# Groundwater Arsenic in Bangladesh: GIS based spatial mitigation planning with public participation

Submitted to

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Date: 27-01-09

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# Introduction

- The existence of arsenic in water has become a more significant issue in Bangladesh.
- World Health Organization (WHO) has set a guideline limit of 10µg/L in drinking water [Holm, 2002].
- 61 districts out of the 64 and more than 30% of the tubewells are contaminated with arsenic [NAISU; Arsenic 2002]
- Remarkable interest towards integrating GIS into participatory planning.

# What is PPGIS

- PPGIS (Public Participatory Geographical Information System) has been developed in combination with a PRA (Participatory Rural Appraisal) and GIS (Geographical Information Systems) modeling.
- PPGIS attempts to design and adapt GIS that specifically address the needs of participant communities.

# Objectives

- Concerned with participatory application of GIS regarding arsenic mitigation which include:
  - Integration of socially differentiated local knowledge in the form of cognitive maps
  - Embedding the ‘community perceptions’ within a GIS for spatial arsenic mitigation policy with deep tubewell planning and management.

# Review of Literature

## Basic queries

| Location | What is at……..? |
|---|---|
| Condition | Where is it……..? |
| Trend | What has changed…….? |
| Routing | Which is the best way…? |
| Pattern | What is the pattern……..? |
| Modeling | What if……..? |

# Arsenic Contamination in Groundwater

- Many parts of the world, including South-Western Taiwan, Southern Thailand, Inner Mongolia, China, West Bengal of India, Bangladesh, and Northern Mexico are suffered.
- Elevated arsenic concentrations are particularly common in places with high geothermal activities and groundwaters in mining areas [Sevil, 2003].
- Low arsenic levels are usually detected in rivers and lakes.

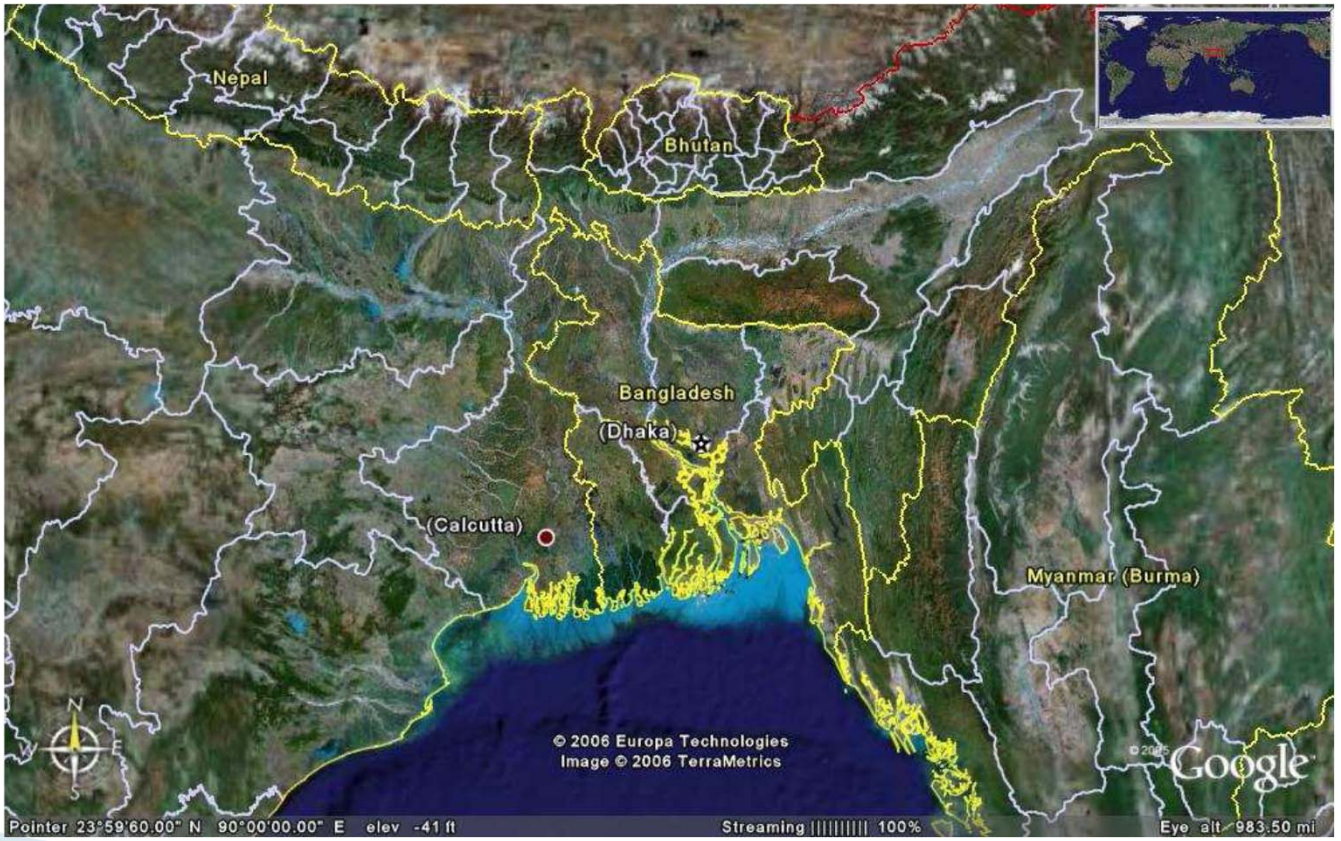
# Health Impacts of Arsenic

- Melanosis (93.5%) and keratosis (68.3%) are common among the affected people.
- Leucomelanosis (39.1%), skin cancer (0.8%) and hyper-keratosis (37.6%) have been found in many cases[Safiuddin, 2001].

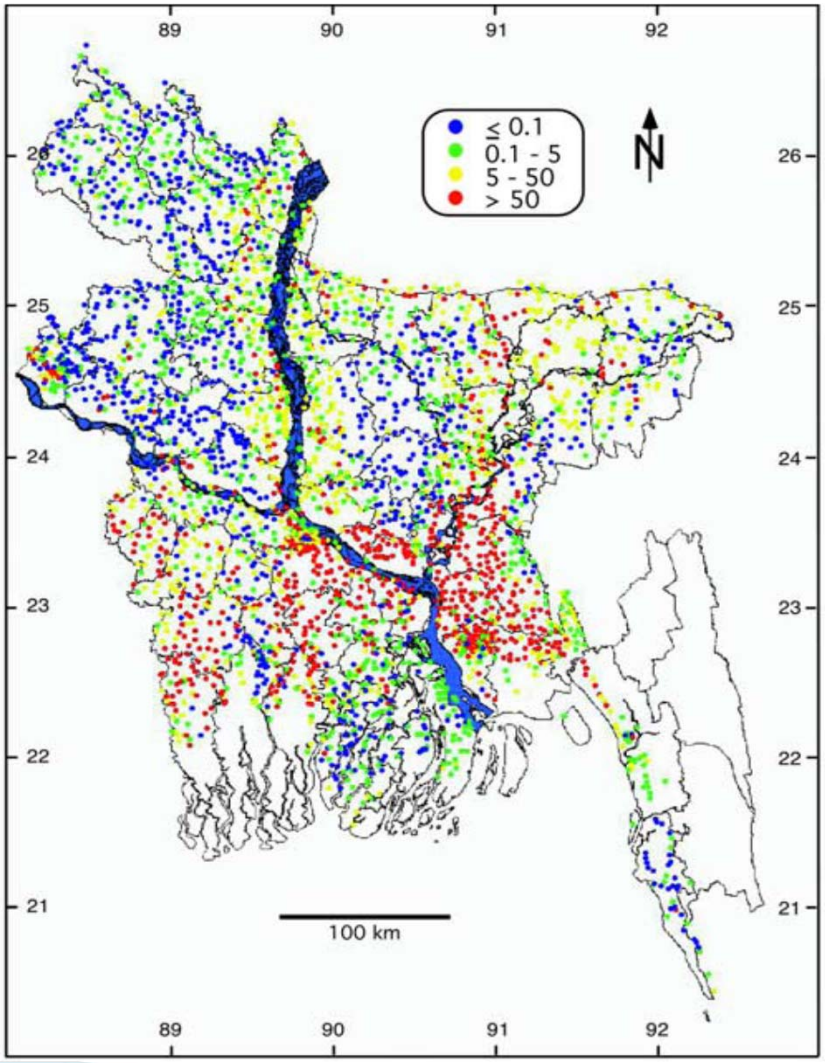
[Safiuddin, 2001]

# Study Area

Location of Bangladesh [Google Earth, 2006]

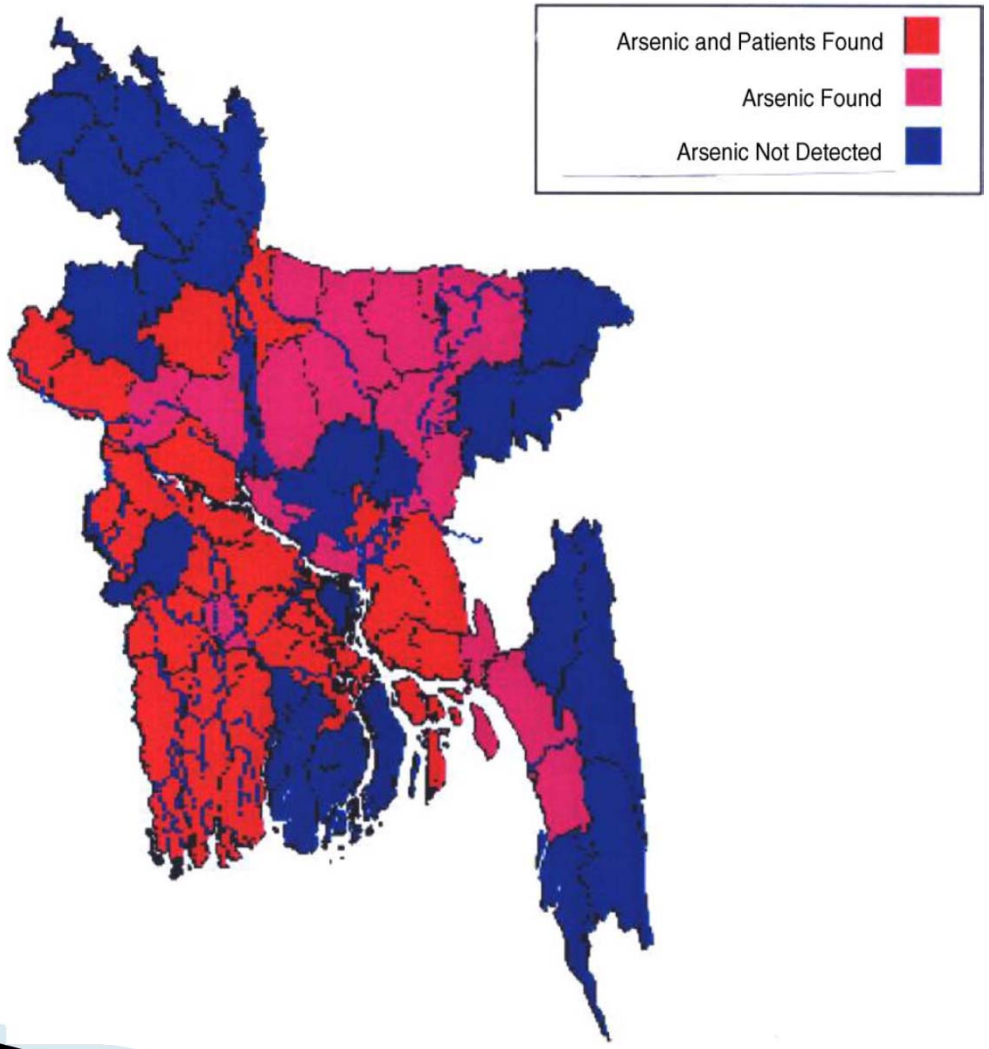


# Arsenic in Bangladesh




[Hossain, 2006)]

# Soil Arsenic in Bangladesh



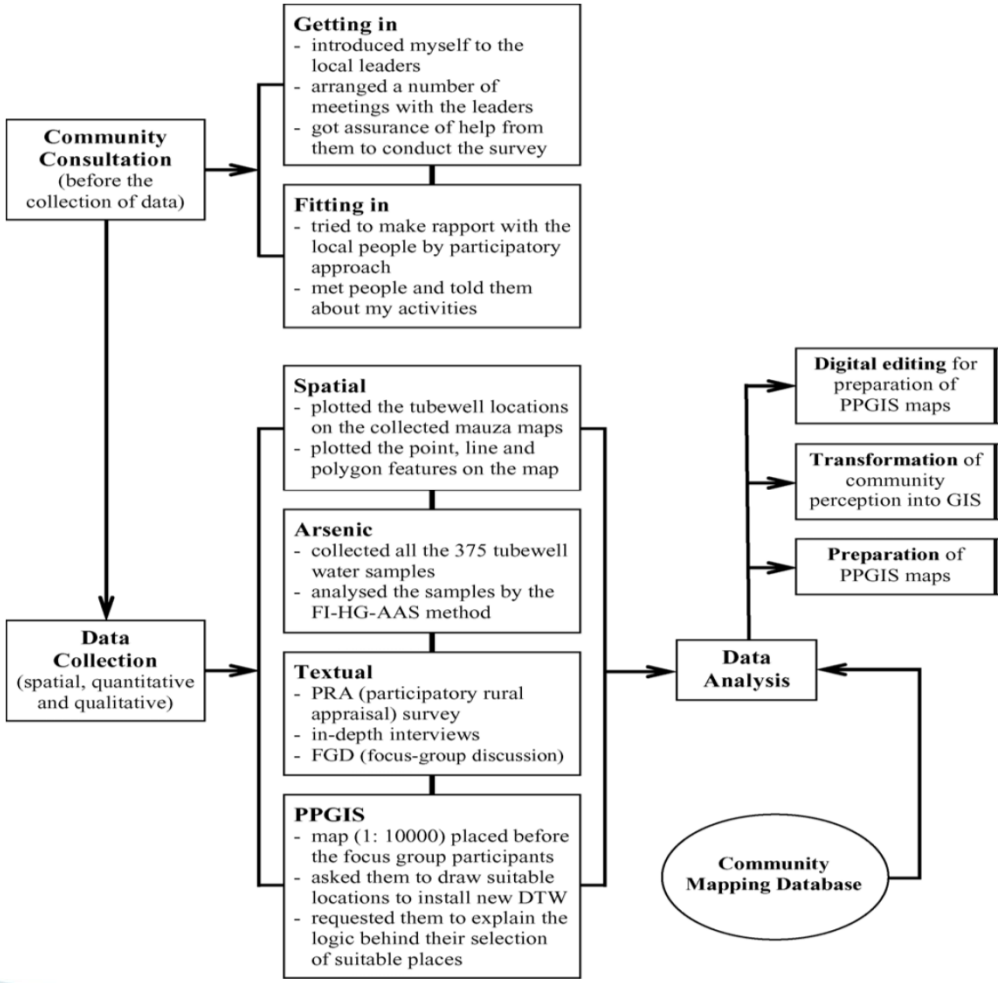

[Jakaria, 2000]

# Methodology

- PPGIS technique for designed and implementation of decision-making process.
- Systematic approach for participatory arsenic mitigation with arsenic-free deep tubewell management.
- Compilation of local knowledge through participatory mapping exercises over GIS maps.

# Case study

Chart for spatial deep tubewell planning with PPGIS techniques



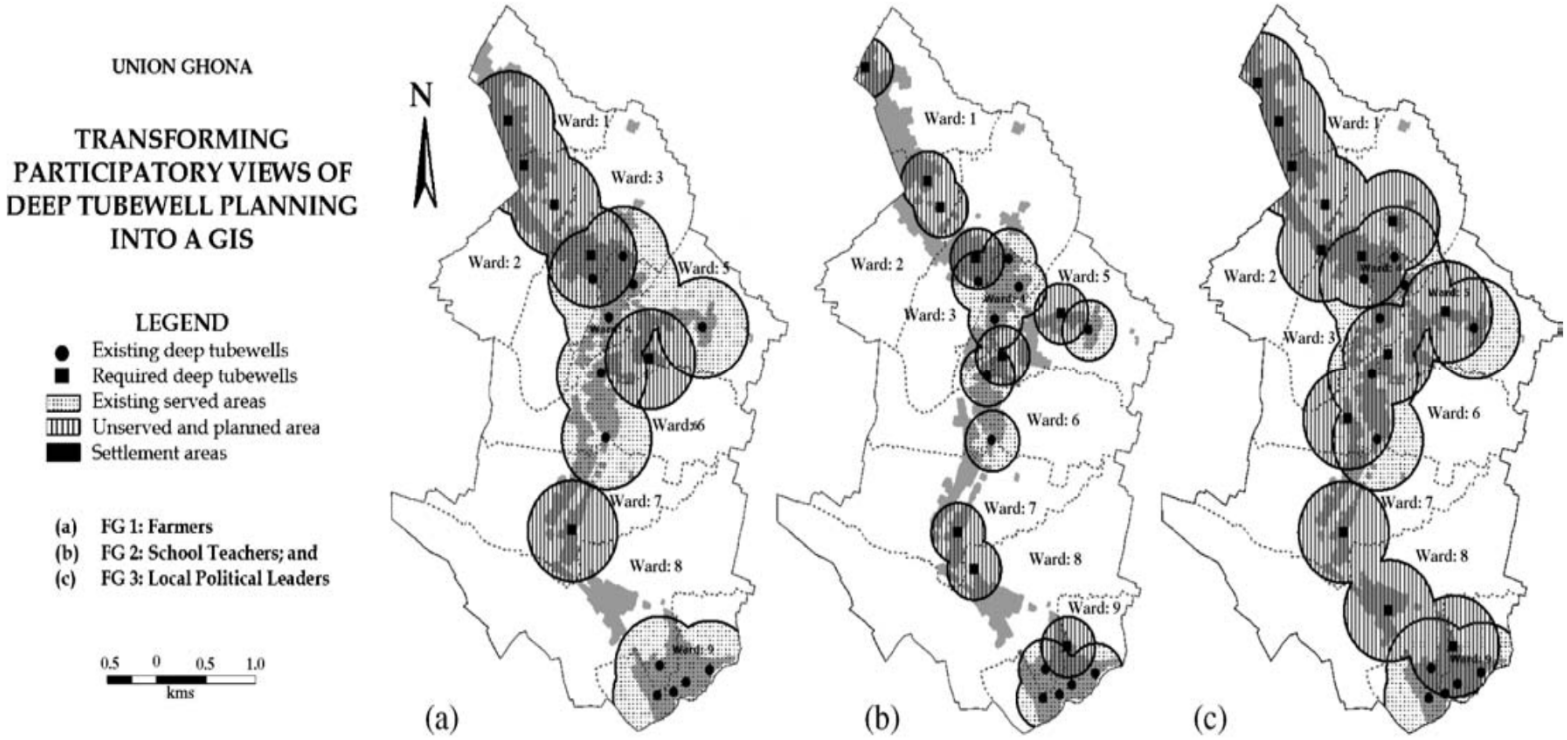

[Hassan, 2005]

# Participation-based Solution

- Transformation of people's opinions into a GIS.
- Transformation was used as a 'triangulation' for method verification.
- Participatory sketching for the locations of deep tubewells with buffer zones.
- Buffer distance of each deep tubewell was measured by field survey.

# Participation-based Solution

- Transforming participatory views into a GIS




[Hassan, 2005]

# Results and discussion

- Deep aquifer is much less contaminated than the shallow one.
- People in the study area cannot afford a deep tubewell.
- Government should installed deep tubewells for arsenic-free water.
- One deep tubewell for each 350 people.

# Final Finding on PPGIS

- PPGIS was found to
  - develop integrating local people's perceptions and analyze their knowledge.
  - to design and adapt GIS that specifically address the needs of participant communities.
  - emphasise the participatory approaches used in introduction of GIS.
  - use as a new window to view the whole of GIS practices in social setting within the domain of 'information-democracy' [Dervin, 1994]

# Conclusion

- Tubewells installed at a depth between 100 and 150 feet are concentrated with high levels of arsenic; while concentrations are very low in deep tubewells.
- One deep tubewell for each 350 people within a buffer distance of 300m were considered as a mitigation planning for arsenic problem.

# Thanks for Listening