



Environment

Water & Environmental Sanitation Network  
(WES-Net India)



## Solution Exchange for WES-Net India Consolidated Reply

**Query: Options for providing quality drinking water/ from Devarao Shivaram Trust, Bangalore/ Comparative experiences**

Compiled and additional research provided by Preeti Soni, Resource Person and Moderator;  
and Ramya Gopalan, Research Associate  
25 August 2005

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Original Query: [Subhash Mehta, Devarao Shivaram Trust, Bangalore](#)  
Posted on: 16<sup>th</sup> August 2005

All human beings require a daily intake of about 2 litres per person, essential to expel the toxins accumulated with the intake of solids and or liquids, most of which now have heavy metal and other residues, higher than the minimum acceptable levels and therefore a cause of many terminal diseases. The water provided by the water management boards is treated with chemicals to make it "safe" and frequently also gets contaminated with sewage water, particularly during the monsoons.

The "solution" as seen in the last decade, has been the shift to household electric water purifiers and high cost bottled drinking water (safe but 'dead' water) affordable only by a few. Surely this is not a solution, as it does not compare with the quality found in pure mountain streams & springs. This is the quality we should be aiming for and need to replicate as it would be one of the major factors in the good health of the nation.

My query is: Does anybody have a **simple, inexpensive and sustainable solution that can be used to provide quality, chemically free and safe drinking water?** If so, what are your **experiences** and the **issues** that you are facing in getting your solution adopted?

Subhash Mehta  
Devarao Shivaram Trust  
Bangalore

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### Solution Exchange received responses from:

1. [Avani Mohan Singh](#), Haritika, New Delhi
2. Deepti Gumber, Community Led Environment Action Network - CLEAN India, Development Alternatives, New Delhi ([Response 1](#), [Response 2](#))
3. Pranab R Choudhury, Independent NRM Consultant, Bhubaneswar ([Response 1](#), [Response 2](#))
4. [S V Anil Das](#), Asian Development Bank (ADB), New Delhi
5. [Shirish Sinha](#), International Water Management Institute (IWMI), New Delhi

6. [Prabhjot Sodhi](#), National Coordinator UNDP GEF SGP, New Delhi
7. [Arnab Bhattacharjee](#), Prakritika Jalasampada Punnarudhar Abhijan, Orissa

Further contributions are welcome

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## Summary of Responses

The most basic issue in all debates related to the water sector is access to safe drinking water. This is also emphasised in the Millennium Development Goals (reduce by half the proportion of people without sustainable access to safe drinking water), and the India development goals and targets as articulated in the Tenth Five Year Plan (all villages to have sustained access to potable drinking water within the Plan period). This query therefore is very relevant in the current context. The Network members provided a range of simple, inexpensive and sustainable solutions for water purification. Many of these, however, are more relevant on a small scale. These, along with additional examples collated from a quick background research are as follows:

- **Sand filtration technique:** This is an age old process that naturally purifies water of harmful bacteria and turbidity. There are two types: **fast** and **slow**. With the slow sand filter system the slow movement of water through the soil layers creates a biological film at the top of the topmost sand layer that ensures bacterial removal and acts as a trap for different kinds of salts. The merits of the technique include: low initial cost (uses local materials and resources), design and operational simplicity (minimal pre treatment or extensive operator control and power requirements). On the other hand, the technique requires ascertaining the quality of the raw water and other pre requisites (especially for fast filters), and normally cannot be applied to water at low temperatures, with high turbidity levels and/or very low nutrient levels.
- **Use of drumsticks seeds:** The drumsticks seeds (*moringa oleifera*) act as a natural coagulant and can be used to purify water with high levels of turbidity. When dried, crushed and powdered drumstick seeds are added to water, the powder binds itself to dirt particles and bacteria (certain disease organisms). The coagulated particles sink to the bottom, leaving clear, clean water which can be poured off. The process is simple, requires minimal investment, and the seeds can be grown in backyards or supplied in inexpensive pouches. However, while drumsticks have high defluoridation capacity, there is inadequate evidence of their capacity in the case of heavy lead and arsenic content. Evidence also suggests that the large scale application of unpurified crushed seeds may result in disadvantages as the organic material could become septic, lead to the growth of microorganisms and formation of harmful disinfection-by-products after chlorination. In addition, whether water is treated with conventional coagulants or the seeds, some harmful micro-organisms will remain which must be removed either by chlorination, simple sand filters, or by boiling.
- **Use of roots of vetiver grass:** Roots of the vetiver grass (*vetiveria zizanoides*) is a traditional method used in the purification of water. Water thus filtered has a sweeter taste, which is attributed to the roots as well as the resulting decrease in its salt content. The off side however is the high ratio between quantities of vetiver grass that needs to be cultivated for a particular quantity of water requiring purification.
- **Use of alum/alumina:** A practical method for chemical defluoridation of water, is by use of alum (aluminum sulphate) and lime. Merits of this method largely include low capital and operational costs (According to estimates (WSP 2001), to de-fluoridify 20 liters of groundwater containing 5 mg of fluoride a liter costs around 6 paise), its easy usage, storage and transportation, and its effectiveness in removing fluoride from water. The technique is considered to be most tried and cost effective method for fluoride removal, but it requires second stage treatment.

A similar chemical process uses **activated alumina technique** for defluoridation. The main difference being in the form – while alum is added to water as a powder, activated alumina can be used in a solid form. As water is filtered through granular activated alumina, the fluoride is absorbed out. This makes activated alumina ideal for community water source defluoridation. However the drawbacks of activated alumina technology are the costs of installation and frequent maintenance.

- **Membrane filtration:** A low cost membrane filter technology for water purification has been developed by the National Chemical Laboratory (NCL), **Pune**. The ultra filtration (UF) membrane cleans the water of suspended particulate matter, bacteria and harmful viruses. The membrane-based separation technique is effective as it works on the principle of physical exclusion of pathogenic species. It does not require electricity and has a short start up time, thereby having immense scope in rural and disaster prone areas. The UF membrane is being commercially marketed in India as well. While its merits include portability, high water permeability, low fouling and ability to reject undesirable species in the water; its disadvantage mainly lies in limited funding and initiative.
- **Other methods:** Some of the other methods include, using the **seeds of the Nirmali tree** to clear muddy water by rubbing them on the insides of vessels; using **Tulsi (basil)** which acts as a water purifier with antibacterial and insecticidal properties; or even using **lime juice** (*Citrus aurantifolia*) maybe for a household to clear water in addition to its disincentive properties.

In addition to technological approaches, examples were provided of **water management strategies** that improved water quality, including community managed initiatives for water supply schemes and simple interventions to avoid contaminated water sources.

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## Comparative Experiences

**Sand filtration** (from [Deepti Gumber](#), *CLEAN-India, Development Alternatives, New Delhi*)

The **Jal TARA filter**, a slow sand filtration system developed by Development Alternatives, **New Delhi**, contains a biological filter merged with advanced technique of fabric protection to improve and simplify the traditional process of slow sand filtration. It consists of a gravel filter to remove turbidity, and sand bed filters to completely remove pathogenic bacteria from raw water. The filter, entailing an initial investment of Rs. 25000/- for a daily output of 3500 L, has been installed at: (a) DA field office at Avani (NGO) in **Pithoragarh district**, (b) DAV School in **NOIDA**, (c) The King College (a school) in **Jhansi**, (d) TARA gram in **Orchha**, (e) DA field office on Mehrauli-Gurgaon Road and DA Headquarters in **Delhi**, and (e) Government School in **Gwalpahari village** (with the help of Hitkari Rural Development Foundation). The problems faced by the developers in promoting the system are the attitudinal bottlenecks and initial costs. On the other hand, it has significant long term benefits and low recurring costs (requires cleaning once in two years which costs about Rs. 200/-).

**Drumstick seeds** (from [Pranab R Choudhury](#), *Independent NRM Consultant, Bhubaneswar*)

This method is common in tropical countries, especially in **India**, for example in **Jhabua (Madhya Pradesh)** and **Dahod areas (Gujarat)**, Indonesia, and in several places in **Africa** (e.g. it is being used on a commercial scale in **Malawi**).

**Alum/alumina** (based on [NER Database, WSP 2001](#))

The **Nalgonda technique** was first developed in **Nalgonda** in Andhra Pradesh, and is being used in several places in India at different scales. A number of plants at the community level working on fill

and draw system are already in operation. A large plant of 2270 m<sup>3</sup>/d capacity based on the Nalgonda technique has also been commissioned at **Kadiri (Andhra Pradesh)** working on a continuous operation system.

## Water Management Strategies

### **Community-based management** (from [Avani Mohan Singh](#), *Hartika*, New Delhi)

Haritika is involved in a community-based initiative facilitating quality drinking water supply in about 40 villages of **Nowgong block** in **Chhatarpur district** in **Madhya Pradesh**. This is under the Swajal project funded by World Bank, and with Madhya Pradesh District Poverty Initiatives Project (MPDPIP) and Water Aid India in Madhya Pradesh. A model in rural water supply is developed where water is collected from all the sources and tested in the Jal Nigam lab. Subsequently, the source identified as fit for potable water by the lab is chosen, and in the long run the communities get water treated by chlorine. In all villages, VWSC are formed and the communities are involved from planning to implementation stages and are also involved in the operation and maintenance of the water supply schemes after the NGO has withdrawn. Soak pit and compost pits have been constructed along with drainage for safe disposal of wastewater. Although this model and method is economical, it is not chemically free. Also, it may not necessarily be viable within larger and more disparate community groups.

### **Fluoride avoidance** (based on [Mishra 1998](#))

Despite their advantages, chemical defluoridation techniques are not in widespread use in fluoride-affected areas largely due to political and social bottlenecks and inadequate community education. An alternative strategy is fluoride avoidance, wherein based on experiences in the **Tamil Nadu**, where not all sources of water are fluorinated, it may be possible to avert its spread by simply closing down taps with high fluoride content or encouraging people to not use this water for drinking.

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## Related Resources

### Recommended Organizations

National Environmental Engineering Research Institute (NEERI), Nagpur

<http://www.neeri.nic.in/WT.html>

*Has been involved in developing several techniques and technologies for water purification*

Centre for Affordable Water and Sanitation Technology (CAWST) – Water treatment using Bio sand filter

<http://www.cawst.org/technology/watertreatment/filtration-biosand.php>

*It examines the working of a bio sand filter as an innovation on the traditional slow sand filter*

### Recommended Contacts

Arun, GVT, Bhopal [gvtbhopal@sify.com](mailto:gvtbhopal@sify.com) (recommended by [Prabhjot Sodhi](#) and [Arnab Bhattacharjee](#))

*For experiences in use of drumsticks for water purification in India*

Subhash Devi, Membrane Filters (India) Pvt. Ltd, Karve Nagar, Pune. (Tel: 020- 56241874 / 09822099528; Email: [membranefilters@vsnl.net](mailto:membranefilters@vsnl.net) / [subhash.devi@usa.net](mailto:subhash.devi@usa.net))

*For information on the innovative membrane filter technique*

## Recommended Websites

NER Databank. [http://databank.nedfi.com/content.php?menu=102015&page\\_id=723](http://databank.nedfi.com/content.php?menu=102015&page_id=723)

*Provides a list of CSIR technologies relevant for drinking water supply*

Lenntech. <http://www.lenntech.com/water-purification-steps-FAQ.htm>

*Provides the various water purification methods and their working*

International Organization for Bio technology and Bioengineering

<http://www.iobbnet.org/drupal/node/view/264>

*Contains an online forum for facilitating an inventory of bio coagulants/indigenous methods of purifying water in Africa*

## Recommended Documentation

Mishra, A.S. (1998), Traditional Knowledge and Management of Natural Resources **in The Cultural Dimension of Ecology**. B Saraswati (ed.) New Delhi

[http://ignca.nic.in/cd\\_07006.htm](http://ignca.nic.in/cd_07006.htm)

*This chapter examines traditional knowledge and management of natural resources*

WSP 2001. **Making drinking water safe: Two user-friendly methods to deal with the scourge of fluorosis**. *Jalvaani*. 3 (4). Water and Sanitation Programme.

*The article outlines two methods for water purification including the Nalgonda Technique*

National Drinking Water Clearing House. **Slow Sand Filtration: Tech Brief**.

[http://www.nesc.wvu.edu/ndwc/pdf/OT/TB/TB14\\_slowsand.pdf](http://www.nesc.wvu.edu/ndwc/pdf/OT/TB/TB14_slowsand.pdf)

*Outlines the advantages and disadvantages and contextual working of the slow sand filtration process*

Narong Chomchalow (2003). **The Role of Vetiver in Controlling Water Quantity and Treating Water Quality: An Overview with Special Reference to Thailand**

[http://www.vetiver.com/THN\\_vetiver\\_water.pdf](http://www.vetiver.com/THN_vetiver_water.pdf)

*This paper discusses how vetiver can control the quantity of water and treat water quality through simple methods, using low cost technology.*

## Information on drumsticks for water purification (recommended by [Pranab R Choudhury](#))

- Ratna Rajaiah (2005). **Miracle Tree** in New IndPress on Sunday dated 12th May 2005.  
<http://www.newindpress.com/sunday/sundayitems.asp?id=SEL20050512081541&eTitle=Living&rLink=0>
- Farm Radio. **A farm radio network announcement**  
[http://www.farmradio.org/english/radio-scripts/54-11script\\_en.asp](http://www.farmradio.org/english/radio-scripts/54-11script_en.asp)
- IRC. **Natural coagulants: simple method to extract protein from Moringa oleifera seeds**  
<http://www.irc.nl/page/24919>

- ***Moringa oleifera* and Water Purification**  
<http://peacecorps.mtu.edu/moringa.htm>
  - **The Drumstick Tree: A Natural Multi-Vitamin - moringa tree cheap solution to malnutrition in Africa - Brief Article**  
[http://www.findarticles.com/p/articles/mi\\_m1594/is\\_3\\_11/ai\\_62298548](http://www.findarticles.com/p/articles/mi_m1594/is_3_11/ai_62298548)
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## **Solution Exchange Responses in Full**

**[Avani Mohan Singh](#), Haritika, New Delhi**

I am the chief functionary of the organization Called Haritika. Haritika is working on safe drinking water since the last few years in Bundelkhand region of Madhya Pradesh and Uttar Pradesh. Under the Swajal project funded by World Bank and now working with MPDPIP and Water Aid India in 39 villages of Nowgong block district Chhatarpur in Madhya Pradesh, we have some experience in providing safe drinking water in about 40 villages. We formed VWSC in all the villages. The communities are involved right from the planning to implementation and doing operation and maintenance of the water supply schemes after withdrawn of our organization. we have created a model in rural water supply in about 39 villages, where we first collect water from all the sources and get tested from the Jal Nigam lab. After that we choose the source which is fit for potable according to the lab, and in the long run the communities get treated water by chlorine.

We have constructed soak pit, compost pit and CC road along with drainage so that waste water get safe disposal in our villages.

This is economical but not chemically free.

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**[Deepti Gumber](#), Community Led Environment Action Network - CLEAN India, Development Alternatives, New Delhi**

There are quite a few solutions available that provide chemical free water.g., the sand filtration technique which is an age old process of natural water purification. It purifies water of harmful bacteria and turbidity due to the presence of some salts. (Bacterial contamination and turbidity area the major problems in Indian water).There are two types of sand filtration - fast and slow.

With this in mind, Development Alternatives developed a slow sand filtration system. The slow system has the advantage of facilitating the process of filtration and making it more effective because slow movement of water through the soil layers helps create a biological film at the top of the topmost sand layer. This film ensures bacterial removal as well as acts as a trap for different kinds of salts. The Jal TARA filter (developed by Development Alternatives) is one such system with an initial investment of Rs. 25000/- for a daily output of 3500 L. It is ideal for community usage.

But there are a few problems in promoting such chemical-free systems. First of all, nobody is ready to believe that we can treat water without using chemicals. An attitudinal change is required. Secondly, it seems to be expensive initially. But then if you see the long term impacts, it's not much and also there are no recurring costs. It just requires cleaning once in two years which costs nothing

more than Rs. 200/-. We are in the process of creating awareness and making people understand all these through our CLEAN-India network.

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**Pranab R Choudhury, Independent NRM Consultant, Bhubaneswar**

Probably you may have heard of use of dried drumstick seeds as water purifier. It has been massively used in many African countries for this purpose. The process is very simple, requires minimal investment, the seeds can be grown in backyards or supplied in inexpensive pouches. It has the potential to be a sustainable solution to provide quality, chemically free and safe drinking water. And there are other benefits too - drumsticks massive contribution towards nutritional security - both production and access.

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**S V Anil Das, Asian Development Bank (ADB), New Delhi**

This is very interesting to note that dried drumsticks may be used for water purification. Can you elaborate on this a bit more with experiences and places where one could visit to witness this process?

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**Shirish Sinha, International Water Management Institute (IWMI), New Delhi**

The Jal TARA filter – has this been implemented in a project or village?

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**Pranab R Choudhury, Independent NRM Consultant, Bhubaneswar**

I am giving below some links/clues/info on drumstick seed as water purifier and the related processes. You can also run a google search to get further information or even try from the links given in these links.

### **1. The answer to clean water in a handful of seeds?**

“Filthy water cannot be washed.” — An African saying

Can you believe that the mammoth problem of providing clean, safe, drinking water to millions of Indians could lie in a handful of drumstick seeds? Water is one of India's most pressing problems — 80 percent of infectious diseases are water borne and 1.5 million pre-school children in India die every year from diarrhoea. Now, researchers at the University of Leicester in England say that drumstick seeds can help to provide safe, cheaply produced drinking water. Again, ironically, this apparently astounding discovery is a native wisdom that women in Sudan and Indonesia have been using for centuries! Except that we now know how this works. When dried, crushed and powdered drumstick seeds are added to water, the powder binds itself to dirt particles and bacteria. Soon, the coagulated particles sink to the bottom, leaving clear, clean water. Just two teaspoons of crushed seeds will clear 90 - 99.9 percent of the bacteria and all the muck in a bucket of water and one tree will provide enough clean water for a family of 5-6 for an entire year. You do the math on how much that would cost an average Indian household.

(source : Ratna Rajaiah's article "Miracle Tree' in New IndPress on Sunday dated 12th May 2005. It also highlights other potentials of Moringa .

<http://www.newindpress.com/sunday/sundayitems.asp?id=SEL20050512081541&eTitle=Living&rLink=0>

**2. A farm radio network announcement** about Use Moringa Seeds to Clean Dirty or Polluted Water [http://www.farmradio.org/english/radio-scripts/54-11script\\_en.asp](http://www.farmradio.org/english/radio-scripts/54-11script_en.asp)

### **3. Natural coagulants: simple method to extract protein from Moringa oleifera seeds**

Researchers from Sweden have developed a simple method to extract and purify coagulating proteins from Moringa oleifera seeds. The research stems from an attempt to find a low-cost locally available alternative to expensive commercial coagulants used in a water treatment plant in Asmara, Eritrea. The single step ion exchange purification process developed will allow scaling-up for large-scale water treatment applications. Moringa oleifera trees, also called horseradish or drumstick trees, are indigenous in many tropical countries.

(source : <http://www.irc.nl/page/24919>)

### **4. Moringa oleifera and Water Purification**

According to Meitzner and Price (*Amaranth to Zai Holes: Ideas for Growing Food Under Difficult Conditions*, ECHO, 1996), *Moringa oleifera* has been compared to alum in its effectiveness at removing suspended solids from turbid water, but with a major advantage. Because it can be produced locally, "using moringa rather than alum would save foreign exchange and generate farm and employment income." The potential for moringa to create a new market for a community is there, and studies and projects are taking place examining this potential.

At the Thyolo Water Treatment Works in Malawi, Africa, two researchers, Drs. Geoff Folkard and John Sutherland from the University of Leicester, England, have worked on substituting moringa seeds for alum to remove solids in water for drinking. Not only were the tests successful in removing as much solid material as alum, but the seeds used were "purchased from enthusiastic villagers in Nsanje Region in Malawi" (Folkard and Sutherland, 1996).

#### **How does it work?**

The processing of the seed is extremely simple. The mature pods can be dried naturally on the tree, or removed and then dried. The seed coats and wings are removed and the kernel is crushed into a powder, similar to making cornmeal. Next, the powder is added to a small amount of water and shaken for a few minutes, then strained into the larger container of water. It should be stirred vigorously for two minutes, then slowly for ten to fifteen minutes. It should be allowed to sit undisturbed for at least an hour so the solids attached to the powder particles can settle to the bottom. Because bacteria is attached to solids, this process removes particles and bacteria as well. It is recommended that boiling or further water treatment be done to finalize the purification process (Optima of Africa, Ltd.).

(source : <http://peacecorps.mtu.edu/moringa.htm>)

### **5. The Drumstick Tree: A Natural Multi-Vitamin - moringa tree cheap solution to malnutrition in Africa - Brief Article**

Moringa's other miraculous quality--its ability to purify water--has been used by households for centuries. But it has only recently been tested commercially. Powdered Moringa seeds, when added to murky, bacteria-laden water, act as a coagulant, binding to the bacteria and silt and falling to the bottom of the vessel. The clean water can then be poured out. Geoff Folkard at the University of Leicester in the United Kingdom tested the use of Moringa to purify water on a commercial scale in Thyolo, Malawi, and found it accomplished as much as the chemical coagulants normally used, and at a fraction of the cost.

Is Moringa now being used to treat water commercially? Not yet, says Folkard. "People are enthusiastic about the potential of Moringa, but water utilities are reluctant to change," he says. Folkard adds, however, that commercial extraction of Moringa protein is now beginning.

CONTACT: Trees for Life, (316) 945-6929, [www.treesforlife.org/drumstick/index.html](http://www.treesforlife.org/drumstick/index.html)

(Source : [http://www.findarticles.com/p/articles/mi\\_m1594/is\\_3\\_11/ai\\_62298548](http://www.findarticles.com/p/articles/mi_m1594/is_3_11/ai_62298548))

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**[Deepti Gumber](#), Community Led Environment Action Network - CLEAN India, Development Alternatives, New Delhi**

The filter has been installed and functioning at 5 places. Our field office at Avani (NGO) in Pithoragarh district, DAV School in NOIDA, Christ The King College - a school in Jhansi, three in Orchha - TARA gram (one for drinking water and two for handmade paper unit), one in our field office on Mehrauli-Gurgaon Road where our Laboratory is situated, and one in our Headquarters wherein about 100 staff members are present.

Recently it has been installed at Gwalpahari village in a Government School with the help of Hitkari Rural Development Foundation.

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**[Prabhjot Sodhi](#), National Coordinator UNDP GEF SGP, New Delhi**

Drum sticks are in use even in tribal areas of Jhabua (MP) and Dahod areas in Gujarat. People have benefited many folds. It is a common practice...contact GVT Arun ([gvtbhopal@sify.com](mailto:gvtbhopal@sify.com))....

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**[Arnab Bhattacharjee](#), Prakritika Jalasampada Punnarudhar Abhijan, Orissa**

Please find the news of low cost technology innovation – a membrane filter that ensures the quality of drinking water ([http://infochangeindia.org/WaterResourceIstory.jsp?recordno=4054&section\\_idv=17](http://infochangeindia.org/WaterResourceIstory.jsp?recordno=4054&section_idv=17)).

I have just seen the article & find it may be good low cost option for water purification. The interesting thing is that it does not require electricity energy investment and can be set up in minutes in the remotest areas.

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**Many thanks to all who contributed to this query!**

**Moderator's Note:** This query has drawn very interesting and varied responses. At the same time, it highlights the issue of 'safety' of drinking water. Our next query from Nupur Bose from A. N. College in Patna is specifically on "Arsenic levels and drinking water quality", and takes the discussion on the safety issue even further. Do take time and share your experiences and information in this regard with the Network. We look forward for your responses and active interactions.

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