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Short Communication

Defluoridation techniques implemented by the government of Karnataka, India – the current situation

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Introduction: Karnataka is an Indian state which has regions with endemic fluorosis. ***Objective:*** To assess the various defluoridation techniques and units implemented by the Government of Karnataka, along with the cost of installation, maintenance and repair, to mitigate the problem of fluorosis. ***Methods:*** Information regarding the various defluoridation units was obtained from the Panchyath Raj Engineering office before they were visited. Local authorities and residents were interviewed regarding the reasons behind the success or failure of the units. ***Results:*** Of the 100 reverse osmosis units installed, 77% are defunct, only one of the two state-of-the-art solar-based technique units is currently functioning but none of the activated alumina or Nalgonda technique units. ***Conclusion:*** Defluoridation units suitable for Indian conditions and operation by unskilled villagers have yet to be developed.

Key words: *fluoridation, dental fluorosis, water, India*

Introduction

For some decades a major concern in India has been and remains the supply of safe drinking water. By early 2004, the rural drinking water supply program in India was estimated to have 3.7 million hand pumps dependent on groundwater. While this has lowered the incidence of water borne diseases, it has led to the emergence of other problems such as depletion of drinking water sources due to excessive withdrawal by irrigation wells and contamination by, for example, fluorides and arsenic (Daw, 2004). The principal source of these fluoride contaminants being the soil (Feenstra *et al*., 2007; Murray *et al*., 1976)

Fluoride has a significant mitigating effect against dental caries if the concentration is approximately 1 mg/l (Feenstra *et al*., 2007).. However, continual consumption of higher concentrations can cause dental fluorosis and, in extreme cases, skeletal fluorosis. The guideline for fluoride in drinking water is 1.5 mg/l (World Health Organization, 2011). High fluoride concentrations are especially critical in developing countries, largely because of lack of suitable infrastructure for treatment (Feenstra *et al.*, 2007).

As many as 20 Indian states, including Karnataka, have regions with endemic fluorosis and up to 66.2 million people are at risk of fluorosis in some form (Government of Karnataka (GoK), 2006). In Karnataka State, 14 districts are facing the problem of high fluoride levels in ground water. Local officials report 10-67% of the people residing in these places being affected in some way by fluorosis caused by groundwater fluoride levels of 2.5-8 ppm (GoK, 2006).

The GoK has urban and rural water supply boards which have over the years adopted and implemented various defluoridation techniques to mitigate the problem of high fluoride groundwater levels. This study assesses the costs and failure rates of these defluoridation units

Methods

Prior permission for the study was sought from the Director of Rural Water Supply and Sewage Board, GoK. Locations with high fluoride groundwater levels were first ascertained then the chief executive officers of the local administrative bodies (Zilla Panchayaths) were contacted. Under their guidance, visits were paid to all the defluoridation units installed by the GoK in their districts.

During the visit, a structured questionnaire was used to gather data from the general population (aged 9 years to 65 years) of the area and local administrators to ascertain the causes for success or failure of the defluoridation techniques and units. Data regarding the number of units, their techniques and the expenditure incurred in their installation and maintenance were collected from Panchayath Raj Engineering Department in the state capital Bengaluru.

A non-governmental organisation in India, Bharatiya Agro Industries Foundation (BAIF), implemented a project to mitigate the problem of fluorosis in the Gadag, Kolar, and Tumkur districts in Karnataka State. This was the first private sector partnership that the GoK had ventured into to mitigate the high fluoride groundwater problem. The officer-in-charge of the project at the regional head office of the organisation was contacted

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and permission was sought to visit their project areas for assessment. The GoK has also recently aided a private company, Waterlife India, to provide drinking water to the residents of Gulbarga, Raichur, Bellary and Koppal: all districts known to have high groundwater levels of fluoride. The data regarding these initiatives was obtained from their technical head.

Results

GoK initiatives had implemented various defluoridation techniques across 11 districts and 128 villages: 100 reverse osmosis, 25 activated alumina, two Nalgonda technique and 2 solar technique units. The present status (June to August, 2011) of these units is given in Table 1 together with the cost of their installation, maintenance and repair. The communities contribute 10% of the total installation cost of a defluoridation unit.

BAIF is carrying out rainwater harvesting, bore-well recharge and farm pond construction projects in three districts, aided by GoK, worth 2,607,874 US$ (converted to US$ at the rate 55 Rs/$). Currently 3,000 houses and some schools are covered in each district under their rain water harvesting project (GoK, 2006). Bore-well recharge and farm pond construction are carried out to increase the groundwater table**.** In the case of rain water harvesting unit installation, the below-poverty line families (income <6.7 US$/head/month) contribute by making themselves available for labour in constructing the unit, while the other families contribute 25% of the installation cost.

Waterlife India has recently installed, operated and maintained 25 activated alumina units and 60 reverse osmosis units across four districts.

Discussion

Only 23% of the reverse osmosis units installed are currently functioning. Most of these units failed within a month of installation. One of the two state-of-the-art solar-based technique units and none of the activated alumina or Nalgonda technique units was working. The reasons for failure of the units were: maintenance funding for the units not being sanctioned by the GoK; irregular power supply and lengthy power cuts; and immense waste of water due to defluoridation techniques in areas of water shortage as just 25% of uploaded water emerges fluoride free. The GoK usually appointed unskilled villagers rather than a qualified person to operate and maintain these units. The GoK should consider the reasons for failure of defluoridation units and consider funding to better use existing units and rethink plans before implementing further initiatives. The development of units suitable for Indian conditions and operable by unskilled villagers is needed. Also, to mitigate the problems discussed here, there may be benefits from public health professionals agreeing and suggesting appropriate measures to the GoK.

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Table 1. Numbers of installed, functioning and defunct units with their costs of installation, maintenance and repair for each type of defluoridation unit: reverse osmosis, activated alumina, Nalgonda technique, solar technique

Type of unit	*Reverse osmosis*	*Activated alumina*	*Nalgonda technique*	*Solar technique*
Number of units	100	25	2	2
Installation cost per unit in US$	14,550 to 18,180	3,637 to 5,454	72,727	9,090 to 10,909
Number of functioning units (%)	23 (23%)	0 (0%)	0 (0%)	1 (50%)
Estimated annual maintenance cost per unit in US$	2,652	2,895	Not estimated	Not estimated
Number of defunct units (%)	77 (77%)	25 (100%)	2 (100%)	1 (50%)
Estimated repair cost per unit for defunct units in US$	4,594	1,898	Not estimated	Not estimated