

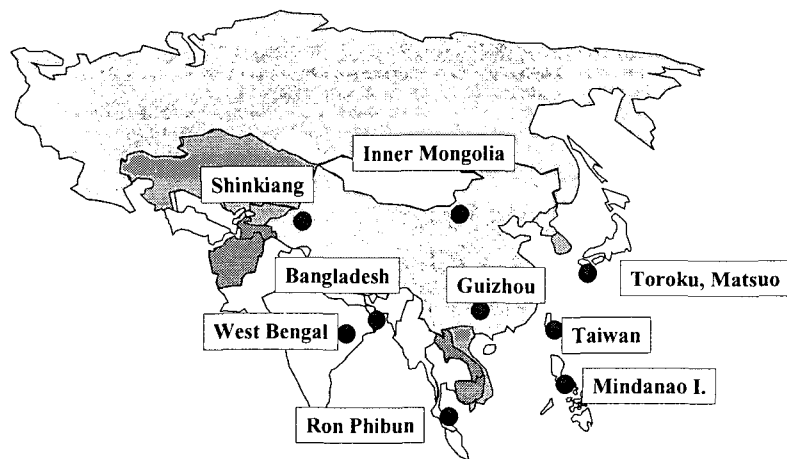
**Arsenic Hazard in Bangladesh:
A Human Ecological Approach to Environmental Health**

Ryutaro Ohtsuka

(Department of Human Ecology, School of International Health,
Graduate School of Medicine, The University of Tokyo)

- 1. Arsenic hazard: The background**
- 2. Surveys in Bangladesh**
- 3. The results (1): Arsenic concentration and arsenicosis**
- 4. The results (2): Nutrition and activity patterns**
- 5. The results (3): The villagers' awareness**
- 6. Nationwide survey for perception of environmental, health and economic conditions**
- 7. Various factors related to mitigation**
- 8. Summary and conclusions**

Arsenic Hazard: The Background

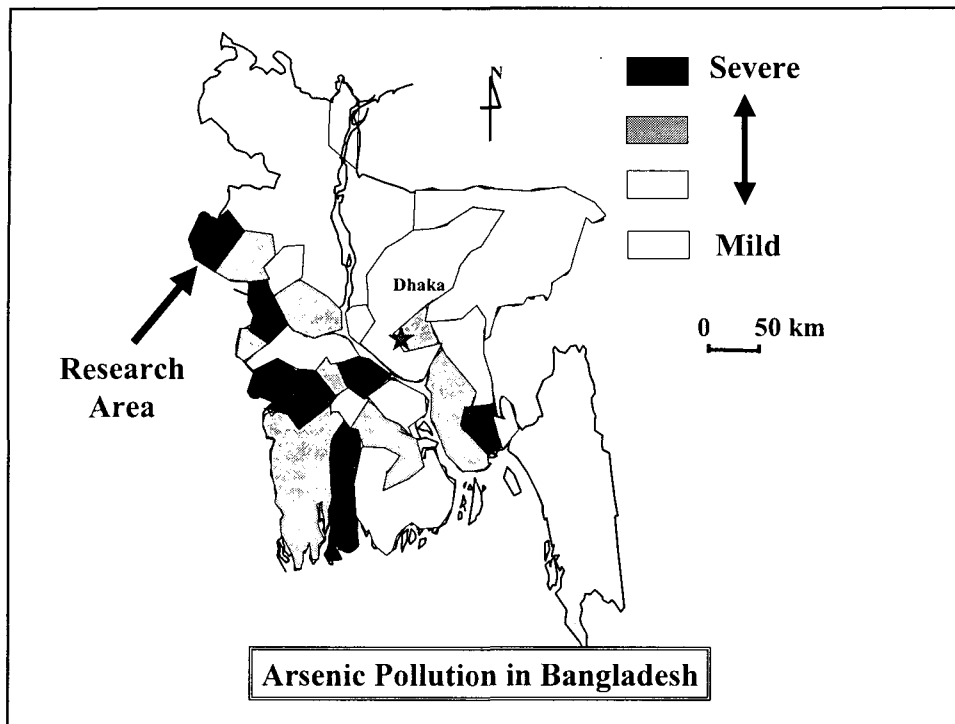


Major Arsenic-affected Areas in Asia

The effects of arsenic poisoning

- 1. Arsenicosis occurs after long-term exposure.**
- 2. Main early-stage health effects are skin manifestations such as keratosis and melanosis, which eventually develop to skin cancer and then to internal organ cancers.**
- 3. Respiratory disorders and hypertension are also observed.**

Surveys in Bangladesh



Brief history of arsenic poisoning in Bangladesh

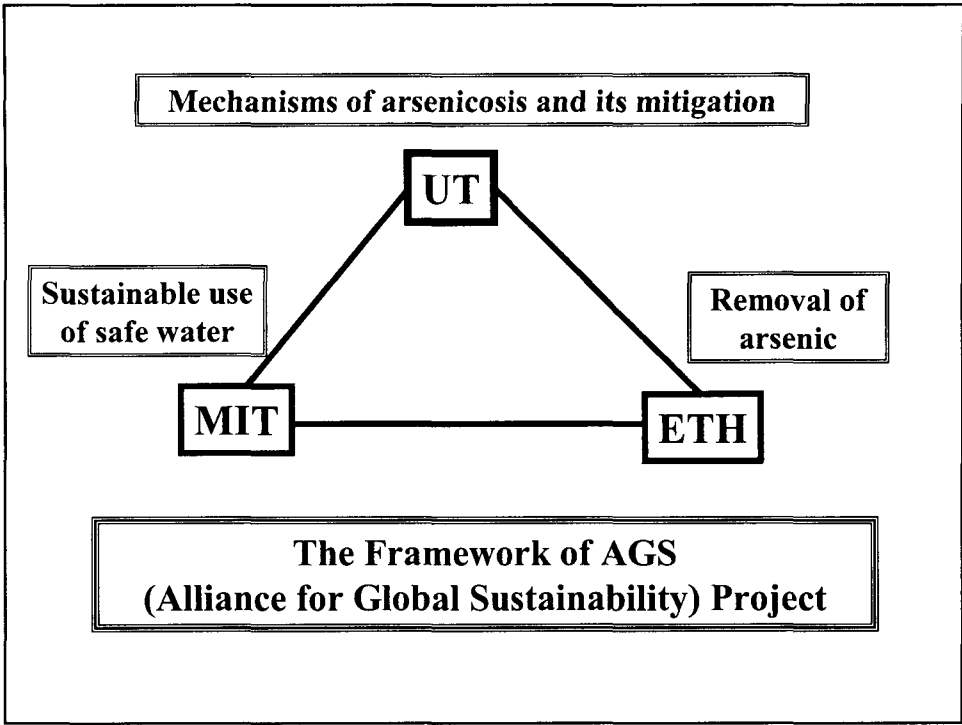
1. High prevalence of diarrhea and other diseases due to drinking surface water.
2. Since the 1970s, tubewells have been dug, with financial support from many organizations.
3. In 1992, the first arsenicosis patients were found.
4. High risk was confirmed in wide area.
5. Bangladeshi government decided safe level of arsenic at 0.05 mg/L (according to WHO, 0.01 mg/L).



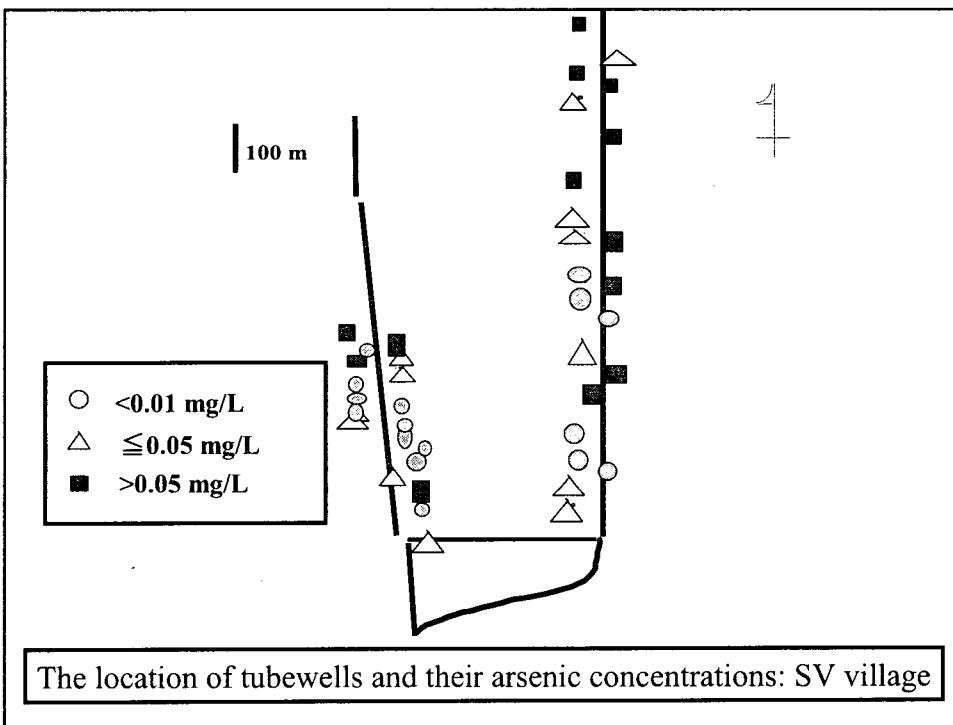
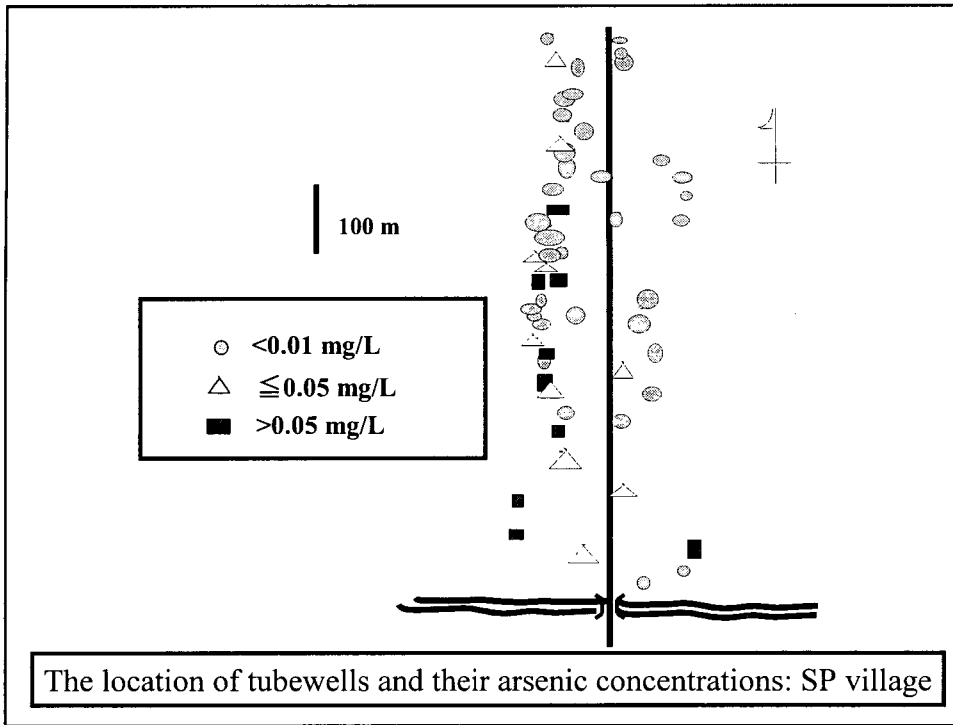
Serpur Vander, Nawabganj (Spring 1999)

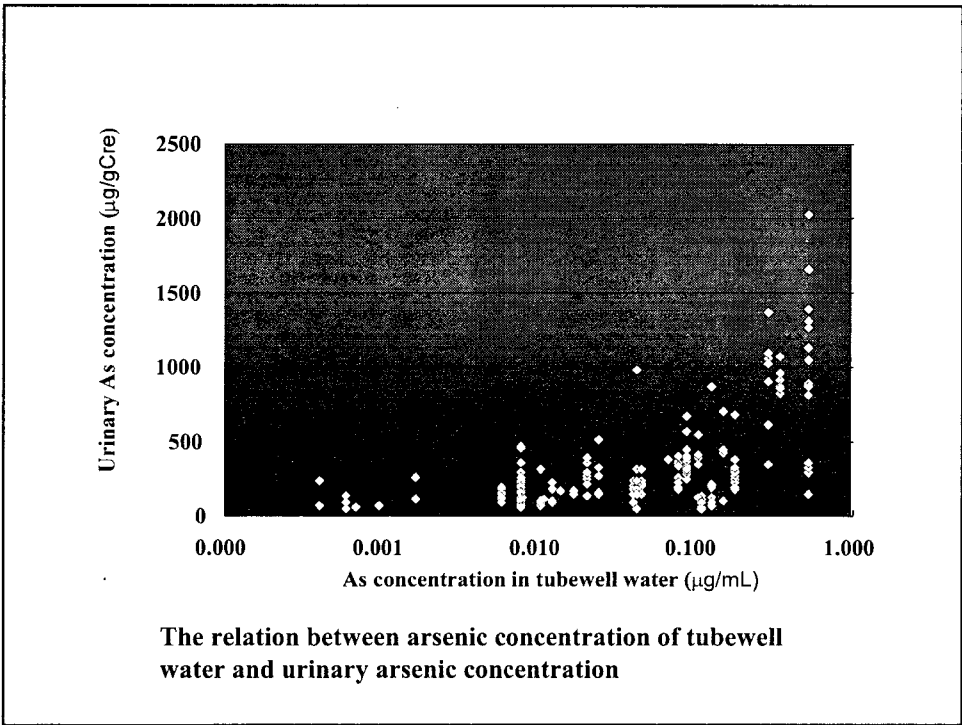
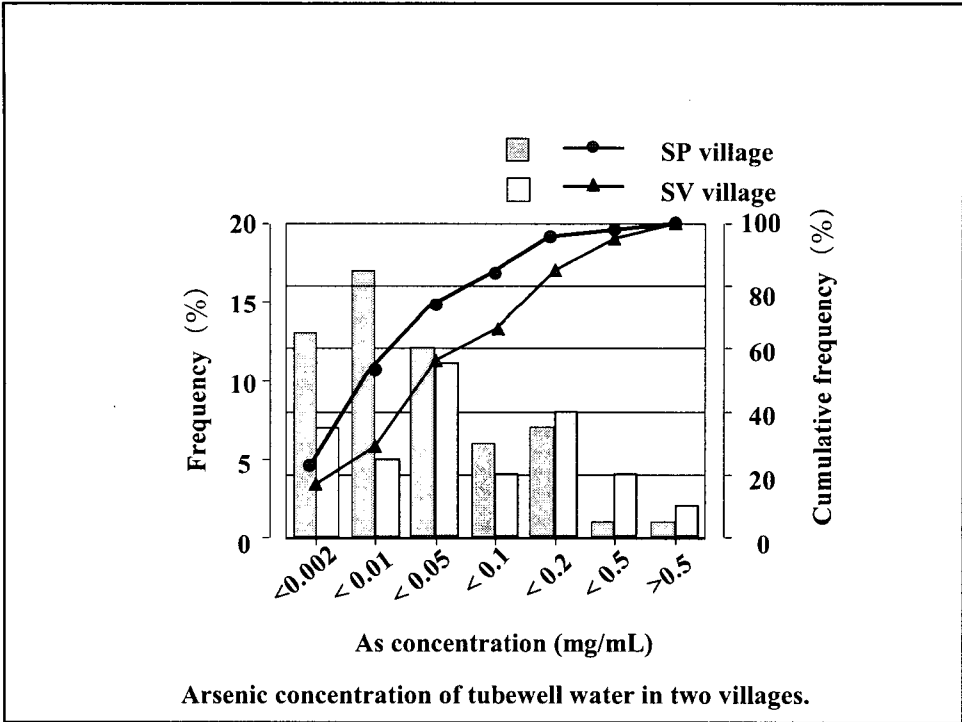






The results (1): Arsenic Concentration and Arsenicosis

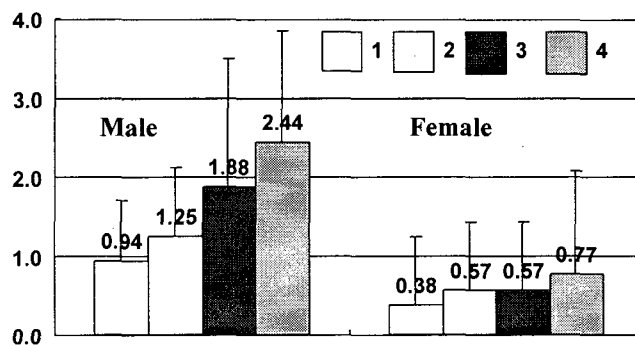




Distribution of the subjects by dermatological score

	Total	By village (%)		By sex (%)*	
		SP	SV	Male	Female
0	308	55	54	11	62
1	129	26	18	24	23
2	73	12	15	17	11
3	28	4	8	8	3
4	17	2	3	6	0
5	6	1	1	1	1
Total	561				

* p<0.01.

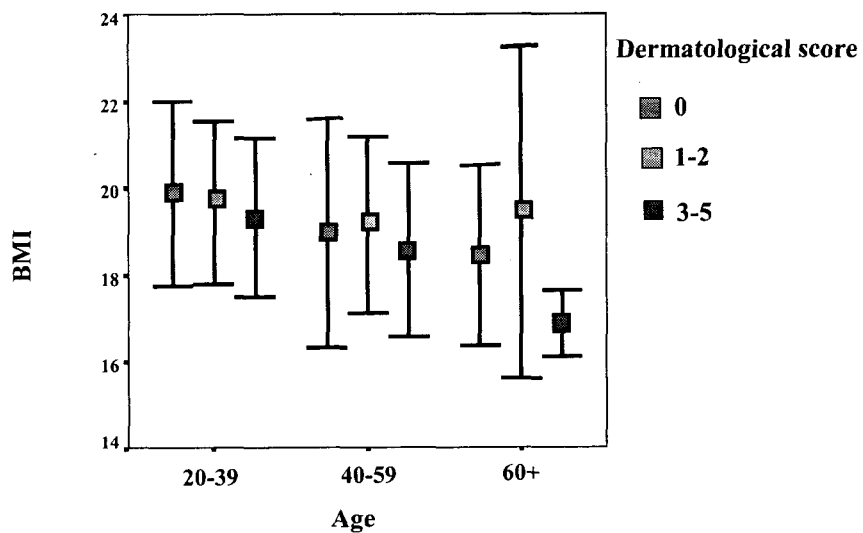


The mean dermatological scores for the subject villagers, broken down into four quartiles by arsenic concentration.

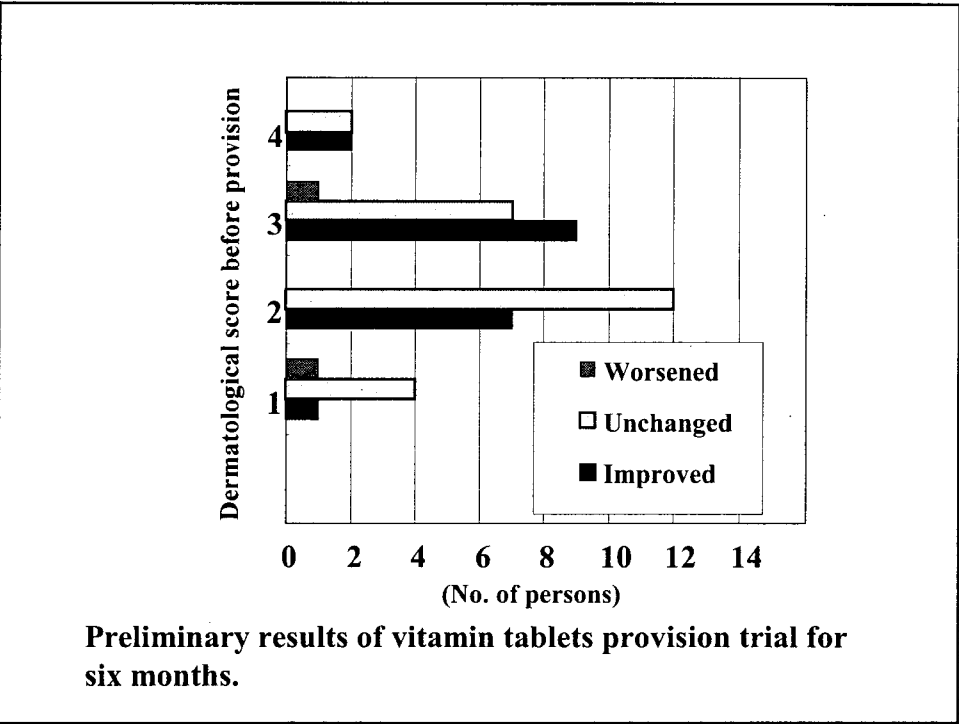
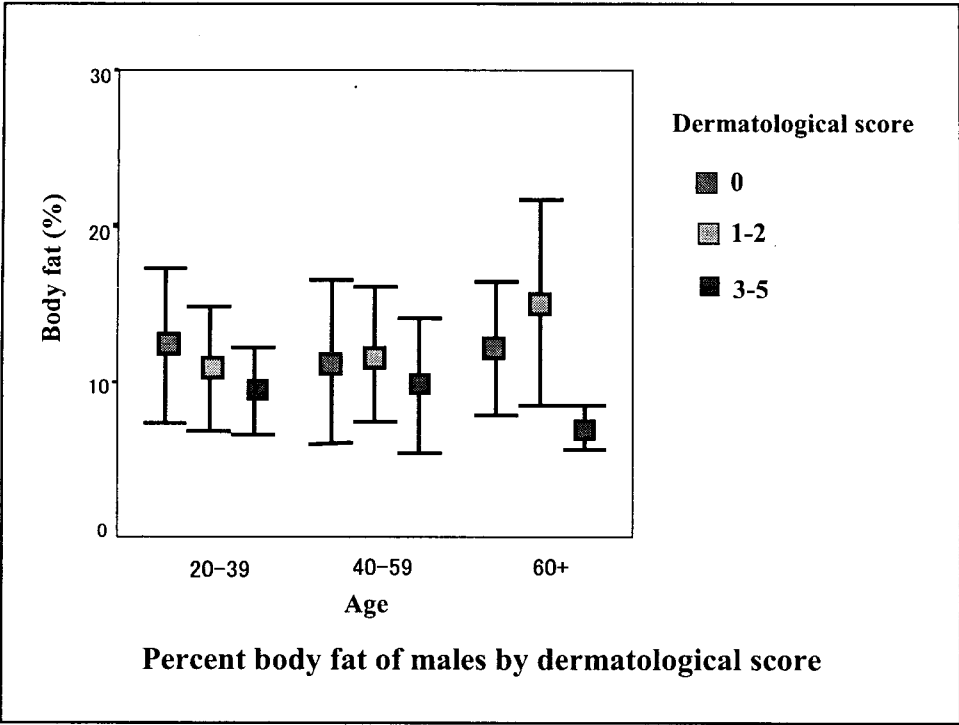
The medians of urinary arsenic concentration ($\mu\text{g/gCre}$)

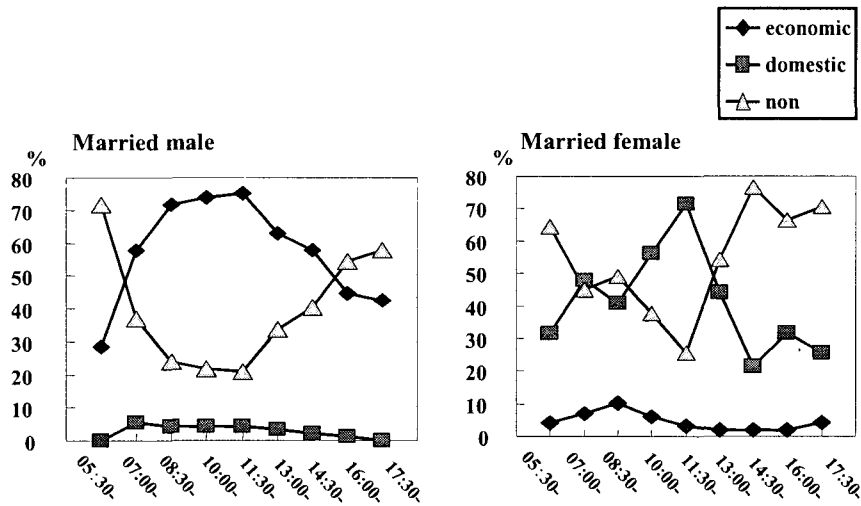
	1	2	3	4
Male	74	166	254	533
Female	75	157	260	855

The Results (2): Nutrition and Activity Patterns



Body mass index (BMI) of males by dermatological score





Percent married males and females who were engaged in three categorized activities in every 90 minutes

Activity time (in hours) broken down into three economic-based categories and two sunlight exposure-related categories (13.5 hours from 5:30 to 19:00)

	Male			Female	
	Married (n=46)	Unmarried (n=14)	Total* (n=61)	Married (n=49)	Total** (n=60)
Subsistence	7.7	8.6	7.8	0.6	0.7
Domestic	0.4	0.1	0.4	5.6	5.0
Non-work	5.4	4.8	5.3	7.3	7.8
Open space	6.3	8.2	6.7	0.6	0.4
Shadowed space	7.2	2.3	6.8	12.9	13.1

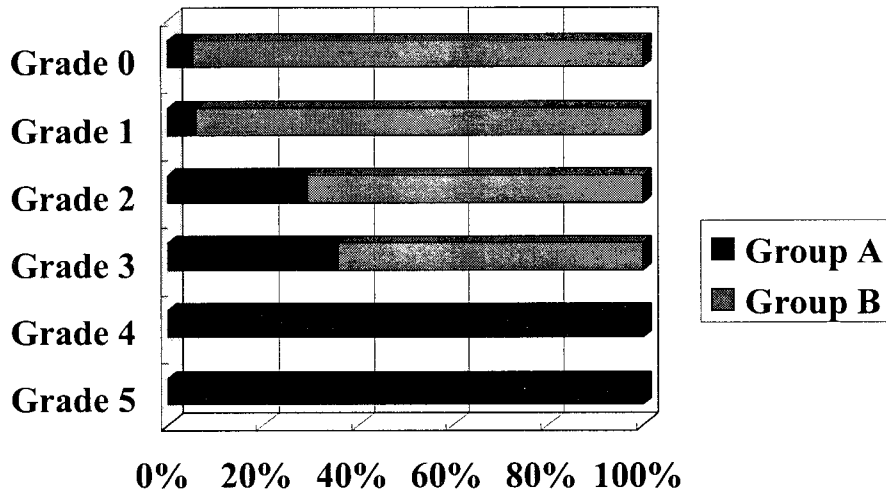
* Including one aged male.

** Including eight aged females and three unmarried females.

Estimated total (24-hour) energy expenditure (TEE: kcal) and total energy intake (TEI: kcal), and their values per kg body weight

	TEE	TEE/kg	TEI	TEI/kg
Male	2664	51.9	2827	55.0
Female	1742	40.1	1696	38.5

The Results (3): The Villagers' Awareness



Self-recognition of arsenic poisoning in relation to by dermatological score. Group A includes people who recognized themselves as the arsenic patients while those in Group B did not.

Treatment/preventive measures by the subject villagers

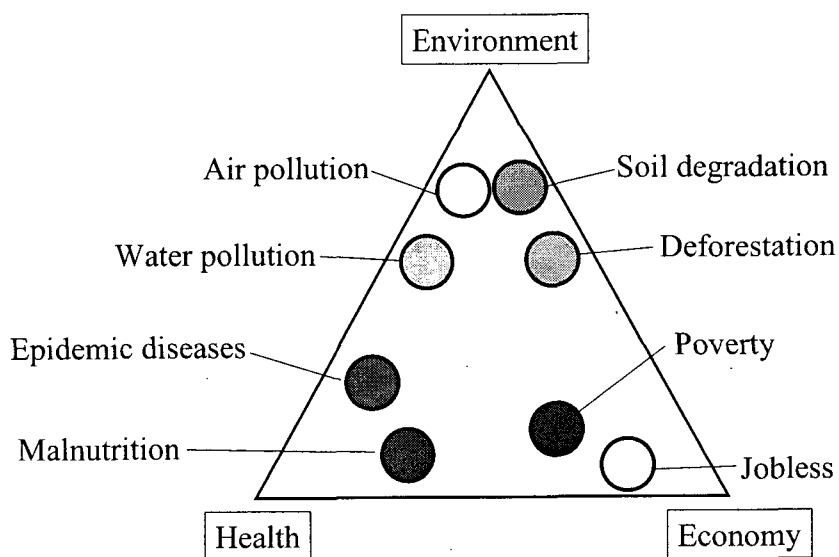
A group (who recognized themselves as arsenicosis patients)

Treated	9 (28.1%)
Not treated	18 (56.3%)
No answer	5 (15.6%)
Total	32

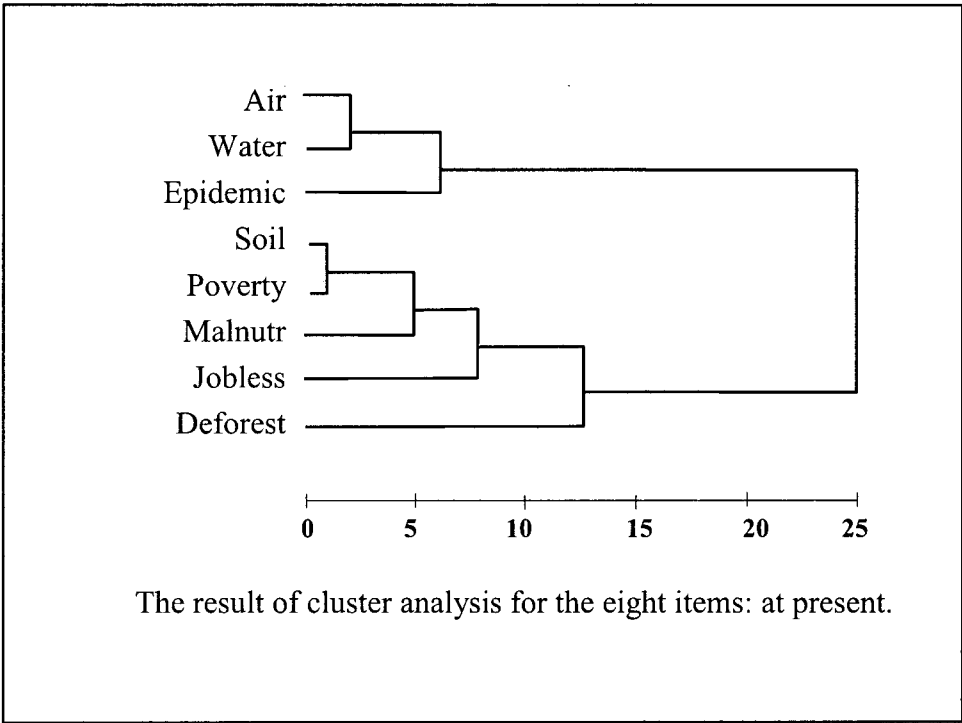
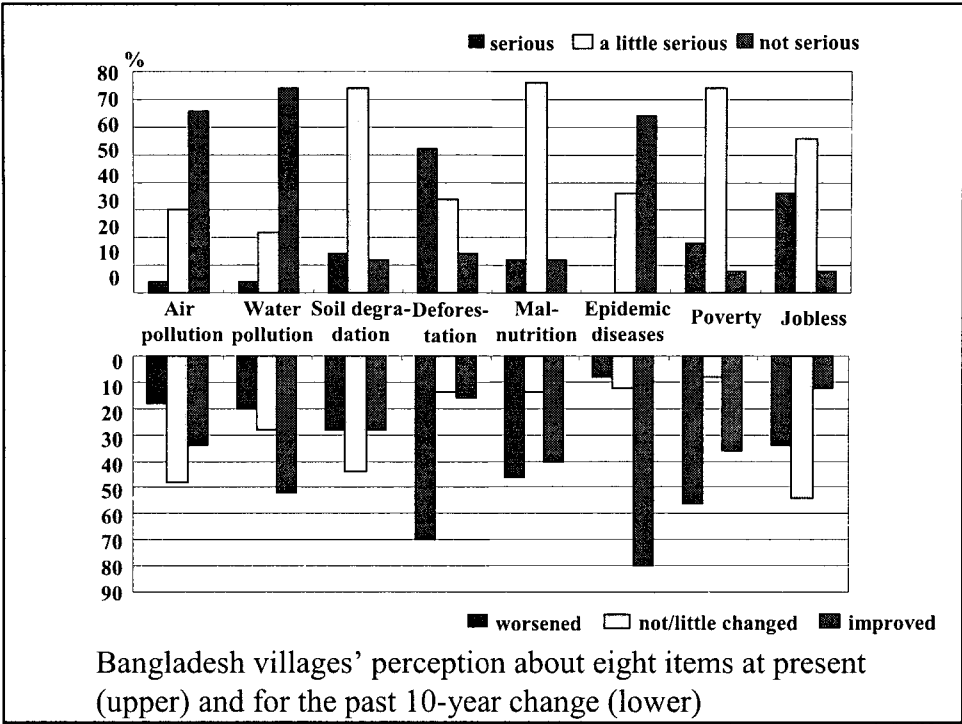
B group (who did not recognize)

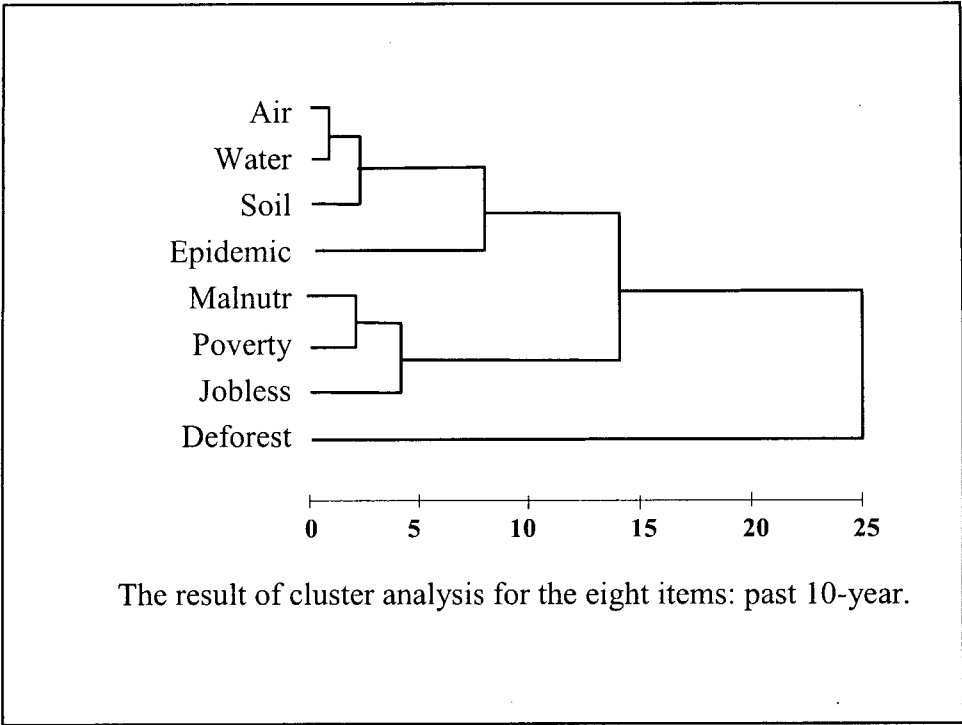
Prevented	46 (24.7%)
Not prevented	126 (67.7%)
No answer	14 (7.5%)
Total	186

Nationwide survey for perception of environmental, health and economic conditions



Eight items in a triangular model.

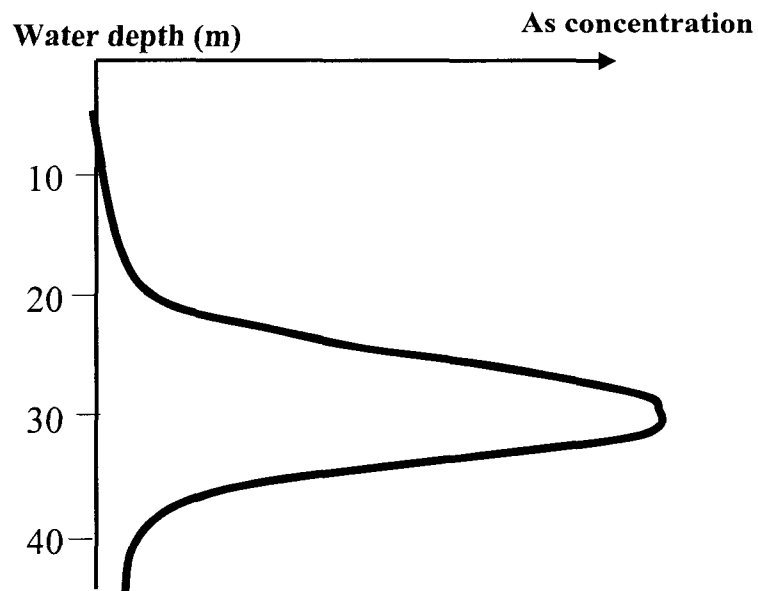




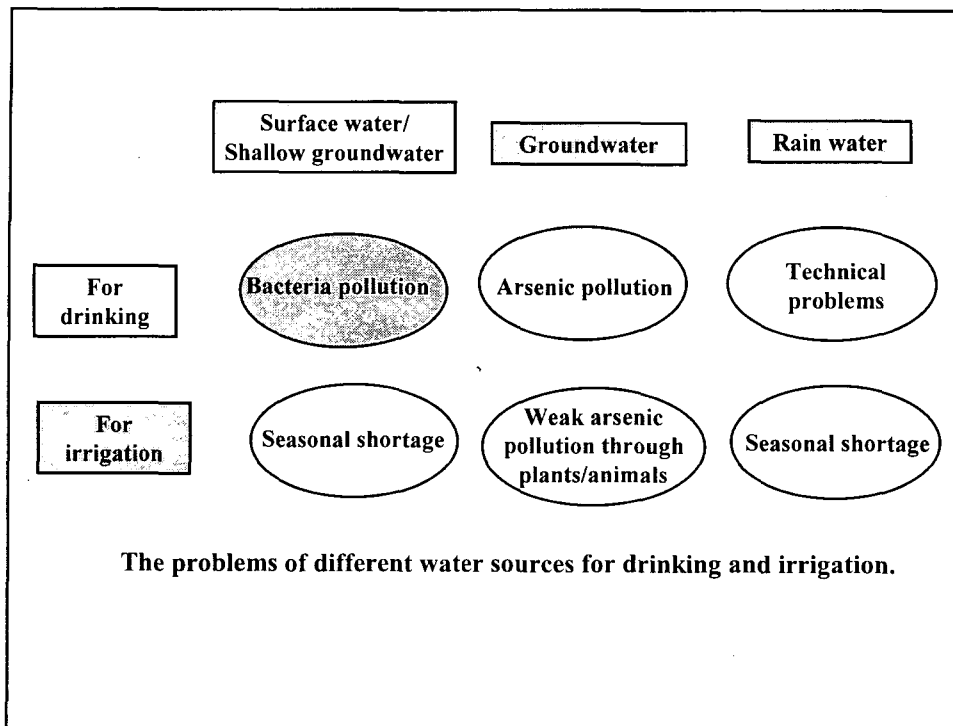
Various Factors Related to Mitigation

Selected sociodemographic characteristics in five Asian countries

	Bangladesh	Nepal	India	Indonesia	Thailand
Annual population increase rate (%)	1.9	2.4	1.9	1.5	1.0
Population density (persons/km ²)	889	148	295	107	119
Infant mortality rate (per 1000 births)	75	83	71	47	33
Female's mean life expectancy (years)	59	57	62	66	72
Female's illiteracy rate (%)	73.9	86.0	62.3	22.0	8.4
Children's malnutrition (%)	68	49	66	40	13
Per capita GNP (US\$)	360	220	370	1110	274



Schematic presentation of arsenic concentration in groundwater in case that many tubewells at 30 m in depth are used.



Summary and Conclusions

1. The dose-response relationships for occurrence/development of arsenicosis were clarified.
2. The nutritional status and behavioral pattern may affect arsenicosis-derived skin lesions.
3. For mitigation and prevention, various efforts should be taken, considering the short-term and long-term settings.