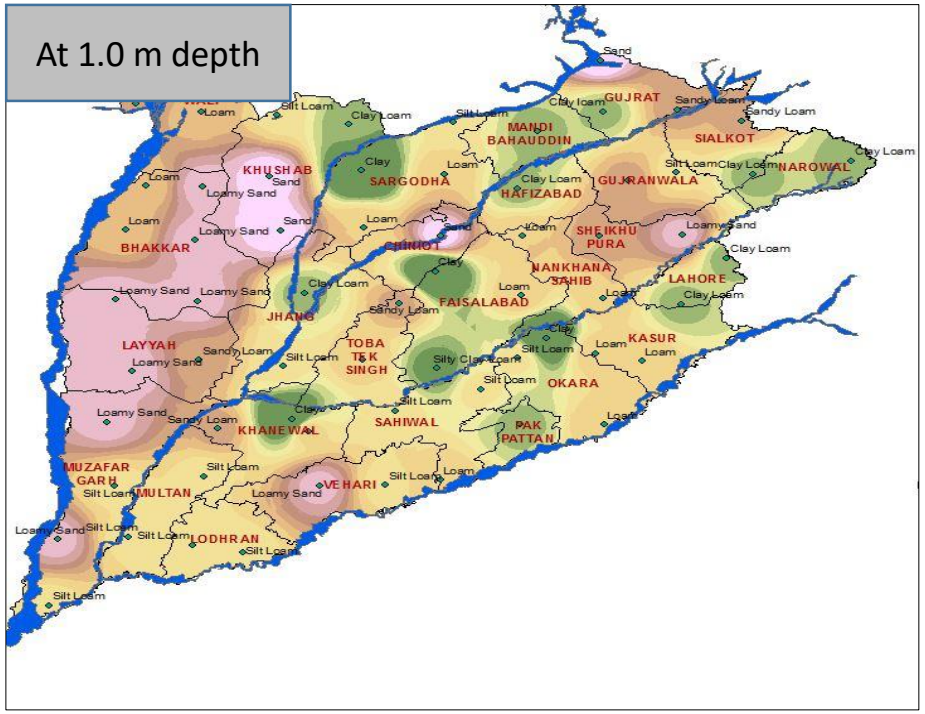


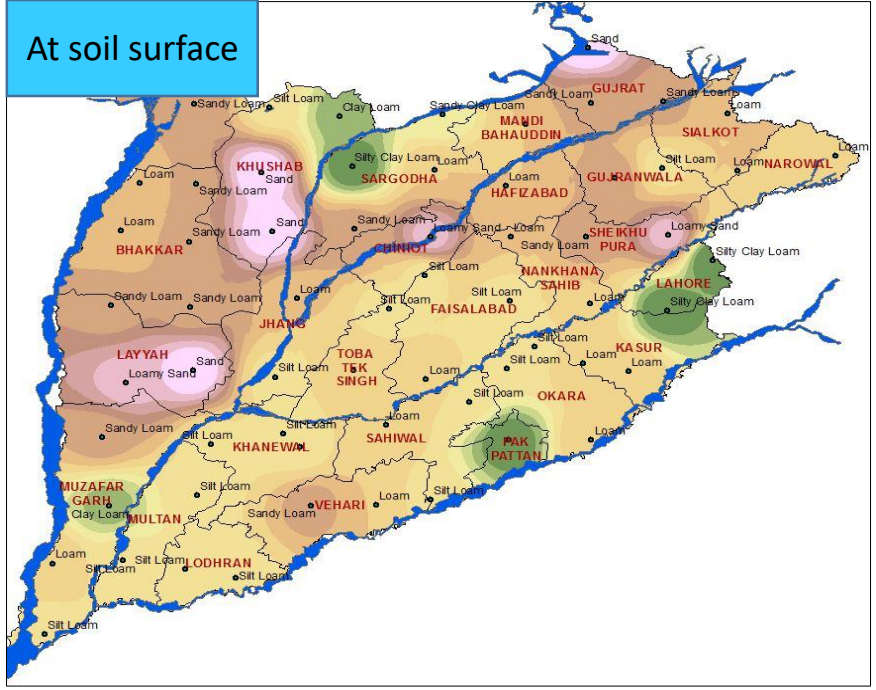


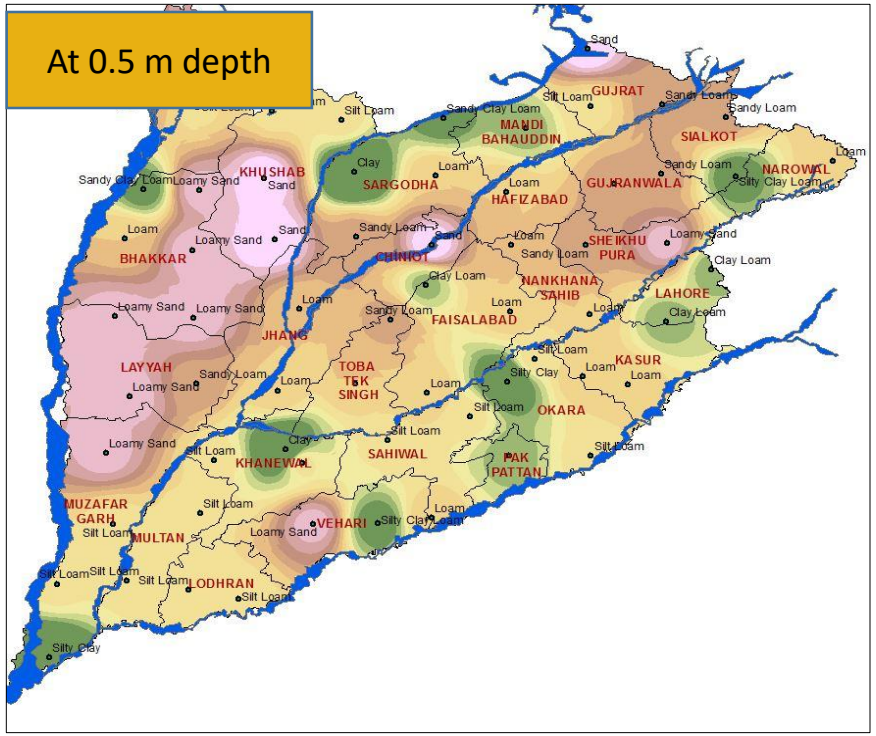


Mapping Soil Classes in Doabas



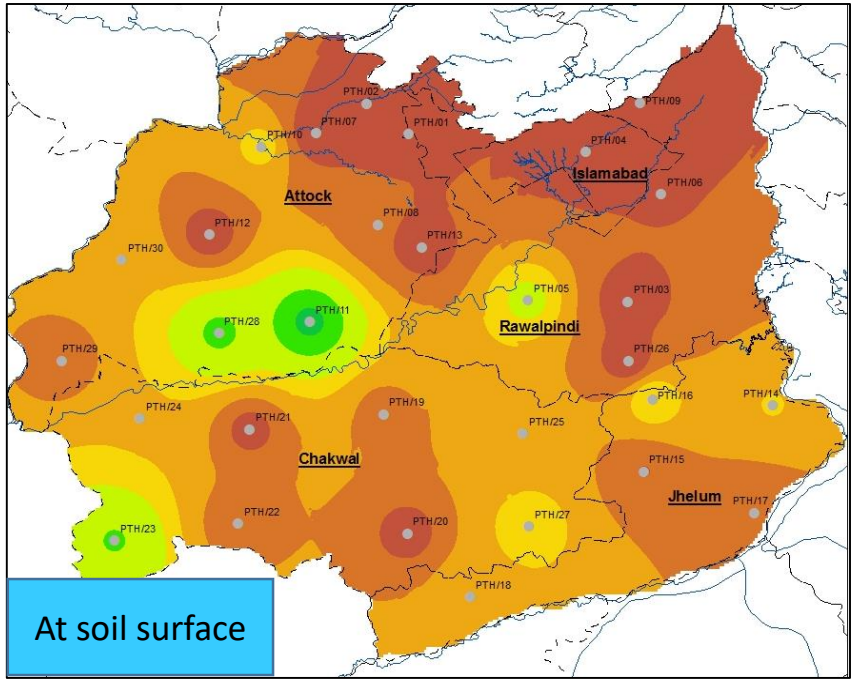


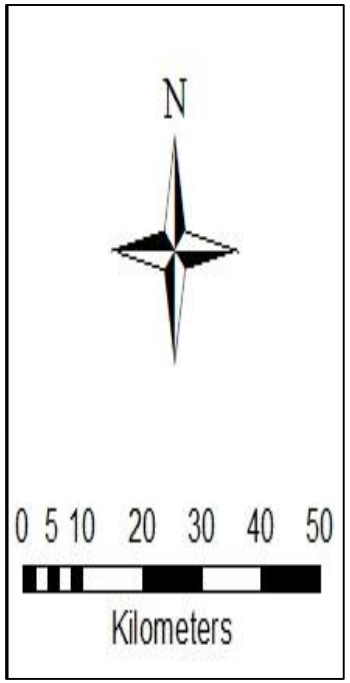


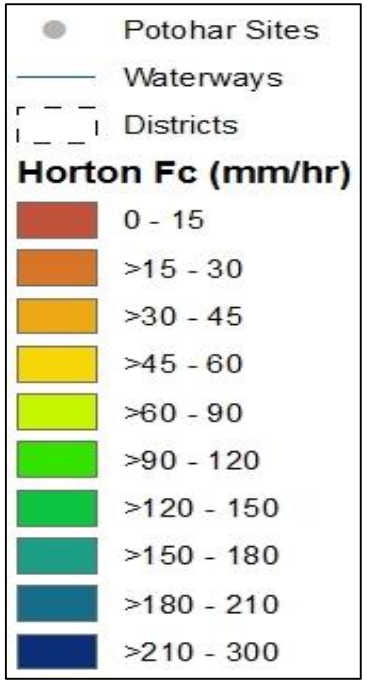


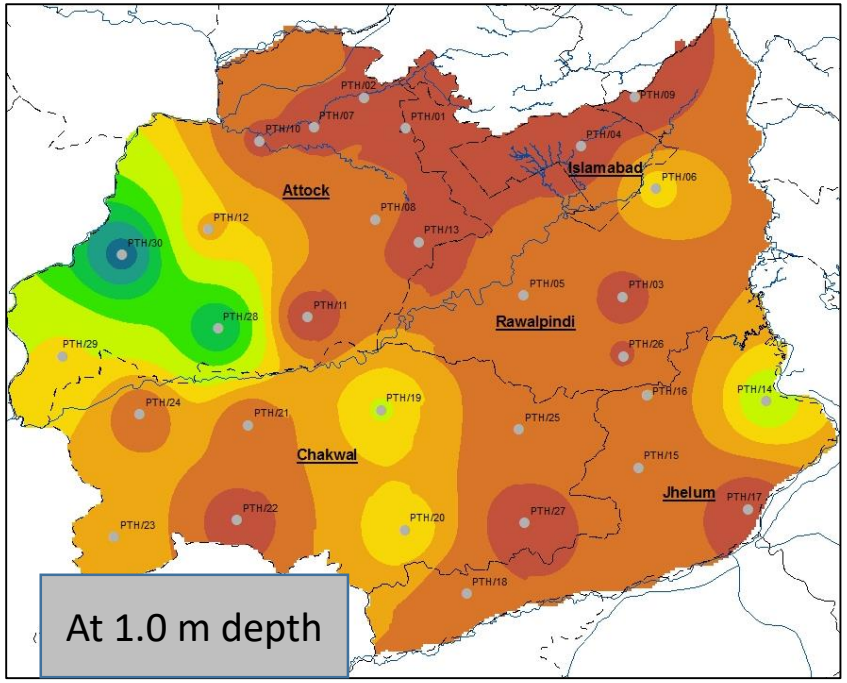
Mapping Horton's Steady State Infiltration Rate in Pothwar

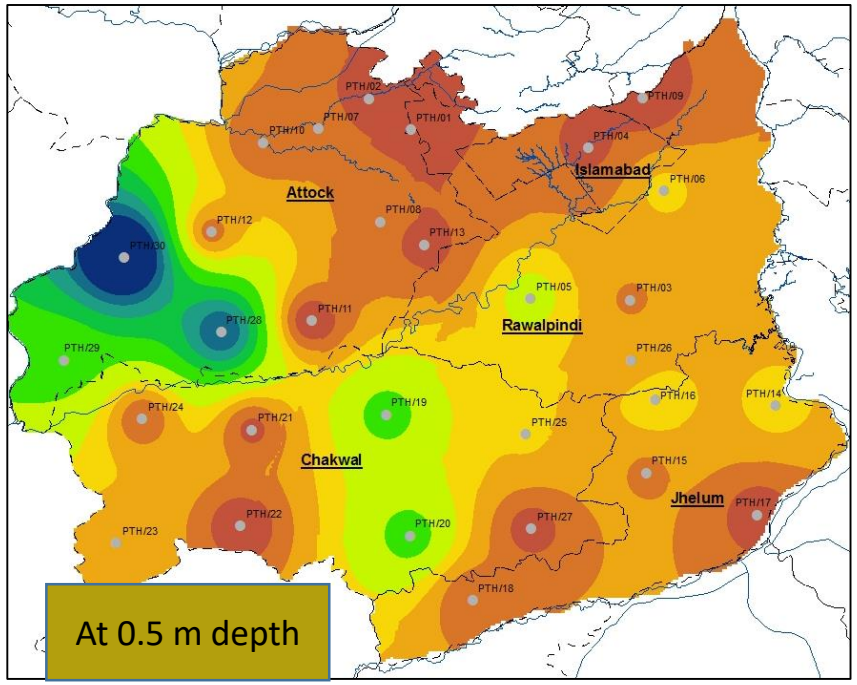
Percent Area of Fc Values										
Fc Class	≤ 15	>15-30	>30-45	>45-60	>60 - 90	>90-120	>120-150	>150-180	>180-210	>210-315
Surface	17.8	**31**	**37**	**8**	**6**	**1**	**0**	-	-	-
Middle	7.9	24	33	14	10	5	2	1	1	1
Bottom	17.6	44	20	9	5	3	1	1	0	-





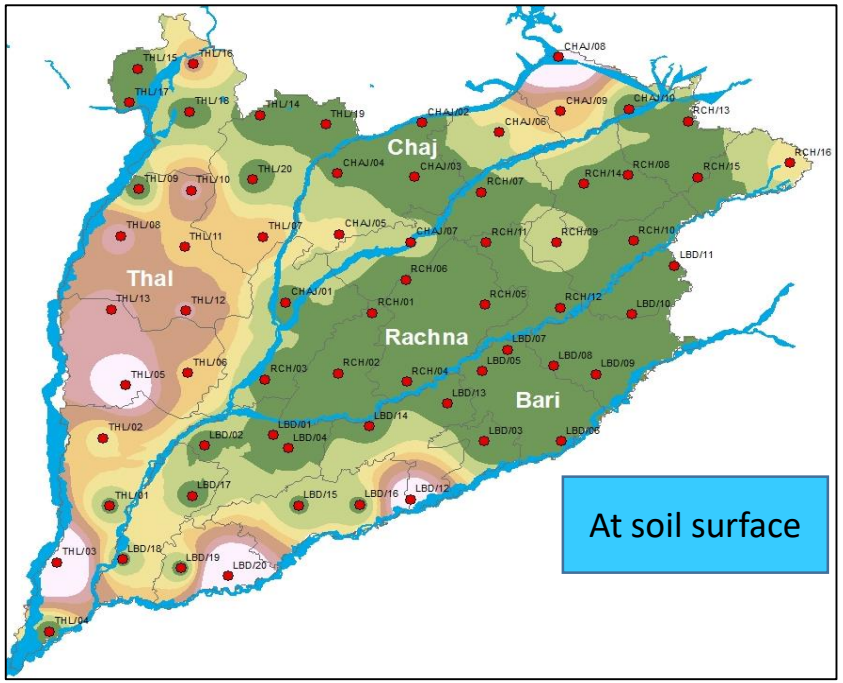


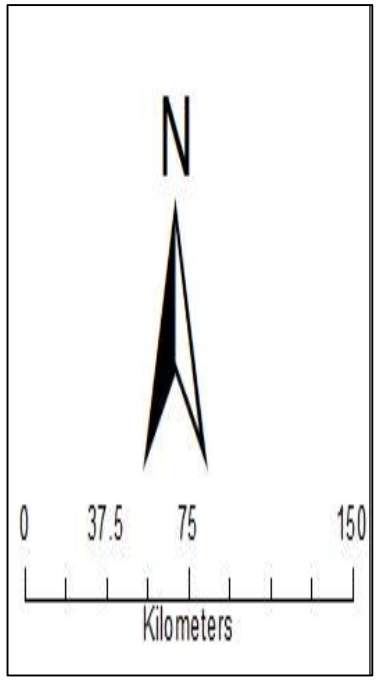


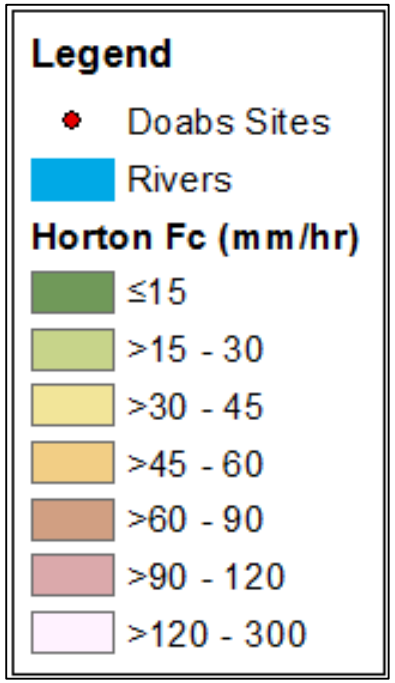


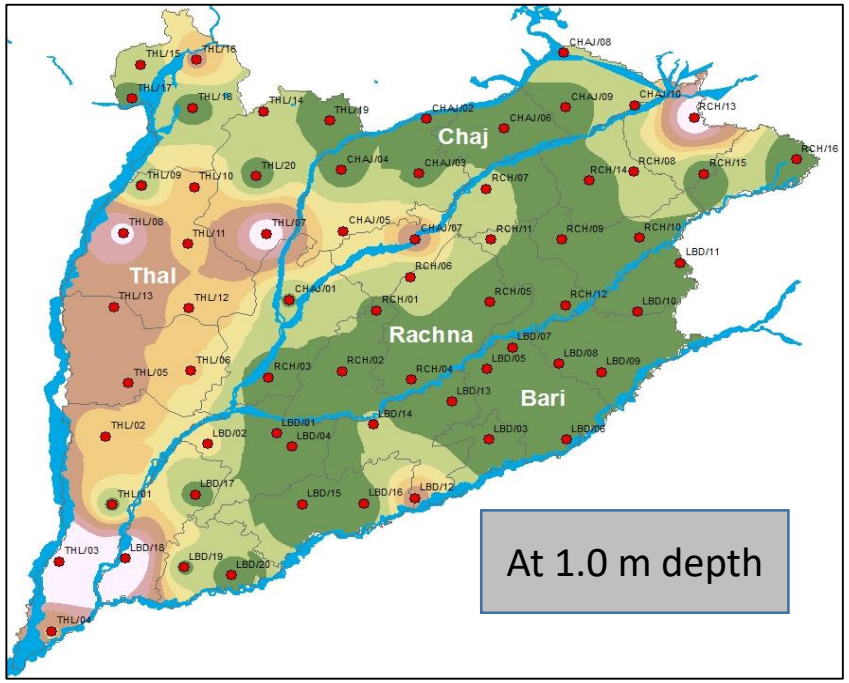
Mapping Horton's Steady State Infiltration Rate in Doabas

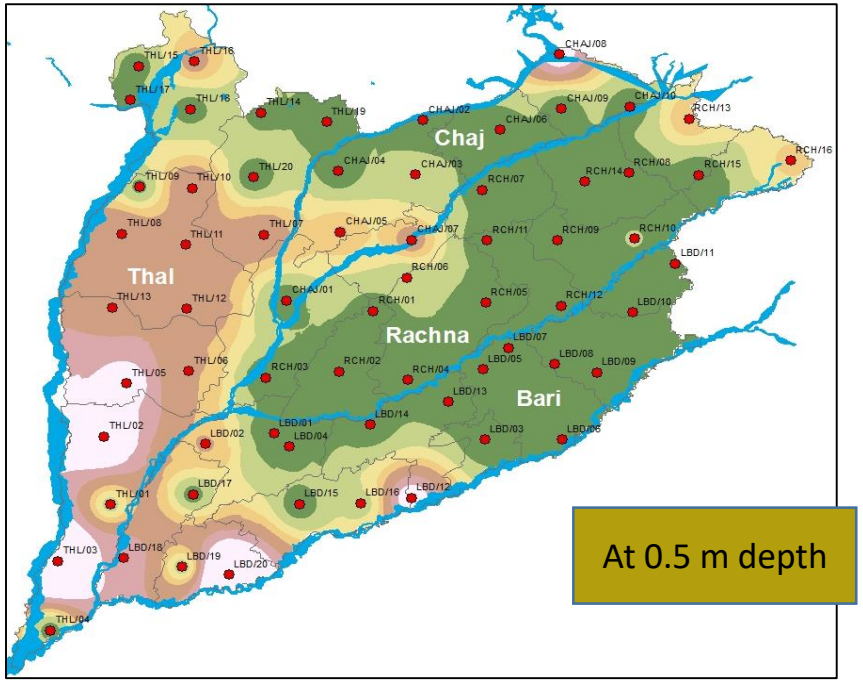
Percent Area of Fc Values							
Fc Class	≤ 15	>15-30	>30-45	>45-60	>60-90	>90-120	>120-300
Surface	44	20	11	8	9	4	4
Middle	42	16	9	8	15	4	6
Bottom	44	21	10	9	10	2	3





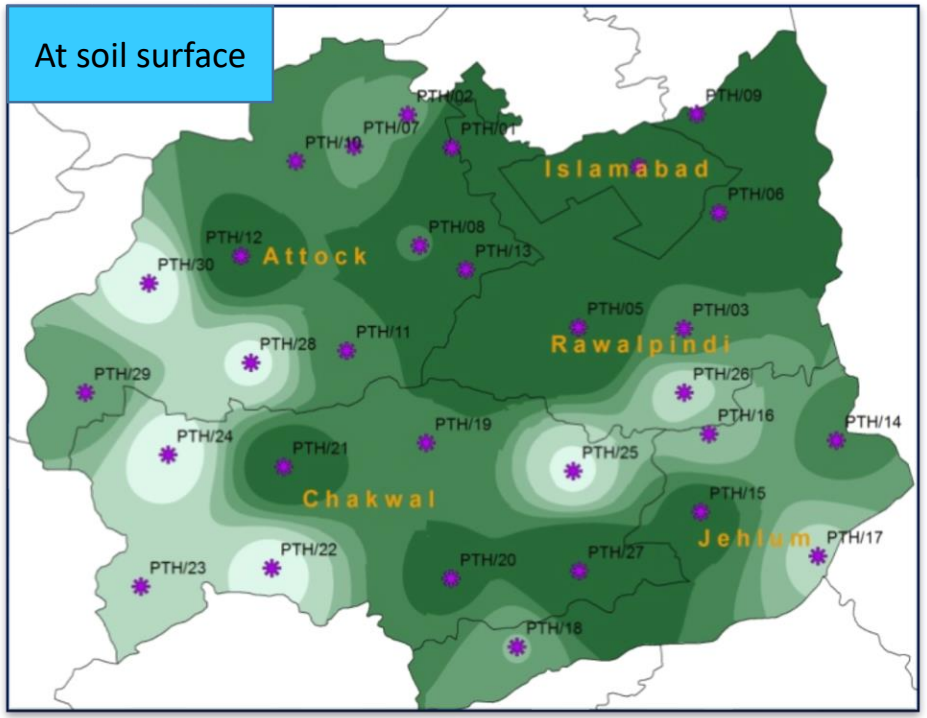






Mapping Organic Matter in Pothwar

Organic Matter %	Percent of area (At soil surface)	Percent of area (At 0.5 m depth)	Percent of area (At 1.0 m depth)
0.2 - 0.5	19	6	16
0.51 - 0.75	17	14	16
0.75 – 1	8	16	23
1.1 - 1.5	14	30	28
1.6 – 2	25	25	11
2.1 - 2.5	19	10	7

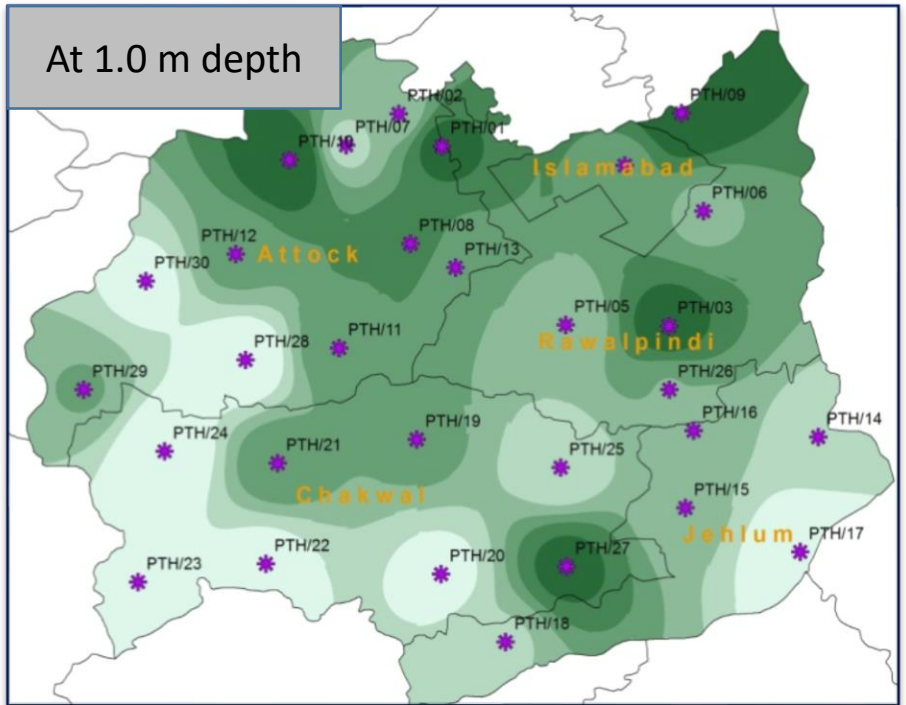


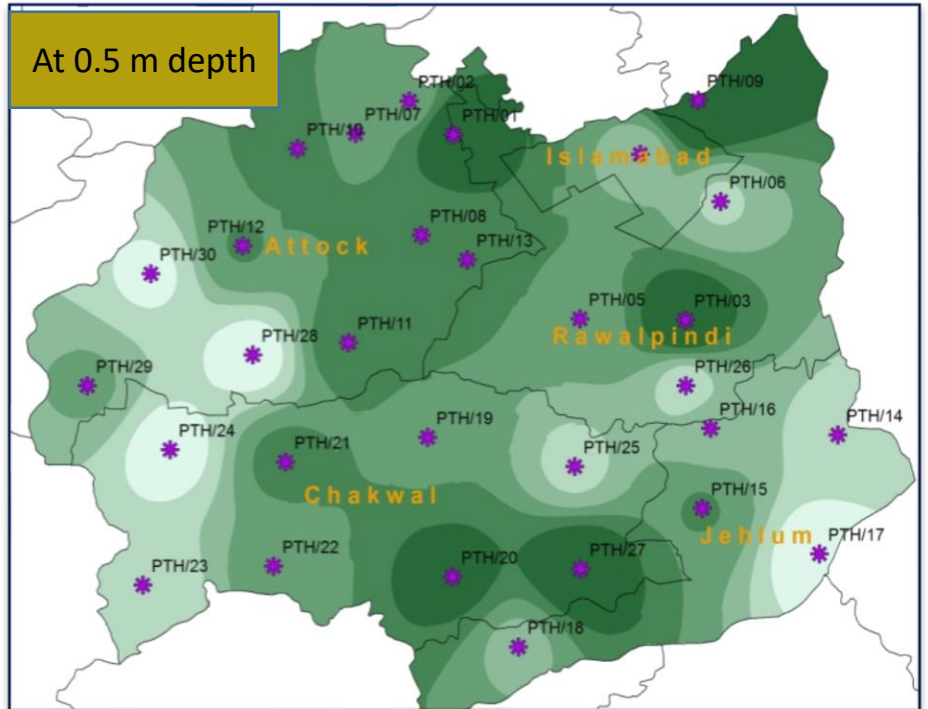
Legend

- Organic Matter Sites
- District Boundary

Organic Matter %

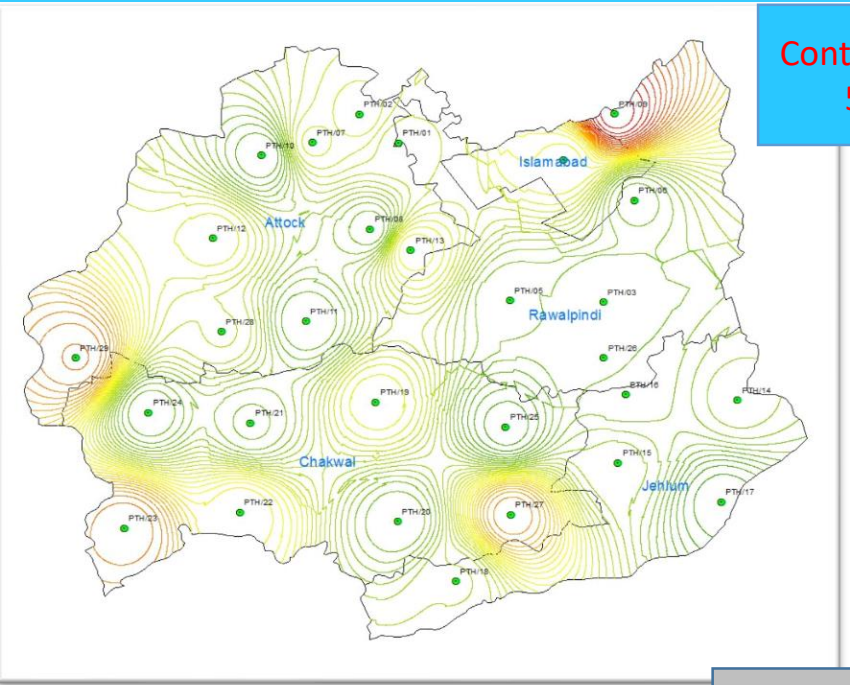
- 0.2 - 0.5
- 0.51 - 0.75
- 0.75 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5



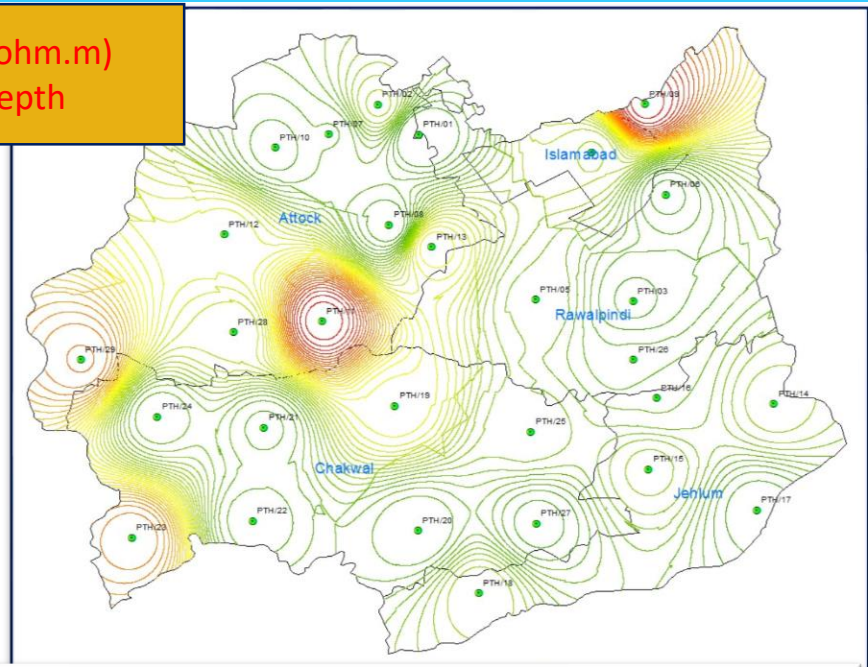


Mapping Lithology in Pothwar

Contours (ohm.m)
5 m depth

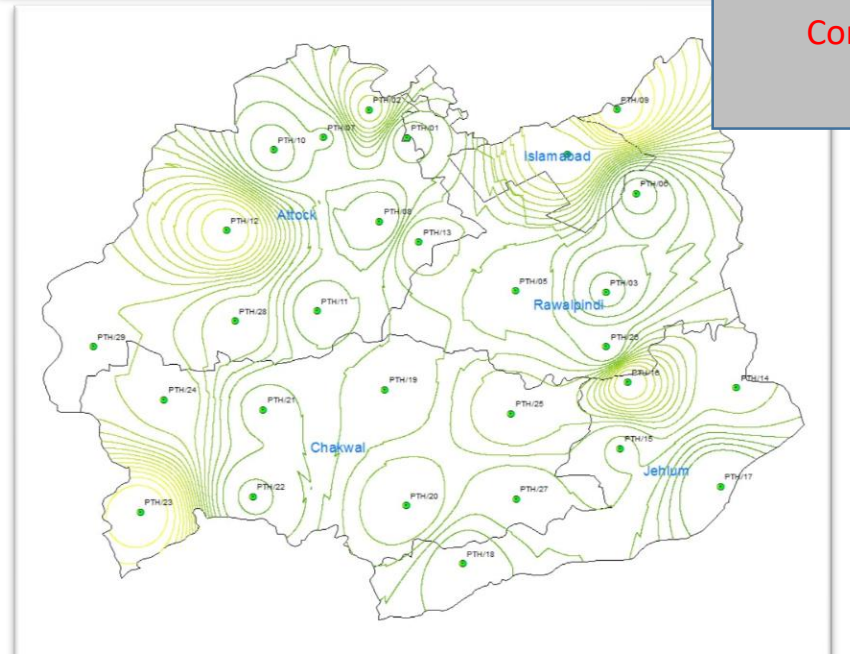


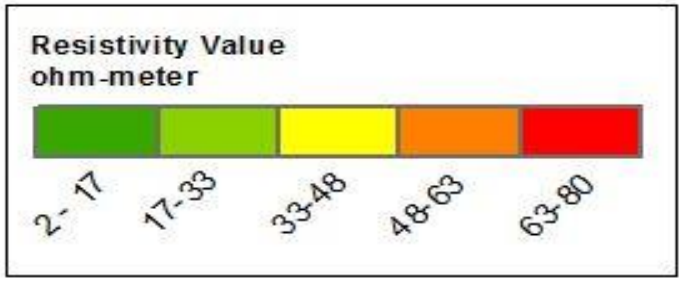
Contours (ohm.m)
15 m depth



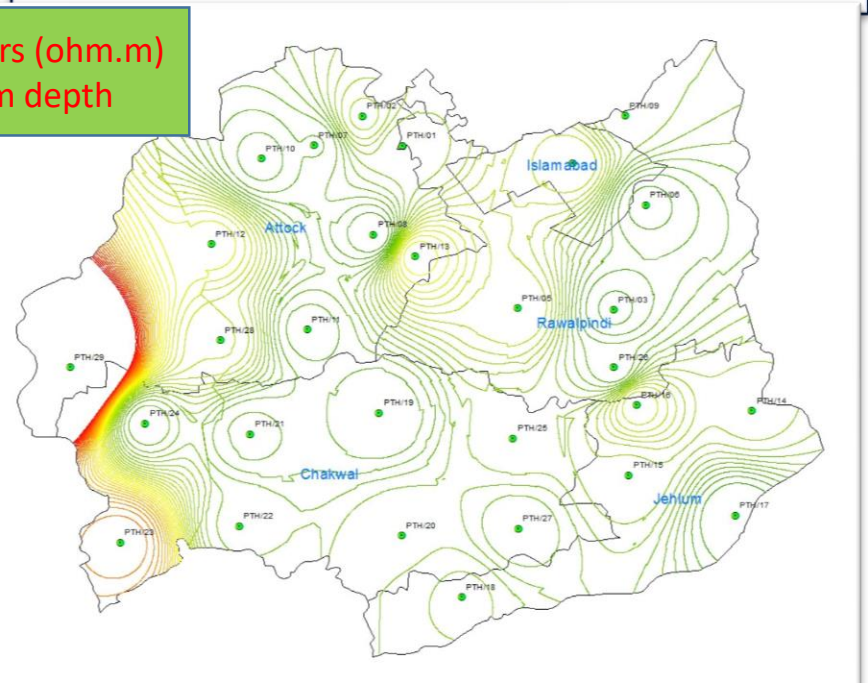
S. No	Resistivity (Ohm-m)	Geology if Groundwater is fresh
1	<10	Clay, Silt
2	11-24	Clayey sand, silty sand
3	25-39	Sand clay Silt
4	> 35	Sand (fine silty)

Contours (ohm.m)
45 m depth

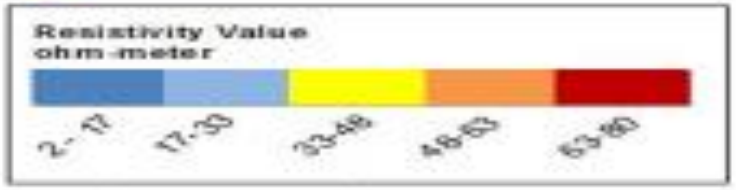




Contours (ohm.m)
30 m depth



Mapping Lithology in Doabas



S. No	Resistivity (Ohm-m)	Geology if Groundwater is fresh
1	<10	Clay, Silt
2	11-24	Clayey sand, silty sand
3	25-39	Sand clay Silt
4	> 35	Sand (fine silty)

Findings

- Cumulative infiltration data of infiltration tests yield less scatter of data due to compensation of random error in the cumulative infiltration, whereas incremental point infiltration rates data reflects more scatter resulting in unimpressive goodness of fit in terms of R^2.
- Horton's cumulative infiltration model persistently fits better or comparable to the Philip's model in terms of R^2 as goodness of fit.
- Horton's infiltration model gives direct estimate of steady state infiltration rates, which is very often required as practical equivalent of field saturated conductivity, whereas it is difficult to acquire the same by using Philip's model.
- Sandy loam, Loam and Silt loam are dominant soil textural classes in both Pothwar and Doabas Regions. However, spatial coverage of Sandy loam decreases with depth in the Pothwar region, whereas clay fraction decreases with depth in the Doabas region.
- Moisture retention characteristics are more variable for similar classes of soil in the Pothwar Region than in Doabas Region.
- Spatial coverage of infiltration rate up to 45 mm/hr is dominant in the Pothwar Region, whereas dominance of the same is up to 30 mm/hr in Doabas Region.
- Lithological strata is more diverse in Pothwar Region as compared to Doabas where it is almost uniform.
- Soil organic matter contents in the Pothwar Region varies from 0.2 % to 2.5%. The higher percentage found in the northern piedmonts and the lower in the southern parts.

THANK YOU