Demand Responsive Fluorosis Prevention in a village in Thailand

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ABSTRACT: A village, Ban Sankayom, in Northern Thailand is surveyed with respect to fluoride in water sources and the use of water. About 40 % of the village wells contain high fluoride concentrations, between 1.5 and 10.3 mg/L. The village has intermittently supplied pipe water from three deep wells, two of which have high fluoride contents. The villagers also use seasonal rainwater and bottled water, both of low fluoride concentration.
Through local initiatives quit few household defluoridators and two larger defluoridators at school and temple are being in operation. The defluoridators are based on locally prepared bone char. However, the awareness of the fluoride problem among beneficiaries was found to be very low.
It is discussed how an informed choice between various low-fluoride options might result in a broader range of solutions in the village, which would all support the effort to bring down fluorosis. It is also discussed how defluoridation projects can learn from core elements in the World Bank introduced Demand Responsive Approach, DRA.

Key words: Demand responsive approach, DRA, fluoride, fluorosis, ownership, water supply projects, Thailand, defluoridation, alternative sources, project management.

INTRODUCTION

High fluoride concentrations in water are found in some areas of the world, giving rise to endemic fluorosis of different severities[1]. Even within such areas two water sources, close to each other, may have quite different fluoride concentrations, depending on the geology of the site. Within a single village some ground water sources may have too high fluoride concentrations while others have low concentrations. Still other low fluoride water sources (dug wells, rainwater, bottled water) may be available in an endemic area, giving a range of choices for fluorosis prevention.

Provision of a functioning water supply is the responsibility of the water authorities, often organised region or county-wise. When fluoride is recognised as an endemic problem in a village or town, the water authorities are therefore expected to provide a solution, being the experts of water provision. Practical experiences are few outside India and probably China. Practical defluoridation experiences have shown that whenever defluoridation is introduced in a village, only one technique is implemented and most often in one design [2,3]. This leaves the citizens with only the choice of

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saying yes or no. Responsibilities for maintenance of the defluoridation system – and small water supply systems, in general in the 90's - are most often given to the villagers.

This is far from the leading paradigm in water service delivery to villages the third world: Demand Responsive Approach, DRA. The background for DRA is plenty of failures. Formerly water service delivery was supply driven; the water authorities, often with help from the international aid organisations, decided which villages should be supplied and designed and implemented the "appropriate" system. The result was water supply systems that were not properly maintained and was abandoned after the first breakdown. An important reason was the lack of ownership with the villagers. This is also the case of most of the defluoridation plants implemented in India [3].

DRA is not a well-defined approach, but it may be shaped by the following characteristics[4,5]:

Demand driven. Communities have to come forward and apply for the service. The project or authority informs broadly about the rules for eligibility.

Informed choice. An overview of the water quality/quantity situation is provided to those communities to apply for help. A range of technologies and service levels is presented to each community together with clear information about their costs and continuing financial or management implications for the community. The community selects a technology based on the amount it is willing and able to pay.

Cost-sharing for implementation/construction. The community should pay part of the capital costs. Contribution can be symbolic compared to total costs if the population is poor.

Local management and self-payment of maintenance. A local organisation manages the water supply system and collects fees for maintenance from the users.

Government is the facilitator through policy making and creation of an enabling environment for e.g. private providers of goods and services.

These measures intend to create ownership and community development through the active participation of all stakeholders in the society in all phases of the project. There is no reason why fluorosis prevention projects with defluoridation could not learn from these experiences.

In this paper, we have examined a fluoride-affected village in Northern Thailand. We will use this as an example for a discussion of how the DRA can be used in fluorosis prevention projects.

METHODS

Sampling and analysis. Fluoride content was measured in water from dug wells, distributed groundwater and effluent from defluoridators. Fluoride analyses of the samples were made using a fluoride electrode and pH-meter Orion, model 720A with auto-calibration, and standard 5.00 mgF/L, containing TISAB, 10 % by volume. Methodology for preparation and analyses of the samples were made according to Standard Methods [7].

Water use survey. The water sources and water use were surveyed. The survey sampled randomly 32 % of the households (39 % of the inhabitants) by individual, closed, quantitative interviews. The interviews were conducted on a single day, sampling all areas of the village. There has not been any kind of pre-selection concerning the interviewees.

Water prices. Prices for bottled water was collected at different grocers in the village; piped water prices were informed by the Water Supply Committee; the defluoridated water was estimated with the help of Mr. Lai, the producer of the school defluoridator. Prices for rainwater harvesting tanks and spare parts were also found locally.

RESULTS

Village of study. Ban Sankayom is village located 28 km South of Chiang Mai city, Northern Thailand. It has a population of 1,043 people, 325 households. There is a primary and junior high school in the village. The Community Administration Committee is responsible for the village administration. Besides, the chief of the village plays an important role in the community's affairs. Other committees are Treasury, Public Health, Social Welfare, Water Supply, and Culture Committees. The village economic status spans from high middle-class to poor.

The village uses many sources of drinking water for daily consumption: virtually one dug well for every household, rainwater, bottled water and two deep wells are in use – one at the school and one for the water distribution system in the village. Dug wells are sometimes supplied with a small pump that delivers pressurised water for the house. The distribution system serves a large area of the village, and is available for people who have bought a house connection.

Bone char defluoridators have been introduced in a few public places and in some households the last couple of years. Bone char and defluoridators are produced in the village by a local water consultant, Mr. Lai. The Intercountry Centre for Oral Health, ICOH, has supported the bone char production and investigated the fluorosis situation in the village [6].

Fluoride mapping. Fluoride measurements from the year of 1999 were used to build a fluoride map, see Figure 1.

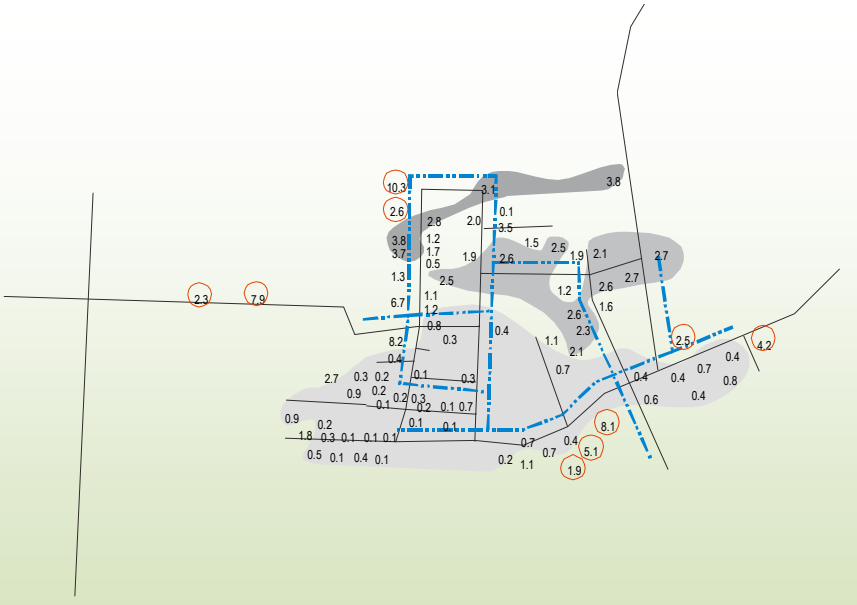

FIGURE 1: Distribution of fluoride concentrations in mg/L in dug wells in Ban Sankayom. Dotted line is piped water distribution system. Shaded areas has uniform fluoride concentrations, while isolated high concentrations are encircled.

Village sources. Fluoride analyses show concentrations between 0.1 and 10.3 mg/L (85 samples, covering all areas of Ban Sankayom). This picture confirms previous data from 1995[6], when concentrations in the village ranged from 0.1 to 13.0 mg/L (71 samples). Fluoride zones have been shaded as 0-1, 1-2 (all but marked), and 2-3 mg F/L. Isolated concentrations are encircled.

Two boreholes are present in the village. One is connected to a distribution system, Figure 1, and had a fluoride content of 0.8 mg/L. This water is only supplied 1-2 hours in the morning and in the rainy season additionally 1-2 hours in the evening. The other borehole is at the school and had a fluoride content of 6.7 mg/L.

Defluoridators. Seven household defluoridators have been sold to and installed in private homes and 4 public defluoridators are installed in the village. The largest bone char defluoridator is installed at the school and another one at the temple, treating ground water from the same borehole. The school defluoridator was funded by a private organisation. The influent and effluent fluoride concentrations have been monitored since the start of operations, see figure 2. After approximately 200 days, fluoride levels had reached 1.5 mg/L of fluoride. At the end of the first year, the defluoridator had its medium changed, as to start a new operation cycle.

Usage of water sources. Table 1 summarises some of the findings of the water sources survey. The use of the sources depends on season, household income, taste preferences, and individual health consciousness. It can be seen that dug wells are

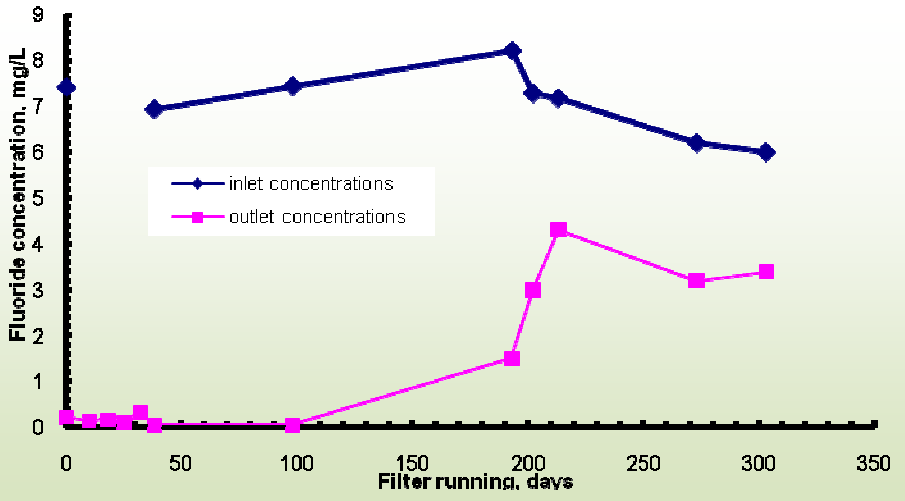

FIGURE 2: Fluoride concentration in influent and effluent of the school defluoridator in Ban Sankayom.

found and used in most of the dwellings and rainwater is used by more than half of the population. Nevertheless, all sources are well distributed in the village. In spite of the relatively high use fraction of bottled water, it is mostly used at special occasions, as for guests and sick people.

Water price. The prices for the different sources of water in Ban Sankayom in 1999 are presented in Table 2.

Awareness. 104 people were interviewed, corresponding to 8 % of the village population. Single interviews were performed with 14 mothers. Group interviews were performed with 3 groups of members of committees, 5 groups of teenagers and a group of health volunteers. They were asked open questions like; What are the problems in this village? What are the main events in the village in recent years?

The result of the interviews was that, for most of the interviewees, fluoride has not a high priority and the awareness towards the problem is low. Problems like drugs, AIDS, and flooding receives much more attention. Some however mention fluoride as a serious problem, among those, influential people in the village committees. When asked directly about the fluoride problem, people told that it was a problem.

TABLE 1: Water sources and its usage distribution in Ban Sankayom. The number of households consuming the sources surpasses 100%, since the households use more than one source of water.

Source consumption	Rainwater	Piped water	Dug well water	Bottled water
Households consuming the source	60.4%	63.4%	87.1%	56.4%
Households drinking the source	52.5%	27.7%	5.9%	55.4%

TABLE 2: Estimation of capital and operation costs of relevant water sources. 1 USD ≈ 45 Baht.

Costs	Defluoridator + Dug well	Rain Water	Piped Water	Bottled Water
Capital, Baht	1,400 – 2,500	900 – 1,200	470 – 620	0.004
Running, Baht/L	0.04	0	-	0.32

DISCUSSION

Ban Sankayom has a variety of drinking water supply systems. Some contain fluoride at high concentrations and some at low. 40 % of the dug wells contain fluoride at higher concentrations than 1.5 mg/L. Until now the presented solution to the fluoride problem has been defluoridators produced by an active retired villager.

Compared to other fluoride-affected villages in the world, it is positive to see private initiative in the community combating the fluorosis problem. It is actually the opposite situation of most places, where outsiders (authorities, projects) implement a project, and often fail to get local participation [2]. Here are no authorities involved, only some professional support from ICOH and a single grant specifically for the purchase of the school defluoridator. The private initiative in fluorosis prevention in Thailand has been reported before [8].

There are however, some problems related to the fluoride problems and its solution:

Based on the overview of the drinking water habits, the problem seems actually related to a small number of households in the village. Only 5.9 % of the population say they drink well water. As only 40 % of the village wells have fluoride concentrations higher than 1.5 mg/L, only about 2.4 % of the population seem to have the fluoride problem at home. All other sources are low in fluoride (except for the school borehole, but this is now defluoridated).

- The villagers seem not to know who among them have the fluoride problems.

- People have in general a lack of knowledge or interest in knowing and solving the problem. The current defluoridation activities have presumably raised the awareness with some villagers because the treatment units are visible and people seem satisfied with them. Awareness creation has however not been disseminated in any structured way and the result is therefore low awareness.

- The current system of maintenance of the defluoridators is very dependent on one single man who produces the bone char and the defluoridators.

- The solution to the fluoride problem – the household defluoridator – is estimated to be too expensive for the poor part of the population.

- What could an approach based on DRA have done? First of all, a DRA needs an agency to implement the approach. This should ideally be the water authority, which is often responsible for ensuring an uncontaminated source of water. In principle, external funding is not necessary, as is the case of Sri Lanka 9.

- Through information about the potential problem of fluorosis in the village and the possibilities to get some support, the village as such would initially have committed itself to look closer at the problem. It is the impression that the village has engaged leaders and activists that would commit themselves if they had the possibility.

- An overview of the fluoride situation would be presented to the villagers. Together with some general information about fluorosis and its prevention, and which water sources are fluoride free, it would demystify the problem and every household would know its own risk.

- A range of possibilities to solve the problem would be presented, first, those who had the fluoride problem (single households and the school and temple). Solutions will include the alternative low-fluoride sources, like rainwater, distributed water and bottled water, as well as various defluoridation solutions. Other parameters like faecal contamination would however have to be investigated for some of the alternative sources. From the range of solutions, they would choose the one they prefer and that is the most appropriate solution for them. In the comparison in Table 2 it is obvious that the defluoridation solution is quite expensive compared to other solutions (but other defluoridation solutions could also be included) and some people would presumably prefer some of the other solutions. By actively selecting ones own device, the interest in maintaining it is assumed to be higher.

- In this case payment of full capital costs would presumably be affordable for all households, especially for the cheaper solutions. Own payment also supports the sense of ownership and interest in performing maintenance. In poorer communities (e.g. in Africa or India) subsidy to capital costs would often be necessary to involve the poorest groups.

- The solutions to provide low-fluoride water would be managed locally and people would cover full payment of maintenance. For community defluoridators, a local institution should usually be in charge (it could be private), while service to household defluoridation may be done by the private providers. This is basically the same situation as today.

- The government could, with the help of e.g. NGO's and fluoride research institutions facilitate the creation of private providers to supply various solutions for especially a selection of defluoridation devices. Since the fluoride problem is

often scattered, defluoridator producers should be able to sell their products more widely. This is for the benefit of the consumers that would have a broader selection of methods to choose from.

CONCLUSION

It has been discussed how central elements in the World Bank introduced Demand Responsive Approach could be applied to defluoridation projects. This approach is designed to ensure feeling of ownership that is often lacking in defluoridation projects. The idea has been discussed using the case of Ban Sankayom as an example, and suggests that, due to personal perspectives, sustainability can be enhanced if DRA projects offer multiple technical solutions for the same community.

ACKNOWLEDGEMENTS

The authors would like to express our gratitude to villagers and informants in Ban Sankayom, especially Mr. Lai, for good collaboration during collection of information. We also thank the staff of ICOH who hosted this investigation in autumn 1999. The authors acknowledge the sponsorship from DUCED-I & UA for support of the travel expenses to Thailand.

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