FLUOROSIS CONTROL IN THE RURAL DRINKING WATER SUPPLY AND SANITATION PROJECT, KARNATAKA, INDIA

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SUMMARY: The Danida assisted Rural Drinking Water Supply and Sanitation Project, Karnataka, India, faces a fluoride problem in some of its areas. 8-53 % of the water sources are estimated to have fluoride content between 1.5 and 3 mg/L. 2-5 % of the sources contain over 3 mg F/L. The project objectives fit well within the Government of India's overall aim to ensure a minimum of 40 litres per capita per day safe water to its rural population. The project classifies its areas in 4 categories: Non-problematic, Moderately fluoride affected, Fluoride affected and Severely fluoride affected. Different levels of interventions are adopted for each category.
Keywords: Fluorosis; India; Danida project; Defluoridation strategies.

INTRODUCTION

The Rural Drinking Water Supply and Sanitation (RDWSS) Project is a DANIDA-assisted project aiming at improved and sustainable drinking water supply and sanitation in three districts of Karnataka India. The project has faced the fluoride problem, which occurs in some of its areas. This paper highlights some of the project's early findings and proposed problem solutions.

THE PROJECT

The RDWSSP is a DANIDA-assisted project aiming at improved and sustainable drinking water supply and sanitation in three districts of Karnataka, India. Among other things, the project envisages the promotion of a decentralised, demand-driven and participatory approach in project planning and implementation. This approach, though being largely focused on Village Councils (Gram Panchayats) as being the lowest, most appropriate level, will involve a wide range of both 'hard' and 'software' activities at other levels, i.e., village, district (taluk), and also state level. In addition to the state-level, departments and the respective district, taluk and gram-level Panchayat Raj Institutions (PRIs), the project organisation includes a Project Advisory Group (PAG) located in Bangalore, and one District Co-ordination Unit (DCU) in each the districts of Kolar, Chitradurga and Bijapur. These units, in addition to providing general advice and assistance in the project implementation, are considered to have an important responsibility in overall action research (R&D).

Based on the experiences of an earlier DANIDA-supported Integrated Rural Sanitation and Water Supply Project (1990-1996), and following the findings of preliminary 'quick' water quality surveys and studies in the project areas, the project partners identified the "development and testing of appropriate solutions to excessive fluoride contents in the groundwater" as one of the four critical, immediate objectives of the project.

NATIONAL FLUOROSIS STRATEGY

During 1986, the Government of India (GOI) introduced the "Technology Mission on Safe Drinking Water" (changed to "Rajiv Gandhi National Drinking Water Mission" in the early 1990s) for providing 'potable' water to the people of rural India. As part

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of this initiative, and to address the specific water quality problems in a focused manner, the Mission identified a number of sub-missions of which the Sub-mission on the "Control of Fluorosis" was one. The Sub-mission's activities started in 1987, with the aim to achieve the following, important objectives:

- to update and create awareness on the relation between fluoride and fluorosis;
- to facilitate/conduct health and water quality surveys in the affected areas; and
- to introduce ameliorative and preventive measures for prevention and control of fluorosis.

Ultimate goal of the activities has been; (i) to provide safe water (i.e., with fluoride levels not exceeding 1.5 mg /L); and (ii) to control and prevent fluorosis in endemic areas.

The above objectives/goals fit well within the GOI's overall aim to ensure adequate access for the rural population to a minimum supply of 40 liters per capita per day (lpcd) of safe water.

PAST PROJECT EXPERIENCES

In the course of an earlier DANIDA-supported Integrated Rural Sanitation and Water Supply (IRS&WS) Project, which was implemented by the Government of Karnataka (GOK) between 1990 and 1996, considerable experience was gained with both the identification and addressing of fluoride problems in rural areas. In line with existing government guidelines the 'normal' approach in this earlier project was to establish new, if necessary distant, sources in those areas where no existing 'safe' sources could be identified (i.e., with F<1.5 mg /L).

Being faced with a situation in which even distant sources could often not be found, the project, towards the end of its implementation, embarked on a number of R&D activities which included several field-level orientation awareness camps. Moreover a detailed study related to the demand for, and the introduction and general utilization of, domestic defluoridation units based on the Nalgonda technique in rural households.[2] In addition, the project supported the installation of one community defluoridation plant, based on activated alumina filtration, in one of the habitations, while the local government sanctioned three similar plants in other villages.

A wide range of specific issues and problems related to local capacity and capabilities were encountered, e.g., to carry out water quality testing, to secure continued high quality manufacture, supply and distribution of spares, tools and chemicals, and to ensure proper, local-based management of the community plants. In addition an important finding was that the success of defluoridation and/or of any other fluoride/fluorosis control measure largely depends on the people's, often individual, knowledge, perceptions and beliefs with regard to fluorosis. Hence, one of the major conclusions was that increased efforts would be required to carry out large-scale awareness creation campaigns throughout the rural areas.

With regard to household and community defluoridation, the findings of the IRS&WS Project generally supported the prevailing view that:

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[2] A report on the Experiences with Household Defluoridation in Peddur and Kondamvarripalli Villages in Bagepalli Taluk, Kolar District, Carel P.M. de Groot and B.H. Vasudev

- household defluoridation may be considered an option for those households which occupants are, first of all, convinced that the practice will protect themselves and their families, and who, at the same time, can afford to buy, operate and maintain the (available) units; and
- community plants, or, for that matter any other O&M-intensive solution, should not be considered unless there adequate, reliable and sustainable arrangements are in place for the overall management of such systems.

FLUORIDE OCCURENCE

Based on the findings of water quality studies carried out during the IRS&WS Project (1990-1996) as well as the current RDWSS Project (1996-1997), excessive fluoride levels (i.e., F>1.5 mg /L) in the groundwater is anticipated to prevail in several parts of the project areas, in particular in the two Districts of Kolar and Chitradurga. At the same time, it has been noted that the fluoride levels in these effected sources are moderately high, and do not generally exceed 3.0-3.5 mg /L.

TABLE 1. Percentage of water sources with different fluoride contents in the stated districts and percentage of villages with cases of fluorosis.

District	Taluk (samples)	% of Sources having conc. in mg/L			Villages with Fluorosis cases
		<1.5 mg /L	1.5-3.0 mg/L	>3.0 mg /L	
Kolar	Bangarpet (257)	85	15	0	15
	Gudibanda (58)	81	19	0	35
Chitradurga	Hiriyur (173)	45	53	2	28
	Hosadurga (209)	73	22	5	22
Bijapur	Bagalkot (100)	63	32	5	20
	Jamakhandi (73)	89	8	3	0

Table 1 presents the findings of 'quick' surveys in only six of the total 31 taluks in the project area. It can be seen that the total number of sources affected with fluoride ranges from about 11% (Jamakhandi) to 57% (Hiriyur). On the other hand, only 2-5% of the total number of sources have fluoride levels exceeding 3 mg /L.

CONTROL STRATEGY

In order to allow the project to address the fluoride-related problems in a focused, cost-effective, appropriate and operational manner, it has been proposed to develop and introduce a strategy, based on the following, guiding principles[3]:

the project will carry out intensive and extensive fluorosis control programmes in Gram Panchayat where sources contain fluoride (>1.5 mg /L), and where it is not feasible to supply the area/habitations from nearby sources. This programme should include awareness campaigns, training and orientation of Gram Panchayat officials, and promotion of household defluoridation;

in villages/areas where the fluoride content exceeds 3.0 mg /L without feasible distant sources, the project will, in collaboration with the engineering sections and with possible assistance from other experts in the field, assess the solution(s) to be adopted on a case-by-case basis; and where water quality problems (fluoride, hardness,

[3] this being a discussion paper, it is important to note here that both the 'guiding principles', as well as the ensuing strategy, are still under study, and that they are yet to be approved and endorsed by the project authorities in Karnataka.

salinity, nitrate, etc.) constitute a major impediment in ensuring a full (40-55 lpcd) supply of safe drinking water, including water for cooking, to the population, the project may - in close association with the Gram Panchayats and subject to extensive awareness creation programmes among the villagers - consider, plan and implement water supply works based on the principle of "dual supply", i.e., providing for at least 10 lpcd of safe drinking water, while allowing other (point) sources, not necessarily potable, to be used for other purposes such as washing, bathing, etc.

While recognising that adoption of the above principles would imply a compromise of the existing standards, as currently specified by the Government of India, it is assumed that they will enable the project to develop a strategy, as suggested in the sections below, which will be both implementable, as well as realistic in terms of funding requirements, technical feasibility, and sustainability. More specifically, it is assumed that the guiding principles will enable the project to:

- rank the problem areas in relation to (a) the extent/geographical distribution, and (b) the level/concentration, of the fluoride problem;
- prioritise its focus and activities on those areas with the most serious problems first (i.e., where fluoride exceeds 3.0 mg /L), while, on the other hand, leaving
- ample mandate and opportunity to carry out intensive fluorosis awareness campaigns and promotion of household defluoridation in the remaining fluoride-effected areas; and
- identify and promote appropriate, technically feasible, affordable, and sustainable solutions to ensure adequate and reliable water supply to the rural population (both for drinking as well as for other purposes), rather than being 'forced into' adopting technically sophisticated, high-cost, and O&M-intensive solutions which, under the prevailing rural conditions, tend to be non-sustainable any way.

TABLE 2 Defined classification of the project areas.

I Non-problematic
Yield and water quality data indicate that the project will be able to ensure a minimum of 40 lpcd of safe drinking water through rehabilitation and/or augmentation of the existing system/technology. Any other sources, though not necessarily potable, can be used for other purposes.
II Moderately fluoride effected
The data indicate that the project will be able to ensure 10 lpcd of safe drinking water through rehabilitation and/or augmentation of the existing system. Any other sources, though not necessarily potable, will make up for the balance of 30 lpcd, and can be used for other purposes.
III Fluoride affected
The data indicate that fluoride levels in the area are generally in the range of 1-5- 3.0 mg/L, that it will not be possible to ensure a minimum of 10 lpcd of safe drinking water through the mere rehabilitation and/or augmentation of the existing system.
IV Severely fluoride effected
The data indicate that most of the sources in the area have fluoride levels exceeding 3.0 mg/L, and thus, that it will not be possible to ensure 10 lpcd of safe drinking water through the mere rehabilitation and/or augmentation of the existing system.

Table 3 Area type and corresponding interventions

Area Classification Preferred Intervention/Solution	Alternative Intervention/Solution[1)]
I Non-problematic	
• Rehabilitation of existing supply; • Information to users about which sources are fit for drinking and which , if any, are not is the only action required.	Alternative inventions not applicable; the preferred solution is assumed to be feasible.
II Moderately fluoride effected	
• Rehabilitation of existing supply is envisaged to ensure a minimum supply of 10 lpcd safe water; • Physical identification of safe sources and those to be used for other purposes. • Intensive and extensive campaigns at both habitation and Gram Panchayat level to create and sustain awareness about the water quality problems and to promote proper protection, use and maintenance of safe sources for drinking.	Alternative inventions not applicable; the preferred solution is assumed to be feasible.
III Fluoride affected	
• Upgrading of the existing technology • Identification and establishment of an alternative, (more) distant source to ensure a minimum of 40 lpcd safe drinking water. • Information to users about which sources are fit for drinking and which, if any, are not, is the only action required.	In case the preferred option does not appear to be feasible, the following combination of actions will be required: Rehabilitate/augment the existing technology utilising the "most potable" sources. Identify and provide adequate protection measures for all safe sources (even though the combined capacity may be less than 10 lpcd) Intensive and extensive campaigns at both habitation and GP level to create and sustain awareness about the water quality problems and promote proper protection, use and maintenance of the (scarcely available) safe sources for drinking. Promote household defluoridation, a/o through the training/orientation of key motivators/staff in the GP and through the support of local manufacturing, supply, distribution, and maintenance systems.
IV Severely fluoride affected	
• Upgrading of the existing technology. • Identification and establishment of an alternative, (more) distant source to ensure a minimum of 40 lpcd safe drinking water. • Information to users about which sources are fit for drinking and which , if any, are not is the only action required.	In case the preferred option does not appear to be feasible, other options will have to be considered on a **case-by-case basis.** Such intervention, which could include surface water intakes, regional schemes, community defluoridation, distribution and maintenance (i.e., active promotion) of Household Defluoridation, will have to be identified and implemented in close association with the relevant government departments and line agencies.

[1)] to be considered only if/when the preferred option is not (or, does not turn out to be) feasible

AREA CLASSIFICATION

Based on the project's past experiences, and taking into consideration both the existing GOI/RGNDWM guidelines, it is proposed to base the identification and classification of fluoride-effected areas on the following important parameters/factors:

- the quality of sources
- the (combined) capacity of the sources
- the distance of sources from the habitation
- the type of water supply scheme envisaged and
- the intended and/or potential use of the sources.

Bearing in mind the above parameters, and taking a habitation as the basis for the area assessment and classification, the categories are suggested as shown in Table 2.

PROPOSED INTERVENTIONS

Based on the above classification, and taking into account the financial and organisational and institutional constraints faced in the field, both within the project organisation as well as among the implementing agencies, the project would subsequently be able to identify different sets of solutions/interventions for different problem areas. As further elaborated upon in Table 3, the interventions could be further sub-divided into the following two groups, i.e.:

- preferred solutions/interventions, which, in all cases, would imply the identification and establishment of alternative, if necessary distant, sources to ensure an adequate supply of 'safe' drinking; and
- alternative solutions for those case where no alternative 'safe' sources can be identified; depending on the extent and seriousness of the problem, such solutions could range from carrying out basic fluorosis awareness campaigns, to adopting technological solutions such as defluoridation, (semi-)regional schemes, surface water intakes with treatment, etc..