The Relationship Between Hydro-Climatic Variables & E. coli Concentrations in Surface & Drinking Water of Kabul River Basin, Pakistan.

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Environmental System Analysis

Water Micro 2015, Lisbon

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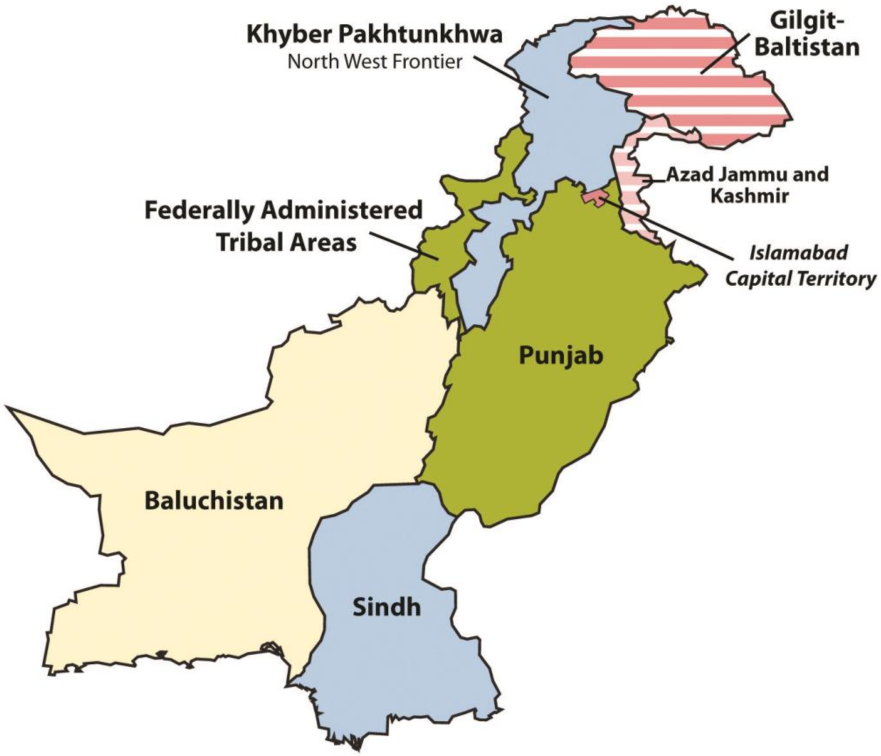
Diarrhea is Global Issue

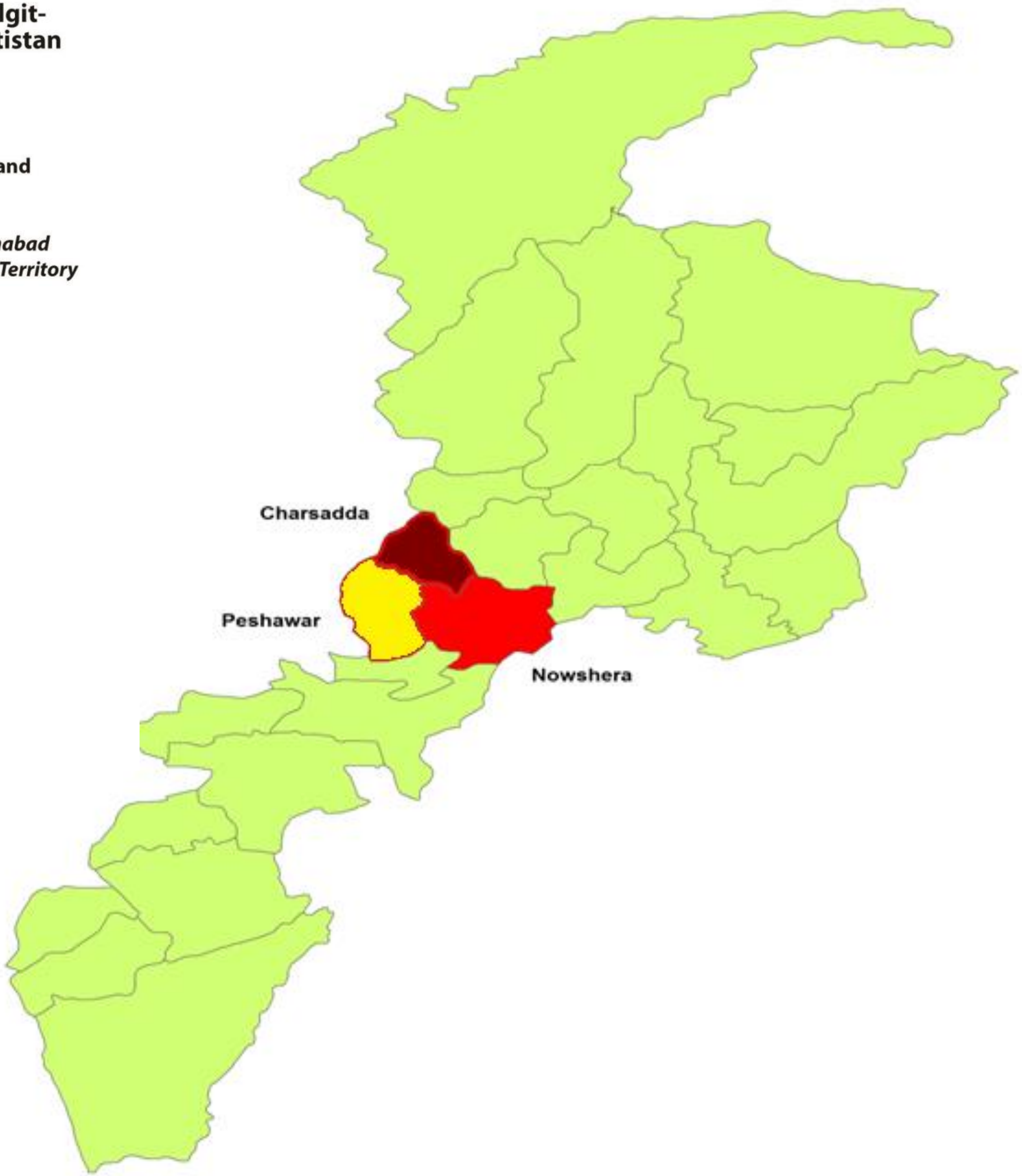
- ✓ 2.3 billion diarrhoea cases (Astrom et al., 200
- ✓ 0.7 million deaths (Lloyd et al., 2007)
- ✓ Diarrhea is ranked 2nd main cause of deaths. (Mathers et al., 2008)

Regionally

(Azizullah et al., 2011)

2010 Flood





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Nowshera 2010 flood

(http://www.gfdrr.org/sites/gfdrr/files/publication/Pakistan_DNA_0.pdf)

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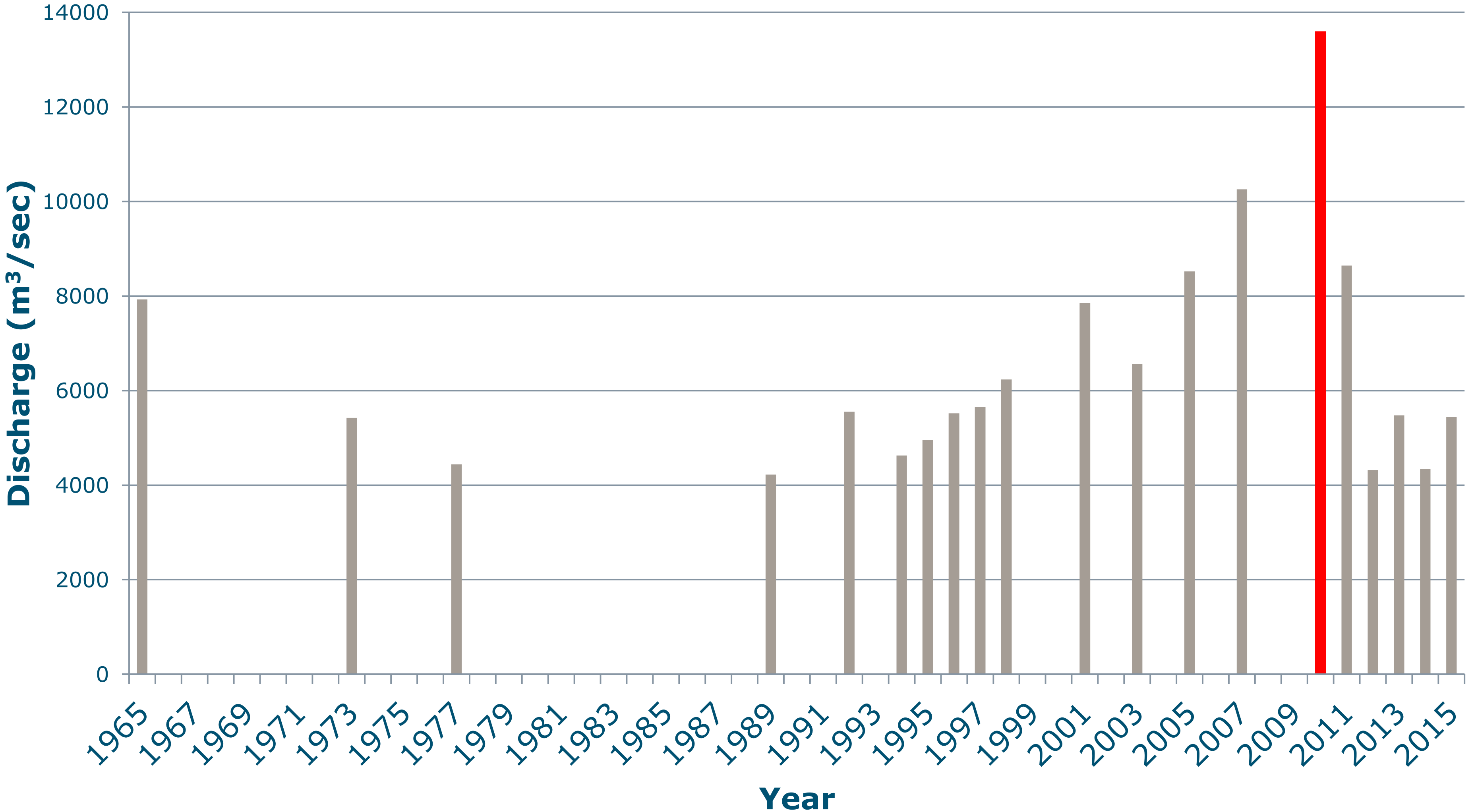
To assess the impacts of flooding and hydro-climatic variables on *E. coli* concentrations in a region that floods every year.

Historical Floods in Kabul River



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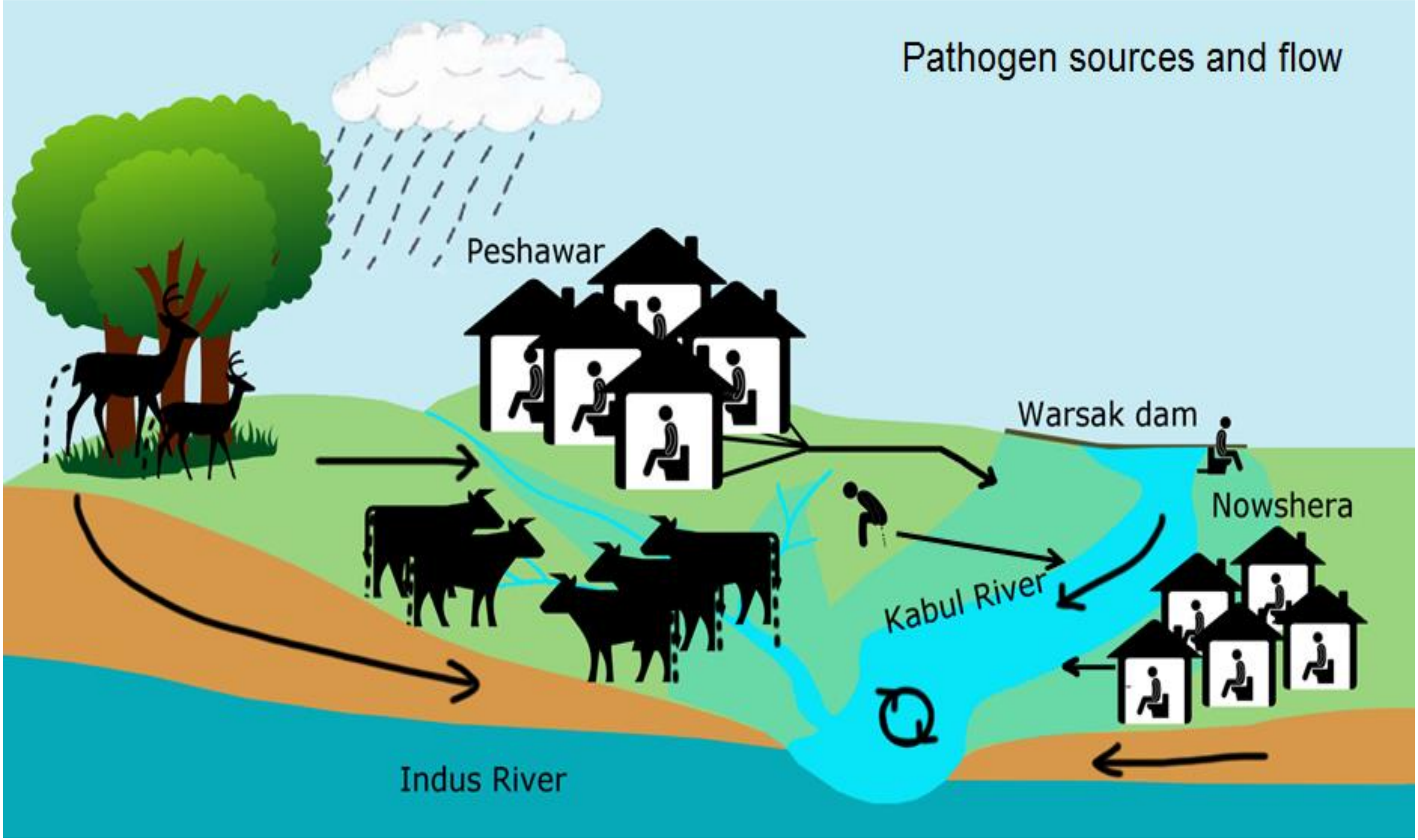
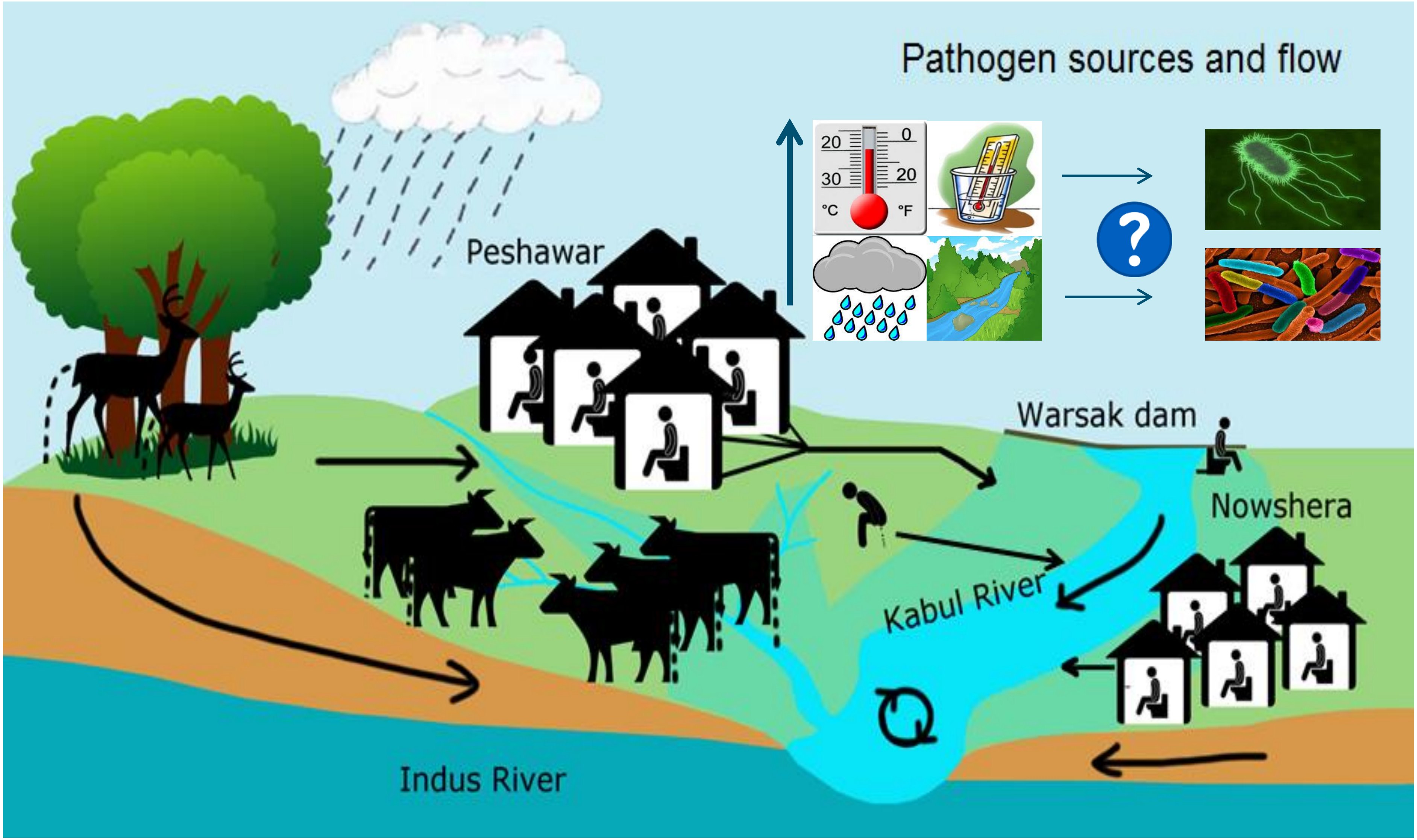
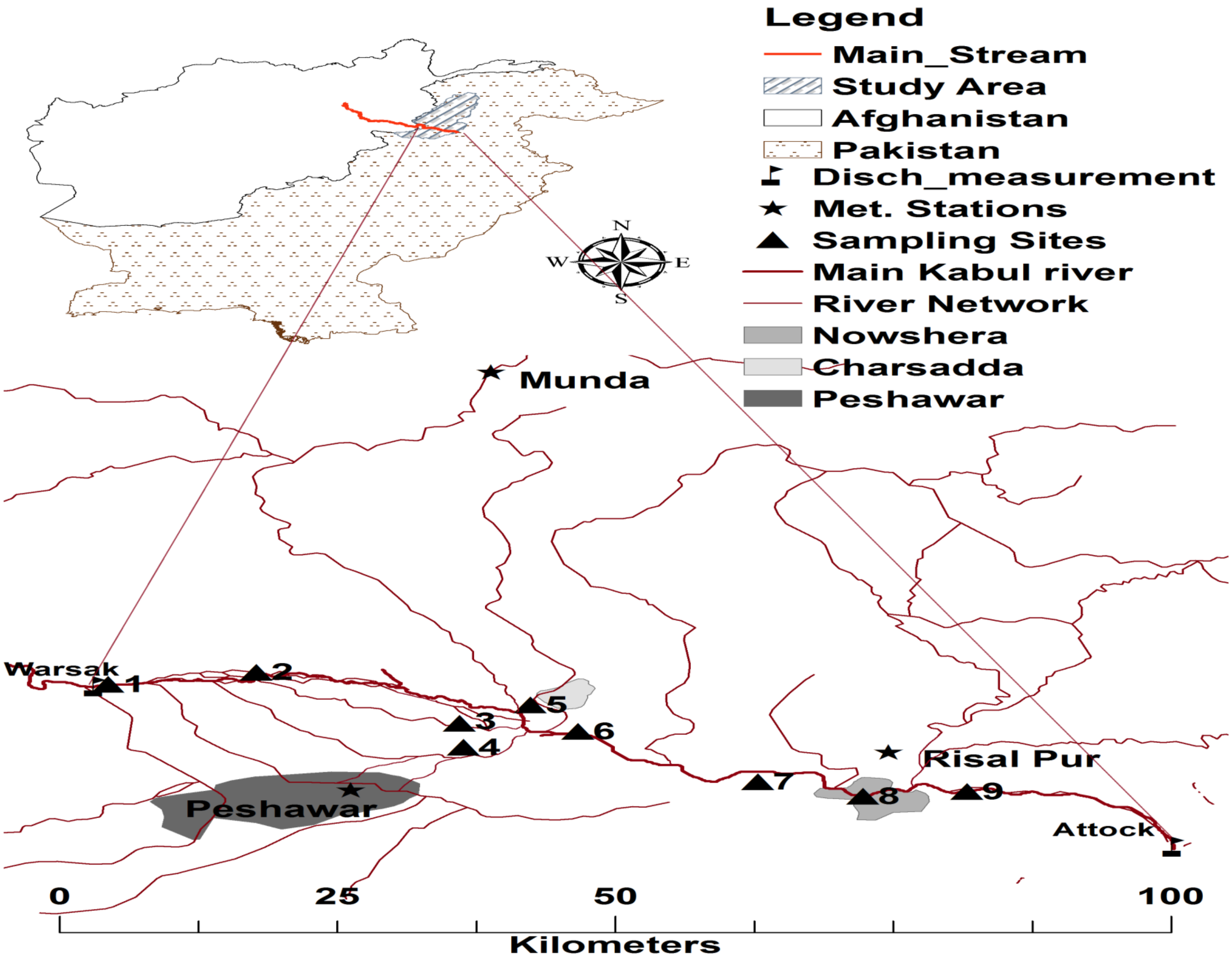
Sources and Pathways of Contamination



Sources and Pathways of Contamination





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Methodology

✓Bi-weekly sampling

✓9 surface water sampling

✓5 drinking water sampling

✓Statistical analysis

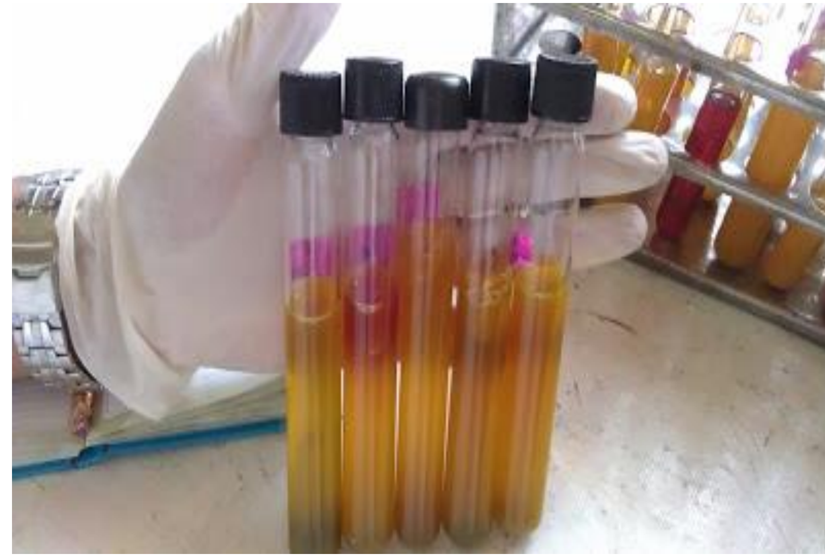
- Correlation analysis
- General Linear Model

Microbial Analysis

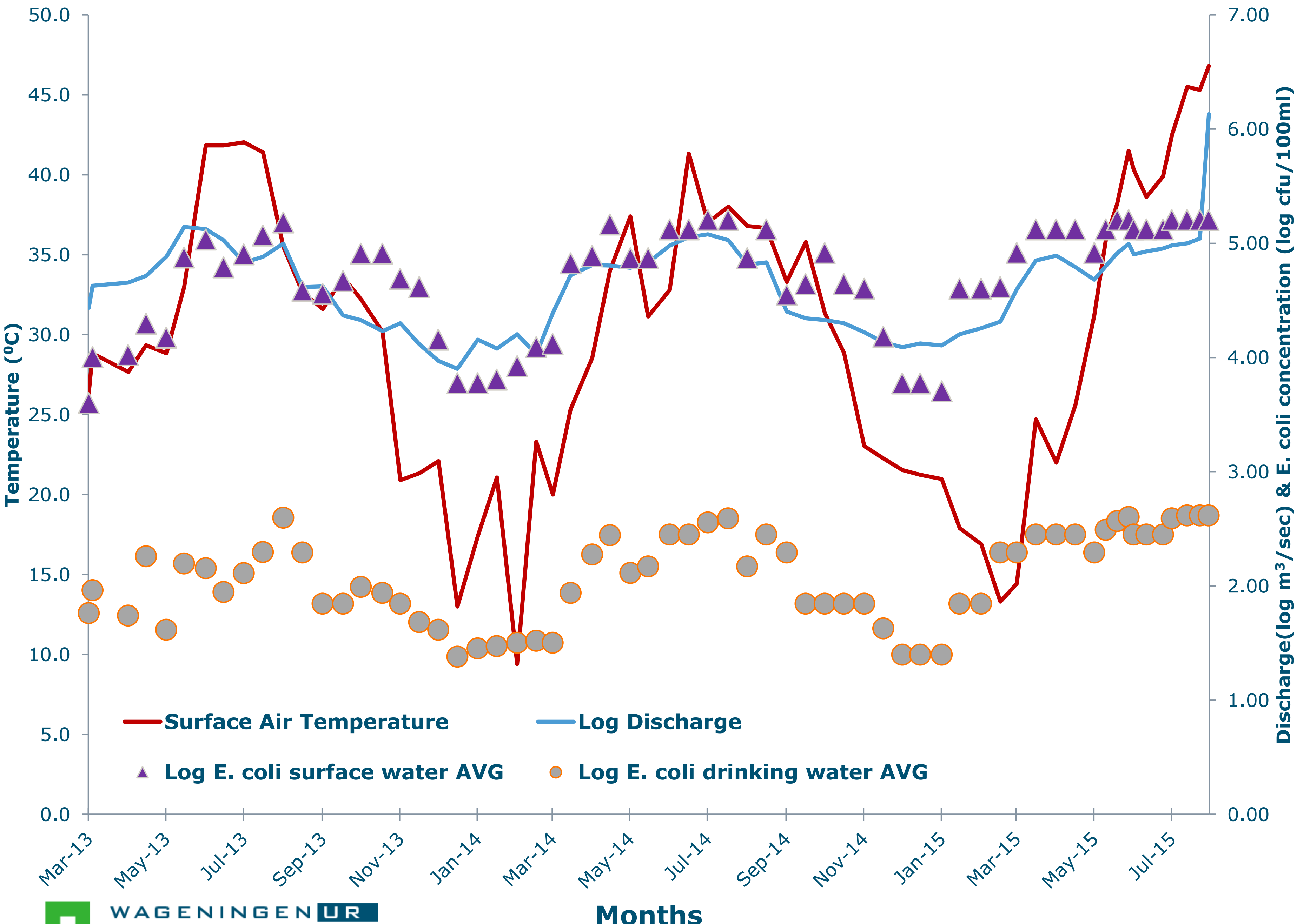
- ✓ MPN methods was used for the enumeration of *E. coli*.
- ✓ Surface water samples.
- ✓ Drinking water samples.

Transported to Lab (NIFA) within 4 hours of collection.
Kept in icebox.


RESULT




Salmonella typhi
Schistosoma
Cholera vibrios



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Correlations of Surface & Drinking water samples

(a) Avg. Surface air temperature (^{0}C)

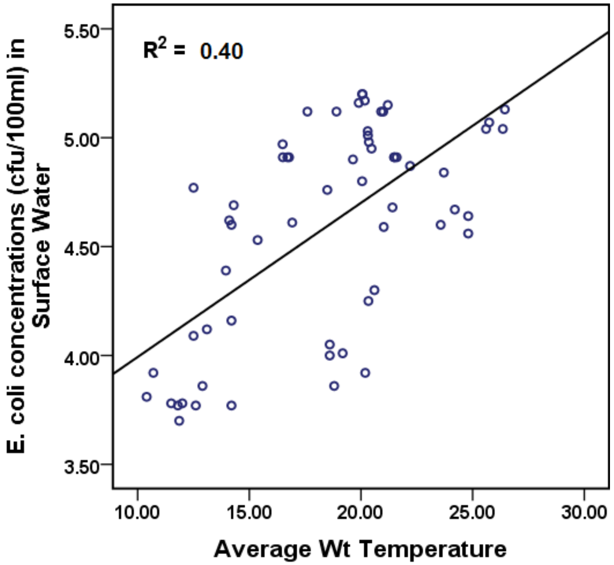
(b) Avg. Water temperature (^{0}C)

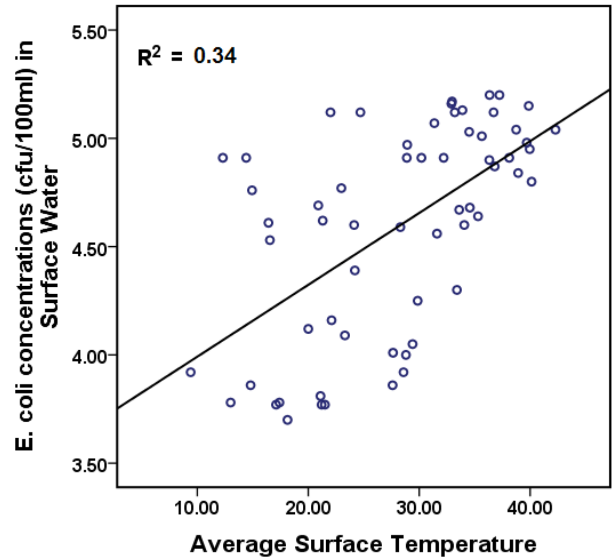
(c) Sum of 5 days precipitation (mm)

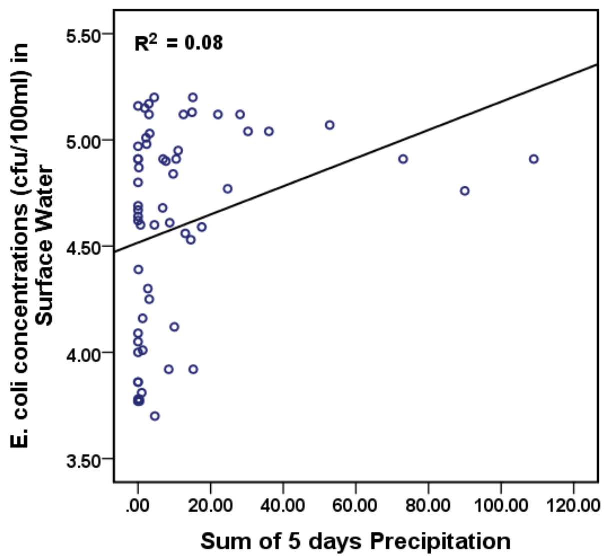
(d) Kabul river discharge (log m^3/s)

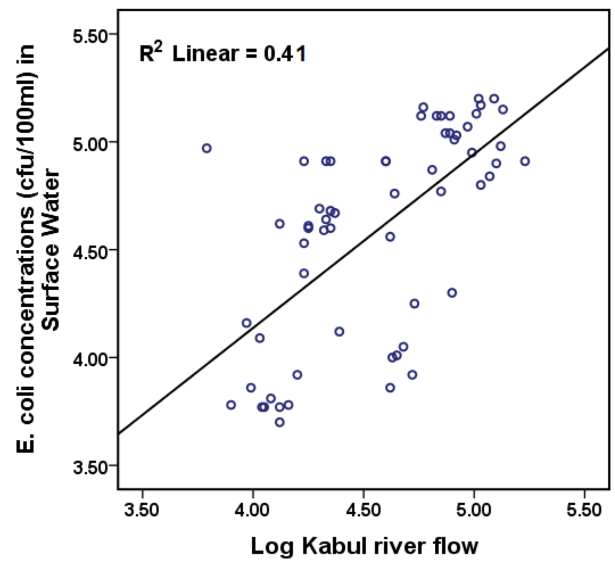


E. Coli concentrations *(log cfu/100ml)* Surface water samples









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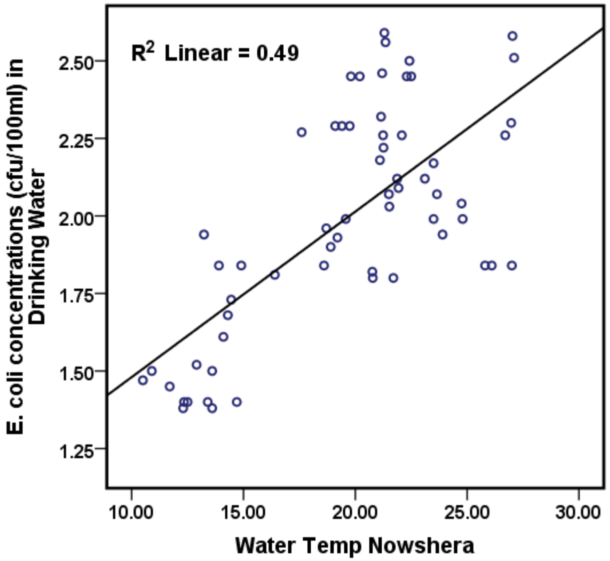
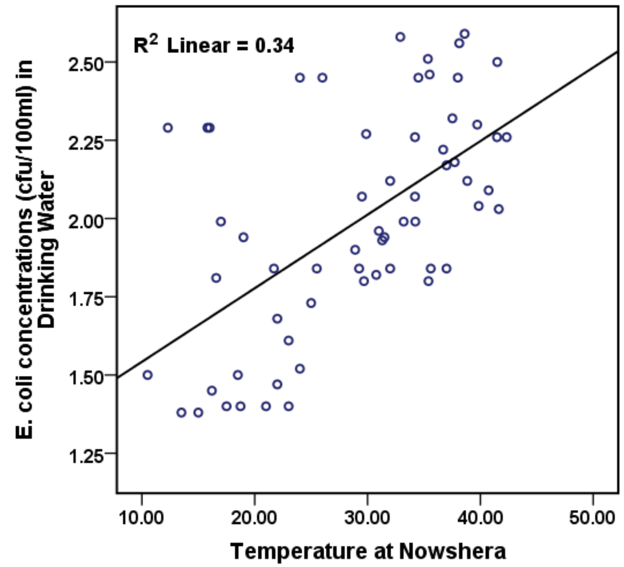
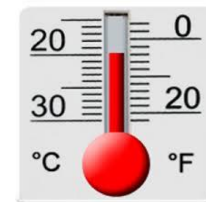
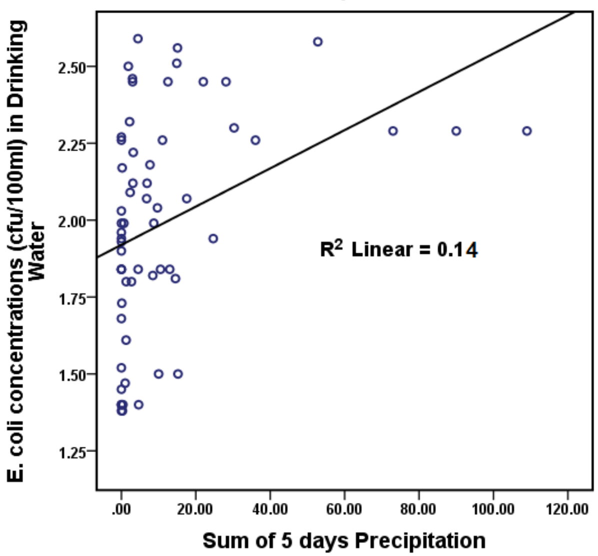
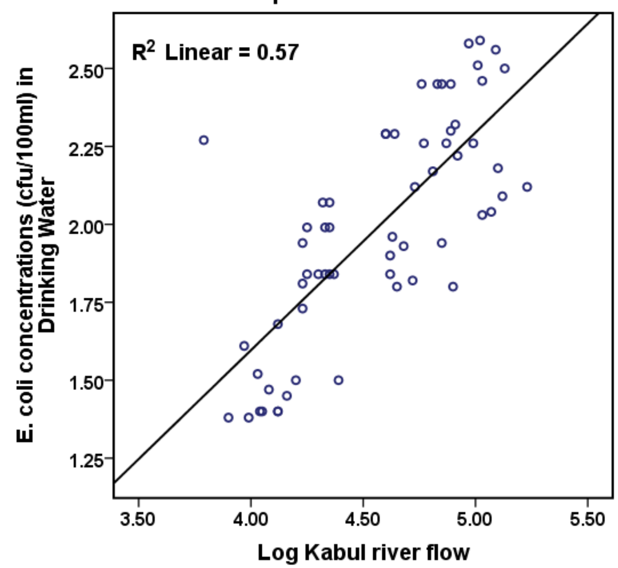
E. Coli concentrations *(log cfu/100ml)* Drinking water samples











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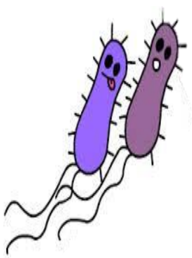
Model outcome

$$\log(Y) = \beta_0 + \beta_1\, Tw + \beta_2\, p + \beta_3 \log\,(D) + \beta_4 Tw * \log\,(D) + \varepsilon$$




- ✓ R^2 value for surface water sources is 0.899.
- ✓ R^2 value for drinking water sources is 0.674.

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Key Findings

- ✓ Based on analysis of our biweekly samples. *E .coli* concentrations (log *cfu/ 100ml)*, positively correlated with
  - ★ Avg. Water temperature.
  - ★ Sum of 5 days precipitation.
  - ★ Discharge of Kabul river (log m^3/s).

- ✓ All the water sources are unfit for drinking.
- ✓ Even not suitable for swimming or bathing

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Next Steps ……

- We are going to model the *E. coli* concentration by using process based hydrological model.
- Also link the pathogen concentration with diarrheal data in the region.
- We have many more data during floods: ~1800 measurement over the period of 30 months. We will do time series analysis.

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Thank you for your attention !

Questions ?

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