Distribution of arsenic in groundwater in three states of India and geochemical data from an arsenic-affected area of Ballia District, Uttar Pradesh

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Presentation Outline

- Distribution of As in groundwater used for drinking in India:
  - West Bengal state
  - Bihar state
  - Uttar Pradesh state
  - Assam, Jharkhand and Chhattisgarh states not covered
- Geochemical data from Ballia District, Uttar Pradesh state
- Conclusions

Overall area under discussion

West Bengal state

- 132,262 govt. handpumps tested using SDDC method with AAS confirmation
- 25.5% > 50µgl^{-1} (India int.)
- 57.9% > 10µgl^{-1} (WHO)
- 79 blocks in 8 districts
- Est. 3.9 million people exposed (>50µgl^{-1})
- 1.45 million (37%) provided with alternative sources
- GoWB US$500 million 'Masterplan' underway to provide PWSS
- Communication required to ensure behaviour change

% sources >50ug/l
- 0
- 1 – 20
- 20 – 30
- 30 – 40
- 40 – 50
- 50 – 100
- No data

Bihar

Bangladesh

West Bengal
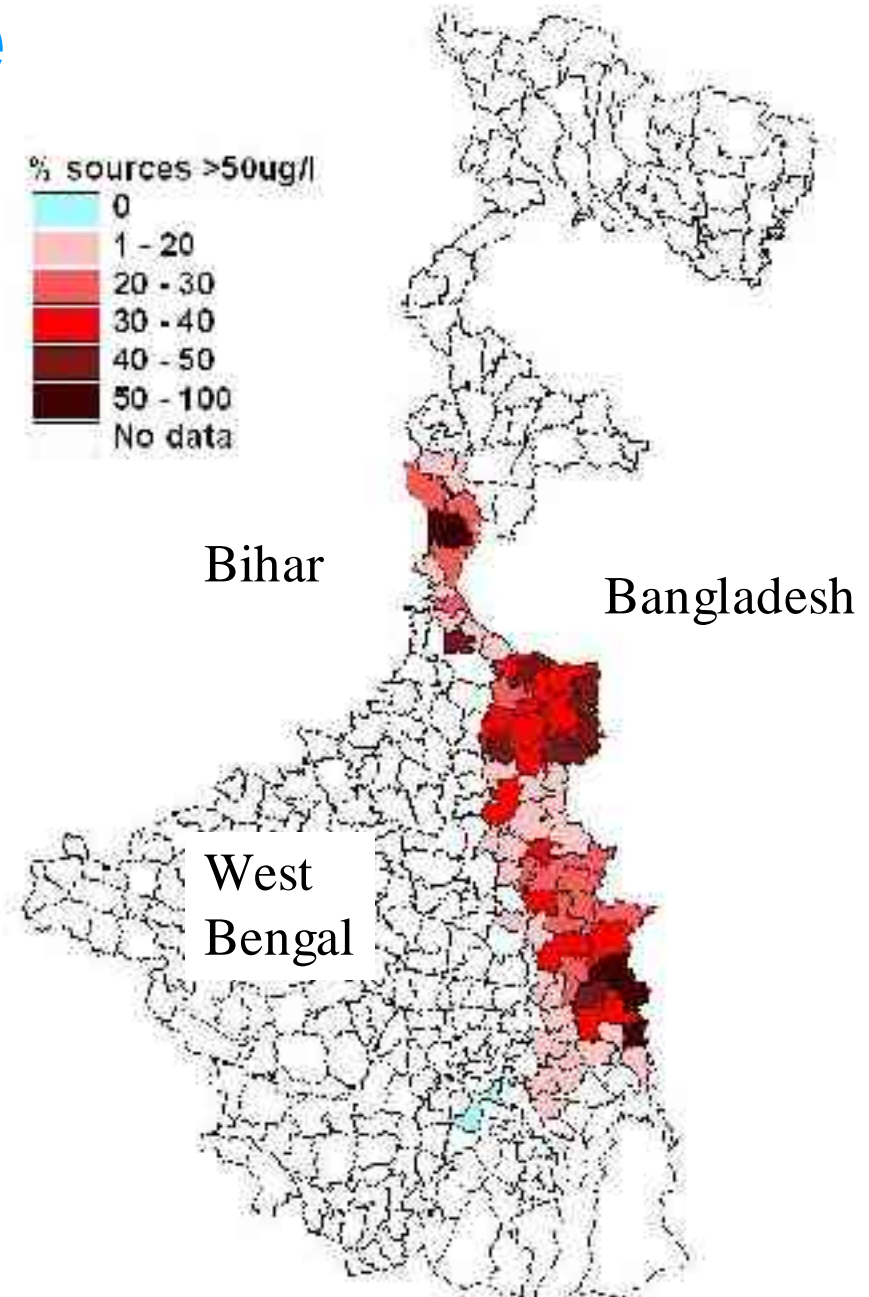
Assam state

- Initial testing of 5,729 sources from 22 districts
- Focus on 25km proximity of Brahmaputra
- 6.3% > 50µgl^{-1}
- 26.4% > 10µgl^{-1}
- 72 blocks in 18 districts affected (>50 µgl^{-1})
- Anomalous that Tinsukia and Dibrugarh not affected
- Blanket testing of govt. sources now ongoing using 80 Arsenator's backed up with laboratory confirmation (SDDC/AAS)
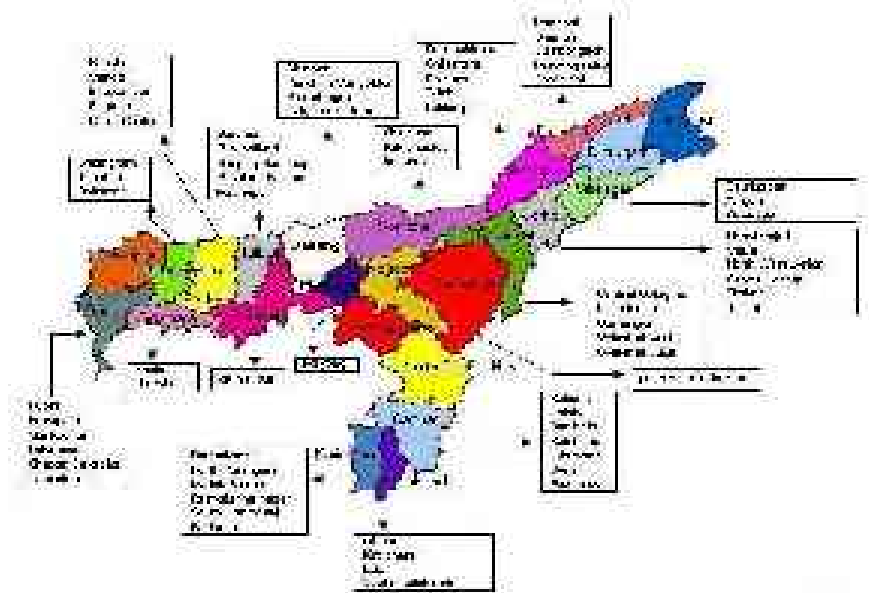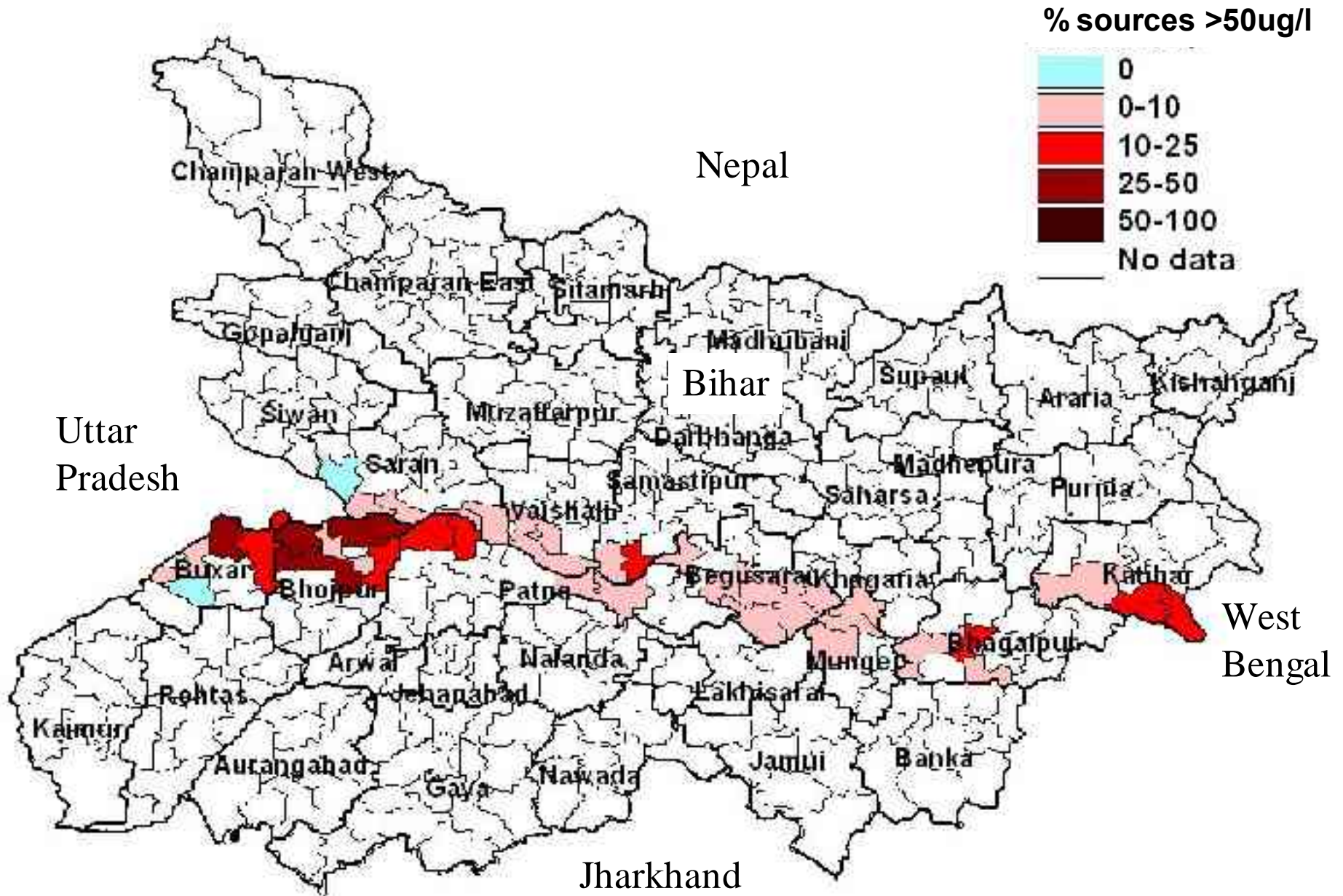
Bihar state

- To date 66,623 sources tested using FTK (laboratory confirmation with SDDC method)

- Focus on areas within 10km of Ganga

- 10.8% > 50μgl^{-1}

- 28.9% > 10μgl^{-1}

- 50 blocks in 11 districts affected (> 50μgl^{-1})

- Testing ongoing, additional testing required along Gandak river floodplain

- GoB providing PWSS, RWH and sanitary wells

Bihar state

% sources >50ug/l

- 0
- 0-10
- 10-25
- 25-50
- 50-100
- No data

Nepal

Bihar

Uttar
Pradesh

West
Bengal

Jharkhand

Champaran West
Champaran East
Sitamarhi
Madhubani
Supaul
Araria
Kishanganj
Gopalganj
Siwan
Mirzaffarpur
Darbhanga
Madhepura
Purnia
Saran
Samastipur
Saharsa
Vaishali
Buxar
Bhojpur
Patna
Begusarai
Khagaria
Katihar
Munger
Bhagalpur
Arwal
Nalanda
Lakhisarai
Rohtas
Jehanabad
Kaimur
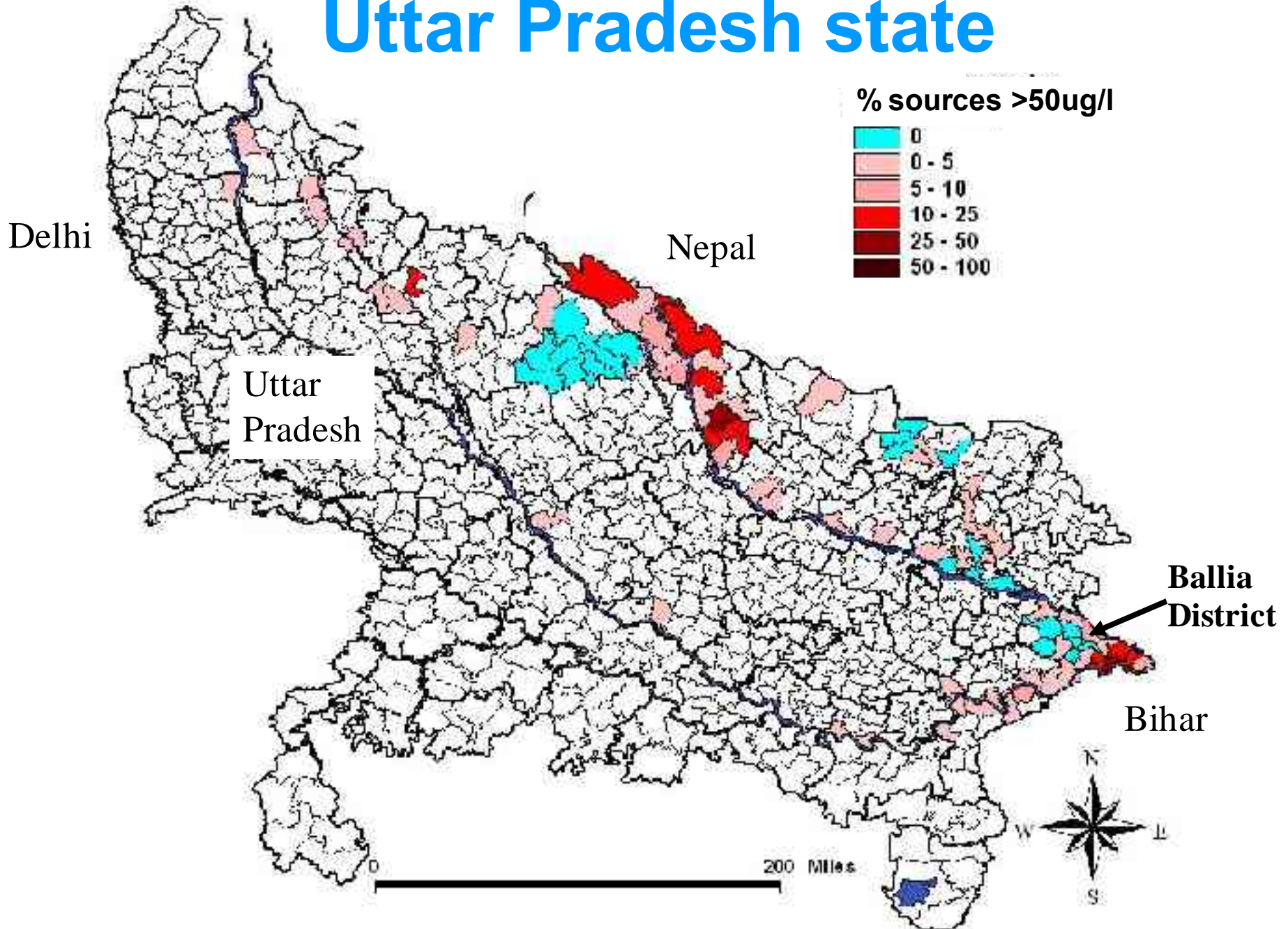Aurangabad
Gaya
Nawada
Jamui
Banka

Uttar Pradesh state

- 103,178 govt. sources tested with FTK in 321 'at risk' blocks in 51 districts to date

- Laboratory confirmation with Arsenator/SDDC method

- 1.3% > 50 µgl^{-1}

- 9.6% > 10 µgl^{-1}

- To date 66 blocks in 20 districts affected (>50 µgl^{-1})

- Testing ongoing

- GoUP providing PWSS and deep handpumps

Uttar Pradesh state

Delhi

Nepal

Uttar
Pradesh

% sources >50ug/l

- 0
- 0 - 5
- 5 - 10
- 10 - 25
- 25 - 50
- 50 - 100

**Ballia
District**

Bihar

200 Miles

Jharkhand state

- Blanket testing of govt. and private sources in two blocks of one district (Sahibganj)

- 9,777 sources tested to date

- 3.5% > 50 μgl^{-1} to date

- 7.7% > 10 μgl^{-1} to date

- Also 32,466 sources tested for arsenic in schools across entire state

- As expected Sahibganj District found worst affected most other areas not affected

Jharkhand state

# Jharkhand state

Geochemical data collection: Methodology

Sample collection & preservation

- Pre monsoon, post monsoon and winter season

- Acidified to pH 2 using HCl for Arsenic and Fe(II)

- Anion and ammonia analysis left unacidified and refrigerated

Analysis

- Arsenic by SDDC Spectrophotometric Method

- Total arsenic was analyzed at 10% HCl

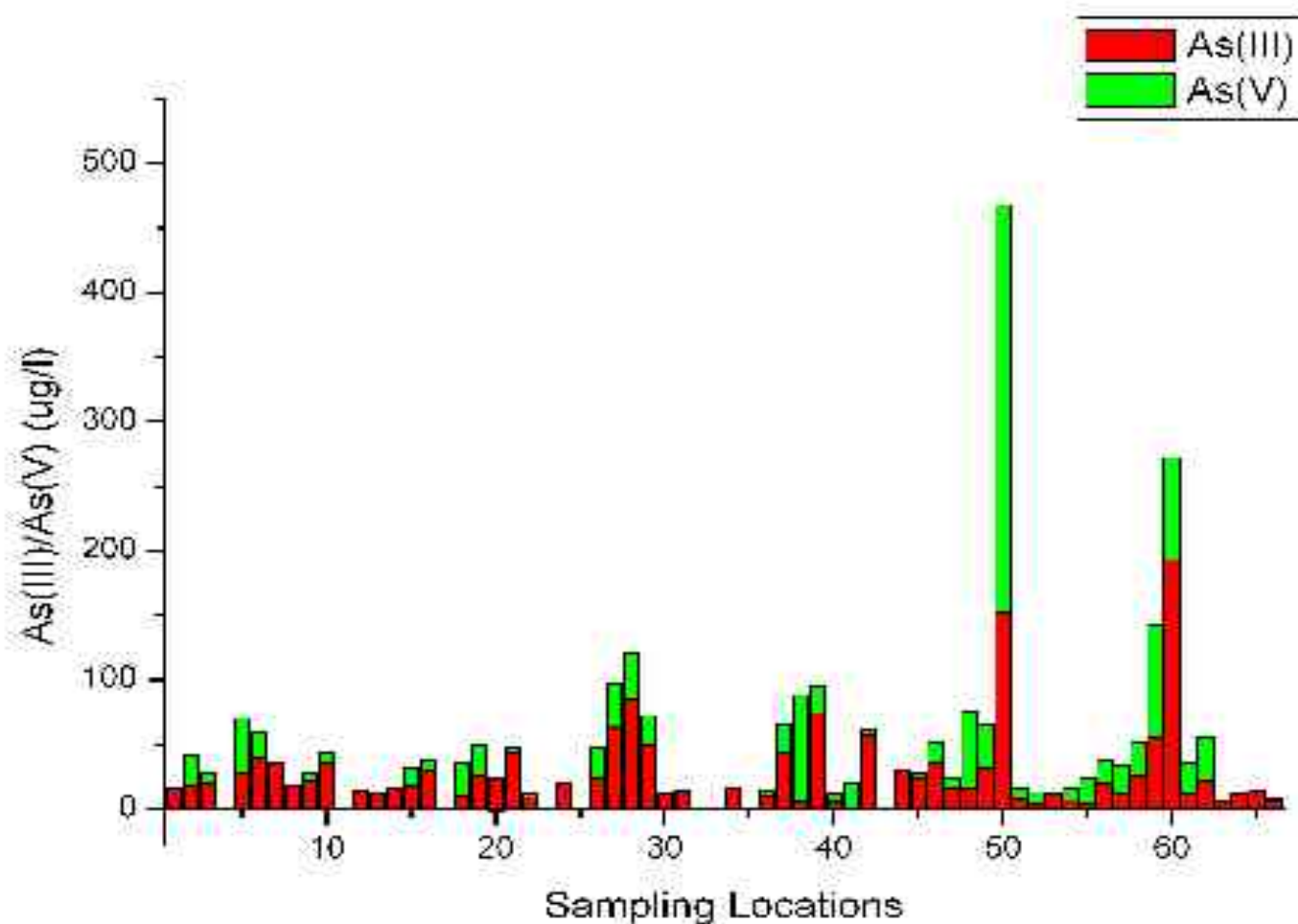- As(III) was analyzed at pH 5 using (0.6M)acetate buffer
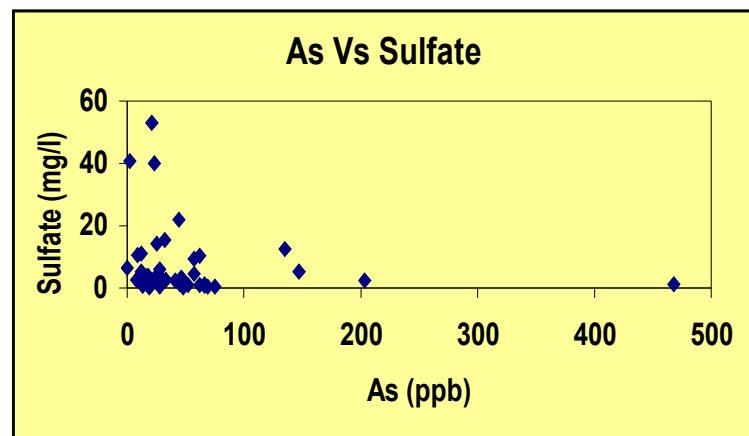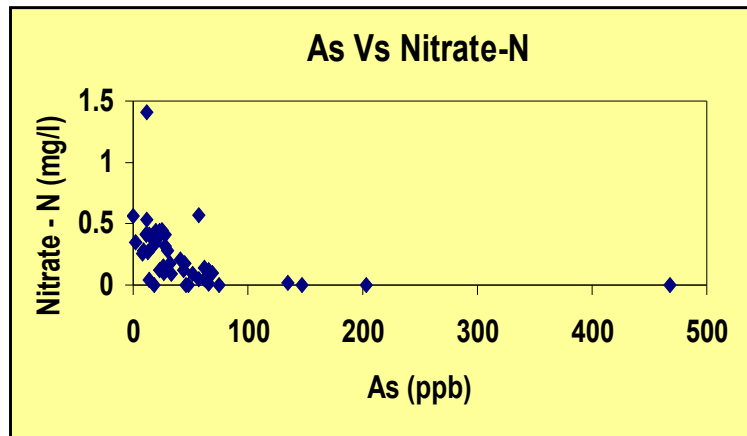
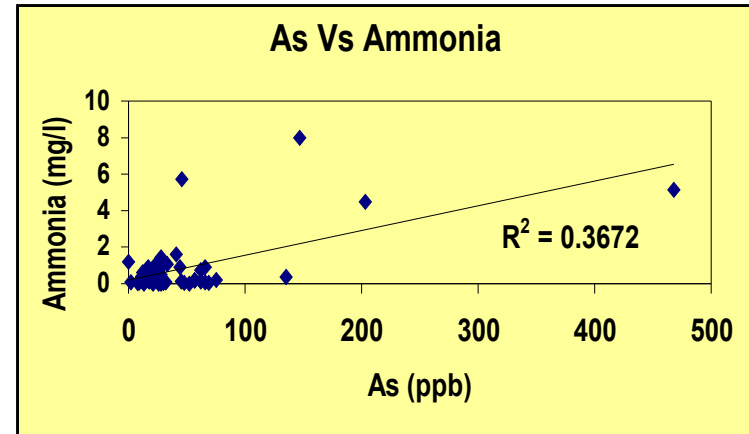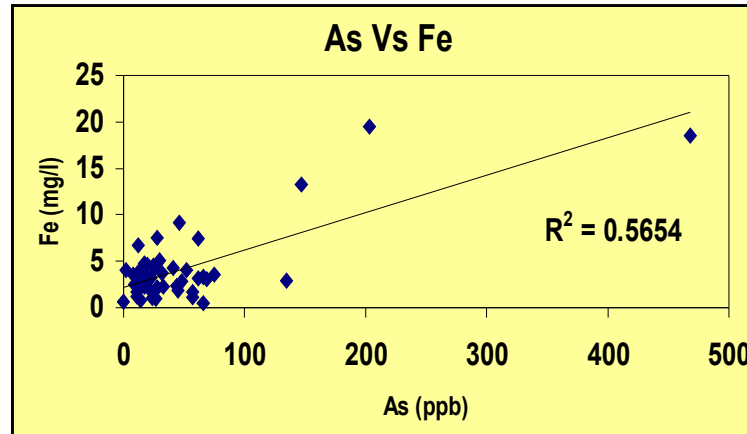Study Area
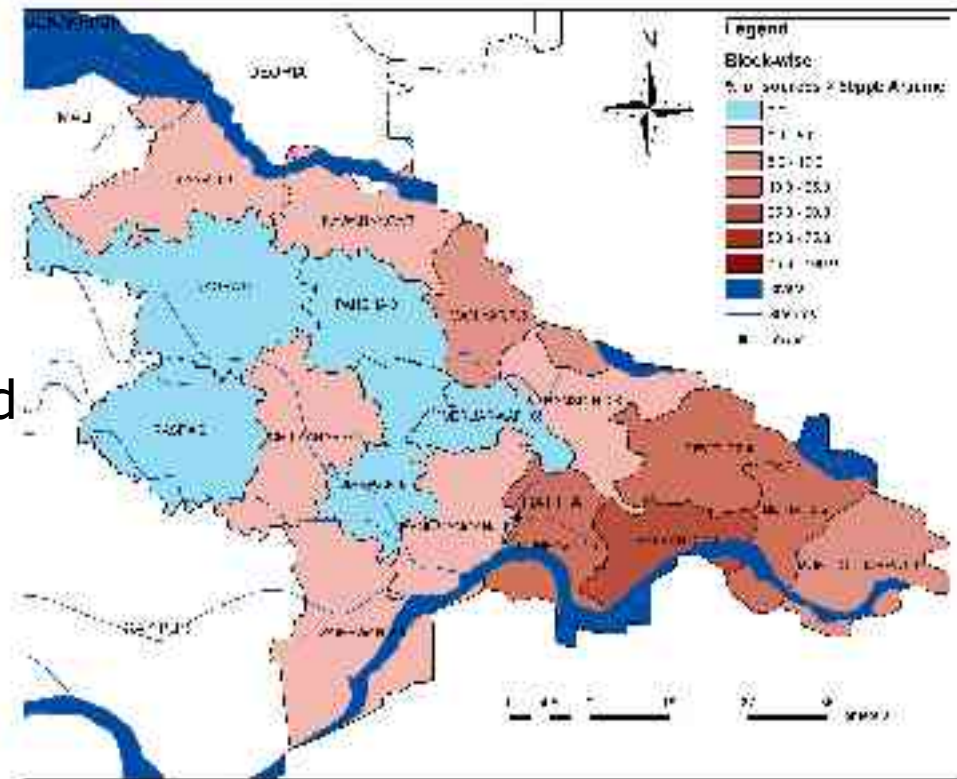
Present Scenario

Fig. 1 Distribution of As(III) and As(V) in various locations of Ballia District

Ground water chemistry in the study area

- pH 7.3 – 7.5, ORP (-100 to -175 mv)
- IM II hand Pumps (30 - 35 m deep) As conc. from $0 - 428 \ \mu gl^{-1}$
- No seasonal variation of arsenic concentration
- Reduction mechanism is the predominant mechanism governing the mobilization of Arsenic in Ballia district

Conclusions

- Arsenic found at >50 µgl^{-1} in groundwater used for drinking in at least 269 blocks of 58 districts of India

- Testing ongoing in some areas and complete picture yet to emerge

- Overall, testing of private sources still required

- Better communication action required in some areas, especially West Bengal

- Field testing backed up by lab. confirmation is a good system for testing a large number of sources in a reasonable timescale without compromising on accuracy

- Upstream of West Bengal most 'at risk' areas for arsenic occurrence are geologically younger sediments with reducing conditions, both As(III) and As(V) found in UP

Thank You