

Implementation of bore-dugwell programs as one of the mitigation options for arsenic-safe water in India

Ground Realities and Opportunities

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West Bengal



WATER IS LIFE !

IS IT TRUE?

GROUND REALITIES

Mr. Nibas Ray, 56, was admitted to the Medical College and Hospital, Kolkata where his right arm was amputated up to the elbow. Mr. Nibash has lost his son, Dhiman Ray, 25, on 31st January 2002 who was also a patient of arsenic poisoning



PEOPLE AFFECTED BY ARSENIC CONTAMINATION



ARSENIC IN DRINKING WATER

According to Epidemiological studies:
1 in 50 person may die if
exposed to arsenic concentration of
100 ppb that is found in most of the
tubewells in our target area.



The primary objectives of Aqua Welfare Society are :

- ❑ provide safe water through modern, modified design dugwells,
- ❑ as well as establish and encourage community-based groups - CBGs, to manage these arsenic-free water sources, so that they are sustainable.
- ❑ Aqua Welfare Society also regularly educates the community on arsenic and other health issues

PRESENCE OF ARSENIC IN THE AQUIFER IN WEST BENGAL, INDIA

BORE-DUGWELL



AQUIFER - 1 (<i>unconfined</i>)	<50 feet	
AQUIFER - 2	50-500 feet (variable)	
AQUIFER - 3 (<i>safe</i>)	500-2000 feet (variable)	

LITHOLOGY OF ROCKS IN WEST BENGAL

The left map shows the distribution of lithology and groundwater arsenic status across West Bengal. It includes a legend for lithology and groundwater, a map of West Bengal with districts labeled, and a table of districts and blocks.

LITHOLOGY

- RECENT DELTAIC/ESTUARINE SEDIMENTS - As absent
- KATWA SEDIMENTARY FORMATION - As present
- SIJUA SEDIMENTARY FORMATION - As absent
- LALGARH SEDIMENTARY FORMATION - As absent
- HARD ROCKS - As absent

GROUND WATER

- As absent
- As present

DISTRICT **BLOCK**

1. MALDA	- 4	5. 24. PARGANA (SOUTH)	- 11
2. MURSHIDABAD	- 19	6. BARDHAMAN	- 2
3. NADIA	- 17	7. HOOGLI	- 1
4. 24. PARGANA (NORTH)	- 20	8. HAORA	- 5

The right map is a cross-section diagram showing the geological structure of West Bengal. It includes a legend for lithology and groundwater arsenic status, a map of West Bengal with districts labeled, and a table of districts and blocks.

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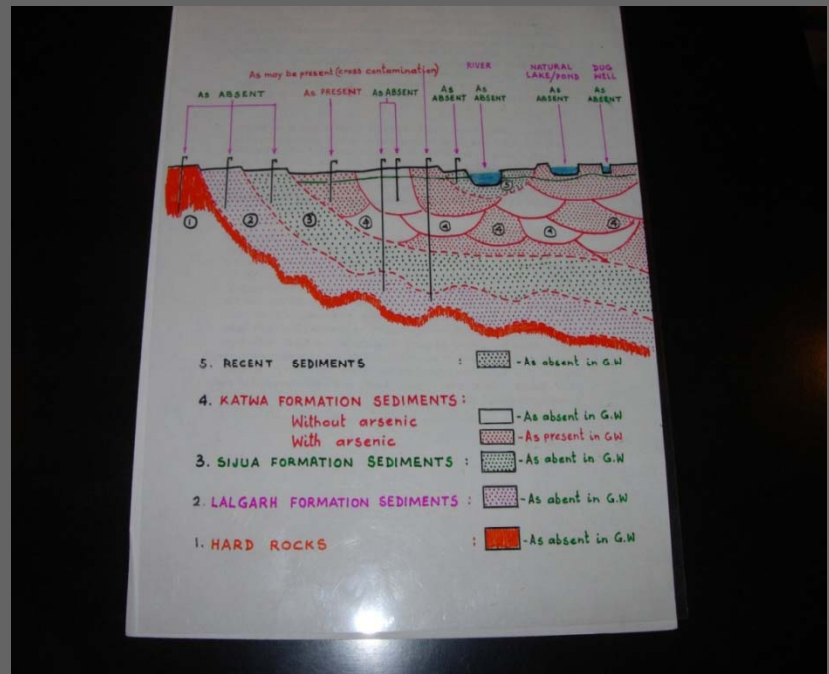
GROUND WATER

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Source : Protap Chakraborti (Geologist)



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Present Groundwater Arsenic Contamination Status of West Bengal, India

Physical Parameters	West Bengal
Area in sq. km.	88,750
Total number of districts (no. of district surveyed)	19 (19)
No. of severely arsenic affected districts *	9
No. of mildly arsenic affected districts*	5
Total population of severely arsenic affected 9 districts in million	50.4
Number of blocks / police station having arsenic >50mgL ⁻¹	111
Number of blocks / police station having arsenic >10mgL ⁻¹	148

Source : SOES Jadavpur

There is NO arsenic in the surface water



'Bore-Dugwell as Source of Safe Drinking Water in Areas with Arsenic Contaminated Ground Water in West Bengal'.

Aqua Welfare Society



Five components of our safe water program:

- 1. Research and Site Selection**
- 2. Construction**
- 3. Maintenance**
- 4. Education**
- 5. Surveillance (self and pwx)**

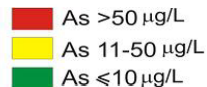
RESEARCH
AND
SITE SELECTION

On the basis of cartographical maps (source: SOES, Kolkata) blocks of most affected districts were selected as shown below.

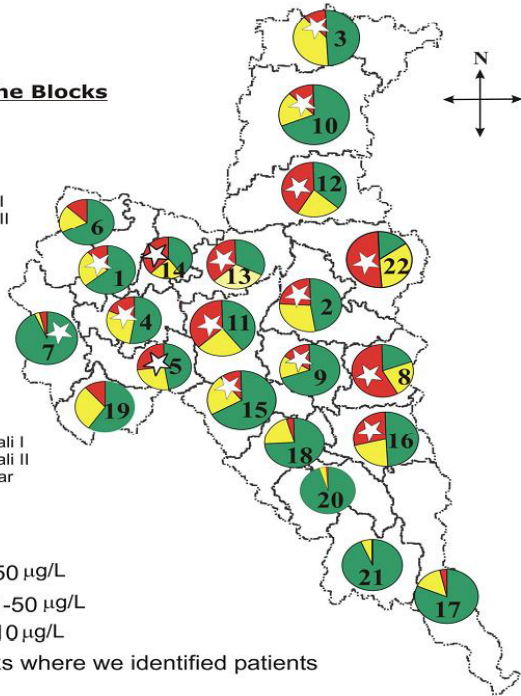
NORTH 24-PARGANAS District

Name of the Blocks

1. Amdanga
2. Baduria
3. Bagdah
4. Barasat I
5. Barasat II
6. Barrackpur I
7. Barrackpur II
8. Basirhat I
9. Basirhat II
10. Bongaon
11. Deganga
12. Gaighata
13. Habra I
14. Habra II
15. Haroa
16. Hasnabad
17. Hingalganj
18. Minakhan
19. Rajarhat
20. Sandeshkhali I
21. Sandeshkhali II
22. Swarnpunar



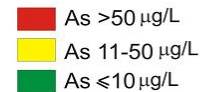
☆ Blocks where we identified patients



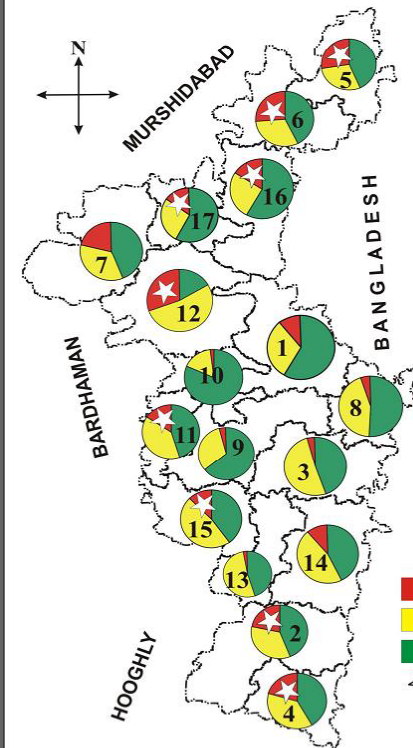
NADIA District

Name of the Blocks

1. Chapra
2. Chakdaha
3. Hanskhali
4. Haringhata
5. Karimpur I
6. Karimpur II
7. Kaliganj
8. Krishnaganj
9. Krishnagar I
10. Krishnagar II
11. Nabadwip
12. Nakashipara
13. Ranaghat I
14. Ranaghat II
15. Santipur
16. Tehatta I
17. Tehatta II



☆ Blocks where we identified patients



**NORTH 24 PARGANAS IN 22 BLOCKS
THE GROUND WATER ARSENIC CONTAMINATION
STATUS IN
HAND TUBEWELLS WAS OBSERVED**

➤ <0.01 -0.05 ppm (53.4%)

➤ >0.05 ppm (29.5%)

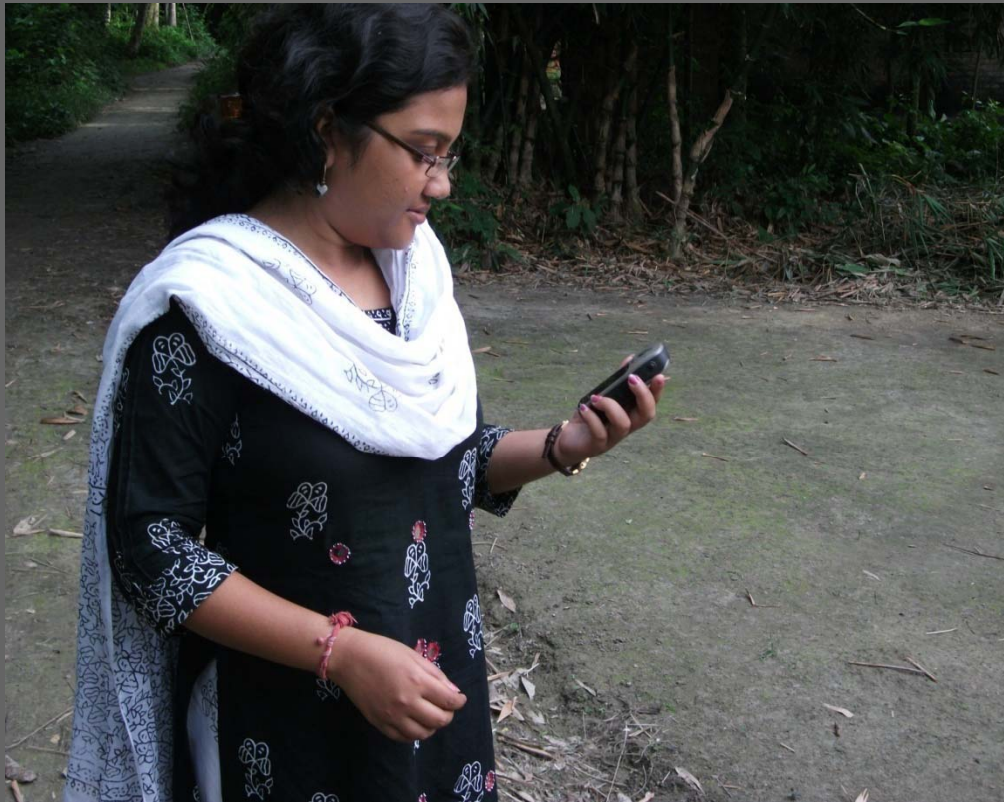
➤ >0.3 ppm (3.4%)

Source: SOES

FEW OF THE SITE SELECTION CRITERIA

- ❖ Elevated land in locality close to pond but not too close.
- ❖ Maintaining proper distance from sanitary pit.
- ❖ Direct sunlight to the dugwells is desirable and trees should be somewhat away from the dugwell.

User friendly GPS device



Geo codes of proposed sites are being recorded during site selection process in Chakdah Block, Dumuria Village in February 2010

The sites are depicted on Earth Google map before consultation with the geologists,
Mr. Protap Chakrabortti & Saumendranath
Banerjee



There are 217 DUGWELLS as of 2011 in N 24 PARGANAS, WEST BENGAL, INDIA



DUGWELLS IN THREE DISTRICTS OF WEST BENGAL

Districts	Blocks	Constructed	functional
	Baduria	10	10
	Deganga	35	15
North 24 Parganas	Habra 1	19	9
	Swarupnagar	31	30
	Gaighata	76	54
Nadia	Chakdah	43	42
Murshidabad	Raninagar II	3	2
	Total	217	162

CONSTRUCTION

PW74GDP1: 12 families, 48 consumers

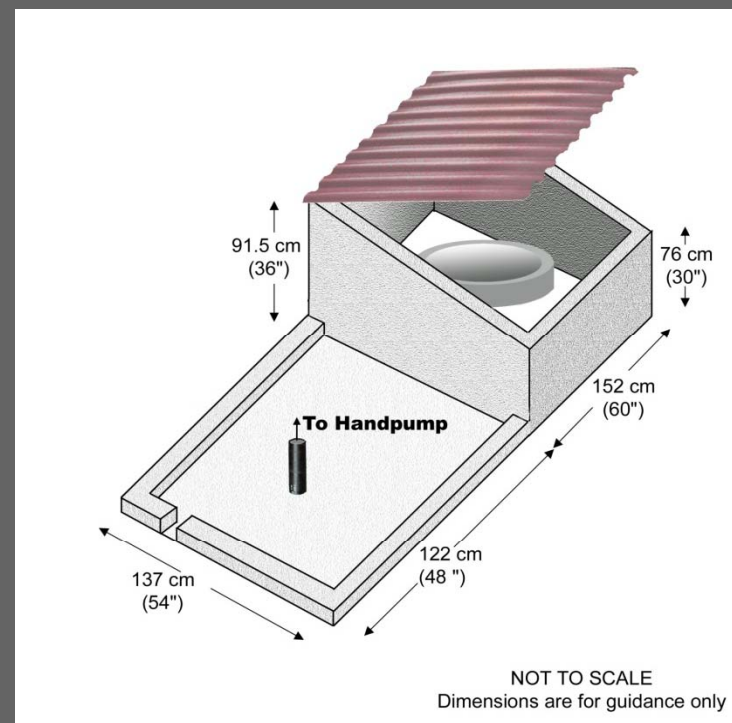
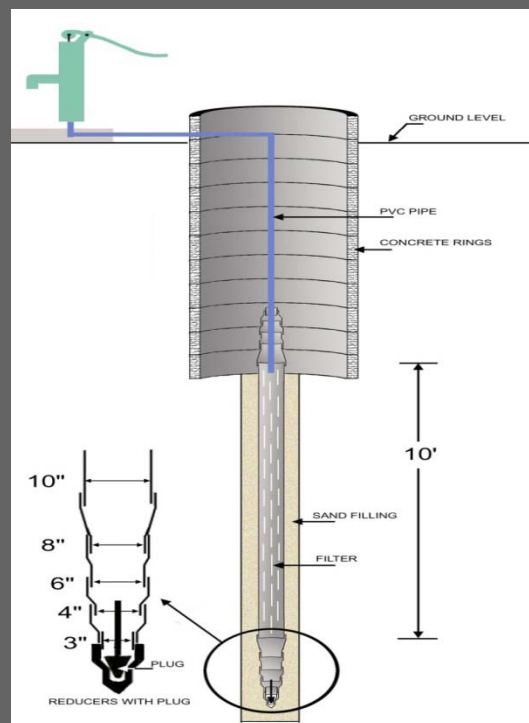


*Constructed on 21st February 2008 in the village, Gawdadhawrpur,
Gaighata*

photo taken on 4 June 2008

BORE-DUGWELL DESIGN

It is different in many forms from the traditional design



Sketch by Suprio Das

PERFORATED PVC PIPE



DRILLING OF THE PIPE



SAND WHICH ACTS AS A FILTER



CONCRETE RINGS

36" DIAMETER AND 10" LENGTH



NET



TIN COVER



INTERIOR OF THE WELL



PW24/KLS12: The net and the tin cover are used for protection from external debris and tampering.

MAINTENANCE

DREDGING OF DUGWELLS WHENEVER IT IS NECESSARY



BACTERIA

Bacteria analysis for Total Coliform and E-Coli is done 30 days after the first application of the disinfectant. During this period people are advised to use water after boiling.

(Theoline contains sodium hypochlorite with 5-10% chlorine in solution.

USEPA std: to disinfect 100 gallons, need 24 ounces of bleach).

From each source blind, duplicate samples are collected and taken to the lab within 6 hours of collection.

Analysis is done in a reliable laboratory.

Article: "Arsenic Concentrations and Bacterial Contamination in a Pilot Shallow Dugwell Program in West Bengal, India". Journal of Environmental Science and Health Part A (January 2007, Vol.42, No.1)

Initial Bacterial counts of 40 functional dugwells in different

DW ID	Const.Yr	TC	FC	Test_Yr	DW ID	Const.Yr	TC	FC	Test_Yr
PW2	2002	70	20	2005	PW28	2003	20	0	2003
PW3	2002	150	20	2004	PW29	2003	30	0	2003
PW4	2002	10	0	2004	PW31	2004	10	0	2004
PW5	2004	10	0	2004	PW32	2004	160	50	2004
PW6	2002	5500	0	2005	PW33	2004	4500	0	2005
PW7	2002	170	40	2004	PW34	2004	3250	0	2005
PW10	2004	30	10	2004	PW35	2005	5000	0	2005
PW11	2003	20	0	2003	PW36	2005	6500	0	2005
PW12	2003	0	0	2003	PW37	2005	475	0	2005
PW13	2003	0	0	2003	PW38	2005	7750	0	2005
PW14	2003	20	0	2004	PW39	2005	3900	0	2006
PW16	2003	80	30	2004	PW40	2005	575	0	2005
PW17	2003	0	0	2003	PW41	2005	1000	280	2006
PW19	2003	460	80	2003	PW42	2005	310	0	2006
PW20	2003	5750	0	2003	PW43	2005	0	0	2006
PW21	2003	30	10	2003	PW44	2005	1500	110	2006
PW22	2003	13	10	2003	PW45	2005	3250	100	2005
PW23	2004	5000	0	2005	PW46	2006	300	70	2006
PW25	2003	525	0	2005	PW47	2006	300	30	2006
PW26	2004	40	10	2004	PW48	2006	0	0	2006

Training the users in the use of disinfectant



Measuring the volume of the disinfectant that contains 5% of chlorine in solution

Understanding the theoline chart



In August 2006 introduced weekly health meetings and in November 2006 introduced earthen, 'mawtka' filters.



FILTER EVALUATION TO SELECT THE BEST AFFORDABLE TYPE



Steel body



Plastic body

Earthen body



Blind tasting of 20 samples of water collected from dugwells, shallow and deep tubewells using three types of filters: matka, steel and plastic. Matka filter was analyzed to be the best followed by steel that is expensive but matka filter breaks.



PUBLIC AWARENESS **(Health Meetings)**

Main concern was and still is
how to make the dugwell community based
program sustainable.

Exposure to arsenic in drinking water has been established to cause many serious health effects, including lung, kidney, liver, skin, bladder cancers and reports of diabetes, respiratory and cardiovascular diseases and birth defects (NRCReport, 2001 Update).

Every year new studies are being published on deaths due to critical diseases caused when the victim is exposed to arsenic in-utero and early childhood (Vahter, 2008);

VILLAGE MEETINGS

KOLSUR GRAM PANCHAYAT
N 24 PARGANAS



DUMURIA CHAKDA





- Emphasis is given on awareness programs.

- Village meetings followed by health meetings are done in communities and in people's houses for better impact



School seminar for the student and teachers.



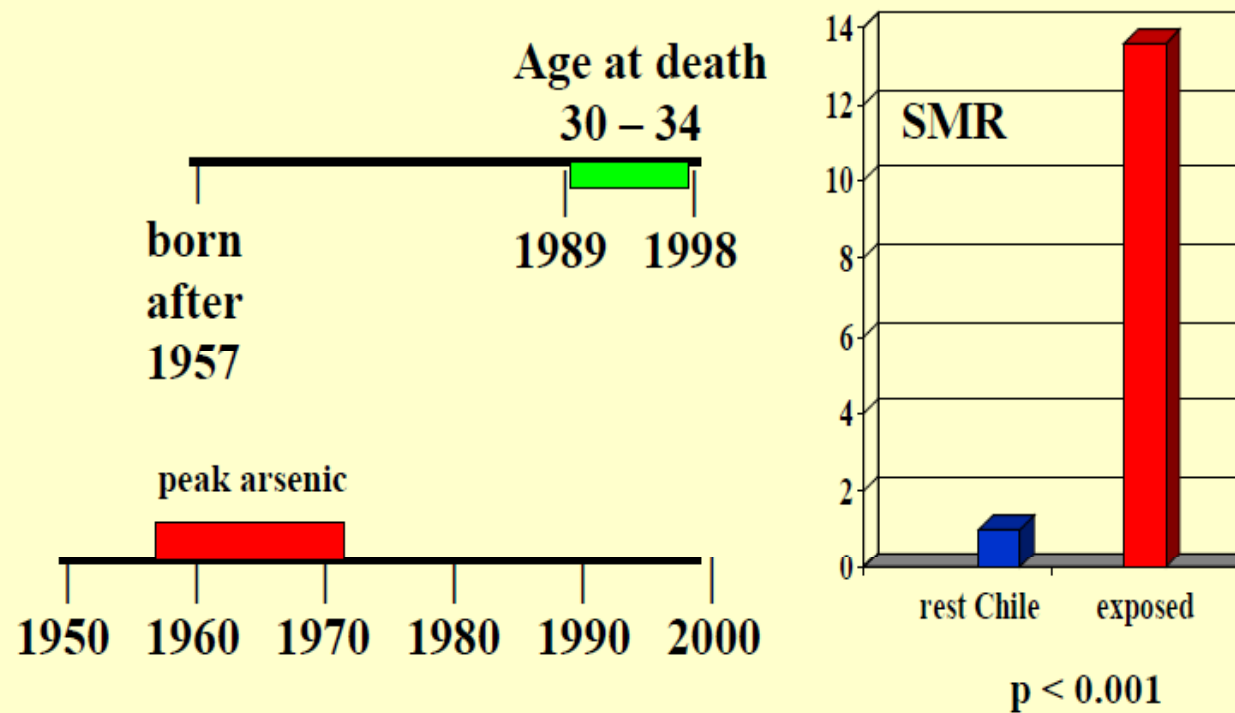
WILL OUR CHILDREN FACE THE
SAME FATE AS THEIR PARENTS ?

RESEARCH ON RESPIRATORY LUNG FUNCTION IN CHILDREN



Lung cancer mortality in men according to exposure in childhood

(SMR = standardized mortality ratio = observed/expected deaths)



SOURCE :Allan Smith

SURVEILLANCE

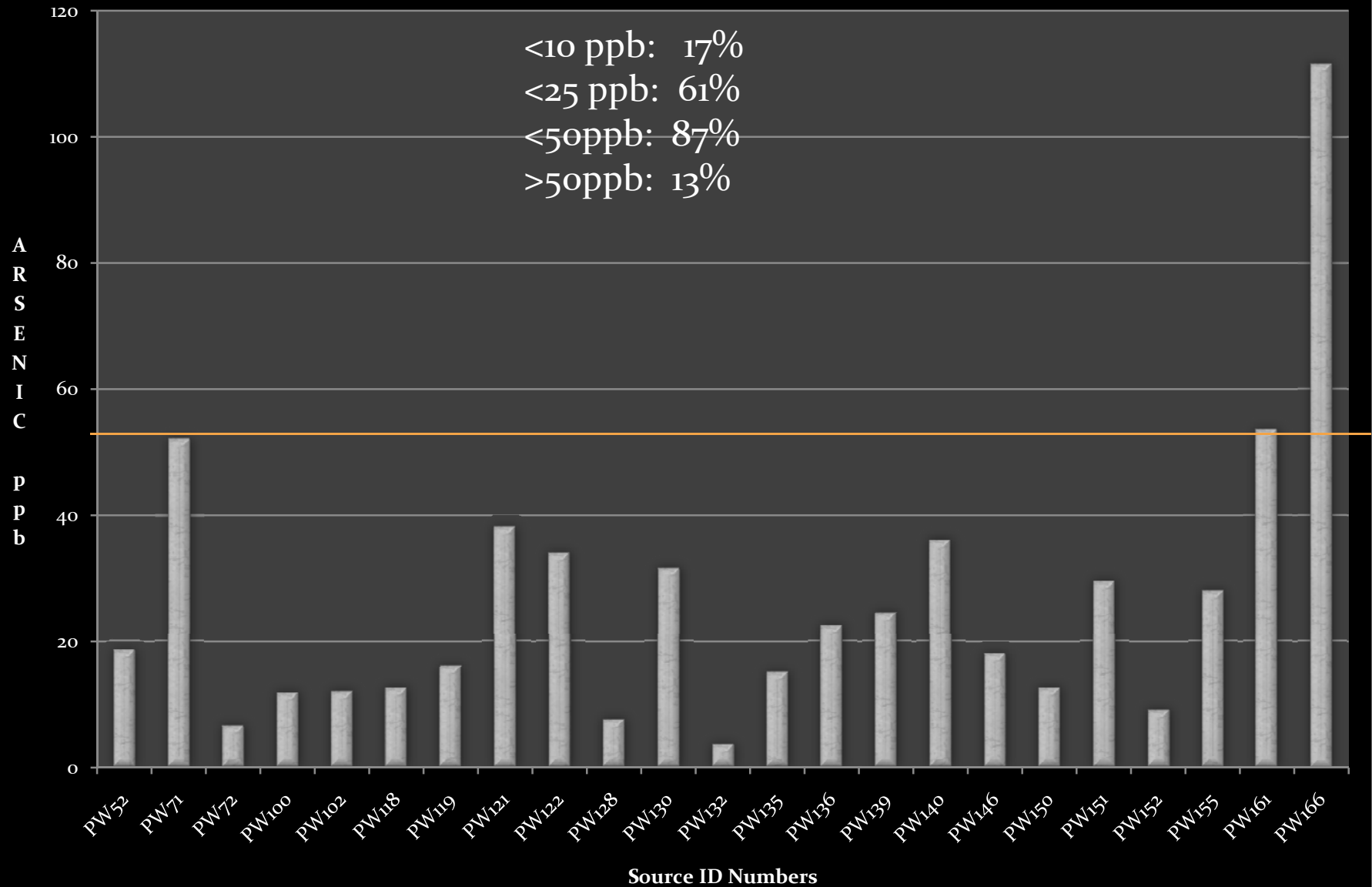
TRACKING– to make the program successful

1. Monthly report of status of dugwells
2. Monitoring of arsenic – annually
Bacteria test after construction.
3. PWX - Uploading reports on Peer
Water Exchange website
(peerwater.org).
4. Use of cell phone to upload reports
right from the village.

Annual water analysis

- analysis for Arsenic level in water (summer)
- Analysis for presence of bacteria in water.

Average arsenic concentrations in ppb of 23 randomly selected wells constructed by AWS measured in March 2012





PW40	6
PW41	0
PW42	4
PW43	4
PW44	2
PW45	0



water is fine
ignorance, neighbor feud
water is fine
water is fine
water is fine
deep tubewell, (arsenic conc. is 253ppb,11/8/07

Change in work culture: team work.
Work whenever they can as long the work is done.
Cross checking of data recorded is essential with the help of the map and
dugwell IDs to improve the practice of data collection.



OUR REAL WORK FORCE



CHILDREN DRINKING ALTERNATE SOURCE OF WATER WILL NOT SUFFER FROM DISEASES CAUSED BY ARSENIC



LETS JOIN OUR HANDS AND MAKE AN EFFORT TO
ASSURE OUR CHILDREN A BETTER SOURCE OF
ARSENIC SAFE WATER

ARE WE SAFE ???



The founding members of Project Well



Dr. Meera M Hira-Smith, Geography, Director, Project Well
(Researcher, University of California, Berkeley, USA)



Dr. Timir Hore, Hydrogeology, advisor, Project well
(Vice President, C&H consultant, New Jersey, USA)



Mr. Protap Chakraborti, Advisor and Member Project Well
(ex-director of Geological Survey of India)



Prof. Allan H Smith, Epidemiology, advisor, Project Well
(Professor, University of California, Berkeley, USA)

Other members and advisors

PW members are from multi-discipline

- Jane Liaw, *arsenic study of health research group, University of California, Berkeley, USA.*
- Dr. Xavier Savarimuthu, *Environmental Science*
- Mr. Suprio Das, *Engineer,*
- Mr. Saumendra Nath Banerjee, *Geologist*
- Punurdan Dutta, *social worker, & technical advisor*

Ex- advisors

- * Mr. D.K Chakraborty, Civil Engineer, LKP
- * Dr. DN Guha Mazumder, gastroenterologist, IPGME&R
- * Dr. Dipankar Chakraborty, Chemistry SOES
- * Dr. S Banerjee, Chemistry, CSME

Other members of Aqua Welfare Society

- Mr. Ashok Paul, President
- Mr. Uday Mukherjee, Secretary
- Mrs. Alpana Hira Davidson, Treasurer

Donors: Private donations, Mosaique of Quebec, Canada, Rotary, Fogarty International and Blue Planet Run Network