Environment

Water & Environmental Sanitation Network (WES-Net India)

Solution Exchange for WES-Net India Consolidated Reply

Query: Removing Fluoride Contamination, from SPWD, Udaipur (Experiences)

Compiled by Pankaj Kumar S., Resource Person and Ramya Gopalan, Research Associate
13 December 2006

From Kanishk Negi, Society for Promotion of Wastelands Development (SPWD), Udaipur, Rajasthan
Posted: 29 September 2006

I work in the western arid zone of India with the Society for Promotion of Wastelands Development (SPWD) on issues related to water, forestry and land.

Members are aware that an increasingly large number of villages and habitations now suffer from Fluoride contamination. Fluorosis causes deterioration of bones and joints, thereby increasing medical expenditure and in some areas like Rajasthan, has prevented people from marrying their daughters in a village where drinking water is contaminated.

The root cause of fluoride contamination is firstly, using water from deeper aquifers and secondly, underground geology (availability of rocks rich in fluoride content) with no relation to the aquifer level. The current practice to deal with fluorosis involves diversion of cleaner surface water from lesser-affected regions to more affected ones. However, this is not a long-term solution and may cause conflicts as scarcity increases.

In order to find a sustainable solution for this problem, SPWD is developing a programme following the approach of increasing ground water levels to dilute the concentration of fluoride, complemented by reducing the amount of water extraction. This would involve artificial recharge of ground water, limiting the draft, harvesting alternate sources like rainwater harvesting and enhancing the immune system of the people.

In the above background, I request members to share their experience on the following:
- Information on centers involved in testing blood serum and urine samples for fluoride concentration, preferably near Rajasthan.
- Low cost/indigenous techniques for treating fluoride-contaminated water, keeping in mind that limited maintenance is possible in rural areas.
- Experiences of other NGOs, government or donors in resolving the fluoride contamination issue in other parts of India.

- Information on resource agencies to provide technical, financial and strategic support to upscale the learnings of our fluoride contamination programme.

Responses received with thanks from:

1. **V. Kurian Baby, SEUF, Kerala**
2. **K. A. S. Mani, APFAMGS, Hyderabad**
3. **D. Chandrasekharam, Indian Institute of Technology (IIT), Mumbai**
4. **Seema Raghunathan, NATCO Trust, Hyderabad**
5. **R. Srikanth, WaterAid India, New Delhi**
6. **K. Kiran Kumar, SKG Sangha, Kolar, Karnataka**
7. **Meghna Das, Independent Consultant, UK**
8. **A. K. Susheela, Fluorosis Research and Rural Development Foundation, New Delhi**
9. **Paul Deverill, UNICEF India, New Delhi**
10. **N. Ramachandran, Periyar PURA, Thanjavur, Tamil Nadu**
11. **Terry Thomas, Participatory Learning and Action Network (PLANET Kerala), Thiruvananthapuram**
12. **Ajit Sheshadri, The Vigyan Vijay Foundation, New Delhi**
13. **T.S. Krishnan Iyer, Development Oriented Operations, Research and Surveys, Noida**
14. **U. V. Sambhu Prasad, Lloyds and Lous Burgers Inc., Varani, Andhra Pradesh**
15. **S. Vishwanath, Rainwater Club, Bangalore**

Further contributions are welcome!

Summary of Responses

Contamination of drinking water with excess fluoride consequent fluorosis is a massive problem affecting increasingly large populations in **Rajasthan** and other states of India, even more widespread than the arsenic problem. In this context, the query on treatment measures of fluoride contaminated water and testing its impact on human body evoked a wide range of responses and suggestions.

The major reason for such contamination, felt members, was the presence of flouride contributing zones and aquifers, which need to be delineated for effective mitigation. Among the various **methods of fluoride mitigation**, members mentioned the Nalgonda technique (using alum, lime and bleaching powder to precipitate fluoride salts from water) as one of the earliest defluoriding techniques. However, they reported that attempts to get panchayats to take up fluoride mitigation in Nalgonda district, **Andhra Pradesh** and other parts of the country have not provided desired results due to inadequate technical and financial capacity of panchayats, incomplete disposajl of hazardous wastes, and lack of demand from stakeholders. Nevertheless, a de-fluoridisation Corporate Social Responsibility project in Nalgonda cited by members appeared to be quite successful in providing safe drinking water to village people at a low cost.

Respondents report that the use of **activated alumina filters** has been quite successful in achieving a household level of outreach at low costs. They also cited the UNICEF-promoted three-tier filter as a good example. The filter calls for adding an activated alumina chamber to a normal two-chamber candle filter. However, activated alumina need to regeneration every three months. This implies recurring costs (about Rs. 30 for 3 kg) and skilled labor to test the filtered

water and to change degenerated filters. Participants suggested that the cost of regeneration of alumina be subsidized in some districts, and the capacity of self-help groups and village entrepreneurs be enhanced to carry out testing and changing of filters.

In addition to these conventional techniques, the group also mentioned other **potential methods** for de-fluoridification such as **Phyto-remediation** – using specific plants like water hyacinth to leach away contaminants from water, and accentuated the need for screening indigenous plant species for this purpose.

Respondents also pointed out that in fluoride-affected areas, promotion of **alternative sources of safe drinking water** such as roof water harvesting could be done. In this regard, they shared examples from Kolar, **Karnataka**, the Karnataka Government's roof water harvesting programme, and another programme in **Tamil Nadu**. Other potential methods for getting pure drinking water mentioned included supporting traditional water harvesting systems such as *tankas* in **Rajasthan** and Solar Distillation.

Members discussed the **efficacy of groundwater recharge** in decreasing the concentration of fluoride. On one hand, they felt that since extraction from deeper aquifers was the reason why concentration levels of fluoride went up, recharging aquifers could be one of the ways of dealing with excess fluoride. They also thought that in the absence of mapping of fluoride contributing zones, recharge may not yield the desired results; noting that recharge may take a long time to show conclusive results, and still not make any significant difference in severely water scarce regions, like **Rajasthan**.

Additionally, respondents stressed the need to develop an **inter-sectoral approach** to tackle the issue of fluoride. Firstly, surveillance on the incidence of contamination needs to be stepped up through regular testing of water samples. In this regard, members felt that ion-specific electrodes and photometers gave more accurate results than titration and other testing methods. They also suggested fully involving all relevant stakeholders such as schools, health authorities and local authorities in the mitigation efforts. Moreover, participants stressed the importance of targeting vulnerable groups such as children, pregnant and lactating mothers. Health officials also need to be trained to recognize symptoms of fluorosis such as staining and pitting of teeth, joint pains, etc. All fluoride mitigation interventions need to be regularly monitoring for impact, felt members.

Members mentioned three **testing centres** for testing blood and urine samples, All India Institute for Medical Sciences (AIIMS), Fluorosis Research and Rural Development Foundation, New Delhi, and the Indian Institute of Technology, Mumbai the rider being that these samples be brought in plastic bottles to prevent glass containers from distorting the fluoride content. In addition, at AIIMS, one needs to register as an Out Patient Department patient and the test is done if the doctor recommends it, while there is no such restriction in the other two centres.

Notwithstanding the above focus on fluoride intake through drinking water, members cautioned that in some districts as much as 58 to 64% of total fluoride intake could happen through **contaminated food**. Calculation of fluoride ingestion therefore needs to account for both routes- food and water. Additionally, consumption of **local foods** rich in calcium such as Chakoda (*Cassia Toria*) was a good way of mitigating impact of fluorosis, respondents suggested.

In conclusion, members were not very sanguine about the efficacy of groundwater recharge on mitigating fluoride; they emphasized collection and storage of rainwater as a safe alternative for drinking water. Respondents proposed an inter-sectoral strategy for addressing fluoride mitigation through more sensitive health services, encouraging calcium-rich foods, and chemical

treatment of contaminated water and better vigilance. These could be the first steps towards a long-term and sustainable response to the fluoride problem.

Comparative Experiences

Andhra Pradesh

Defluoridation Project as part of CSR *(from Seema Raghunathan, NATCO Trust, Hyderabad)*
As part of its social commitment, NATCO Trust through its Corporate Social Responsibility project installed deflouriding units in remote villages of Nalgonda District. The units work on cost basis and decontaminated water costs 20 paisa per liter. Additionally the Trust installed a UV ray filter at the government institution Gurukul and constructed safe water tanks for schoolchildren.

Karnataka

Locally Constructed Alternate Rainwater Based Drinking Systems *(from S. Vishwanath, Rainwater Club, Bangalore)*
The Karnataka Government is trying an alternative water collection system in 1,000 villages. A small tank (1,500 liters to 2,000 liters) built using locally available materials and skills, collects rainwater during the rainy season and acts as storage, to provide fluoride-free water for most of the year (20 liters/family/day). Additionally the government is developing a small sand filter to pre-filter water before storage and trying SODIS with chlorine tablets for bacterial disinfection.

Rainwater Based Drinking Systems Using Slow Sand Filters *(from K. Kiran Kumar, SKG Sangha, Kolar, Karnataka)*
As part of its social activity SKG Sangha installed 16 rainwater based drinking systems at government schools in Bagalkot district. The systems have slow sand bed filters with activated carbon in the form of wood charcoal and a sealed storage tank in brick masonry with capacities of 1,500 to 3,000 liters. The savings in electricity charges to pump ground water will recover the cost of the units within two years and provide clean potable water to fluoride-affected areas.

Tamil Nadu

Water Purification Plant under Periyar PURA *(from N. Ramachandran, Periyar PURA, Thanjavur, Tamil Nadu)*
The Periyar College adopted 65 villages near the college under the Periyar PURA scheme. Since the drinking water that people get from deep bore well is not potable, the Institute made efforts to find alternate options and succeeded in getting a water purification plant from US based Pure O Tech Company, installed in Muthuveerakandian Patti, Thanjavur taluk. This plant brings all water within safe parameters, including fluoride, thus providing the village people purified water.

Related Resources

Recommended Organizations

From V. Kurian Baby, SEUF, Kerala

Rajiv Gandhi National Drinking Water Mission (RGNDWM)
http://rural.nic.in/rgndw.htm

For details and experiences of the sub-mission projects under the RGNDWM particularly aimed at drinking water quality and supply with emphasis on de-fluoridation experiments

United Nations Children's Fund (UNICEF), Jaipur *(from V. Kurian Baby, SEUF, Kerala and R. Srikanth, WaterAid India, New Delhi)*
B-9 Bhawani Singh Lane, C-Scheme, Opposite Nehru Sahkar Bhawan, Jaipur 302 001, Rajasthan; Tel.: 91-141-2382694; Fax: 91-141-2382910; jaipur@unicef.org

To obtain feedback on the domestic de-fluoridation experiments tried out in Rajasthan with UNICEF support and for details on the activated alumina filter

Development Alternatives (DA), New Delhi *(from Meghna Das, Independent Consultant, UK)*
111/9-Z, Kishangarh, Vasant Kunj, New Delhi 110070; Tel.: 91-11-26134103, 26890380; Fax: 91-11-26130817; tara@devalt.org; http://www.devalt.org/active.htm

Evaluates performance of domestic and community level defluoridation techniques & engaging in capacity building of PHED officials and NGOs in Rajasthan & Andhra Pradesh

From A. K. Susheela, Fluorosis Research and Rural Development Foundation, New Delhi

All India Institute of Medical Sciences (AIIMS), New Delhi

Hospital involved in testing blood serum & urine samples for fluoride wherein one needs to be an OPD patient and if the test is required, it is done

Fluorosis Research and Rural Development Foundation
Contact Prof. (Dr) A. K. Susheela; susheela@bol.net.in
http://education.vsnl.com/fluorosis/foundation.html

Centre for testing blood serum and urine samples for fluoride wherein anyone referred to the foundation can undertake tests by providing samples in plastic vials/bottles

Arghyam, Bangalore *(from S. Vishwanath, Rainwater Club, Bangalore)*
2nd Floor, 840, 5th Main (Above Aafreen's Salon), Indiranagar 1st stage, Bangalore 560038; Tel.: 91-80-25210378; Fax: 91-80-25252003; info@arghyam.org;
http://www.indiawaterportal.org/arghyam/waterquality.htm

Provides financial assistance of fluoride mitigation programs and information on Sachetna Plus Govt. of Karnataka Project funded by Arghyam and implemented by BIRD-K

Centre for Environmental Science & Engineering, Indian Institute of Technology Bombay, Powai *(from D. Chandrasekharam)*
Mumbai 400076; Tel.: 91-22-25767851; Fax: 91-22-25786530

Includes laboratories designed for environmental engineering research with a full range of research equipment used for environmental testing and analysis of air and water

Recommended Contact and Expert

Dipak Roy, UNICEF, Jaipur *(from Paul Deverill, UNICEF India, New Delhi)*
DRoy@unicef.org

Recommended for more specific advice on fluoride contamination status and fluoride mitigation programs of Rajasthan

Recommended Documentation

A Household Defluorodation Technique *(from V. Kurian Baby, SEUF, Kerala)*
C. Banuchandra and P. Selvapathy; TWAD Technical Newsletter; August 2005

http://www.twadboard.com/photos/7.pdf (Size: 765.3 KB)

Presents the findings of investigation on the use of alum, lime (Nalgonda technique) and activated alumina for household level defluoridation.

Solar Desalination *(from Terry Thomas, Participatory Learning and Action Network (PLANET Kerala), Thiruvananthapuram)*
PLANET Kerala
http://www.planetkerala.org/downloads/SolarDistillation.pdf (Size: 768.34 MB)

Details Solar Desalination as a compact and point of use treatment for chemical, physical and biological contaminants in drinking water citing its experience in Kerala

Water quality in Sustainable Water Management *(from K. S. Murali, UNDP, New Delhi)**
Sudhakar M. Rao and P. Mamatha; Current Science, Vol. 87, No. 7; October 10, 2004
http://eprints.iisc.ernet.in/archive/00002390/01/water_quality.pdf (Size: 161.1 KB)

Analyses water pollution by point and diffuse sources and introduces a new method of treating fluoride contamination using magnesium oxide, developed at IISc, Bangalore.

**Offline Contribution*

From Ramya Gopalan, Research Associate

Fluorosis Management Programme in India
A. K. Susheela
http://www.ias.ac.in/currsci/nov25/articles13.htm

Focuses on awareness generation, opting technology for fluoride removal/strategy, and emphasizes importance of antioxidant-rich diet to minimize fluoride effects

Common Treatment Techniques
Excel Water Technologies Inc.
Click here to view link

Provides details on a number of techniques such as Activated Alumina, Anionic Exchange, Reverse Osmosis which enable the removal of fluoride amongst other contaminants

Fluoride Detection Kit for Groundwater, A Field-Kit for Quick Estimation of Fluoride in Ground-Water
Bhabha Atomic Research Centre, Mumbai
http://www.barc.ernet.in/webpages/technologies/fdk/fdk_br.html

Details FDK as a simple, user-friendly and highly cost effective kit for estimation of fluoride in groundwater in comparison with currently available techniques.

Mobile Drinking Water Treatment/Disaster Management Unit
Update; Ion Exchange India, No. 1; August 2003
http://www.ionindia.com/pdf/water_tech/updates/update_august%2003.pdf (Size: 435.81 KB)

Provides information on water and waste water treatment technologies particularly the mobile drinking water treatment unit for rural communities

Fluoride Contamination in Water Highest in Dharmapuri
S. Prasad; The Hindu; May 24 2004
http://www.healthlibrary.com/news/2004/24-29-may04/news6.html

Article finds that Dharmapuri due to Failure to conserve rainwater and excessive depletion of groundwater has a high concentration of endemic fluoride

Defluoridation of Water Using Inexpensive Adsorbents

A. V. Jamode, V. S. Sapkal and V. S. Jamode; Journal of Indian Institute of Science; Sep–Oct 2004
http://journal.library.iisc.ernet.in/vol200405/paper4/jamode.pdf (Size:74 KB)

Study assesses the suitability of inexpensive leaf adsorbents to effectively remediate fluoride-contaminated water.

The Dark Zone
Nidhi Jamwal and D. B. Manisha; Down to Earth
Click here to view link

Reports the extent of the problem and enormity of human tragedy due to fluoride and arsenic contamination in groundwater

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Responses in Full

V. Kurian Baby, SEUF, Kerala

Negi's approach and strategy is the most feasible route for fluoride treatment. The best way to answer water quality is to address it at source, which is cost effective and sustainable. If my understanding is correct, we are yet to perfect a simple, community friendly and cost effective system for fluoride treatment. The oft suggested 'Nalgonda technique' has encountered serious problems of waste disposal and effective maintenance. In 2001, when I visited Nalgonda (Andhra Pradesh), almost every treatment plant, supposed to have been maintained by the PRIs, are found to be defunct.

In Nalgonda, my inference is that the system failed on account of the following; (a) responsibility assigned to PRIs, which are not empowered and technically and financially equipped for the purpose (Water Boards in India are happy to devolve the most difficult part of their service like rehabilitation of defunct schemes, quality assurance, aquifer recharge etc., to PRIs while resisting to devolve the production and investment functions); (b) treatment and disposal of hazardous waste system not perfected and the treatment plants not maintained/managed properly; and (c) the demand for treatment has not been adequately generated across the stakeholders. Many variants to the Nalgonda technique are being practiced across the country, with varying degree of success and the main determinants are the soft elements.

We have generally failed not mainly in terms of technology, but in terms of institutions, management, and generation of demand.

I would request Negi to kindly get in touch with the UNICEF team in Jaipur for feedback on the domestic de-fluoridation experiments tried out in Rajasthan with UNICEF support and the PHED on their experiences on the sub-mission projects under RGNDWM.

I was always thinking in terms of reviving the traditional 'tanka system' for drinking water in rural Rajasthan, which could address both quantity and quality (fluoride) issues at a stroke to a large extent, and is really cost effective.

K. A. S. Mani, APFAMGS, Hyderabad

The critical task in reducing the fluoride in the affected areas is to first get a good understanding of the depth and extent of fluoride rich aquifers. To believe that deeper aquifer (an ambiguous statement) are fluoride rich is highly erroneous. Once the fluoride contributing zones are delineated, their source and recharge zones need to be identified.

Only after having a good understanding of the fluoride rich aquifer and recharge zone should the scope for dilution through induced recharge be attempted. Alternatively, modified well design involving blanking of fluoride rich zones while tapping the less or no fluoride aquifer zones might be an option that can work in areas with multiple aquifers.

D. Chandrasekharam, Indian Institute of Technology (IIT), Mumbai

Considerable work on this problem has been carried out in parts of Rajasthan and other regions of India. The number of people affected by Fluorosis is much greater than the number of people affected by arsenic problem in West Bengal.

This problem has been addressed by several workers. We experimented to solve this problem using locally available vegetables in certain parts of Karnataka. The results were encouraging and further work in this direction is being carried out by my students. We can work out a method to work out a programme of assistance, if you are interested.

Testing facilities are also available with us (but not in Rajasthan). In case you need further assistance, contact us. Alternately, you can contact University of Rajasthan at Jaipur. Perhaps they may be in a position to help you.

Seema Raghunathan, NATCO Trust, Hyderabad

I am Seema, working for a corporate trust (NATCO Trust) as part of a Corporate Social Responsibility project. As part of our social commitment, we have installed deflouriding units in remote villages of Nalgonda District. The units work on cost basis and decontaminated water costs 20 paise per liter. For schoolchildren, we have installed a UV ray filter at the government institution Gurukul. We have also constructed safe water tanks for schoolchildren and sanitation facilities for children at school level.

R. Srikanth, WaterAid India, New Delhi

Fluoride contamination can be tackled by using household activated 'alumina filter'. This is promoted by various agencies including UNICEF. The major challenge that remains to be addressed is capacity development of community on the use of this filter including regular monitoring of filtered water, and regeneration of activated alumina. This requires dedicated and trained persons to take charge of these software components; otherwise, this intervention will fail to address this core issue. Concept of entrepreneurship within self-help groups can be tried in this area where persons trained in the software of defluoridation can do the job of recharging, regeneration the filter after making assessment of filter on periodic basis at a nominal cost.

Secondly, looking for alternate sources of ground water with less fluoride is effective.

Thirdly, fluoride contamination can also be addressed by promoting foods that are rich in calcium and available locally. These are the alternative measures WaterAid India is adopting in project areas where fluoride is the major contaminant including the worst affected areas of Palamau in Jharkand.

However, I am skeptical with regard to defluoridation using groundwater recharge, which may take a long time to show any conclusive result and may still not lead to in a drastic dilution in water stressed areas like Rajasthan.

K. Kiran Kumar, SKG Sangha, Kolar, Karnataka

This is an NGO working from Kolar, Karnataka state. As a part of our social activity we have installed 16 rain water based drinking systems with capacities ranging from 1500 to 3000 liters at government schools in Bagalkot district of Karnataka State. The savings in electricity charges to pump ground water would recover the cost of the unit within 2 years.

These rain water based drinking water systems have slow sand bed filters with activated carbon in the form of wood charcoal and a sealed storage tank with the above capacities in brick masonary.

I feel that this method is a sustainable solution to provide clean potable water to fluoride affected areas.

Meghna Das, Independent Consultant, UK

I am Meghna Das, presently based in UK but I had been working on fluoride related issues in Development Alternatives (DA), New Delhi. We have been involved in the capacity building of PHED officials and NGOs in Rajasthan and Andhra Pradesh under a project funded by UNICEF. Also we have been responsible for evaluating the performance of both domestic and community level defluoridation techniques (mainly activated alumina). If you are interested in finding more about the reports and the techniques, you could get in touch with my colleagues at DA or I would be pleased to respond to more queries.

A. K. Susheela, Fluorosis Research and Rural Development Foundation, New Delhi

The information for Centres involved in testing blood serum and urine samples for fluoride are only two in the whole country.

- AIIMS, New Delhi, one needs to be an OPD patient and if the test is required it is done
- Fluorosis Research and Rural Development Foundation, New Delhi

Tests are done for anyone referred to the Foundation from anywhere in the country. Samples need to be brought in plastic vials/bottles.

Paul Deverill, UNICEF India, New Delhi

It is good to see that there is still quite a bit of interest about fluoride in drinking water. I would like to use the opportunity to share a few lessons that UNICEF has learnt over the last few years in this respect, particularly in Rajasthan, Madhya Pradesh and Andhra Pradesh.

I think that we need to recognize that the problem we are dealing with is fluorosis, not just excess fluoride in drinking water. Studies recently undertaken by UNICEF Bhopal, and Dr. Chakma and his team from the Regional Medical Research Centre for tribals (ICMR) in Jabalpur indicate that 58 to 64% of fluoride consumed in survey areas in Jhabua District is ingested as

food. The worst culprits in this respect were cereals and pulses such as red gram. Earlier studies undertaken by ICMR in Mandla, Madhya Pradesh, had also concluded that those most severely affected by fluorosis were markedly deficient in calcium and micro-nutrients.

Interventions designed to reduce fluoride should be informed by such studies, and include diet and nutrition interventions. In MP, the promotion of Chakoda (Cassia tora), which is rich in calcium, has helped mitigate the disease. It should be said that Chakoda was already used by tribals - but its significance in mitigating fluorosis was not appreciated.

When designing fluorosis control measures, we also need to ensure we know how effective they are. This implies the need for surveillance. Screening for dental fluorosis in schools is an effective surveillance measure, provided those carrying out the inspection can identify the dental staining and pitting associated with fluorosis. It is astonishing and depressing that a whole generation after fluorosis was first diagnosed, many health officials and health works in areas where this is a problem are unable to diagnose the disease.

To be effective and sustainable, interventions must be intersectoral, involving health centres, schools, Anganwadis, water service providers and local government. Specific interventions can be focused on vulnerable groups within a population - such as pregnant and lactating mothers. Monitoring impact of interventions is essential - and a key role for health authorities. Only then will we be able to arrest the disease.

In this context, we can look at water quality. Here I have two points. Firstly, screening water supplies should be carried out with an ion-specific electrode or photometer, not a semi-quantitative test kit. Laboratory titration methods are better than field test kits but the process takes too long given the number of tests required. Field test kits should be used in the context of determining whether a fluoride removal filter is working or not (see below). Almost 200 ion meters were provided by UNICEF and WHO to Government departments over the last ten years - but how many are still functional and in use?

Secondly, when designing water quality interventions, we need to consult users and take into account their wishes and demand. The most simple and most sustainable interventions may include rain water harvesting and dilution and sanitary wells. Multi-village water supplies are expensive to build and maintain, and are vulnerable to faecal contamination if the supply is interrupted by power cuts. As in the case on Anantapur, we must be sure that the water source can meet projected water demand. But, if well designed and supported with extensive capacity building, piped water supplies may provide a longer term solution.

Fluoride removal, by comparison, may be even more difficult to sustain. UNICEF and others have developed domestic systems using activated alumina. These work in the lab. However, in the field, domestic filters must be supported with a network of regeneration centres. In addition, all users must be informed (and sufficiently motivated) to ensure that their filters are "re-activated" every three months or so. The costs of regeneration are also quite high - typically 30 rupees for 3 kg of activated alumina. The poorest families may be willing to contribute something, but may need a subsidy to afford this. All these points must be taken into account when designing a filter-based intervention. Otherwise there is a significant risk that we end up distributing filters which are not going to be used.

For more specific advice on Rajasthan (requested by Kanish Negi), please contact Dipak Roy, PO WES in UNICEF Jaipur: DRoy@unicef.org

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N. Ramachandran, Periyar PURA, Thanjavur, Tamil Nadu

We are thankful for the information given on Solution Exchange to remove Fluoride contamination. In this connection, we would like to furnish our experience in supplying pure drinking water to three villages in Thanjavur district, Tamilnadu where our institution is located.

Our institution, Periyar Maniammai College of Technology for Women, has taken up the scheme Periyar PURA inaugurated by His Excellency the President of India Dr. A.P.J. Abdul Kalam. We have adopted 65 villages near our college under Periyar PURA scheme and are working towards achieving:

- Physical connectivity
- Electronic connectivity
- Knowledge connectivity
- Economic connectivity

The drinking water that people get from the deep bore well is not potable. However, people are forced to consume it as there is no other option. Keeping this in mind, our Institute made efforts and succeeding in getting a water purification plant from Pure O Tech, a US based company. This plant was installed in Muthuveerakandian Patti of Thanjavur taluk and was dedicated to the village people by Dr. A.P.J. Abdul Kalam on 24.09.06.

This plant purifies water and brings all parameters including fluoride well within permissible limits providing people of these villages purified water.

Terry Thomas, Participatory Learning and Action Network (PLANET Kerala), Thiruvananthapuram

Referring to fluoride contamination, I am highlighting two aspects for consideration - firstly a biological option and, secondly a physical option

Phytoremediation- There are many traditional processes of using plants to improve water quality. Many plants were scientifically validated regarding the unique capability of the roots to absorb excess contaminants from soil/ aquifer and maintain water quality under control. Many indigenous plants absorb the commonly found excess nitrates, phosphates, chlorides from the soil. A combination of these plants can be used to provide a practical option/s for controlling water quality, especially in shallow homestead water ponds. Excess Fluoride can also possibly be treated using locally available plants with such properties, either naturally or through constructed phytoremediation systems. However, more inputs are needed in screening local plant species with these properties *we have not ventured into this area yet.* In the long run, it can offer environmentally sustainable options with multiple values.

Solar Distillation *(not SODIS)* units are now become compact and affordable. They can treat excess Fluoride along with other excess salts and biological contamination, producing fresh water. Solar Distillation is the only technology that addresses both biological and chemical contamination. Further information may be found at the following link: http://www.planetkerala.org/downloads/SolarDistillation.pdf

Hope this adds some value to the WES professionals.

Ajit Sheshadri, The Vigyan Vijay Foundation, New Delhi

We endorse fully the potential of plants - phytoremediation process to clean up domestic wastewater from the experiences of 2 projects in Delhi. Definitely, it would work to process raw water from sub-soil or from ponds etc. Constructed wetlands have a lot of scope. Please feel free to write in for further discussions on these aspects.

T. S. Krishnan Iyer, Development Oriented Operations, Research and Surveys, Noida

I find the suggestions of Shri Terry most valuable, as they are nature-oriented therapies. He mentions that we have not ventured in the field of identifying plants that could absorb excessive harmful substances from soil/water. Could we take steps to collect more information on this aspect? Does anyone know persons or institutions researching or initiating research on this aspect?

U. V. Sambhu Prasad, Lloyds and Lous Burgers Inc., Varani, Andhra Pradesh

I think most of you are aware of the three-tier household water filtration kit that is being promoted by UNICEF. It is like any other domestic candle water filter with an additional middle chamber having a bag of activated Alumina. This granular chemical looks like sugar (more like sooji - farina). The Fluoride level of the output water is comparable to WHO standards for consumption. However, the chemical needs to be thoroughly cleaned once every two to three months.

As far as plants are concerned, water hyacinth, though an IAS (Invasive Alien Species-IUCN) has been used in Mudiali experiment near Calcutta to absorb Arsenic and other trace metals. It involves multi channel purification. I am not certain if it works for Flouride or not. The best person to advice on this account would be Dr. Dhrubajoti Ghosh, now with CESS in Calcutta. He was instrumental in using water hyacinth for decontamination and for propagation of the same through CBOs.

S. Vishwanath, Rainwater Club, Bangalore

I wish to inform members that the government of Karnataka is trying out an alternative in a 1000 villages with the following rooftop rainwater harvesting ideas:

- Make a small tank of about 1500 litres to 2000 litres built from locally available materials and local skills. This tank collects rainwater during the rainy season.
- The tank, if used properly, can provide fluoride-free water for most of the year (and at least for 6 months) at the rate of 20 litres per family per day for drinking and cooking.
- It can also be used as a tank to store alternate water from other sources during the non rainy season.
- The whole system costs about Rs 5000 /- per unit including the pipes, the filter and the tank.
- A small sand filter has been developed to pre filter the water before storage. This consists of passing the rainwater through 3 inches of sand kept in aluminum bowl or funnel.
- SODIS is being tried along with chlorine tablets for bacterial disinfection if the Hydrogen Sulphide strip test shows bacterial contamination.

The use of harvested water has increased. However, a great deal of interaction is needed before people start using rainwater for drinking (unlike say in Rajasthan or Gujarat where rainwater from rooftops have traditionally been used for drinking).

NGO's like BIRD-K are also adopting this method along with dilution through artificial recharge to lower fluoride levels in groundwater.

For some financial assistance for these kinds of work you may look at www.arghyam.org for support

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Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for WES-Net at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-wes] Query: Removing Fluoride Contamination, from SPWD, Udaipur (Experiences) Additional Reply."