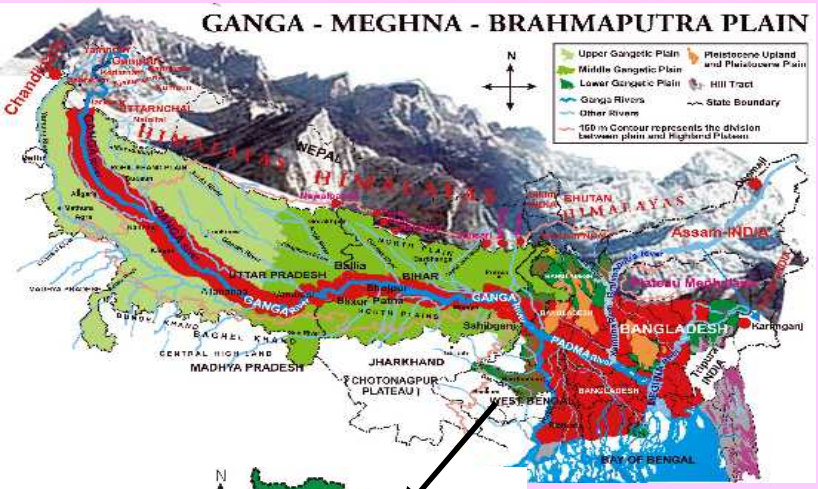
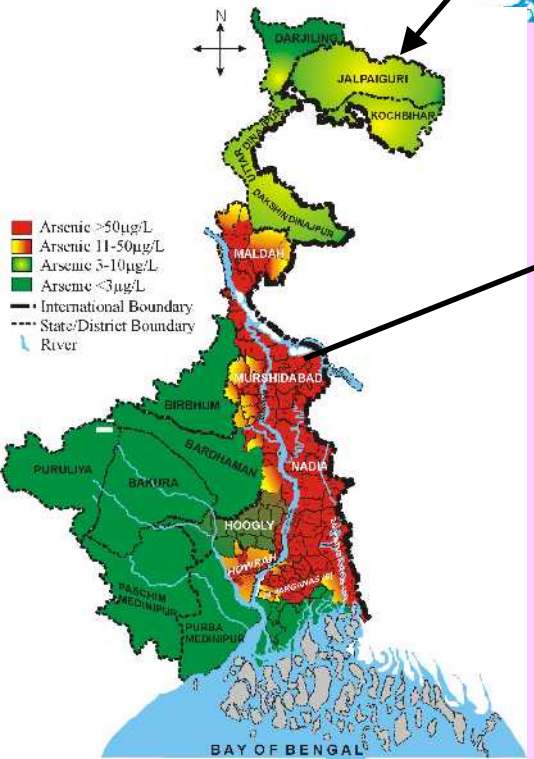
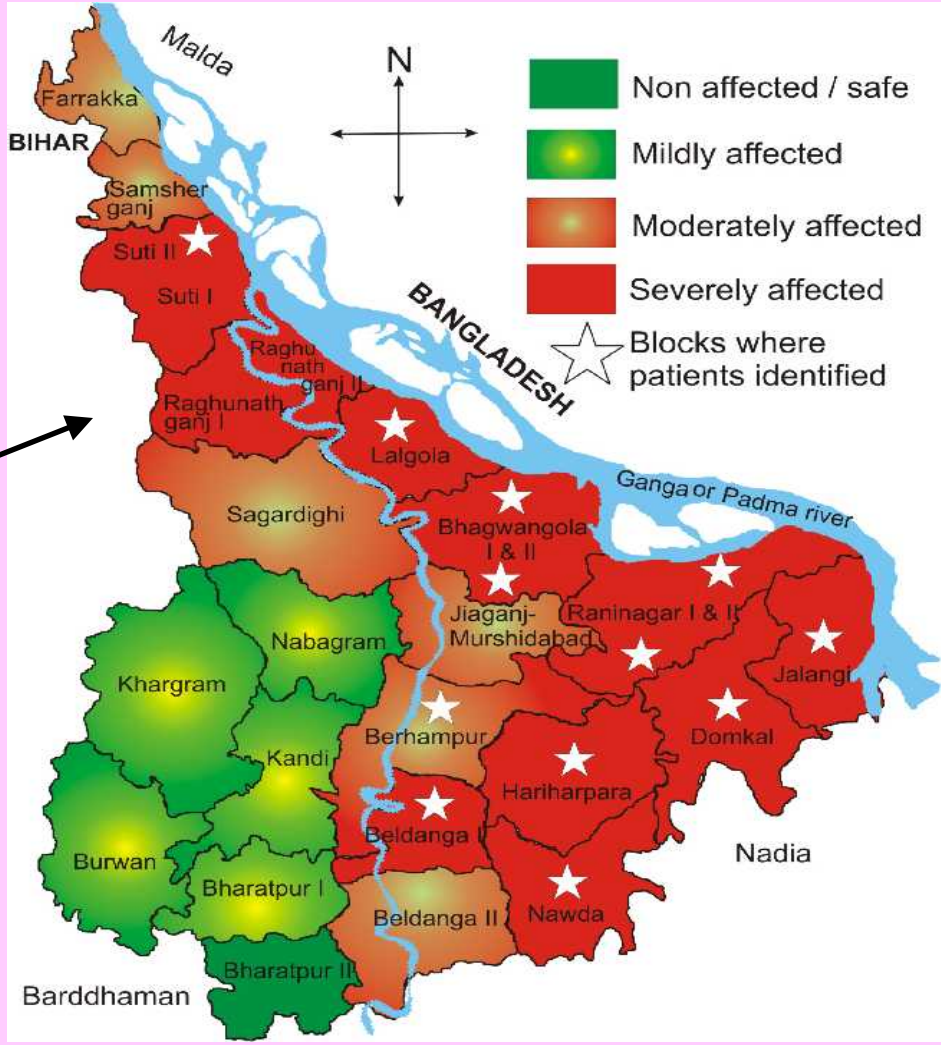
Groundwater arsenic contamination and its health effects in West Bengal with focus on Murshidabad

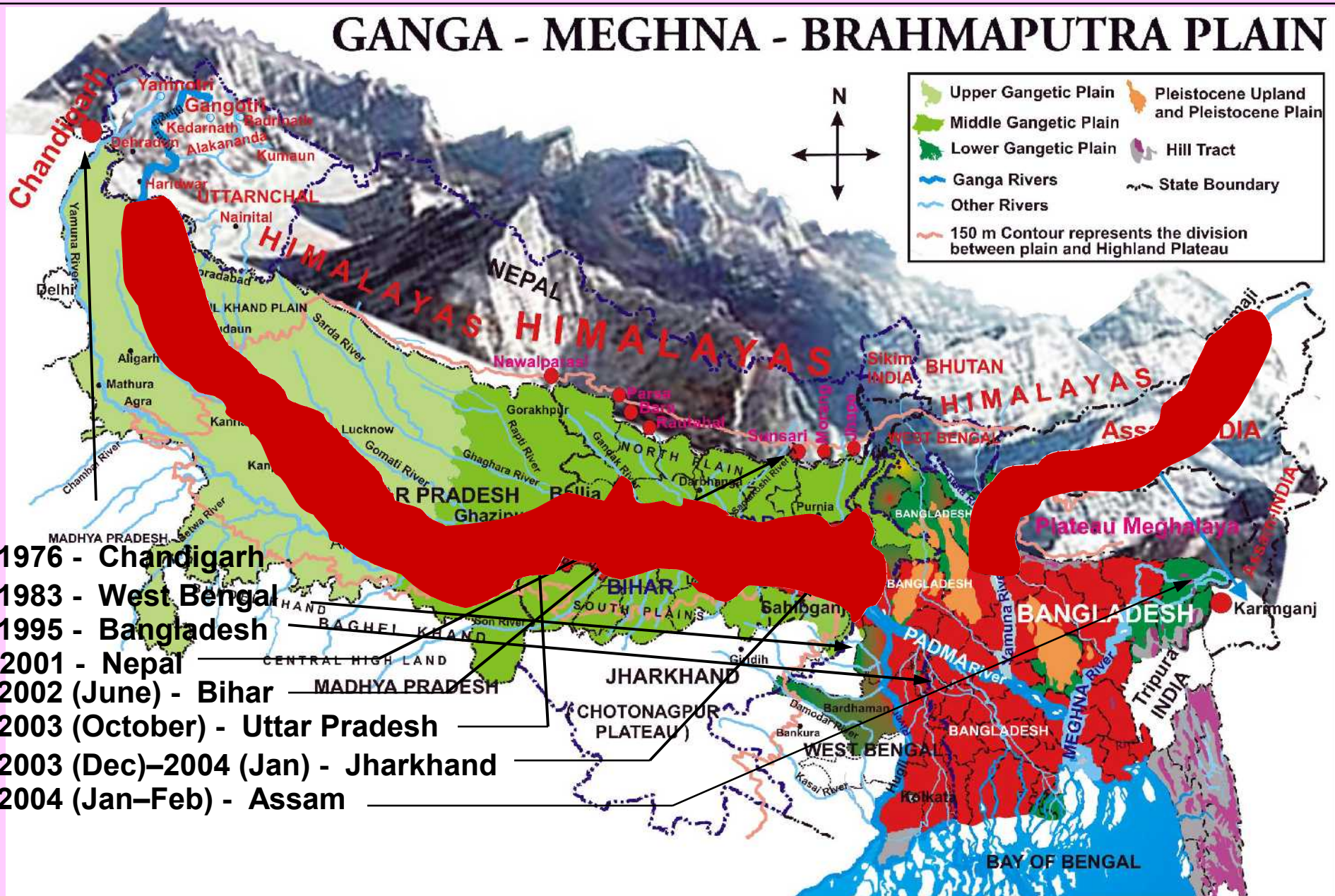


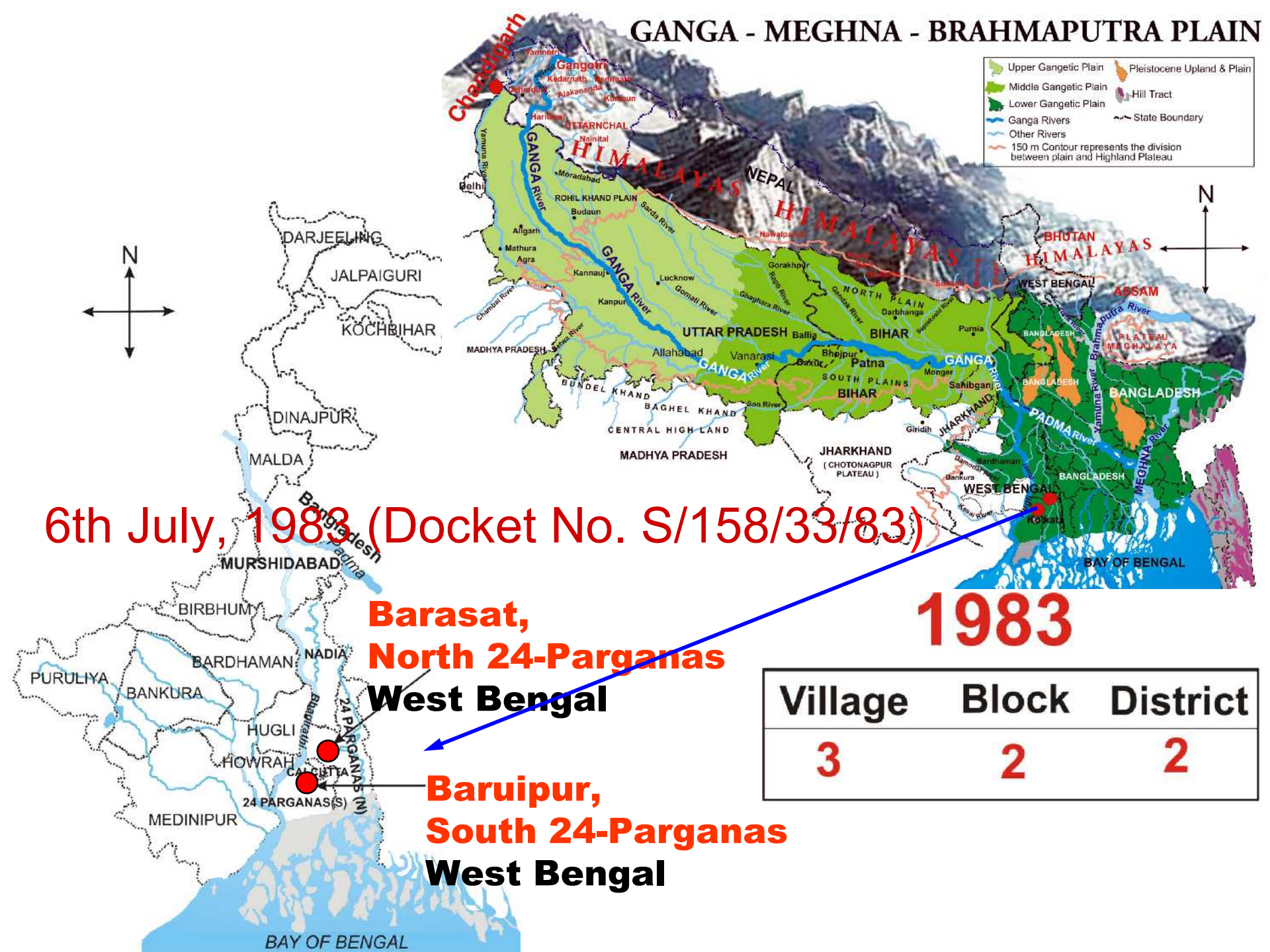




Area of Ganga-Meghna-Brahmaputra Plain = 569749 sq.km

Population of Ganga-Meghna-Brahmaputra Plain = >500 million





6th July, 1983 (Docket No. S/158/33/83)

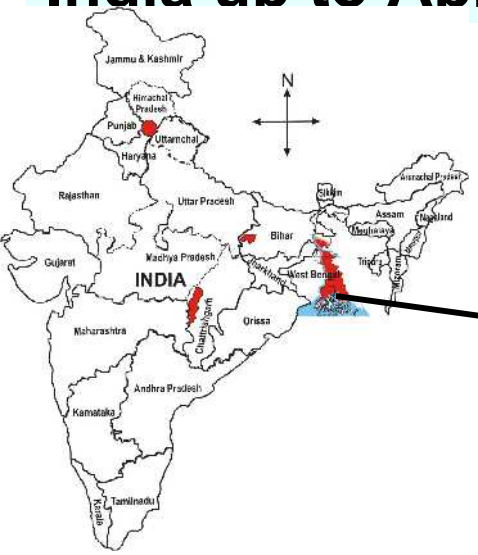
Barasat,
North 24-Parganas
West Bengal

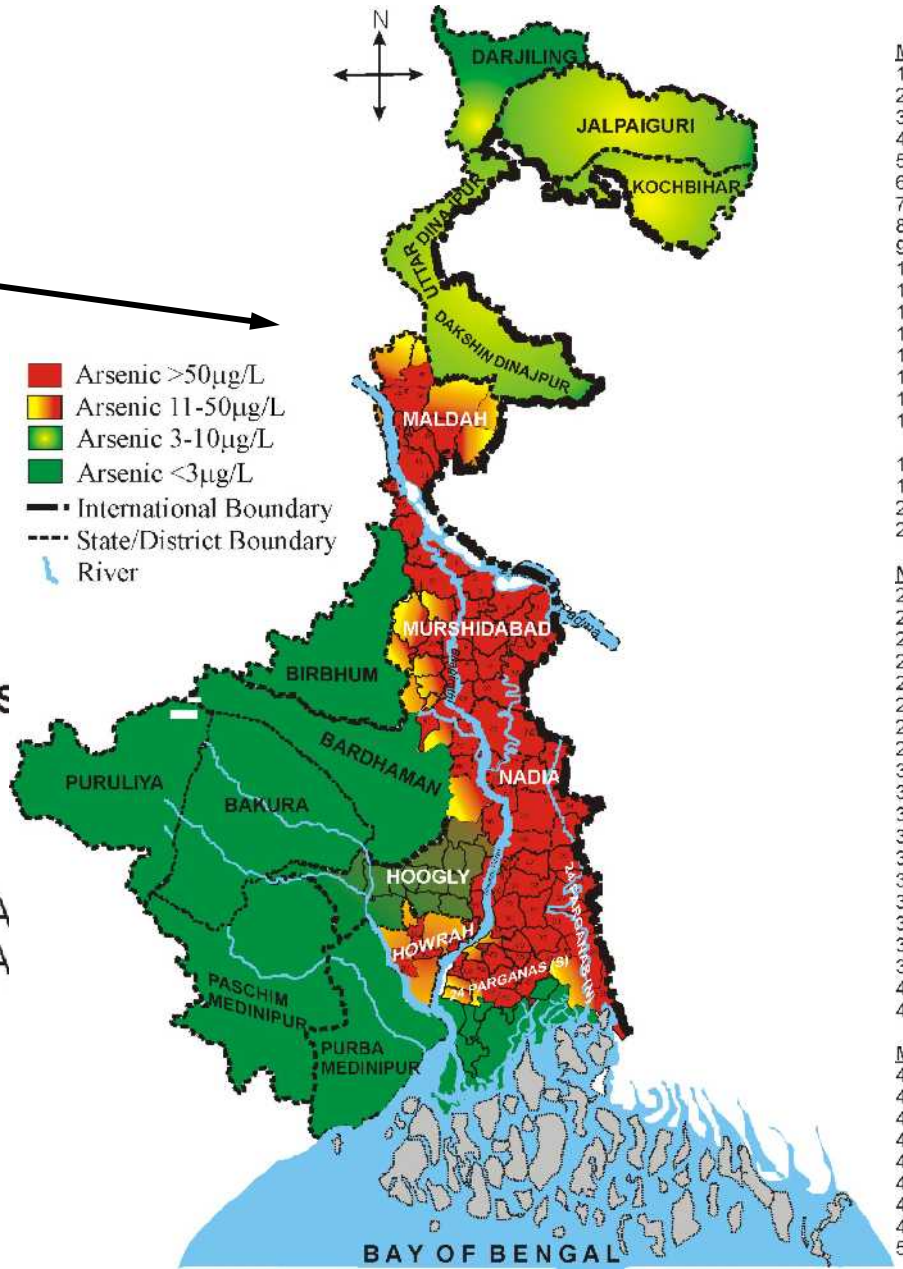
Baruipur,
South 24-Parganas
West Bengal

1983

Village	Block	District
3	2	2

Groundwater Arsenic Contamination Status in West Bengal-India up to April 2005 [Arsenic affected 9 districts and 90 blocks]





Arsenic affected districts

1. MURSHIDABAD
2. MALDAH
3. NADIA
4. NORTH 24-PARGANA
5. SOUTH 24-PARGANA
6. BARDDHAMAN
7. HOWRAH
8. HOOGHLY
9. KOLKATA

ARSENIC- AFFECTED BLOCKS

MURSHIDABAD
1. BAHARAMPUR
2. BHAGABANGOLA I
3. BHAGAWANGOLA II
4. BELDANGA I
5. BELDANGA II
6. SUTI I
7. SUTI II
8. RANINAGAR I
9. RANINAGAR II
10. DOMKAL
11 JALANGI
12. HARIHARPARA
13. NAWDA
14. RAGHUNATHGANJ I
15 . RAGHUNATHGANJ II
16. FARAKKA
17. MURSHIDABAD (Jiaganj-Lalbag)
18. LALGOLA
19. SHAMSHERGANJ
20. KANDI
21. SAGARDIGHI

NORTH 24 PARGANAS
22. BARASAT I
23. DEGANGA
24. BASIRHAT II
25. BADURIA
26. SWARUPNAGAR
27. HABRA I
28. HABRA II
29. GAIGHATA
30. BARASAT II
31. BASIRHAT I
32. HASNABAD
33. BANGAON
34 BAGDAH
35 BARRACKPUR I
36 RAJARHAT
37. HAROA
38. HINGALGANJ
39 AMDANGA
40 BARRACKPUR II
41. MINAKHAN

MALDA
42. KALIACHAK I
43. KALIACHAK II
44. KALIACHAK III
45. ENGLISHBAZAR
46. MANIKCHAK
47. MALDA (OLD)
48. CHANCHAL II
49. RATUA I
50. RATUA II

SOUTH 24 PARGANAS
51. BARUIPUR
52. SONARPUR
53. JOYNAGAR I
54. MOGRAHAT II
55. BHANGOR I
56. BHANGOR II
57. BUDGE-BUDGE II
58. BISHNUPUR I
59. BISHNUPUR II
60. CANNING I
61. CANNING II

NADIA
62. CHAKDAHA
63. SHANTIPUR
64. NABADWIP
65. TEHATTA I
66 TEHATTA II
67. TEHARINGHATA
68. KALIGANJ
69. KARIMPUR I
70. KARIMPUR II
71. HANSKHALI
72. RANAGHAT II
73 NAKASHIPARA
74 CHAPRA
75 KRISHNANAGAR I
76 KRISHNANAGAR II
77 RANAGHAT I
78 KRISHNAGANJ

BARDDHAMAN
79 PURBASTHALI I
80 PURBASTHALI II
81 KATWA I

HOWRAH
82.BALLY-JAGACHA
83. ULUBERIA II
84. SANKARAIL
85. AMTA II
86. BAGNAN I
87. BAGNAN II

HOOGHLY
88. BALAGARH
89. SERAMPUR UTTARPARA

KOLKATA
90. SOUTH KOLKATA

Groundwater Arsenic Contamination In Five Districts Of Northern Part Of West Bengal-India

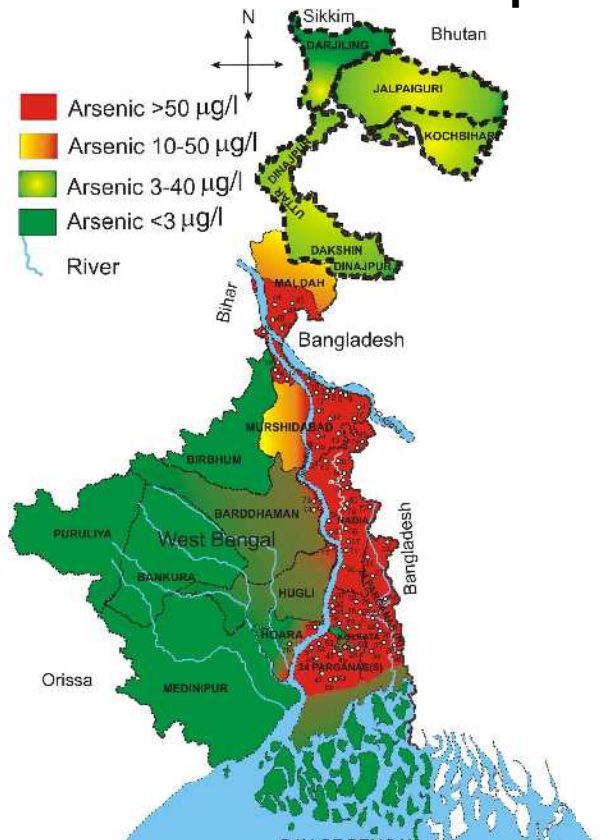
Total hand tubewell water samples analyzed: 2755

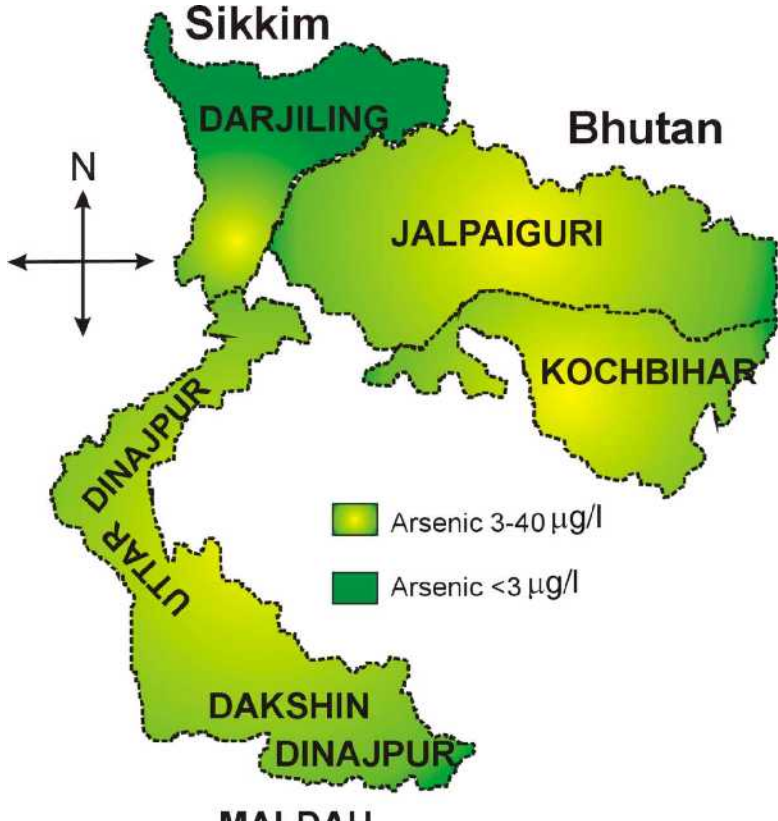
% of samples contain arsenic less than 3 µg/l : 82.4

% of samples contain arsenic between 3 and 9 µg/l : 14.4

% of samples contain arsenic between 10 and 50 µg/l : 3

% of samples contain arsenic above 50 µg/l : 0.2





Groundwater Arsenic Contamination In Four Districts Of Western Part Of West Bengal-India

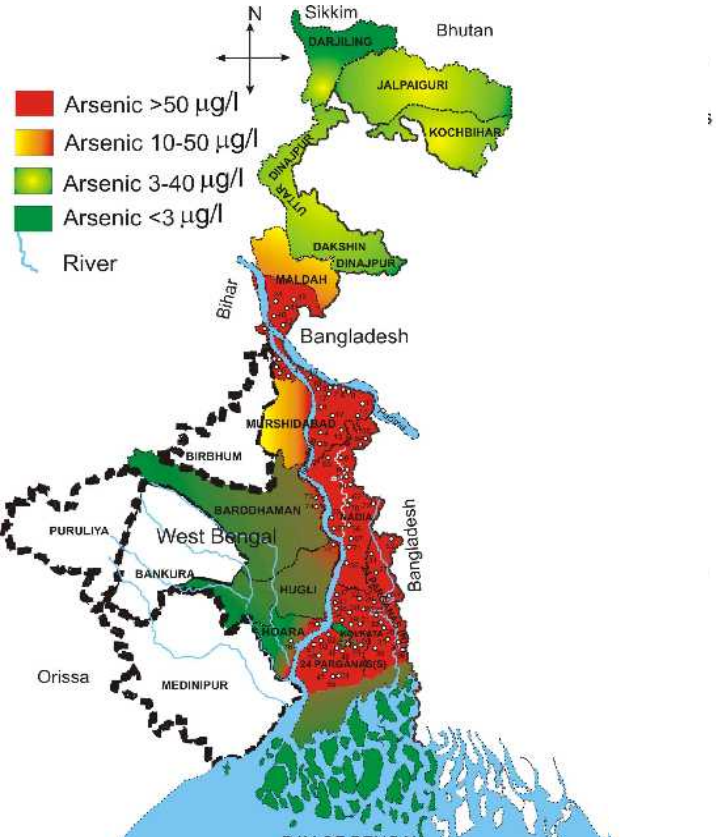
Total hand tubewell water samples analyzed: 659

% of samples contain arsenic less than 3 μg/l : 100

% of samples contain arsenic between 3 and 9 μg/l : Nil

% of samples contain arsenic above 10 μg/l : Nil

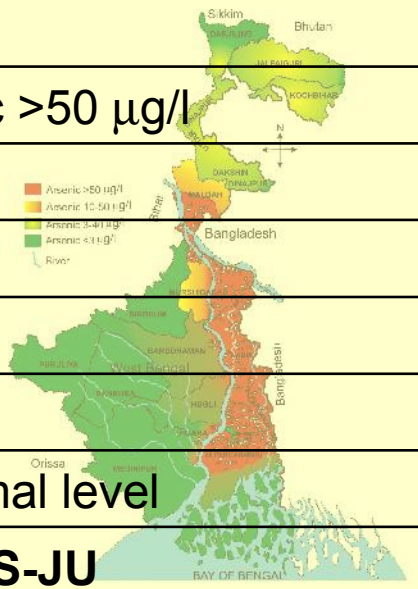
% of samples contain arsenic above 50 μg/l : Nil



Present Arsenic Contamination Status in West Bengal, India

[up to April 2005]

Total arsenic affected districts	**9**
Total arsenic affected blocks	**90**
No. of villages where groundwater contains arsenic >50 μg/l	**3500**
Total hand-tubewell water samples analyzed	**145000**
% of samples having arsenic >10 μg/l	**48.7**
% of samples having arsenic >50 μg/l	**23.8**
Total biological samples analyzed	**30,000**
% of biological samples having arsenic above normal level	**85**
Total people screened by medical team of SOES-JU	**96,000**
Registered no. of arsenicosis patients	**10,000**
Expected people drinking arsenic contaminated water in 9 affected districts above WHO recommended value (10 μg/l)	**9 million**
Expected people drinking arsenic contaminated water in 9 affected districts above WHO maximum permissible limit (50 μg/l)	**7 million**
People expected to be arsenic affected*	**300,000**
*** On the basis of no. of tubewells having arsenic >300 μg/l**	



Some arsenicosis patients from arsenic affected districts of West Bengal

Dorsal keratosis

Squamous cell carcinoma on heel

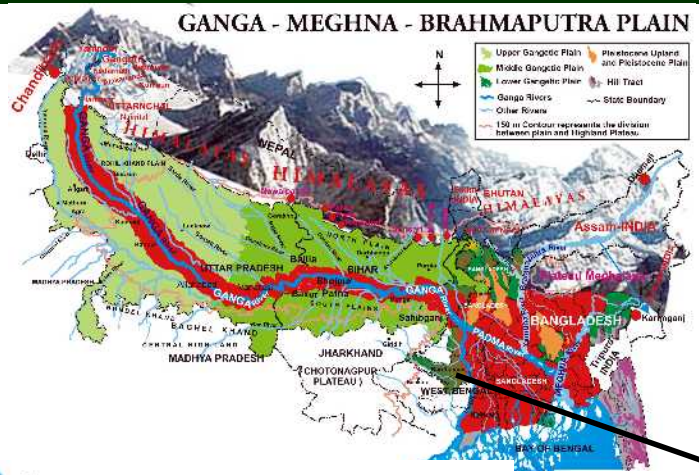
Gangrene on finger

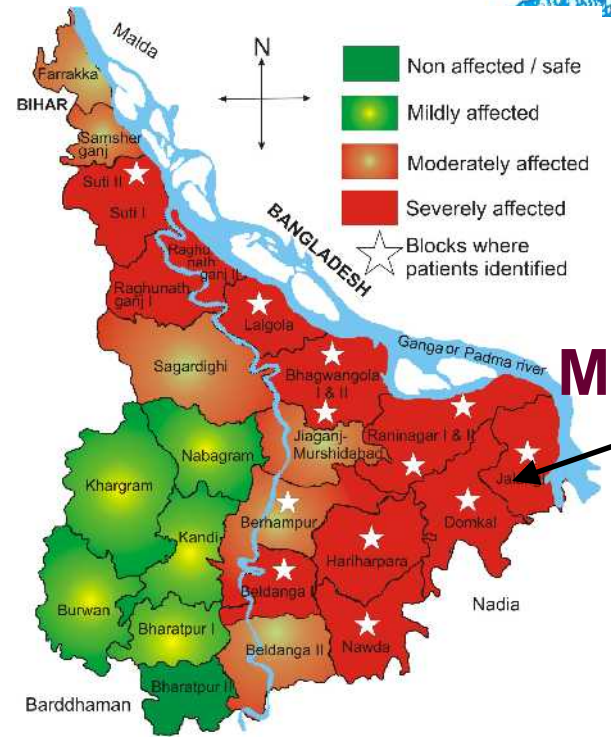
Hyper-keratosis on sole

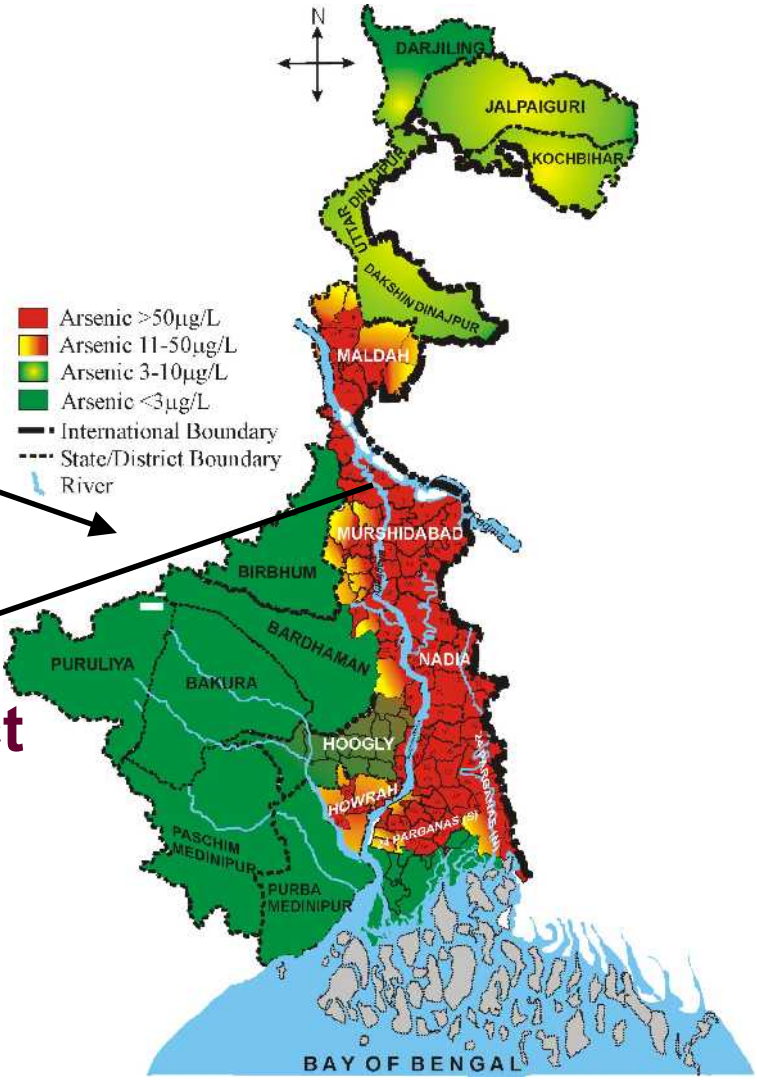
Arsenic affected children

Pigmentation

Micro-level Study In Murshidabad, One Of The Nine Arsenic Affected Districts Of West Bengal





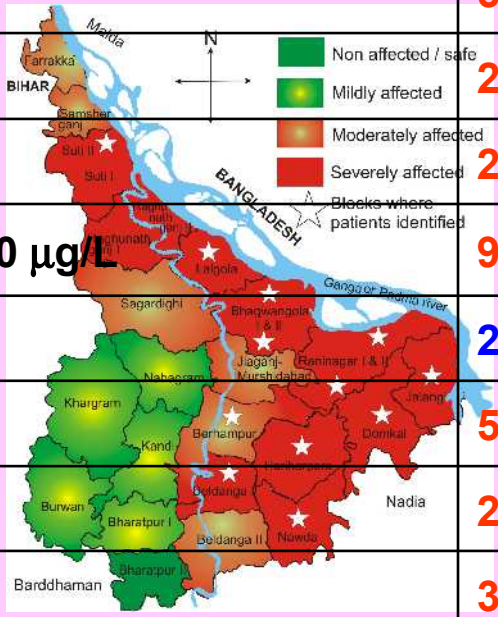


Murshidabad district

SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

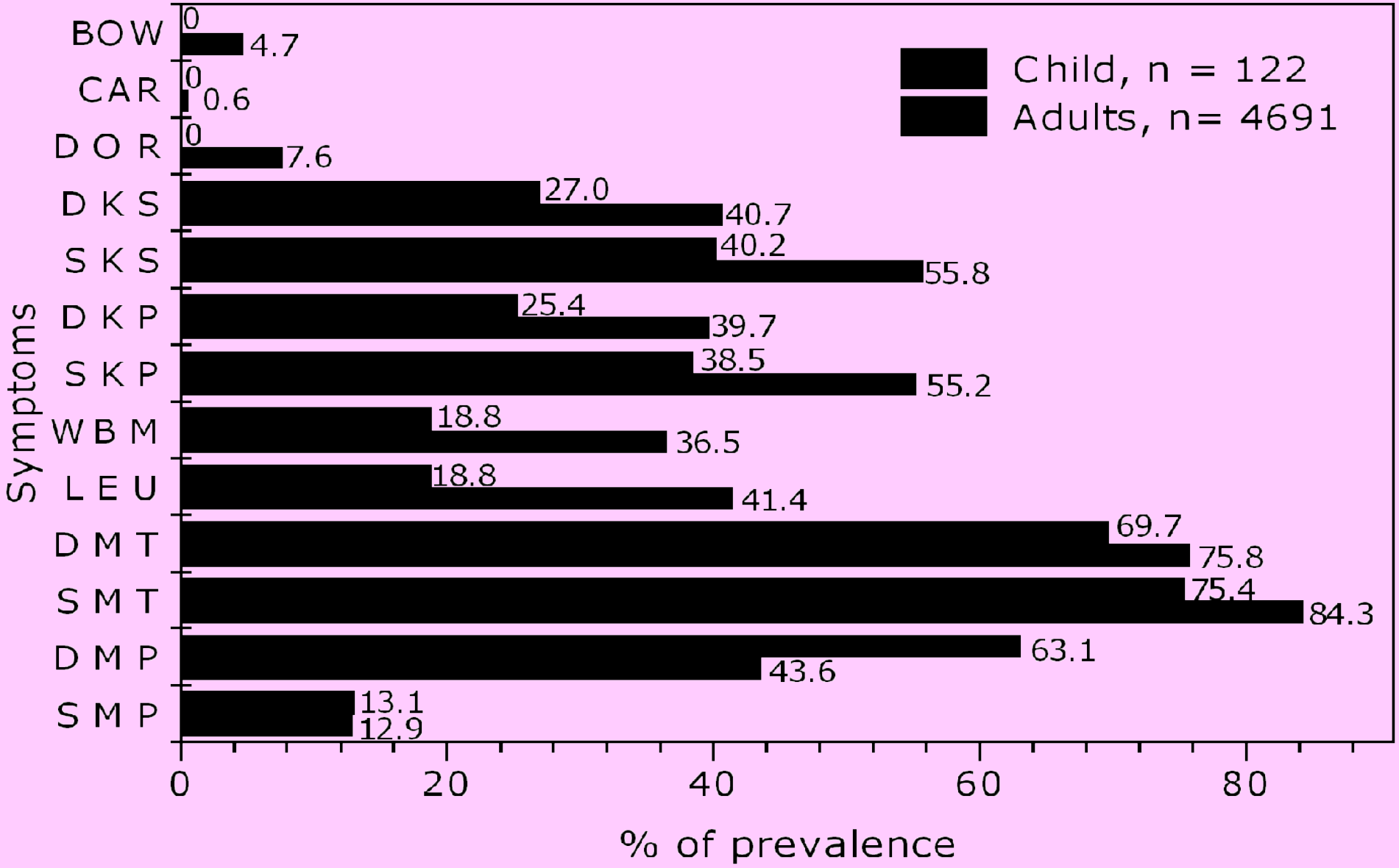
Present groundwater arsenic contamination status in Murshidbad district, West Bengal-India

Area of Murshidabad in sq. km	5324
Population of Murshidabad in million	5.3
Total no. of blocks of Murshidabad	26
Number of blocks where arsenic above 50 µg/L	24
No. of villages where groundwater contains arsenic >50 µg/L	990
Total hand-tubewell water samples analyzed	29612
% of samples having arsenic >10 µg/L	53.8
% of samples having arsenic >50 µg/L	26.0
Total biological samples analyzed	3700
% of biological samples having arsenic above normal level	88
Total people screened by medical team of SOES-JU	25274
Registered no. of arsenicosis patients	4813
Expected people drinking arsenic contaminated water above 10 µg/L	2.5 million
Expected people drinking arsenic contaminated water above 50 µg/L	1.2 million



SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

Prevalence of dermatological symptoms



SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

Arsenic in biological samples

Parameters	Samples from arsenic affected villages of Murshidabad			Samples from control population		
	Arsenic in hair[a] (µg/Kg)	Arsenic in nail[b] (µg/Kg)	Arsenic in urine[c] (µg/L)	Arsenic in hair[a] (µg/Kg)	Arsenic in nail[b] (µg/Kg)	Arsenic in urine[c] (µg/L)
No. of observations	1136	1523	1184	75	75	75
Mean	2373	5512	221	341	748	16
Median	1758	4357	120	338	743	15
Minimum	222	589	10	499	1066	41
Maximum	18245	35076	2870	217	540	10
Standard deviation	1972	4271	294	103	107	10
% of samples having arsenic above normal/ toxic (hair) level	75	95	94	-	-	-

a Normal level of arsenic in hair ranges from 80-250 µg/Kg; 1000 µg/Kg is the indication of toxicity (54)
b Normal level of arsenic in nail ranges from 430-1080 µg/Kg (55)
c Normal excretion of arsenic in urine ranges from 5-40 µg/1.5L (per day) (56)

SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

Peripheral neuropathy

	No. of patients examined (n = 249)	
	No. of Patients	Percentage
Distal paresthesias	104	41.7
Limb pains	30	12.0
Hyperpathia / allodynia	15	6.0
Distal hypesthesias	86	34.5
Calf tenderness	12	4.8
Distal limb weakness/ atrophy	38	15.3
Diminshed or absent tendon reflexes	28	11.2
Tremor	18	7.2
Abnormal sweating	8	3.2
Overall incidence of neuropathy (n=249)	127	51.0
Type of neuropathy (n=127)		
Sensory	107	43.0
Sensorimotor	20	8.0
Severity of neuropathy (n=127)		
Mild	110	44.2
Moderate	17	6.8

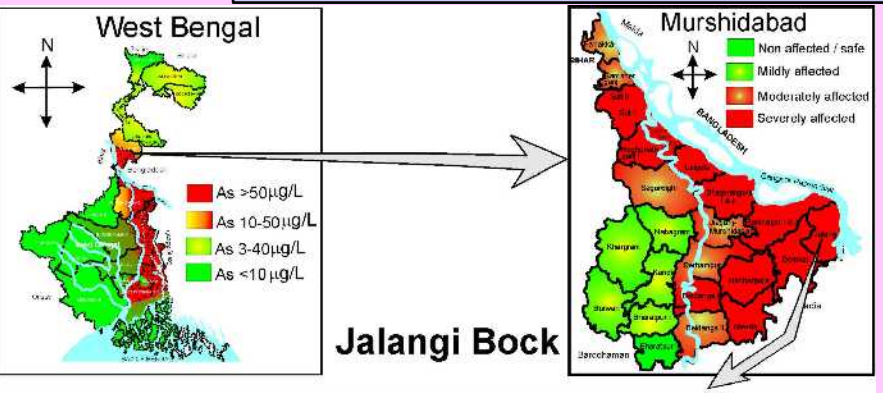
SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

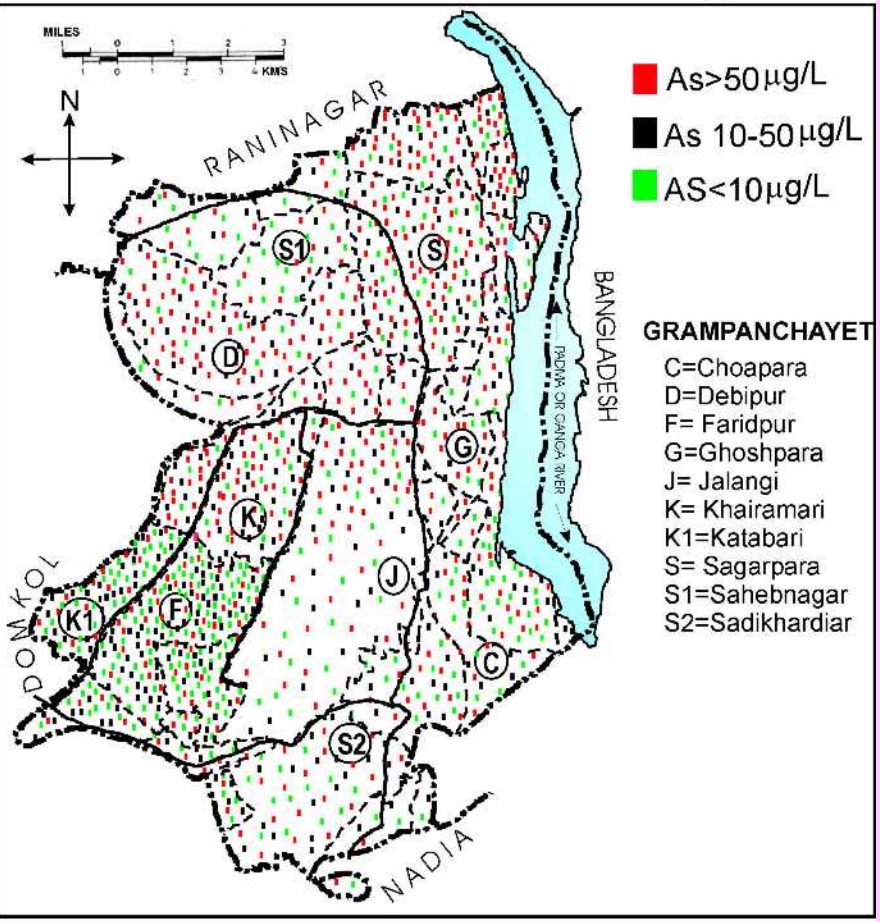
Pregnancy outcome

Duration of exposure	5-10 years (n = 10)	Per 1000 pregnancies/ total births/ live births	>10 years (n = 7)	Per 1000 pregnancies/ total births/ live births
Skin lesions	6	-	7	-
Number of pregnancies	35	-	30	-
Spontaneous abortion (per 1000 pregnancies)	4	114	6	200
Stillbirth (per 1000 total births)	4	129	1	42
Preterm birth (per 1000 live births)	11	407	9	391
Low birth weight (per 1000 live births)	7	259	11	478
Neonatal death (per 1000 live births)	1	37	1	43
Range of arsenic concentration in water (μg/L)	284 – 1474		444–1222	

SOES Group Publication: Clinical Toxicology (Part 1 and Part 2), 2005.

Detailed study in block level: Jalangi

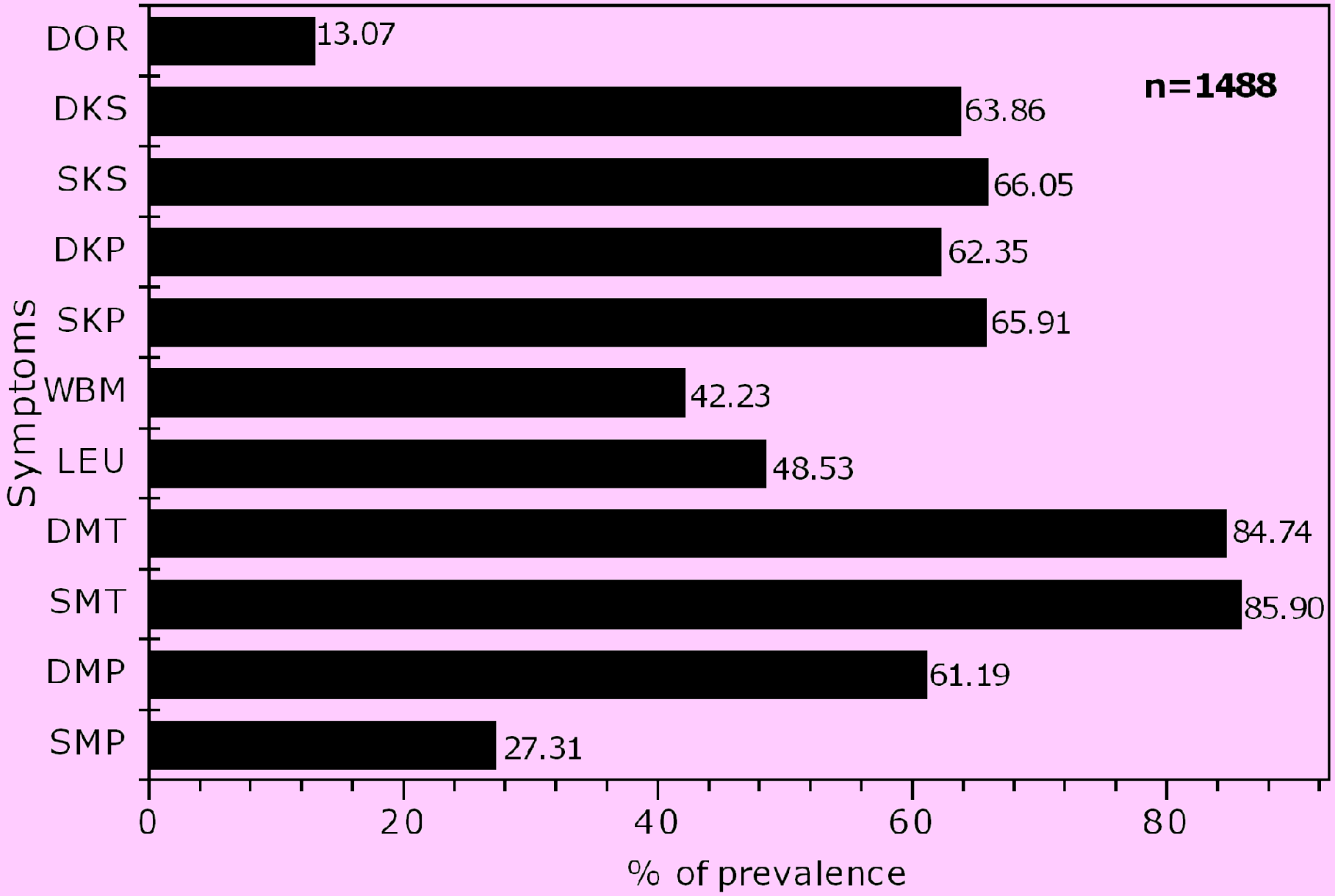




Area in km^2	122
Population (according to 2001 Census)	215 538
Total number of Gram Panchayets (GP)	10
Number of GPs surveyed	10
Number of GPs where groundwater contain arsenic above 50 µg l^{-1}	10
Total number of villages	117
Number of villages surveyed	104
Number of villages where groundwater contain arsenic above 50 µg l^{-1}	95
Number of hand tubewells water samples analyzed	1916

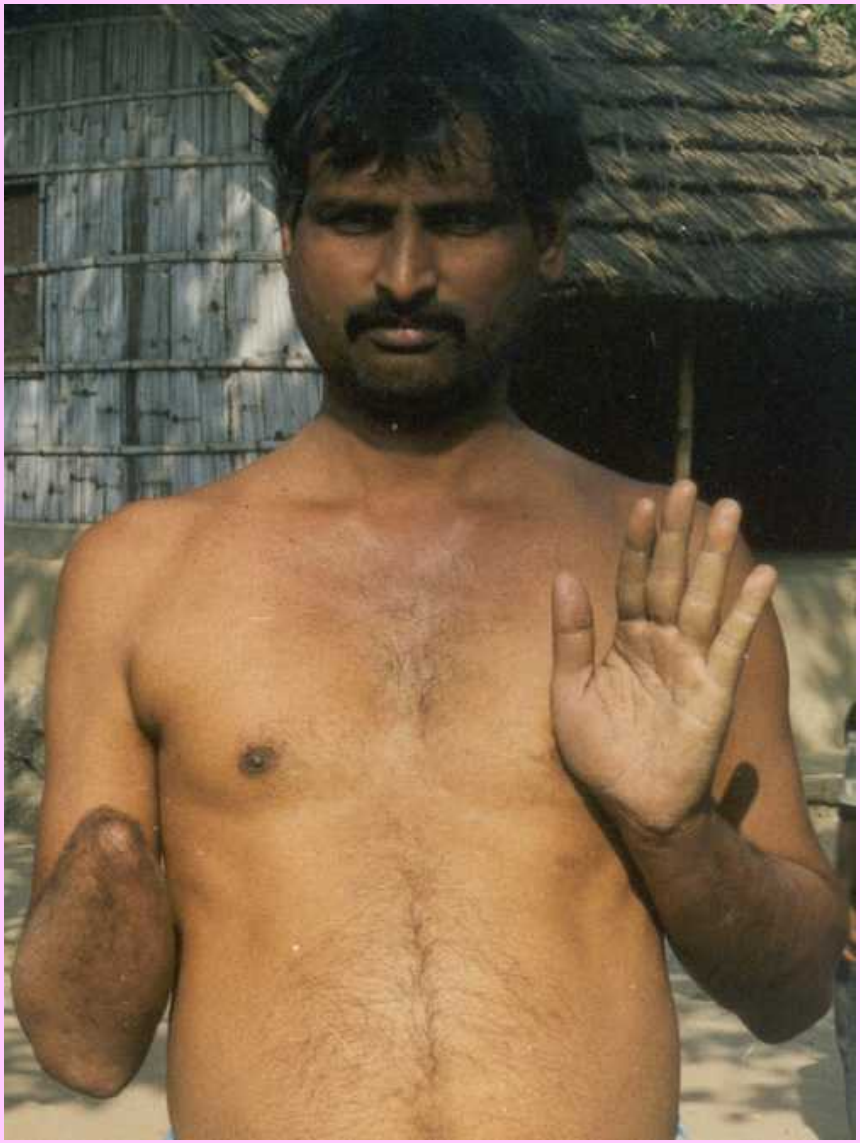
SOES Group Publication: Sc Tot Envron 2005.

Prevalence of dermatological symptoms

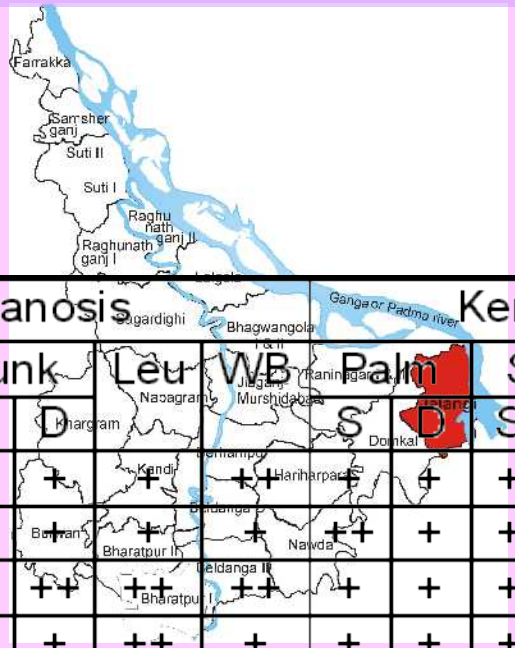


SOES Group Publication: Sc Tot Envron 2005.

Gangrene and Cancer Patients from Jalangi Block of Murshidabad, West Bengal



The family of Faizuddin Malitha, Jalangi, Murshidabad where all 9 adults have severe arsenical skin lesions and suspected Bowens*



Name	Sex & Age	Melanosis						Keratosis					Suspected
		Palm		Trunk		Leu	WB	Palm		Sole		Dorsal	
		S	D	S	D			S	D	S	D		
Rahada Bibi	F/25	-	+	++	+	+	++	+	+	+	+	+	Bowens
Hasina Bibi	F/35	-	-	+	+	+	+	++	+	+	+	-	Bowens
Fazle Rabbi Malitha	M/45	-	-	+++	++	++	++	+	+	+	+	-	Bowens
Faizuddin Malitha	M/70	-	-	++	+	++	+	+	+	+	+	-	Bowens
Shahidul Islam	M/22	-	-	++	+	+	+	+	+	+	+	-	Bowens
Hafijul Islam	M/19	-	-	++	+	+	+	+	+	+	+	-	Bowens
Mafijul Islam	M/15	+	+	+++	++	+	++	+	+	+	+	-	Bowens
Sarajan Bibi	F/60	+	+	++	++	+	++	+	+	+	+	-	Bowens
Hasena Bewa	F/30	-	-	++	++	+	+	+	+	+	+	-	Bowens

S = Spotted, D = Diffuse, Leu = Leuco, WB = Whole Body; + Mild, ++ Moderate, +++ Severe,
Not drinking contaminated water for last 2-3 years

SOES Group Publication: Sc Tot Envron 2005.

Arsenic in biological samples

Parameters	Arsenic concentration in hair[a] (μg kg^{-1})	Arsenic concentration in nail[b] (μg kg^{-1})	Arsenic concentration in urine[c] (μg l^{-1})
No. of observations	557	561	501
Mean	2345	5273	155
Median	1826	3766	90
Minimum	222	597	12
Maximum	15 021	33 572	1613
Standard deviation	1802	4737	182
% of samples having arsenic above normal/ toxic (hair) level	79	95	91

a Normal level of arsenic in hair ranges from 80-250 μg/Kg; 1000 μg/Kg is the indication of toxicity (54)
b Normal level of arsenic in nail ranges from 430-1080 μg/Kg (55)
c Normal excretion of arsenic in urine ranges from 5-40 μg/1.5L (per day) (56)

SOES Group Publication: Sc Tot Envron 2005.

Pregnancy outcome

Range	Arsenic concentration in drinking water (μg l^{-1})			
	284 – 500 Group A (n = 6)	%	501-1474 Group B (n = 7)	%
Skin lesions	3		7	
Number of pregnancies	22	-	29	-
Spontaneous abortion	3	13.62	4	13.79
Stillbirth	2	10.52	2	8.0
Preterm birth	6	31.56	7	28.0
Low birth weight	7	36.82	9	36.0
Neonatal death	1	5.26	1	4.0
Range of arsenic concentration in hair (μg kg^{-1})	453-2564		536-3546	

SOES Group Publication: Sc Tot Envron 2005.

Arsenic Toxicity and Obstetric Outcome

Village: Godagari

Gram Panchayet: Sagarpara

Block: Jalangi, District: Murshidabad

Arsenic in drinking water = 1617 µg/L

Arsenic in urine = 1474 µg/L

Obstetric outcome of Ashima Das, wife of Mr. Barun Das

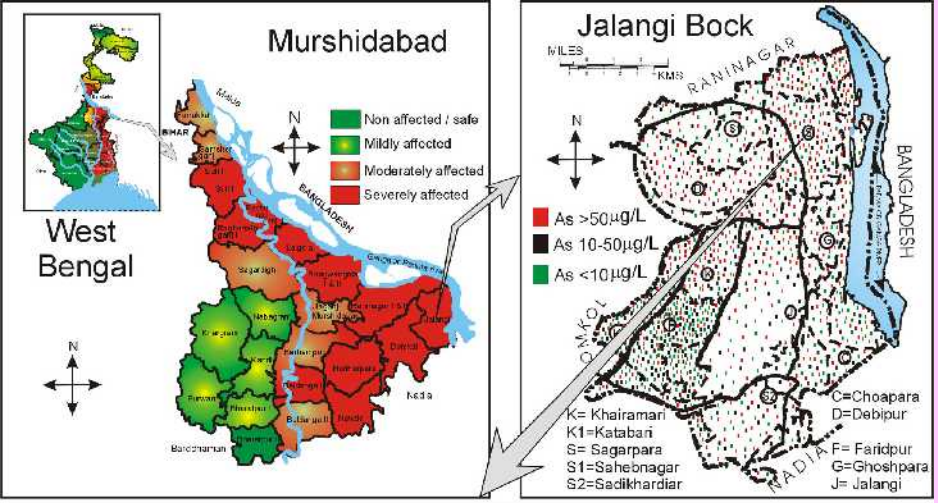
First Pregnancy: Preterm Stillbirth

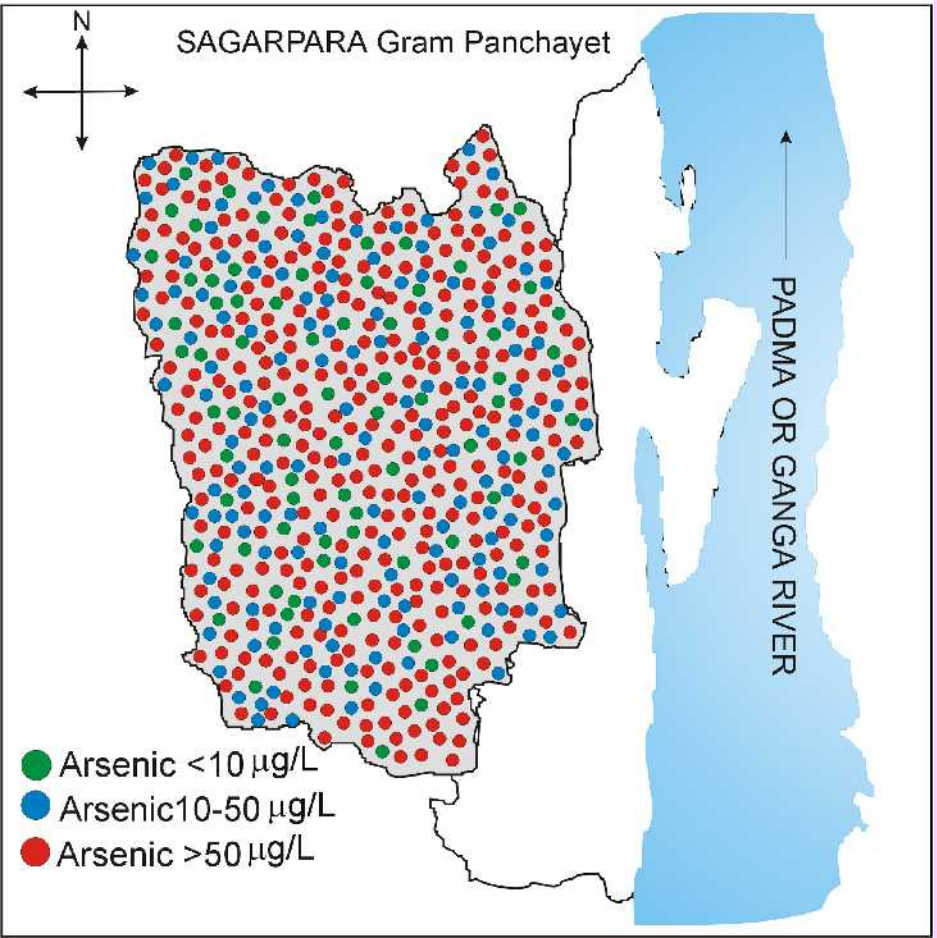
Second Pregnancy: Abortion

Third Pregnancy: Early neonatal death

SOES Group Publication: Clinical Toxicology, 2005

Detailed study in GP level: Sagarpara

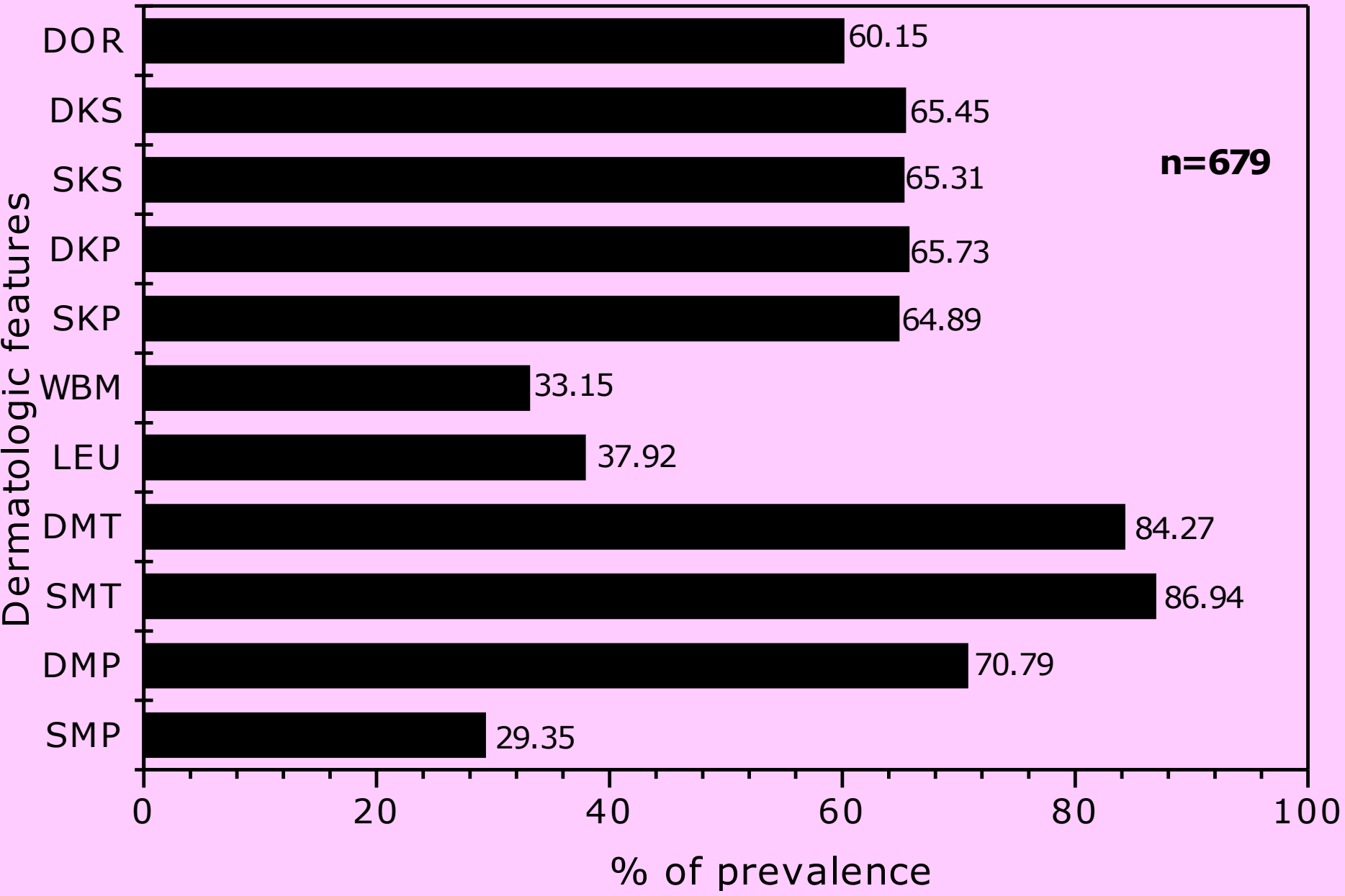




Physical parameters	Sagarpara
Total area of Sagarpara in km²	20
Total population of Sagarpara	24419
Number of villages including sub-villages	21
Number of villages surveyed	21
Number of villages where we have found arsenic above 50 µg/l	21
Number of villages surveyed for arsenic patients	21
Number of villages where we identified arsenic patients	21
People screened for arsenical skin lesions	3302
Registered arsenic patients from Sagarpara (preliminary survey)	679 (20.6%)

SOES Group Publication: J Water & Health 2005.

Prevalence of dermatological symptoms



SOES Group Publication: J Water & Health 2005.

Arsenocosis patients from Sagarpara

Arsenic in biological samples

Parameters	Arsenic in hair[a] (µg/kg)	Arsenic in nail[b] (µg/kg)	Arsenic in urine[c] (µg/L)
No. of observations	301	382	176
Mean	2291	5071	181
Median	1864	8576	109
Minimum	222	611	22
Maximum	15021	27892	1613
Standard deviation	1723	4534	208
% of samples having arsenic above normal / toxic (hair) level	76	93	91

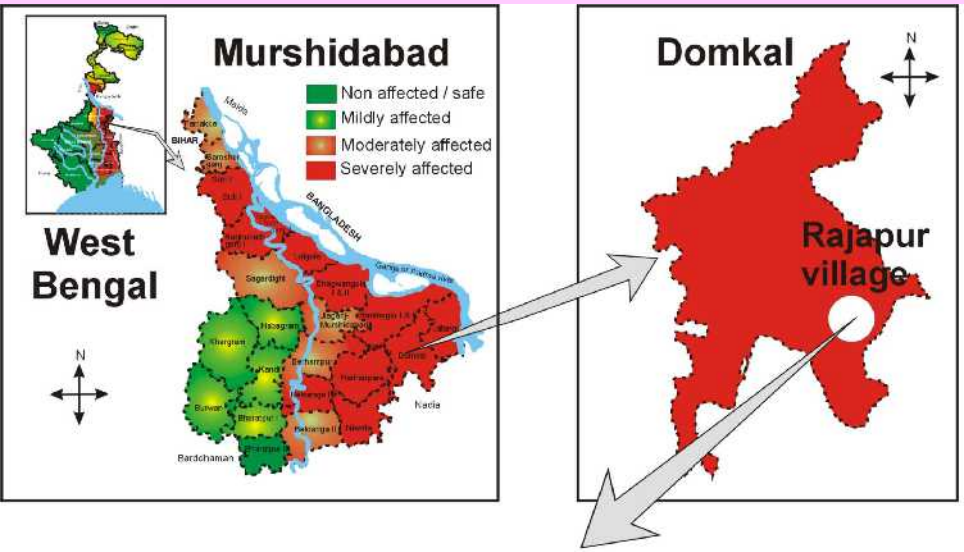
a Normal level of arsenic in hair ranges from 80-250 µg/Kg; 1000 µg/Kg is the indication of toxicity (54)

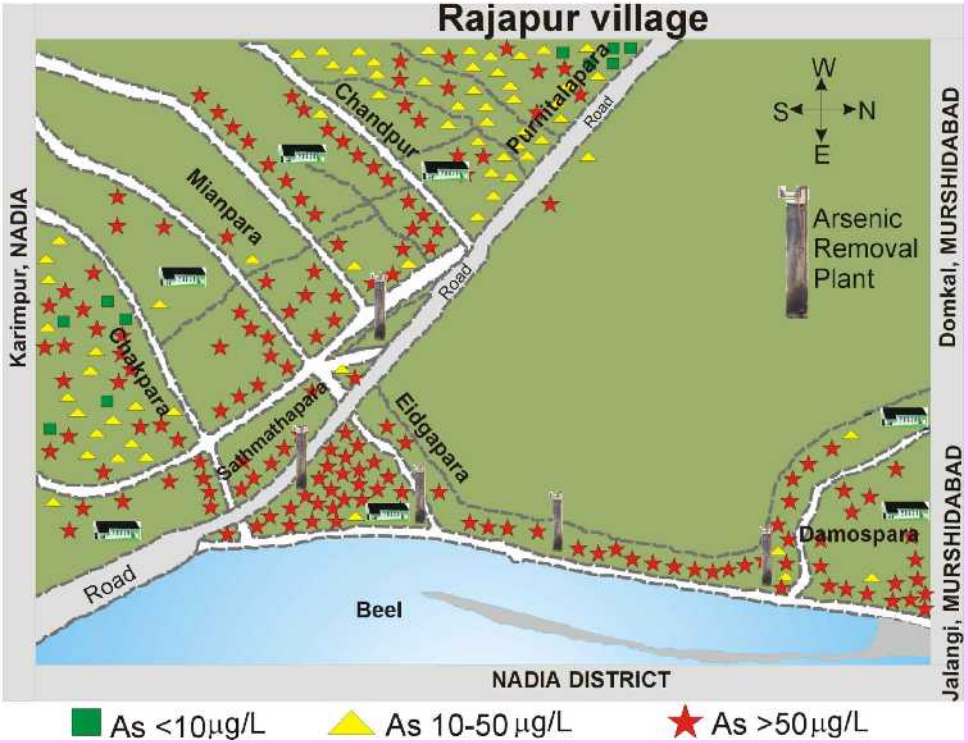
b Normal level of arsenic in nail ranges from 430-1080 µg/Kg (55)

c Normal excretion of arsenic in urine ranges from 5-40 µg/1.5L (per day) (56)

SOES Group Publication: J Water & Health 2005.

Detailed study in village level: Rajapur

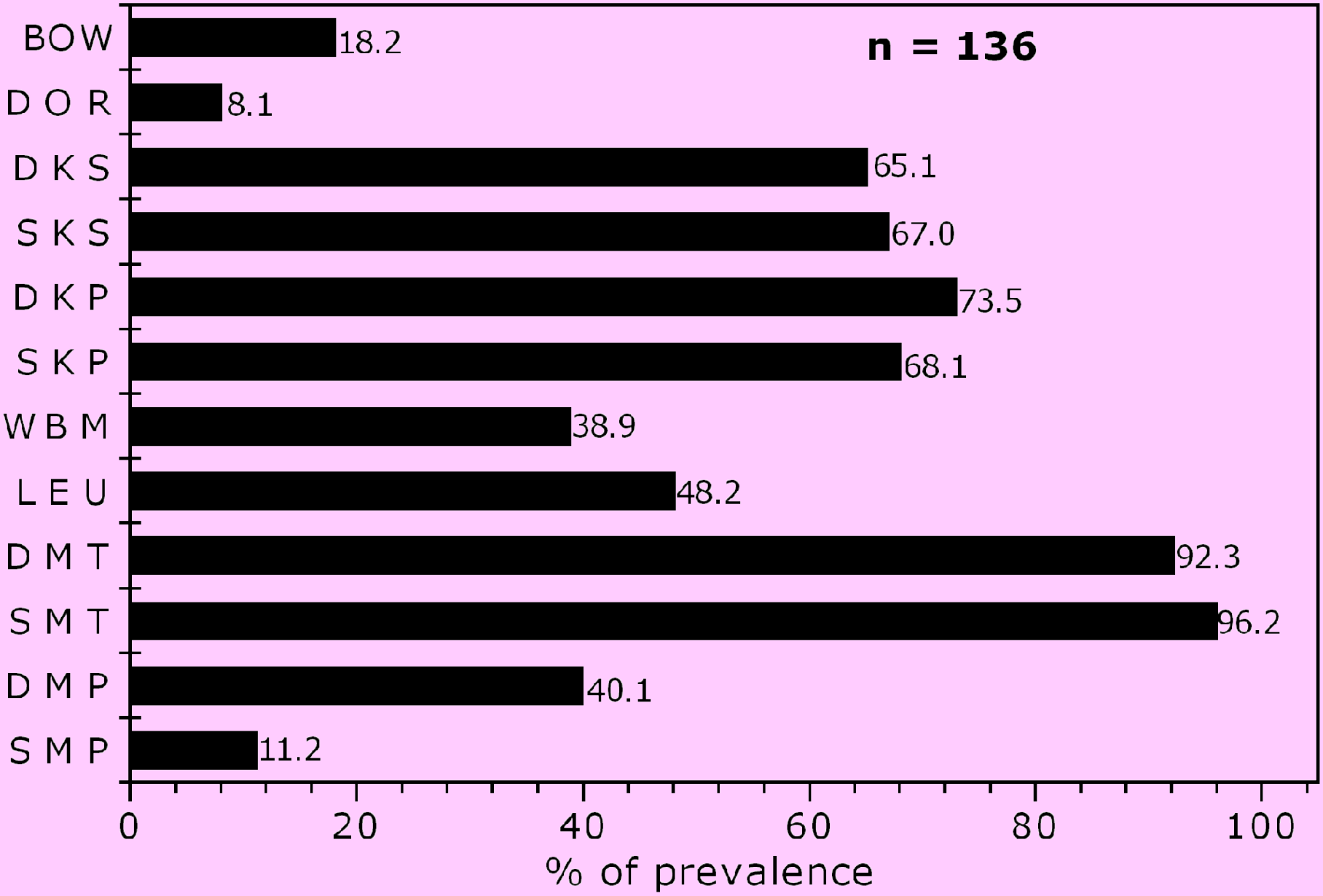




Sub-regions	Population surveyed for arsenical skin lesions	No. of arsenicosis patients found	No. of Bowen's cases
Rajapur Eidgapara	325	71	16
Rajapur Damospara	300	65	7
Rajapur Miapara	100	4	-
Rajapur Chakpara	100	9	-
Total	825	149	23

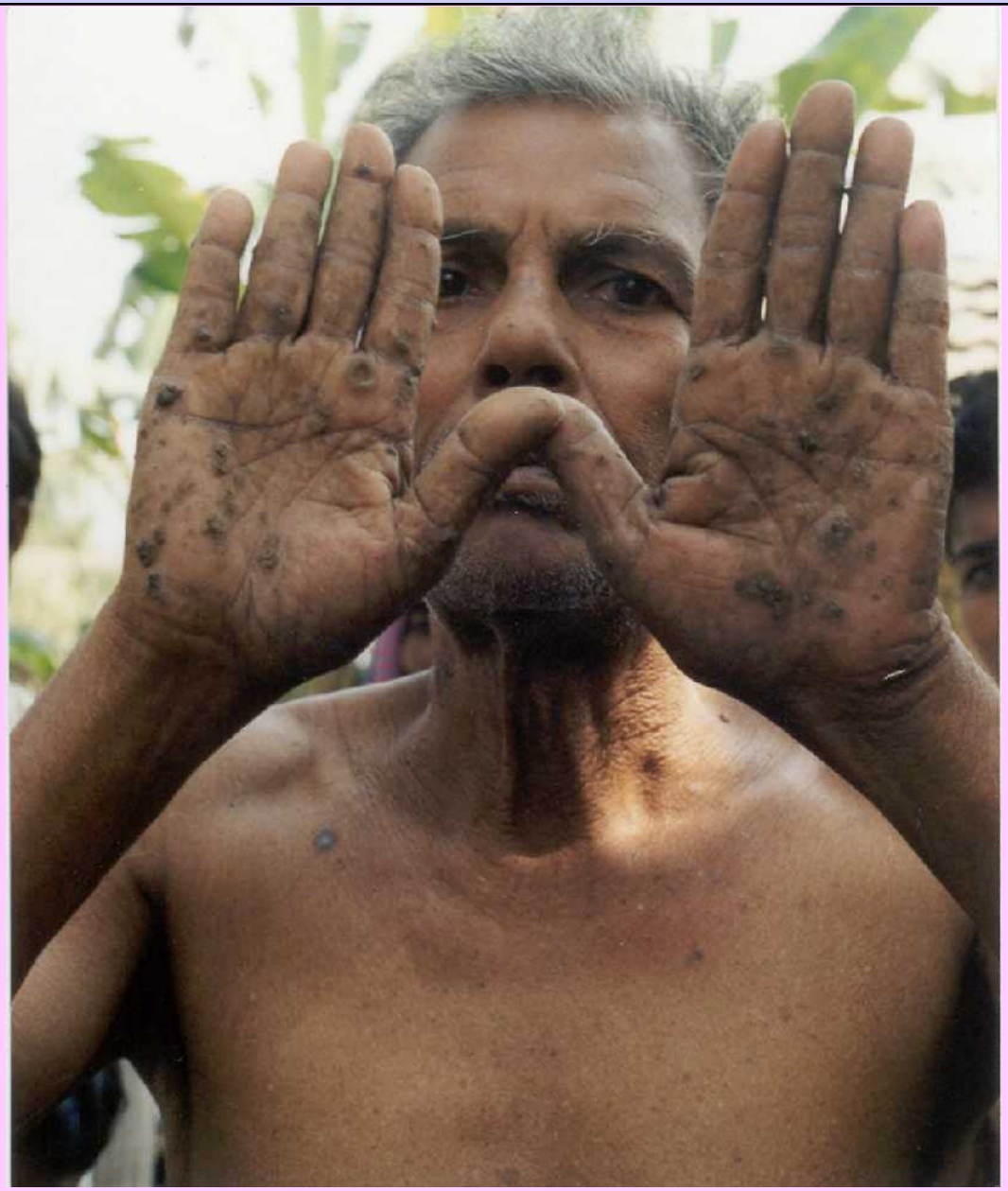
SOES Group Publication: Bull WHO 2005.

Prevalence of dermatological symptoms



SOES Group Publication: Bull WHO 2005.

Arsenocosis patient from Rajapur



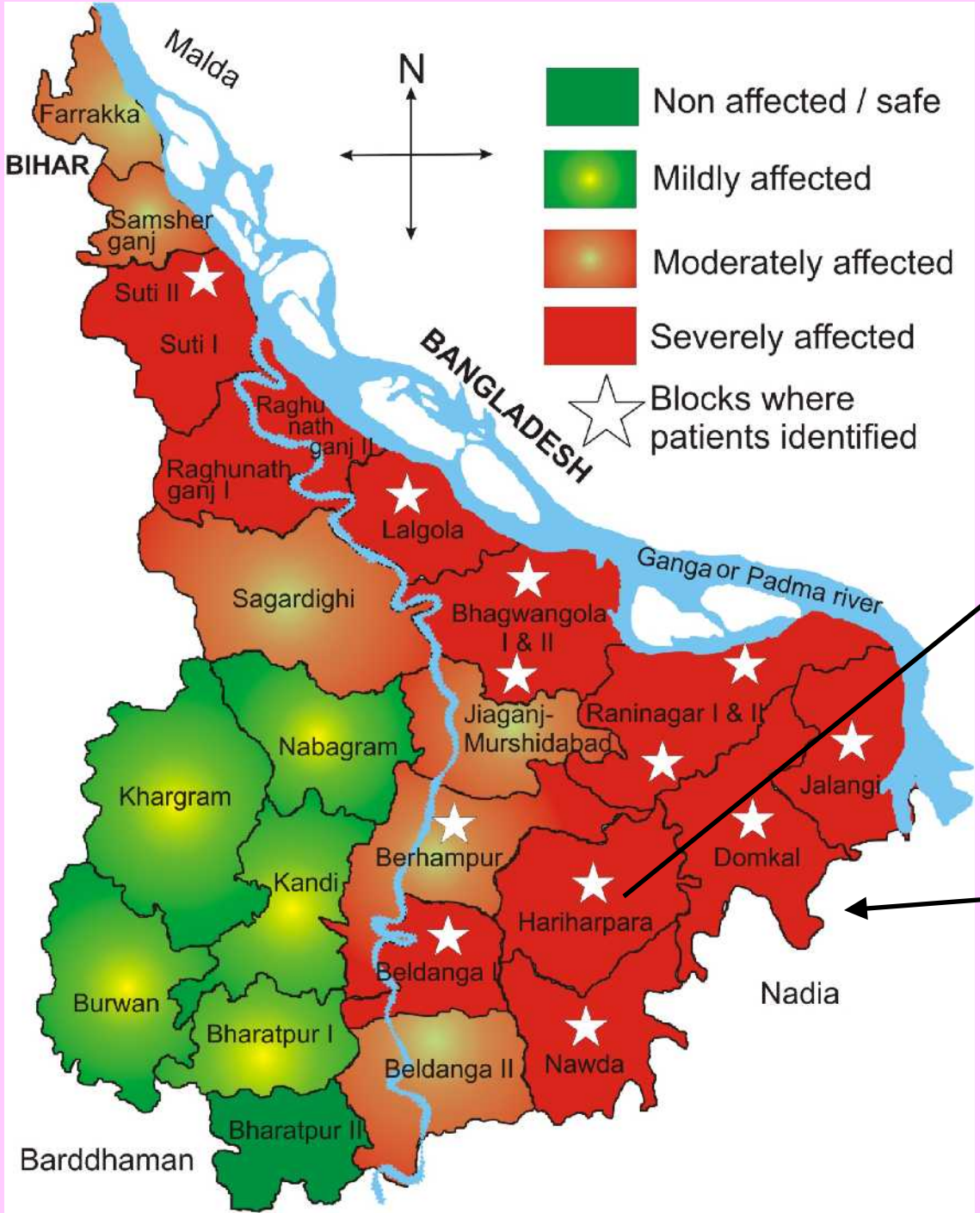
SOES Group Publication: Bull WHO 2005.

Arsenic in biological samples

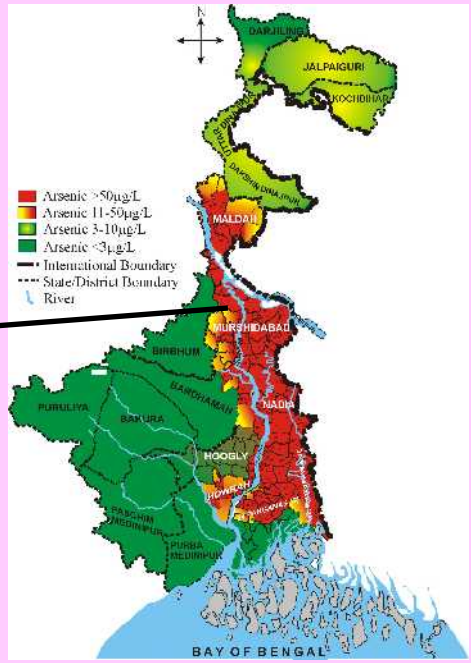
Parameters	Arsenic in hair[a] (µg/kg)	Arsenic in Nail[b] (µg/kg)	Arsenic in urine[c] (µg/l)
No. of observation	188	182	50
Mean	1931	3139	420
Median	1587	2401	244
Minimum	535	851	33
Maximum	8453	9706	2353
Standard deviation	1240	2139	485
% of samples having arsenic above normal / toxic (hair) level	84	96	98

a Normal level of arsenic in hair ranges from 80-250 µg/Kg; 1000 µg/Kg is the indication of toxicity (54)
b Normal level of arsenic in nail ranges from 430-1080 µg/Kg (55)
c Normal excretion of arsenic in urine ranges from 5-40 µg/1.5L (per day) (56)

SOES Group Publication: Bull WHO 2005.


Malda
N
Non affected / safe
Mildly affected
Moderately affected
Severely affected
Blocks where patients identified
Farrakka
BIHAR
Samsher ganj
Suti II
Suti I
BANGLADESH
Raghu nath ganj II
Raghunath ganj I
Lalgola
Ganga or Padma river
Sagardighi
Bhagwangola I & II
Jiaganj-Murshidabad
Raninagar I & II
Jalangi
Nabagram
Khargram
Berhampur
Domkal
Kandi
Hariharpara
Beldanga I
Nadia
Burwan
Bharatpur I
Beldanga II
Nawda
Bharatpur II
Barddhaman


?

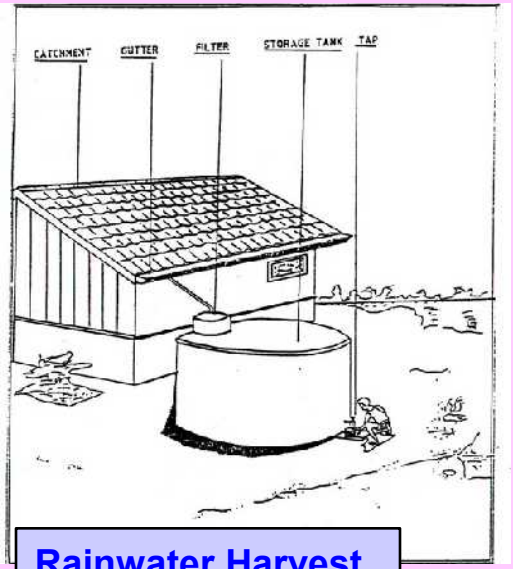

Arsenic >50µg/L
Arsenic 11-50µg/L
Arsenic 3-10µg/L
Arsenic <3µg/L
International Boundary
State/District Boundary
River
DARJILING
JALPAIGURI
KOCHBIHAR
MALDAH
MURSHIDABAD
BIRBHUM
BARDHAMAN
NADIA
PURULIYA
BAKURA
HOOGLY
HOWRAH
PASCHIM MEDINIPUR
PURBA MEDINIPUR
BAY OF BENGAL

Alternative sources of Water

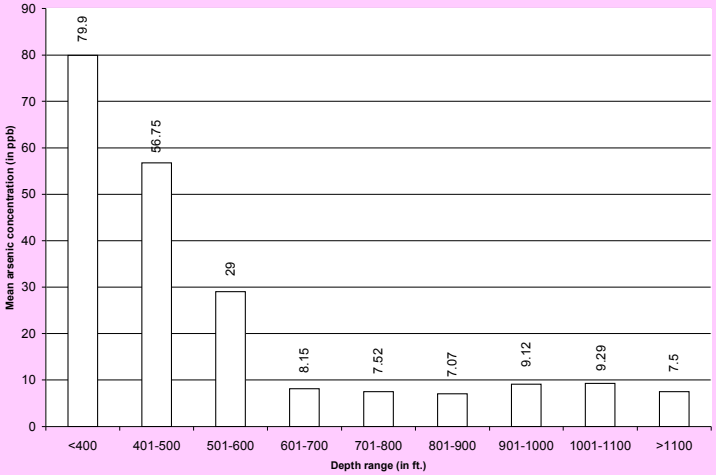
Dugwell from Mohenjodaro

Management of a Dugwell

Dugwell Zam-Zam, The Great Prophet Hazrat Mohammed used to drink this water



Rainwater Harvest



Deep Tube-well

Surface Water

FLUORIDE CONTAMINATION IN GROUNDWATER !

62 million people are fluoride affected in India alone

Fluoride affected villagers in Assam

Can someone make a toilet for me

ARSENIC CONTAMINATION IN GROUNDWATER !

The area and population of GMB Plain are 569749 sq. km. and over 500 million respectively. A good portion of the population is at risk for arsenic contamination

WHAT'S NEXT ?

To Combat this situation we need awareness to the villagers specially women and children and the whole arsenic situation can be controlled with PEOPLES PARTICIPATION