Drinking water crisis due to arsenic contamination in Bangladesh: public health consequences, mitigation strategies and sustainability

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Zaragoza, June 30, 2008

Bangladesh: some indicators

- Population: 144 million (2007) living in 143,000 sq. km
- Main economy: Argiculture based on irrigation
- Poverty level: 40% under poverty line
- Rural: 75%
- Water availablity: Huge surface and undeground water
- 3 major rivers: The Ganges, Brahmaputra and Megna
- Drinking water: >95% people use underground water
- .....

Switching from surface water to underground water: are we safe?

People use surface water until 1970s

Poor quality due to pollution

Increase water -borne diseases

High infant and child mortality

Demand pathogen free safe drinking water

Best option was underground water

Installed millions of tubewells

Reduce infant and child mortality

Underground water becomes widely popular

Problem arose due to arsenic contamination

Affected almost whole country

Poses severe health problems

Questions?

- How contaminated?
- How rapid?
- How are people affected?
- Who is at risk?
- What health consequences?
- What mitigation strategies adapted?
- Are they feasible and sustainable?
- What prevention?

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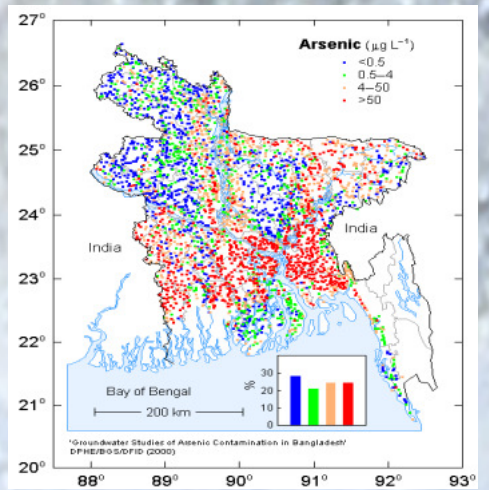
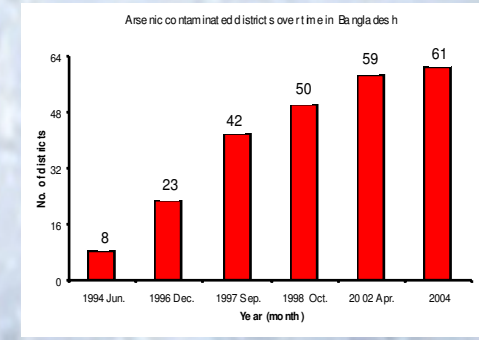
How is water arsenic contaminated?

- Several hypothesis were proposed initially (e.g...)
- The use of arsenic based pesticides
- The use of arsenic based fertilizers
- Excessive use of underground water for irrigation
- Arsenopyrite oxidation (oxidation hypothesis)
- Arsenic-rich iron oxy-hydroxide reduction (reduction hypothesis)
- Reduction hypothesis seems more generic but .....

How rapid?

- Firstly identified (year): 1993
- Affected districts: 61 (detection bias?)
- Population at risk: 30-70 millions
- 97% rural people use UGW
- Arsenicosis identified: ≈ 100,000
- Projected arsenicosis: Huge
- Biomarkers: Excessive level of arsenic in skin, nail, hair





What are the health consequences?

Dermatological:
-Melanosis
-Keratosis
-Hyperkeratosis
-Itching and burning

Respiratory:
-Cough
-Bronchitis
-Shortness of breath

Haematological:
-Anaemia
-Bone marrow depression

Reproductive:
-Still birth
-Low birth weight
-Abortion

Gastrointestinal:
-Nausea
-Abdominal pain
-Diarrhoea
-Anorexia

Neurological:
-Headache
-Muscle weakness
-Drowsiness
-Numbness

Renal:
-Hematuria
-Proteinuria
-Kidney failure
-Cortical necrosis

Mental health:
-Depression
-Insufficient sleep

Cardiovascular:
-Hypertension
-Myocardial infarction
-Gangrene

Hepatic:
-Jaundice
-Cirrhosis
-Elevated liver enzymes

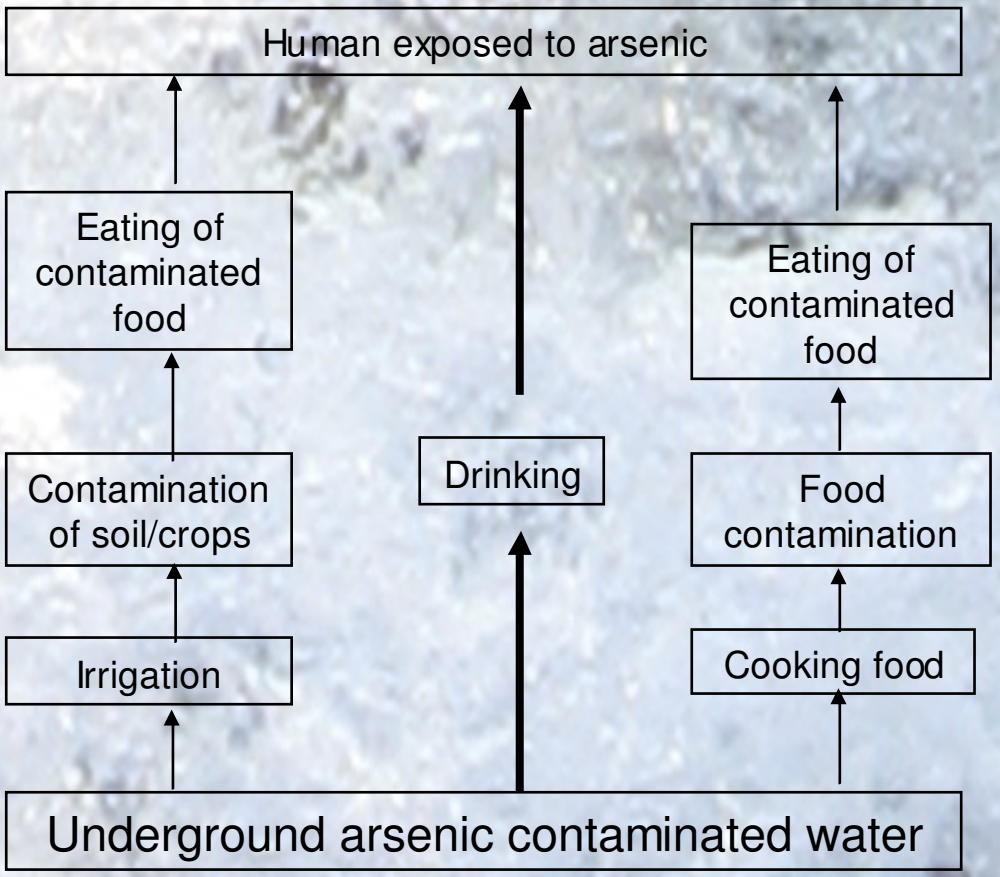
Cancer:
-Skin
-Lung
-Liver
-Kidney/bladder

Mutagenesis:
-Chromosomal aberration
-DNA damage
-Inhibited DNA repair

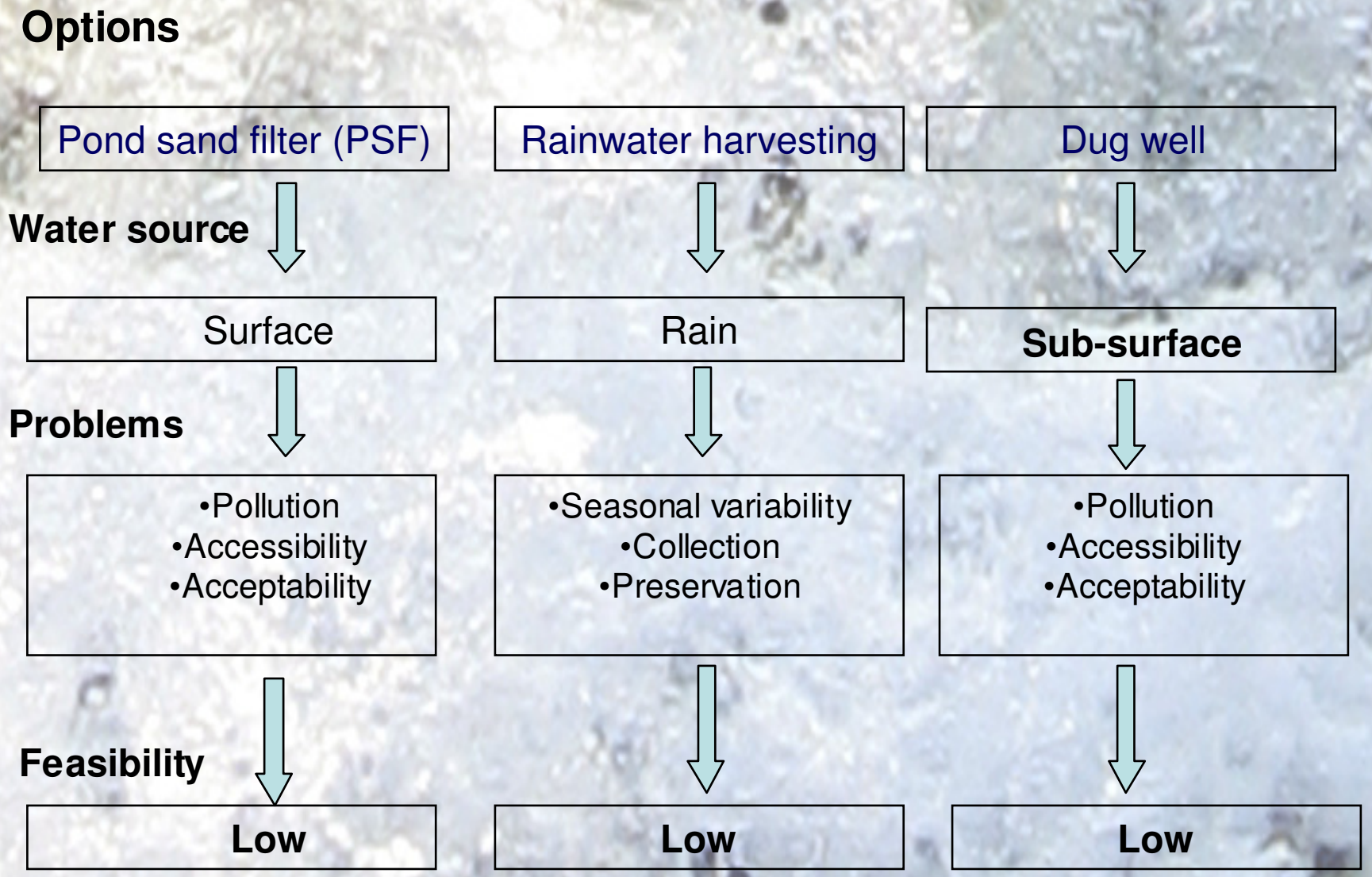
How people exposed in Bangladesh?

Who is at risk?

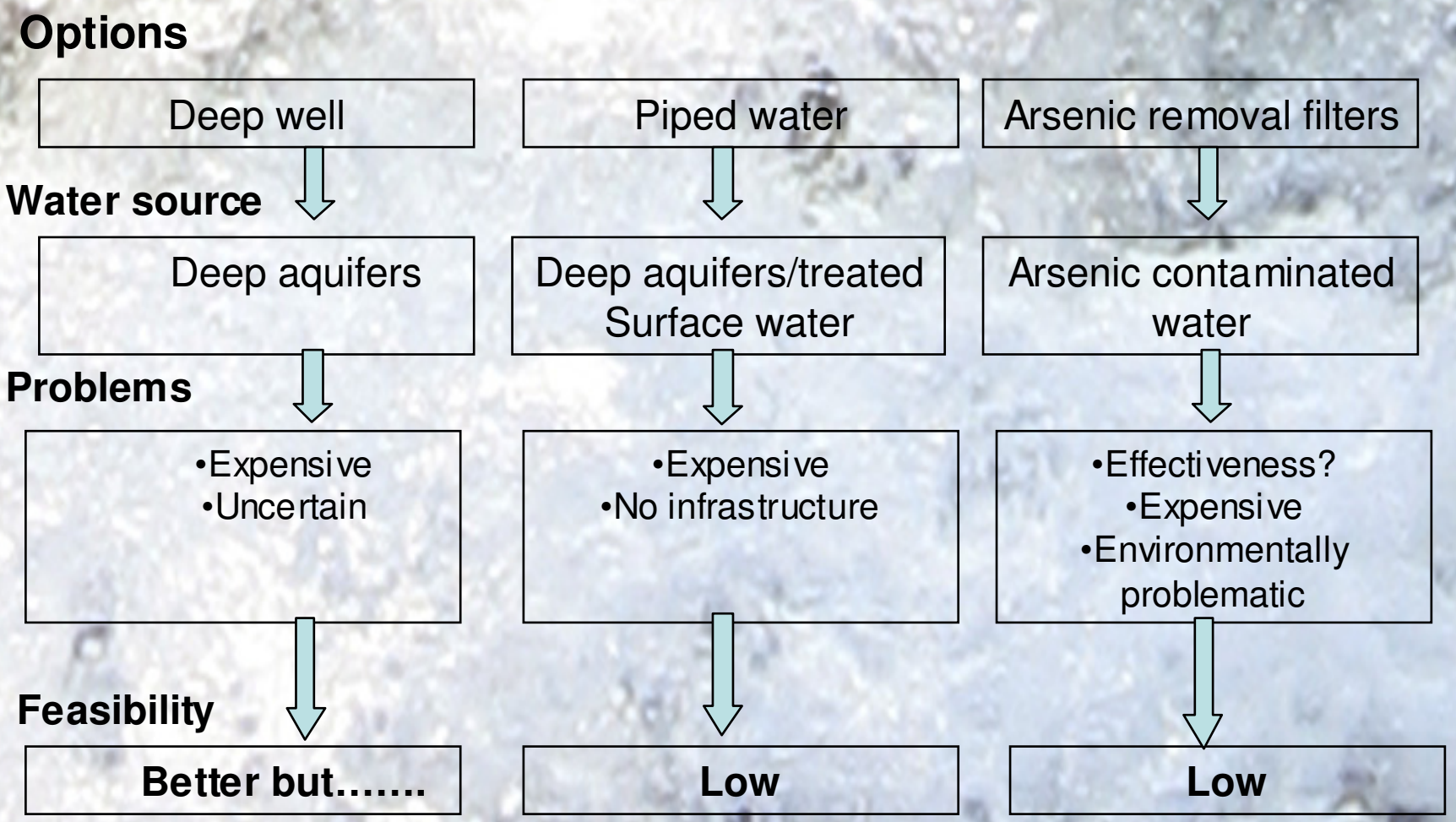
- Poor people
- Rural people
- Undernourished
- Illiterate
- Male and children



Arsenic mitigation strategies and sustainability (I)



Arsenic mitigation strategies and sustainability (II)



Possible prevention strategies

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Conclusion

- Arsenicosis is still a major public health problem
- Overall situation is improving gradually
- Rural poor people and vulnerable areas need supports
- Mitigations based on surface and rain water are not feasible
- Community deep tubewells may be best option
- Preventions strategies are necessary
- Needs interdisciplinary collaboration