Final Report

"FLUOROSIS MITIGATION IN THE SELECTED VILLAGES OF SONBHADRA DISTRICT, UTTAR PRADESH"

Study Period: September 2020 to November 2022

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People for Progress in India (PPI)

By

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Executive summary

Banwasi Seva Ashram (BSA) proposed a three-year project for establishing a model for fluorosis mitigation in four villages to PPI. This was modified to a two-year project based on the grant offered by PPI.

The study was undertaken in the two villages of **Kusmaha and Govindpur** that are located close to BSA and is endemic area for fluorosis with the technical support of People's Science Institute, Dehra Dun. initially, a health survey of the residents of the village was undertaken. A total of 1793 people were surveyed, and it was found that 176 and 26 residents of Kusmaha and Govindpur suffered from serious dental fluorosis respectively, and 32 and 9 residents of Kusmaha and Govindpur suffered from serious skeletal fluorosis, respectively.

Sources of water in the two villages were sampled and tested for fluoride. Fluoride concentration was found to vary between 0.6-7.26 mg/L in Kushmaha and between 0.8-6.76 mg/L in Govindpur. The dependency of each household on each source of water and the concentration of fluoride in the source was also mapped out.

Community meetings were carried out, and the residents of the villages were told the risks of fluoride. Charts were prepared that showed the water monitoring data and these were posted at the Panchayat house.

100 individuals were selected on the basis of the health survey, urinary fluoride concentration and the concentration of fluoride in their primary source of drinking water. Interventions were done with 94 residents, and 6 were control. Blood tests of these residents were carried out to check the levels of red blood cells haemoglobin, ESR, uric acid and serum calcium. On the basis of these results, nutritional and medical intervention was begun.

Urinary fluoride was tested and it was found that urinary fluoride levels increased with fluoride in drinking water.

A comparative study of Watson de-fluoridation kit and activated alumina kit was carried out. It was found that both were effective at removing fluoride from drinking water. Watson kits were installed in 74 homes as it was found that they were easier to maintain since they did not require to be recharged within three months an in addition they remove germs and heavy metal toxicity in source water along with white kit for the removal of excess fluoride in source water.

In addition to providing de-fluoridated water, the individuals were supported to make a *Poshan vatika*, wherein they were encouraged to grow green leafy vegetables for self-consumption in a small patch of land for which they were provided seeds. In addition, they were given nutritional supplements such as *till methi Mahuwa laddoo* and medical supplements.

Regular monitoring of the de-fluoridated water from the kits as well as the installed solar de-fluoridation kit was carried out. Teams of volunteers in both the villages were formed who were taught to monitor fluoride. Seasonal monitoring of all the public sources of water for fluoride was carried out.

In the second year there were regular *tola* meetings in which short documentaries, charts and sharing by the individuals using de-fluoridated water were helpful in spreading awareness among the other residents of the village. In these meetings, severity of fluorosis in the village and neighbouring villages was discussed, and strategies to deal with fluorosis were explored.

Monitoring of the effect of the interventions was done by measuring the urinary fluoride levels. The respondents were also surveyed to assess if they felt there had been any change due to these interventions, in their pain, symptoms, and if they felt the interventions were useful.

X-rays of selected individuals were taken. Of the 8 individuals who had x-rays taken at the end of the both years, it was found that 5 of them showed improvement in their bone health.

Meetings were carried out with the Village Health and Sanitation Committees regarding the issue of fluorosis. Advocacy with district and state level authorities was carried out.

The project commenced in September 2020, and was hampered due to the successive waves of Covid. Community interactions and awareness building could not be carried out as planned due to restrictions on public meetings, and the Arogya Kendra was assisting in helping the villagers deal with Covid. Extension of the project by one year would enable in establishing a good model for fluoride mitigation that could be used for advocacy.

Introduction

Sonbhadra district is one of the critically polluted districts of the country due of the multiple industries in the region. One of the pollutants that severely affect the residents is fluoride, that causes a disease known as fluorosis. There are multiple sources of fluoride in the region – the thermal power plants that burn three lakh tonnes of coal every day, releasing 30,000 kgs of fluoride into the environment; the aluminium smelting industries, that release fluoride as a part of the production process; as well as from the rocks in the region.

This has led to deteriorating health of the tribal as well as other villagers living here. The Banwasi Seva Ashram (BSA) has been advocating with the government over the years regarding the issue of fluorosis. In a case filed by villagers of the region in the National Green Tribunal, the NGT acknowledged the problem of fluorosis in the region especially for occupational hazards, and in its judgement ordered the setting up of a hospital in the region, training for the doctors of the region so they can identify cases of fluorosis at an early stage so treatment can be begun before the disease has progressed, and for medical supplements for the residents of the region to be provided. However, implementation of this order has not taken place.

Banwasi Seva Ashram has identified many villages with multiple cases of fluorosis in villages across Dudhi, Myorpur and Chopan blocks. This project was undertaken to establish a model for fluorosis mitigation at village level that can then be expanded. Two villages, Kushmaha and Govindpur, located close to BSA were selected, where multiple cases of dental and skeletal fluorosis have been identified.

Water monitoring has been carried out multiple times, including in 2004, 2005 and 2016 in association with People's Science Institute. A health survey focusing on school going children in 2004 had found cases of dental and skeletal fluorosis in both these villages.

Villages –

1. Kushmaha – Kushmaha village has a total population of 1439, and in 2004 itself, 848 residents had been observed to be affected by fluorosis.
2. Govindpur – Govindpur has a population of 562, and in 2004 itself 355 residents were affected by fluorosis.

Objectives –

- To identify safe sources of all the drinking water sources in selected 2 villages Kushmaha and Govindpur.
- Assess the current prevalence of fluorosis in the above selected villages.
- Prepare plans and their implementation to reduce the prevalence of fluorosis in the selected villages by providing safe drinking water and nutritional interventions.
- To investigate the relationships between the incidence of fluorosis and the concentration of fluoride in the drinking water in these villages.

Project plan –

The project was divided into the following phases for implementation –

S. No	1st phase (September 2020- August 2021)	2nd Phase (August 2021- September 2022)
1	**Health survey** • Health survey of two villages Kushmaha and Govindpur villages	• Health survey in second year to assess impact of interventions on test and control population
2	**Water quality monitoring** of all the drinking water sources • Sample collection, results and analysis • Urinary fluoride test of residents of the Kushmaha and Govindpur	• Seasonal analysis of public water sources. • Monthly monitoring of water defluoridation kits distributed • Identification of safe sources for drinking water
3	**Awareness** • Awareness meeting of fluorosis and its impacts • Data of fluoride monitoring of water sources shared among residents of village	• Tola meetings to detail impacts of interventions and encourage others in village. • Large scale Sandesh Yatra in nearby villages and a conference to disseminate the outcome.
4	**Planning** • Literature survey to finalise interventions to be carried out for fluorosis mitigation • Selection of 100 households where intervention was carried out • Meeting with VHSNC regarding fluorosis	• Safe drinking water sources were marked green • Community meeting to plan for fluorosis removal and fluorosis mitigation in village • In tola meetings, planning for defluoridated water for all residents • Meetings with VHSNC and planning to include

S. No	1st phase (September 2020- August 2021)	2nd Phase (August 2021- September 2022)
		fluorosis in VHSNC plan for GPDP (Gram Panchayat Development Plan)
5	**Intervention** • Comparison of Watsan and Activated alumina defluoridation kits • Blood tests like Hb, S.calcium, ESR and X-rays. • Installation of water household defluoridation kits • Nutritional intervention – establishing poshanvatika, tilmethiladdoos, medical supplements • Urinary fluoride testing	• Continued follow up with selected households and individuals where intervention was carried out • Maintenance of *poshanvatika* and encouraging other families in village to start them. Problems of cattle being left stray and lack of irrigation water affected *poshanvatika* • Urinary fluoride testing • Analysis of all interventions and their impacts, and further improvement
6	**Advocacy** • Advocacy with district government and state government agencies • With Jal Nigam • With District Magistrate	Advocacy with district government and state government agencies • With Jal Nigam • With District Magistrate

Note : *The completion of first phase was delayed 3 months due to second wave of Covid-19 last year. So the first phase ended in November 2021 and second phase interventions were started from December 2021. (as stated previously in our brief progress report on secondphase in September 2022)*

Health survey:

A health survey of 284 HHs in Kushmaha and 104 HHs in Govindpur were carried out. A total of 1793 persons were surveyed. The *swasthyamitras* were trained to identify the severity on the basis of the symptoms and their responses to a questionnaire.

Dental fluorosis – this was identified on the basis of staining and pitting of the teeth.

- Serious - completely affected enamel surfaces, pitting teeth, all the teeth either discrete or run together
- Medium - white opaque areas affect more than 50% of the enamel surface
- Mild - white opaque areas on the surface are more extensive and affect less than 50% of the surface
- Doubtful - Enamel shows slight changes from white flecks to white spots
- No symptoms

Skeletal fluorosis - Fluorosis is a crippling disease resulting from the deposition of fluorides in the hard and soft tissues of body. Early symptoms include stiffness and joint pain. In severe cases, changes may occur in bone structure with the calcification in ligaments which together resulted in impairment in flexibility of muscles affecting its functioning and pain. There can also

be constriction in vertebral canal and foramen exerts pressure on nerves and blood vessels causing paralysis and pain.

During the survey physical tests were conducted in both the villages.

1. Touching the toes without bending the knees
2. Touching the chest with the chin
3. Stretching of the arms and folding them to touch the back of the head

On the basis of the above symptomatic observations the severity of fluorosis of people was classified.

- Serious – completely unable to perform test 1, 2& 3
- Medium – performed up to the 50 %
- Mild – performed less than 50 %
- Doubtful – sometimes pain in joints
- None – no pain in joints, no problem in movement

Table 1 and 2 give the data of the health survey of fluorosis among villagers of Kushmaha and Govindpur.

Table 1: Different levels of fluorosis during health survey in Kushmaha and Govindpur

Category	Dental fluorosis		Skeletal fluorosis	
	Number	%	Number	%
Serious	202	11.26%	41	2.28
Medium	327	18.23%	386	21.52
Mild	853	47.57%	983	54.82
Doubtful	400	22.30%	352	19.63
None	11	0.61	31	1.72

Table 2: Number of households with serious dental and skeletal fluorosis

Description	Kushmaha	Govindpur
No. of households surveyed	284	104
No. of persons surveyed	1323	416
No. of households suffering from serious dental fluorosis	44	11
No. of persons suffering from serious dental fluorosis	176	26
No. of households suffering from serious skeletal fluorosis	11	5
No. of persons suffering from serious skeletal fluorosis	32	9

Water quality monitoring:

Water sources in Kushmaha and Govindpur were tested for the levels of fluoride. The allowable level of fluoride in drinking water is 1 mg/l, and the maximum permissible level in the absence of other drinking water sources is 1.5 mg/l.

86 water sources were tested in Kushmaha and the fluoride concentrations ranged from 0.6-7.26 mg/l. 33 water sources were tested in Govindpur and the fluoride concentration ranged from 0.8-6.76 mg/l. In Kushmaha, only 66 of 86 sources had fluoride levels higher than 1.5mg/l. In Govindpur, 22 of 33 drinking water sources had fluoride higher than 1.5 mg/l.

The concentration of fluoride in the different sources of drinking water was mapped on the basis of the dependency of each household's drinking water source (figure 1 and 2).

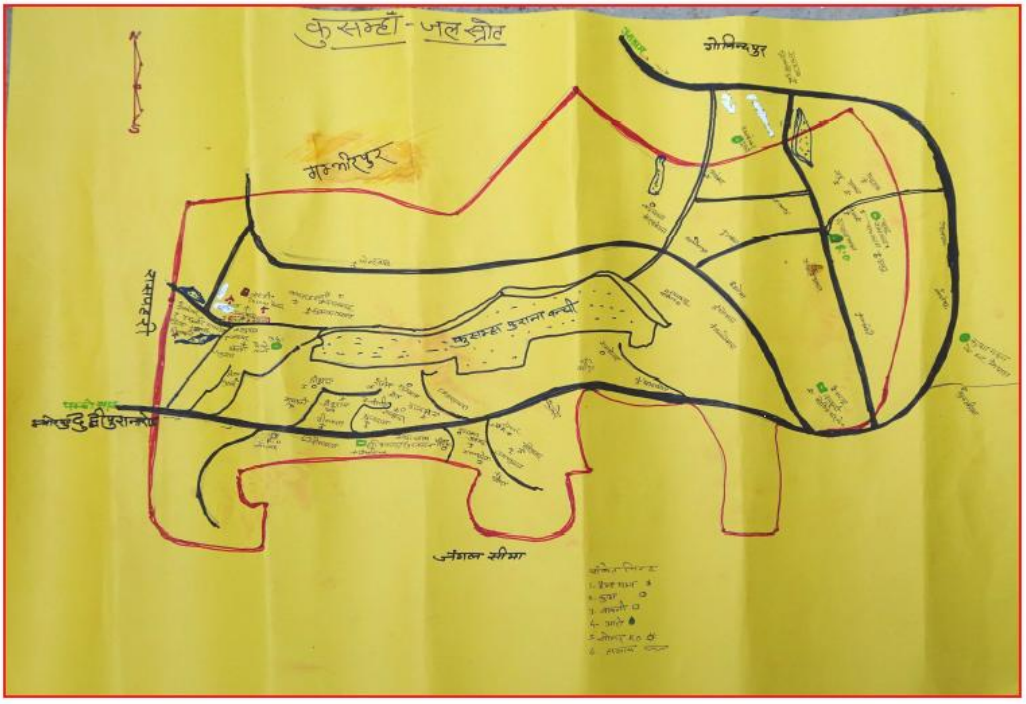


Figure 1: Mapping of available water sources and drinking water dependency in Kushmaha

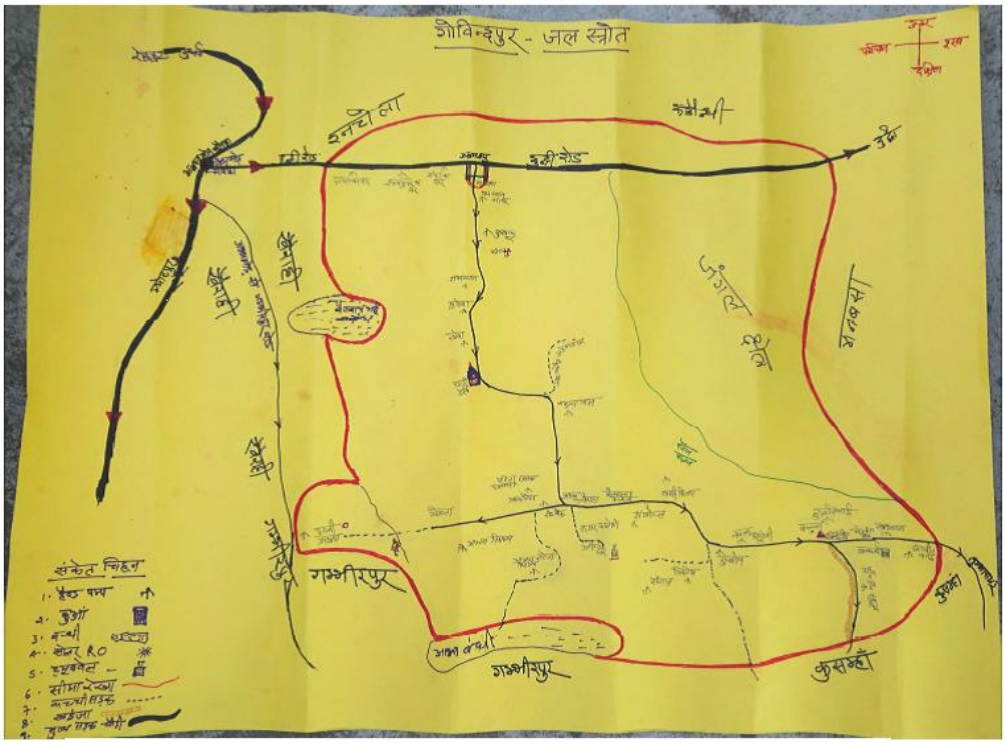


Figure 2: Mapping of available water sources and drinking water dependency in Govindpur

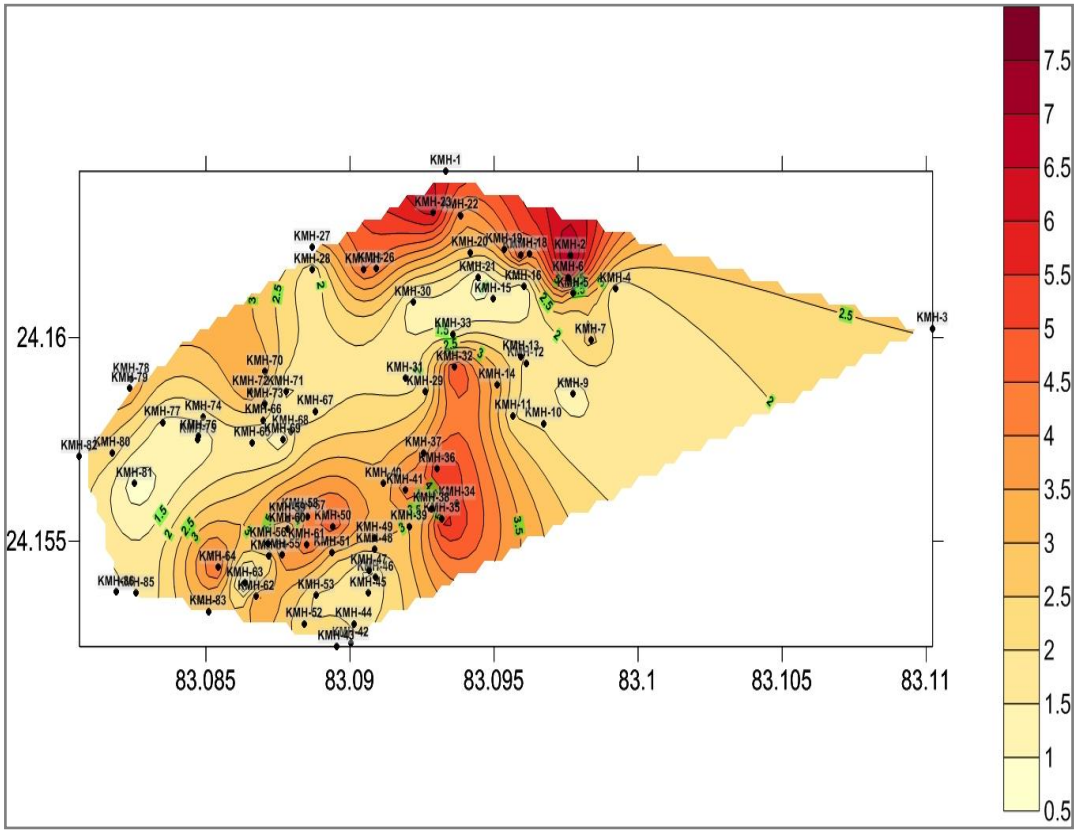


Figure 3a: Distribution of Flouride in Kushmaha village

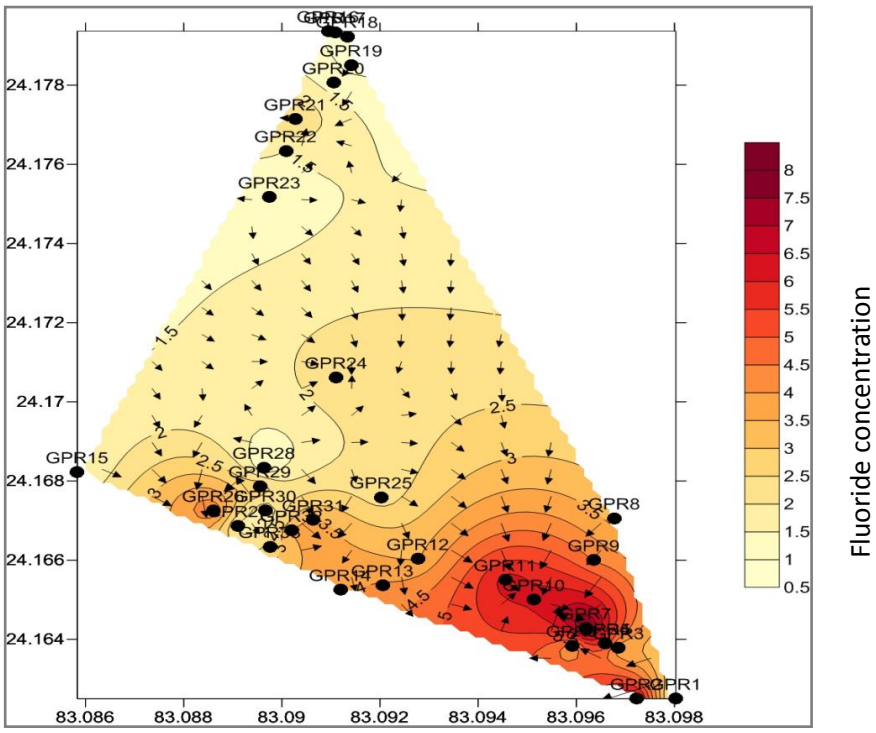


Figure 3b: Distribution of Flouride in Govidpur village

Regular monitoring

A youth team of 7-10 volunteers were trained, who perform qualitative monitoring of fluoridein which they are able to analyse if the water has fluoride levels less than or above 1.5 mg/l. They visit each of the houses monthly and perform qualitative fluoride monitoring of defluoridation kit water.

They also check fluoride levels in the tanker water supplied by Hindalco Industries and the solar defluoridation system installed in a hand pump by the Jal Nigam in the village. When they found that the levels of fluoride ion in these community water sources was greater than 1.5 mg/l, they tested the water using fluoride ion meter and informed the community. The community then put pressure on the concerned authority of supplier, who took action and changed the filter cartridge.

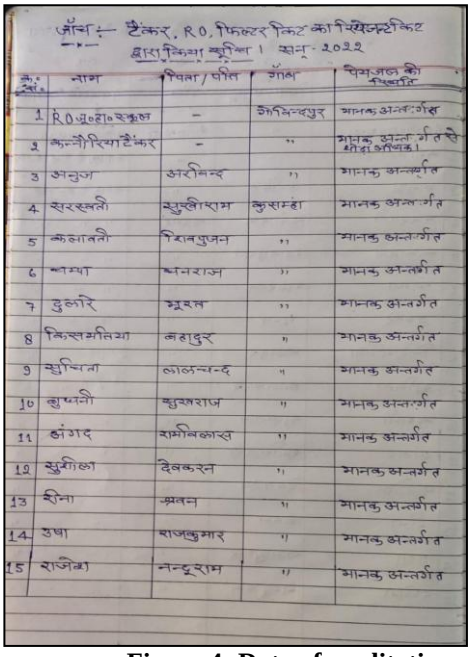


Figure 4: Data of qualitative monitoring by village volunteers

Table 3: Showing various water quality parameters in Feb 2021, Sept 2021, March 2022 and Oct2022 Findings in Govindpur Village

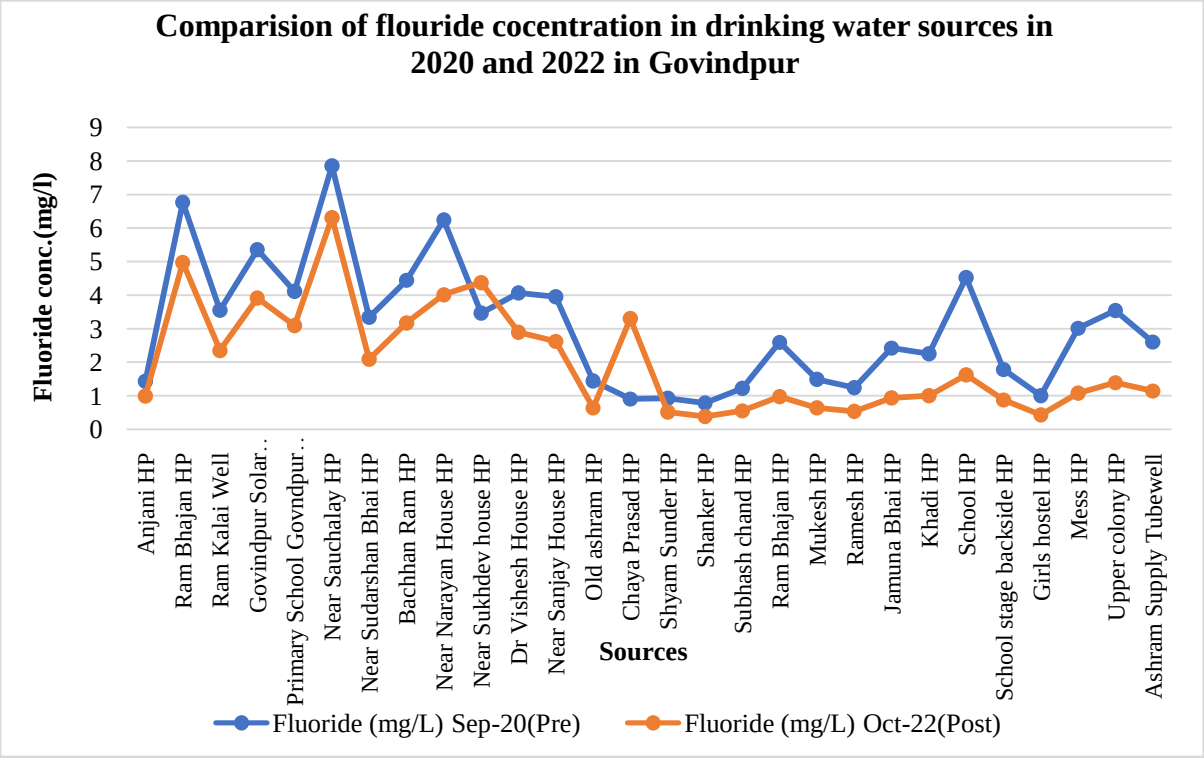
pH range				TDS range				Total Hardness range				Total alkalinity range				Calcium hardness range				Magnesium Hardness range				Fluoride range			
Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022
7.1-7.8	6.7-7.8	6.7-7.4	6.2-7.9	219-581	178-607	248-703	261-892	42-368	38-398	40-412	36-448	44-112	40-108	44-106	42-112	32-108	31-102	31-104	28-112	5.76-21.12	3.84-23.04	4.2-20.02	4-28	0.8-6.76	1-7.85	0.6-7.26	0.38-6.31

Findings in Kushmaha Village

pH range				TDS range				Total Hardness range				Total alkalinity range				Calcium hardness range				Magnesium Hardness range				Fluoride range			
Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022	Feb 2021	Sept 2021	March 2022	Oct 2022
6.9-8.0	6.8-8.1	6.7-8.0	6.5-8.3	205-433	165-510	182-473	173-665	40-400	49-421	44-408	36-480	16-76	20.2-81.3	20-90	14-102	32-99.2	34.4-100.6	32.8-104	28-112	5.8-42.6	5.6-39.4	5.8-44.4	4.8-46.2	0.6-7.26	0.8-8.2	0.73-5.84	0.35-4.69

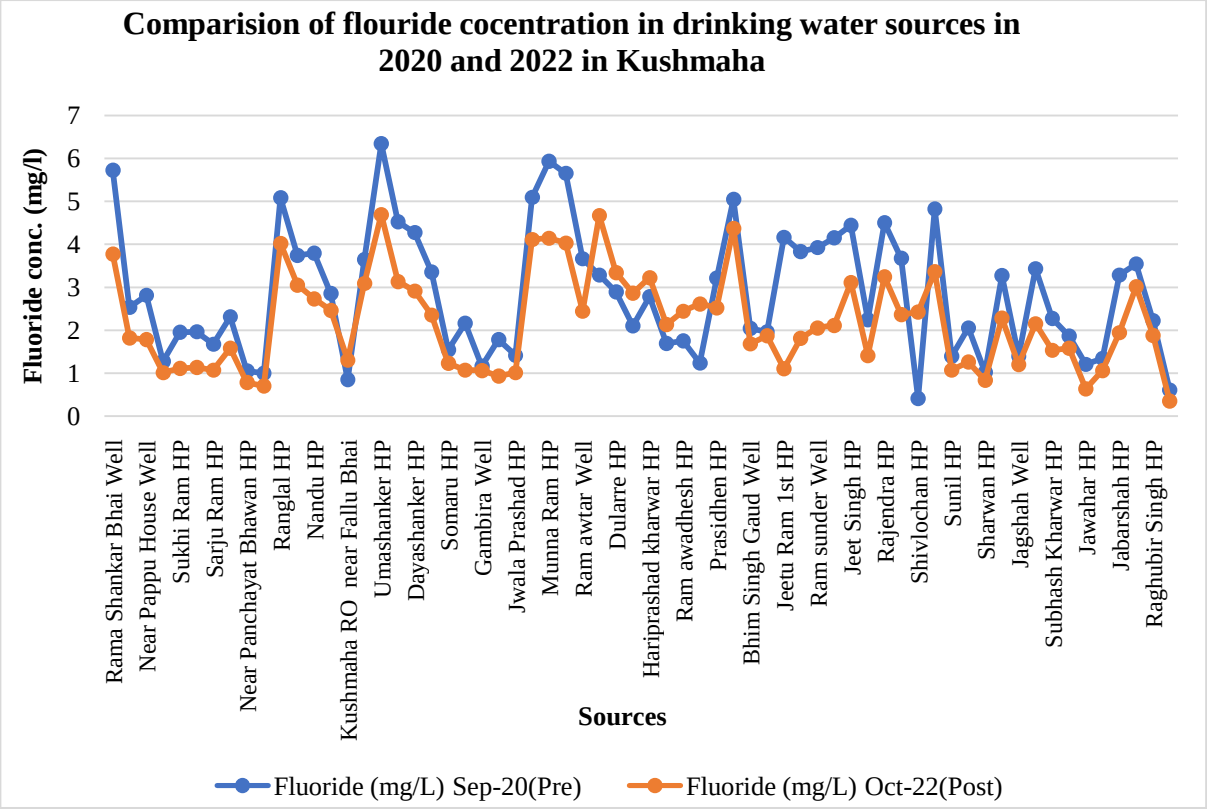
Permissible limit as Bureau of Indian standard (10500:2012) specification for drinking water
1. pH- 6.5-8.5 2. TDS (mg/L)- 500 3. Total Hardness (mg\L)- 200-600. Total Alkalinity (mg/L)-200-600 5. Calcium (mg/L)- 75-200 6. Magnesium (mg/L)-30-100
7. Fluoride (mg/L)- 1.5

The data shown in Table 3 reflects the permissible limits for pH while few sources in both the villages are showing lower value from the minimum limit. High TDS from the permissible limit (8 source) in Oct-22 (3 source) in march-22 and (1 source) in Sep-21in Govindpur and in Kusmaha (5 source) in oct 2022. The data of Total hardness, Total Alkalinity Calcium Hardness and Magnesium Hardness are within the permissible limit of BIS (2012) in both Govindpur and Kusmaha villages. It is interesting to further monitor these parameters in next seasonal water quality test.



Water sources from Govindpur village shows fluoride in range of 0.8-6.76 mg/L in Feb 2021, 1-7.85 mg/L in Sep 2021 and 0.6-7.26 in March 2022 and 0.38-6.31 mg/L in Oct 2022. In Kushmaha village fluoride in water sources varies from 0.6-7.26 mg/L in Feb 2021 0.8-8.2 mg/L in Sep 2021 0.73-5.84 mg/L in March 2022 and 0.35-4.69 mg/L in Oct 2022. With the help of community people water sources having high fluoride concentration were marked as black and mentioned as “Not for use for any purposes”. Increased fluoride concentration is due to the post-monsoon effect and also air pollution may play a significant role in adding fluoride to the water sources.

Changes in fluoride concentration are seasonal. This is rain came very late (end of July) and continued till October 2022. Because of it fluoride concentration got diluted. It means that if water recharging capacity will increase concentration of fluoride will reduce.



Urinary fluoride testing

Urine samples from 345 persons in Kushmaha and 229 persons in Govindpur were tested for fluoride concentration and the data is given in Table 4.

Table4: Urinary fluoride concentration

Urinary fluoride levels (mg/l)	Kushmaha		Govindpur	
	Number	%	Number	%
<1.5	10	2.89	26	11.35
1.5-5	166	48.11	151	65.93
5-10	141	40.86	50	21.83
>10	28	8.12	2	0.87

The concentration of fluoride in the drinking water and the urine were plotted to each other to see if there was a relationship, and it was observed that those people who depend on water sources that have a high fluoride levels have high urinary fluoride levels (Figure 5). Multiple studies have shown that drinking water is one of the main sources of fluoride, and those who intake larger amounts of water secrete larger amounts of fluoride.

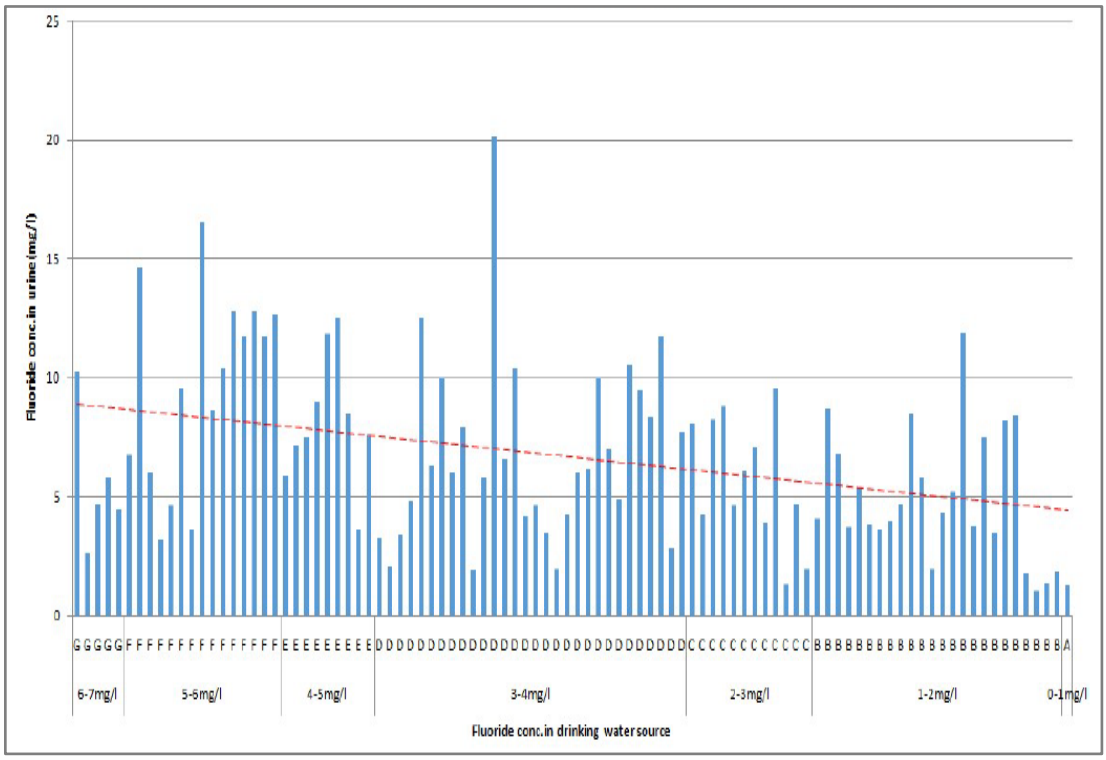
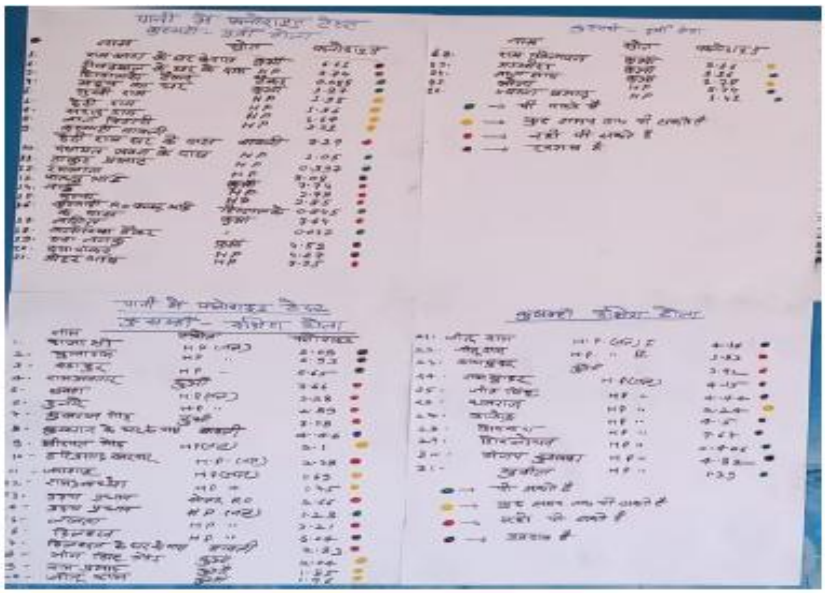


Figure 5: Relation between drinking water fluoride concentration and urinary fluoride levels

Awareness

Initially, discussions and meetings were held with the residents of the villagers on the issue of fluorosis, its symptoms, causes, as well as drinking water sources. The data of urinary fluoride that had been monitored was shared with the villages.

Charts that show the different sources of drinking water in the village and their levels of fluoride were displayed in the *panchayat*house; so that people could easily see what the levels of fluoride in the water source they used (Figures 6, 7 and 8). The RO water that is supplied through tankers in the villages by the industries was also tested.



Green – safe

Yellow – under danger

Red – cannot be used for drinking but can be used for other purposes like agriculture

Black – cannot be used

Figure 6: Chart of concentrations of fluoride in drinking water sources in Kushmaha village

Figure 7: Chart of concentrations of fluoride in drinking water sources in Kushmaha village

Figure 8: Chart of concentrations of fluoride in drinking water sources in Govindpur village

Planning:

The handpumps whose water contained fluoride below 1.5 mg/l, that is below the permissible limit were marked green. Discussions for planning for a village level plan so that all the residents of the village could access fluoride free water were undertaken. Due to advocacy by BSA and the villagers in the region, some defluoridated water is provided by the state government in the form of solar defluoridation kit installed on two handpumps in the villages and RO water that is supplied by tanker from Hindalco Industries. People were encouraged to use this water and monitoring of this water was carried out toc heck the levels of fluoride.

Each village has a Village Health and Sanitation Committee (VHSNC). Meetings were organised with the VHSNCs and it was found that there was no awareness regarding this body, its responsibilities and resources. Meetings with the VHSNC in both villages were carried out, for spreading awareness about fluorosis and mitigation strategy, and also about the statutory resources and responsibilities.

Figure 9a: Meeting with VHSNC

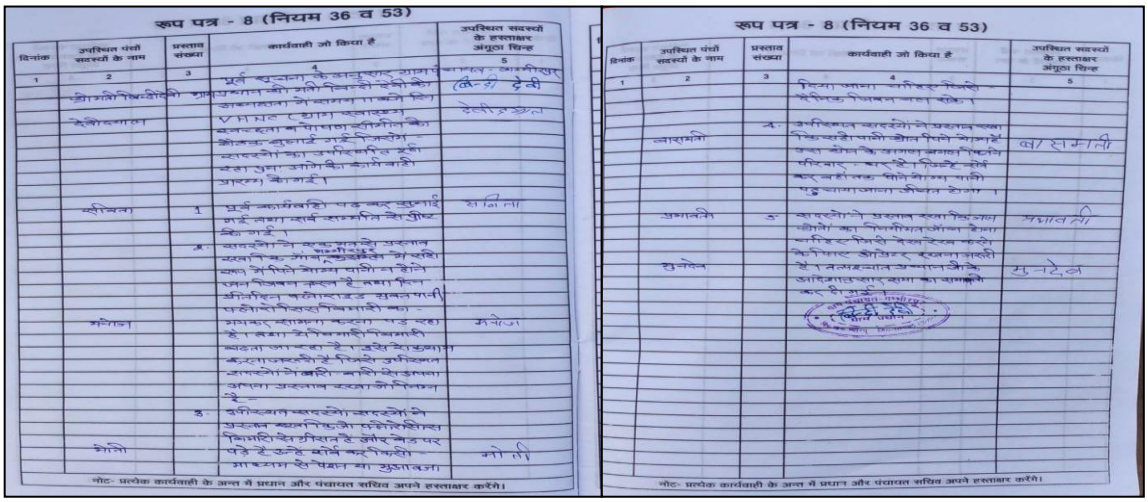


Figure 9b: Minute of VHSNC Meeting

Each village is mandated to prepare a Gram Panchayat Development Plan (GPDP) for economic development and social justice utilizing resources allotted to them. Engagement with the Gram Panchayat and VHSNC to include fluorosis as a component in the GPDP is being undertaken.

In the second year, there were regular *tola* meetings in which the information that was generated through the study was shared with the villagers. Four *tolas* with 80-85 households were formed and discussions initiated in the mornings and evenings on the severity of fluorosis, its

Figure 10:Tolameeting in village

prevention and awareness about the problems through video clips, posters and pamphlets etc. Households with whom interventions were carried out shared their experiences, usage of defluoridated water and poshanvatika with other residents of the village

A fluoride awareness and mitigation centre has been made in BSA campus where villagers and visitors from various sectors are able to avail information regarding fluorosis as well as the information collected during this study.

Figure 11: Fluoride awareness and mitigation centre in BSA campus

Interventions

100 individuals were selected with whom interventions were to be carried out. These were people who were still dependent on drinking water that had higher than permissible levels of fluoride, showed symptoms of dental or skeletal fluorosis, and/or had increased levels of urinary fluoride.

Medical tests were carried out in January and February 2021. Blood samples were collected and tested for red blood cells, haemoglobin, and erythrocyte sedimentation rate (ESR), uric acid and serum calcium levels. The figures obtained are given in the Table5.

Table 5: Medical test of study participants

SN	Medical test	Range obtained in Test	standard	
			Male	Female
1	Haemoglobin	8 - 14 gm/dl	14 - 16 gm/dl	12 - 14 gm/dl
2	RBS	82 - 399 mg/dl	90 - 160 mg/dl	90 - 160 mg/dl
3	ESR	12 – 51 mm/hr	19 mm/hr	20 mm/hr
4	Serum Calcium	7.32 – 11.2 mg/dl	8.3 – 11 mg/dl	8.3 – 11 mg/dl
5	S. Uric acid	3.5 – 7.53 mg/dl	3.4 – 6.5 mg/dl	2.5 – 6.0 mg/dl
6	Alk Po4	31.57 – 181.92 u/l	53 – 128 u/l	53 – 141 u/l

On the basis of the medical test data, nutritional supplements were given. Some of the participants were again sampled in August 2021 for serum calcium levels.

People exposed to high levels of fluoride have been observed to have lower levels of serum calcium. In January-February the levels of serum calcium were found to be better as compared to the levels observed in August. One of the reasons for this could be the availability of green leafy vegetables as well as higher intake of *till* (sesame) in the colder

months as compared to summer. These are all high in calcium and thus people have better levels of serum calcium. The festival of *Makar Sankranthi* falls in January is associated with the consumption of large amounts of *til laddu.*

Of the 100 individuals, it was planned to undertake intervention with 94 individuals, and 6 were to be control.

But 74 kits were installed from out of 94 selected HHs as 20 HHs sold residents to accepted the problems of fluorisis due their feeling of social hindrance in marriages of their children. Somehow we are able to convince them to an extent that they are ready to aware intervention when Ashram dose it for whole the village.

The following interventions were carried out –

- Provision of de-fluoridated water
- Nutritional supplements in the form of *til, methi Mahuwa laddoo*
- Provision of medical supplements on the basis of the medical tests
- Encouraging villagers to grow *poshan-vatika* in their farms where they would grow green leafy vegetables for self-consumption

Provision of defluoridated water –

One of the major sources of fluoride in individuals is drinking water, thus de-fluoridation kits were provided so they could access fluoride free water. This is a pilot project, hence household level de-fluoridation kits were installed (Fig 12), and that could be easily maintained by the families where they are installed, and families were encouraged to use this water.

94 participants, 20 individuals showed resistance, and hence 74 Watson defluoridation kits were installed in 74 homes. Demonstration of the kits was carried out in community meetings, and the kits were installed with Rs 1000 contribution for maintenance and new candle if required. They were taught how to use and maintain the Watsan kits, and asked to use water from the kit regularly for drinking and cooking. The *swasthyamitras* carried out constant monitoring of the installed kits. Monthly monitoring of the water from the installed defluoridation kits was carried out to see their functioning.

Figure 12: Watsan filter installed in the home of study participant

Comparison between Watsan and Activated Alumina defluoridation kits

In March 2021, PPI suggested that a comparison between activated alumina (AA) and Watsan defluoridation kits be carried out. 20 Watsan and 5 AA kits were installed in the homes of 25 individuals and then the functioning of both these defluoridation kits was studied.

Both the kits were found to remove fluoride to the level required within 24 hours.

Watson kit have additional advantage of having another blue kit for the removal of germs and metals toxicity in source water along with white kit for the removal of excess fluoride in source water.

75 % kits work with the efficiency of 70-75 % fluoride removal in24 hours while 25 % kits remove 75-80 % Fluoride from the source water. Gradually, in 7 daysdata showed 75 % of the kits still remove 70-75% fluoride while fluoride removing efficiency in 25% of the kits came down to 65-70% which also remains same in next 15 days. After 21days, only 50% of the kits show 70-75% fluoride removal while rest 50% of the kits show 65-70% fluoride removal. This data indicates the time within which the AA kits need to be recharged, further study would enable in estimating to further precision as to how many days recharge of AA kits needs to be carried out for effective water de-fluoridation.

50 % of the Watson kits removed 70-80% fluoride, 30% kits removed 60-70%, 15 % kits showed best removal which is 80-90% while 5 % kits removed 50-60 %fluoride from the source water. After 7 days, 70 %of the kits removed 70-80 %, 20 % kits removed 60-70 % fluoride while 10 % kit removed 50-60%fluoride.From the 15 days and 21 days, 60 % of the kits removed 70-80% fluoride, 20% of the kits removed 60-70% fluoride. Again 10 % of the kits showed 80-90 % fluoride removal while 10 % of the kits showed 50-60 %.

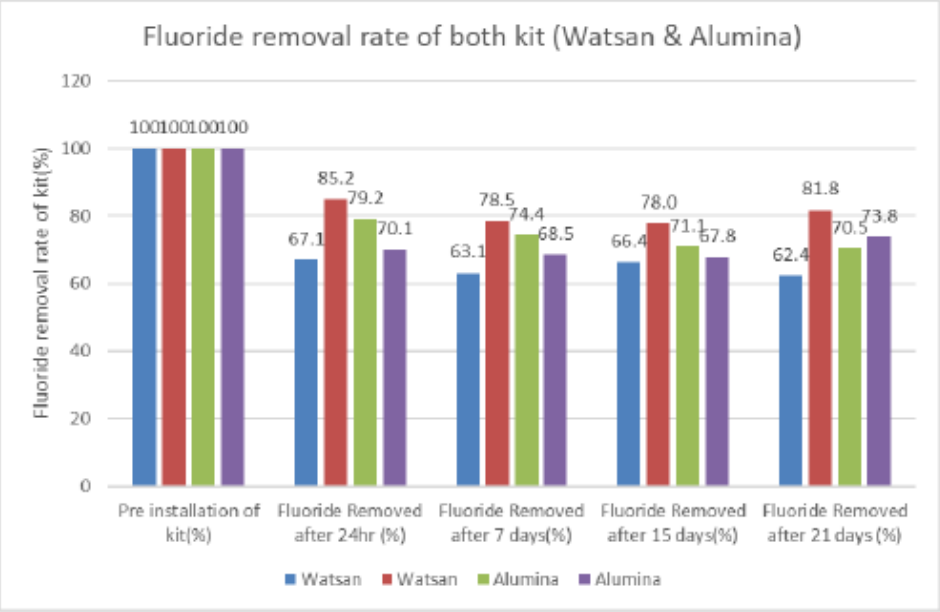


Figure 13: Comparison of fluoride removal by WATSAN and Activated Alumina kits

Status of the use of defluodridation kits during the study: KUSHMAHA- 52 HHS & GOVINDPUR-22 HHS, TOTAL 74 HHS IN OUR STUDY

S. No.	Remedial interventions during the study	
1	Use of Defluoridation Kits	Households 74
(a)	Regular user of defluridation kit from April 2021 to Till now **(18 months)**	20
(b)	Regular user of defluridation kit from Nov 2021 to Till now **(13 months)**	24
(c)	Regular from May 2022 to Till now **(7 Months)**	18
(d)	Irregularly using de-fluoridated kit water	12

Poshanvatika –

It has been observed by BSA that villagers rarely grow vegetables for self-consumption, and do not buy sufficient vegetables also, especially in summer months. The villagers were encouraged to keep a small patch of land aside where they could grow green leafy vegetables for self-consumption as these are also high in micronutrients and calcium that help in alleviating symptoms of fluorosis.

Figure 14: *Poshanvatika* of one of the study participants

Seeds were provided to the villagers in March 2021 so they could grow different vegetables in the *poshanvatika* or kitchen garden. Initially 70 *poshanvatikas* were established. Due to cattle being left to stray, only 32 *poshanvatikas* survived.

People were again encouraged to maintain *poshanvatikas*, and to find solutions for stray cattle. Some of them covered their *poshanvatika* with wire netting, and there was discussion in gram sabha about how to deal with the issue of stray cattle, with a proposition to ban the practice of leaving cattle to stary. In June 2021 again seeds were distributed to establish 65 poshanvatika, with some villagers other than the families with whom interventions were being carried out also showing interest. This year the rainfall was delayed and scanty, which affected establishment of successful poshanvatikas.

Status of the use of Green leafy vegetables with establishment of Poshan Vatika : KUSHMAHA- 52 HHS & GOVINDPUR-22 HHS, TOTAL 74 HHS IN OUR STUDY

S.No.	Poshan vatika (Seasonal Nutrition Garden establishment)	Nutritional garden
(a)	March 2021 (Covid Phase)	45
	Successful establishment and families used the produces such as leafy vegetables and fruits. Also protected from free cattle grazing during summer	30
(b)	Oct 2021	40
	Successful establishment and families used the produces such as leafy vegetables and fruits	32
(c)	March 2022 (Free cattle grazing in the area in summer)	70
	Successful establishment and families used the produces such as leafy vegetables and fruits	32
(d)	June 2022 (Late onset of monsoon this year)	65
	Successful establishment and families used the produces such as leafy vegetables and fruits	17
(e)	Oct 2022	74
	Successful establishment and families used the produces such as leafy vegetables and fruits	67

Provision of nutritional and medical supplements

Medical supplements were given to some of the people severely affected with fluorosis monthly in the form of zincsupplements, iron tablets, Vitamin C, vitamin E and calcium. They were also asked to use roasted *til*, *methi*, peanut and jaggery (*gur*) combined as Laddu. We started doing this to demonstrate the importance of nutritional benefits of these items. Some other examples of foods that will provide benefits to them are *dalia* of ragi millet (rich in calcium) and laddu of *mahua* (rich in Iron and energy) with *til*. It has been observed by researchers that fluoride reacts with the calcium to form fluorapatite crystals, affecting calcium levels, thus improving calcium levels is helpful in mitigating the symptoms of fluorosis.

Status of the use of medical supplements : KUSHMAHA- 52 HHS & GOVINDPUR-22 HHS, TOTAL 74 HHS IN OUR STUDY

S.No.	Medical supplements zinc supplements,Calcium, Iron, and Vit-E, etc for the most needy people, for 15 days (twice in a year)	People
(a)	March 2021	54 people
(b)	Sept 2021	54 people
(c)	March 2022	56 people
(d)	Oct 2022	56 people

We gave a short training to 10 people from different *tolas* (hamlets) of boththe villages. These trained people then voluntarily spread the message of nutritional benefits andmotivating people to make and use these items regularly at their home. Also, our field workerstarted visiting all the 100 HHs at least twice in a month to monitor them and to providenecessary medical supplements. Monthly they were provided with *tilmethi* laddoos.

Figure 15: Preparation of *til, Methi, Tissi, & Mahuwa Laddoos* by BSA workers

Status of the use of Nutritional Laddu: KUSHMAHA- 52 HHS & GOVINDPUR-22 HHS, TOTAL 74 HHS IN OUR STUDY

S.No.	Nutritional Laddu distribution for 10 days to affected people	People
(a)	March 2022	67 people
(b)	June 2022	67 people
(c)	Sept 2022	70 people

<u>Urinary fluoride monitoring& water monitoring:</u>

There was sustained interaction with the selected villagers in both the years to ensure use of de-fluoridated water for drinking and cooking.

In both the years, this activity was affected due to Covid-19, especially in the July- August 2020 and then during the second wave in March-April 2021 during the second wave that saw devastating damage through the country. Due to this, in some of the months there could not be regular village meetings, the impact of nutritional activities could not be followed, and the regular house visits of health workers could not be carried out. Previous studies have observed that loss of urinary fluoride from adults after removal from drinking water has half-life of 120 weeks ***(Fluoride: Its Metabolism, Toxicity, and Role in Dental Health, Journal of Evidence-Based Complementary and Alternative Medicine 2012 17:28m DOI:10.1177/2156587211428076 Authors: Esperanza Angeles Martínez-Mier)*** Urinary fluoride levels were tested in September 2020, September 2021, March 2022 and then in October 2022.Figure shows the decrease in urinary fluoride in study participants between September 2020 and October 2022 who used filter regularly and irregularly, in comparison to control, and it can be seen that the median decrease in urinary fluoride levels was greatest in those who used filter water regularly. Table 6 gives the maximum and minimum decrease in urinary fluoride concentrations in the three categories, and it can be seen that due to regularly drinking de-fluoridated water has led to a marked decrease in urinary fluoride levels.

Figure 16: Graph showing median decrease in urinary fluoride levels

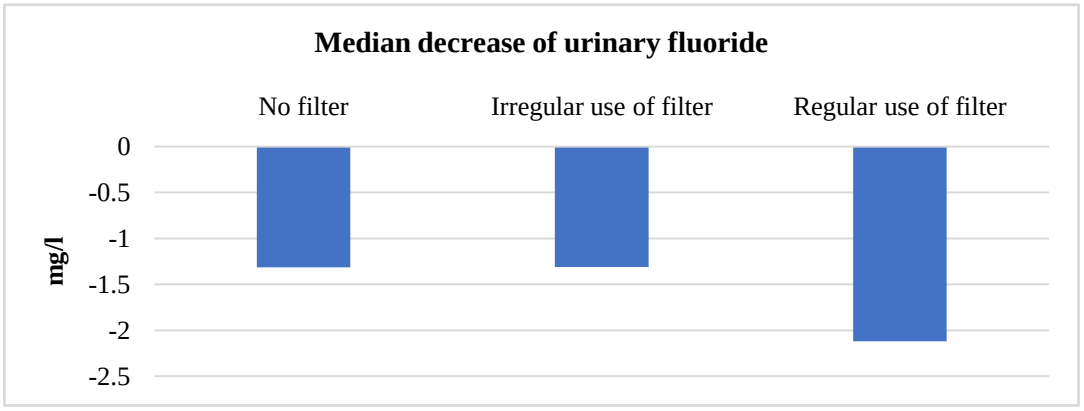


Table 6: Table showing data of change in urinary fluoride levels in participants

	No filter	Irregular use of filter	Regular use of filter
Median decrease	-1.315	-1.31	-2.12
Max decrease	-6.38	-9.5	-13.1
Min decrease	8.96	8.68	5.88

Figure 15 shows Comparison of Urinary Fluoride data of pre intervention and post interventions (October 2022) is classified under 4 categories which can be seen in following tables and Pie-diagram 15. It is observed here that out of total 82 persons 41 persons i.e. 50% are showing decrease in their urinary fluoride by more than 2mg/l and in 22 persons i.e. 27% are showing decrease in their urinary fluoride by more than 0.1 to 2 mg/l in 22 respectively. Total 77% persons are showing decrease in their urinary fluoride. Data of our post intervention health survey shows that total 44 persons are using de-fluoridated kit water for more than 13 to 18 months, while 18 persons from 7 months regularly, while 12 persons are still irregular in their use of safe kit water. So it clearly indicates that with regular drinking of de-fluoridated water there is a decrease in urinary fluoride

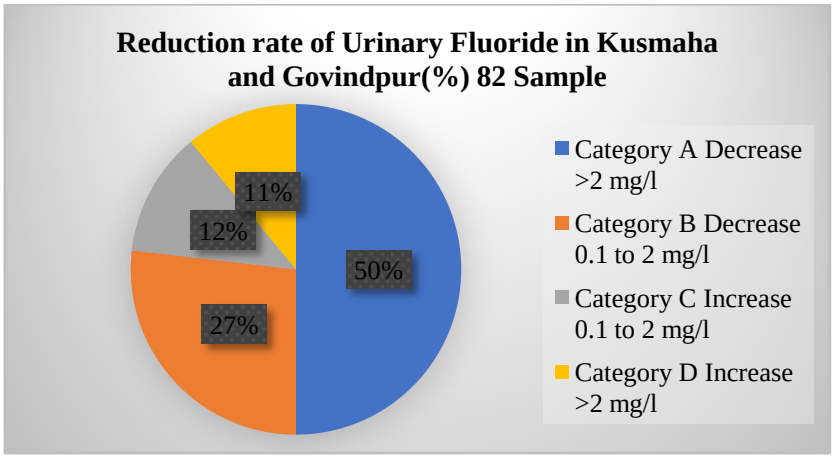


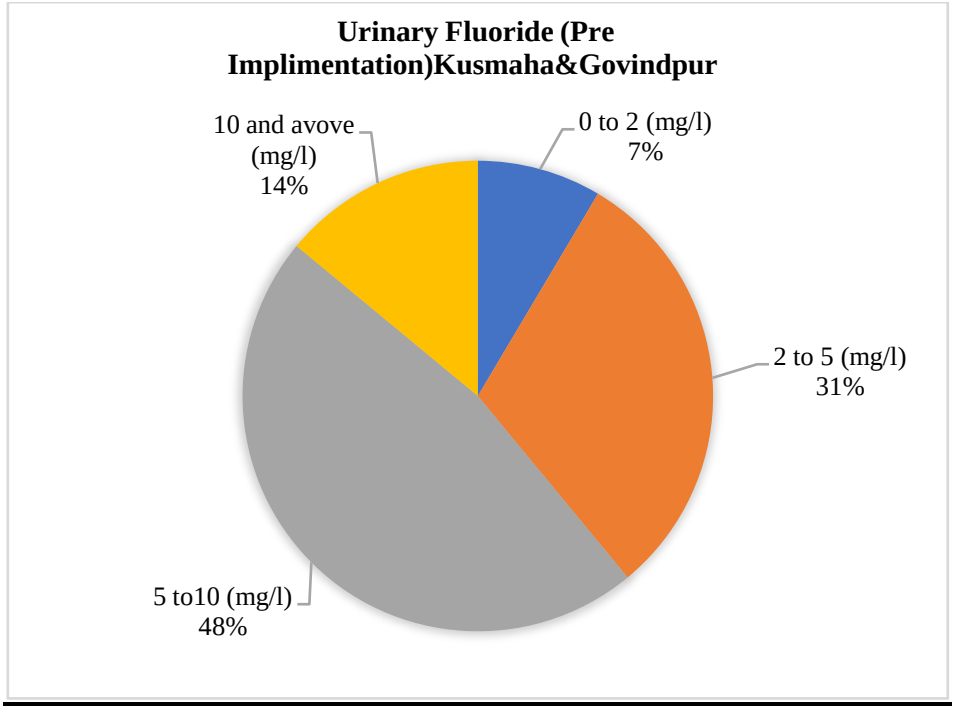
Figure 17 : Reduction rate (in %) of Urinary Fluoride in Kusumaha and Govindpur village

Table 7 :

Category	Urinary Fluoride	Individuals	%
Category A	Decrease >2 mg/l	41	50
Category B	Decrease 0.1 to 2 mg/l	22	27
Category C	Increase 0.1 to 2 mg/l	10	12
Category D	Increase >2 mg/l	9	11
	Total	**82**	**100**

Table 8: Showing comparison of Urinary fluoride data of Kusmaha & Govindpur (Pre & Post intervention)

SN	Urinary Fluoride	No of Peoples	PRE (%)	No of Peoples	POST(%)
a-	0 to 2 (mg/l)	6	7	19	23
b-	2 to 5 (mg/l)	25	31	31	38
c-	5 to10 (mg/l)	39	48	24	29
d-	10 and above (mg/l)	12	14	8	10
	Total	**82**	**100**	**82**	**100**



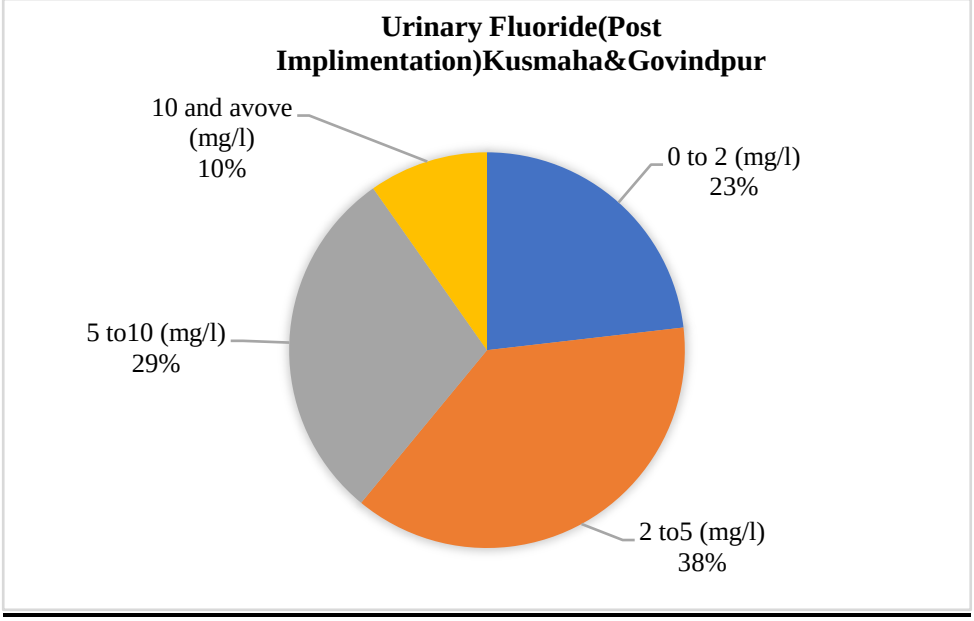


Figure 18 : Pie chart showing Comparison of Urinary fluoride data of Kusmaha & Govindpur (Pre & Post intervention

From about table and pre and post intervention pie-diagrams, it is very clear that there is a shift 16% persons shift in urinary fluoride with in more or less near to normal limit i.e. 0-2 mg/l, 7% increase in 2 to 5 mg/l category total 23% persons from selected house hold are showing a significant improved in urinary fluoride, that is below 5 mg/l. Persons having urinary fluoride up to 5 to 10 mg/l in pre intervention phase have decreased to 29% in post intervention phase and 14% having 10 mg/l and above have decreased by 4% in post intervention phase. This is a significant change. Again shows a relationship between decrease in urinary fluoride level with regular use of de-fluoridated water.

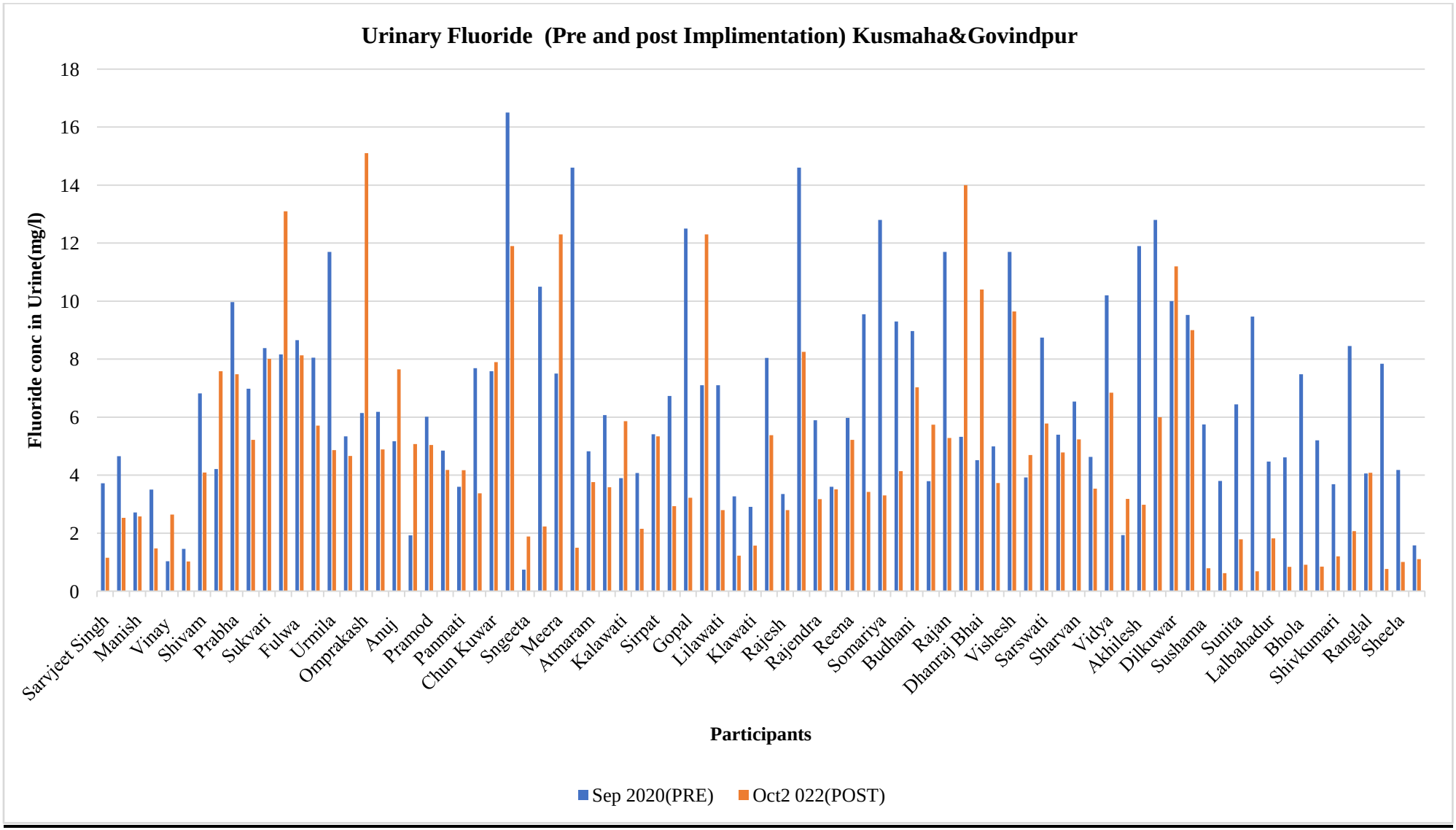


Figure 19 Urinary fluoride (pre and post implementation) Kusumha and Govindpur

Medical tests

To assess the impacts of the interventions, medical testing of some of the participants of the study was carried out. Figures show the values of medical testing observed pre- and post-intervention in the study participants.

Status of the use of Medical test:

Tabel 9:

S.No.	Medical test	Range obtained in test		
		Jan. To Feb 2021	**In August 2021**	**In Nov. 2022**
1	RBS (Random blood sugar)	82-399	-	65 to 326
2	**Haemoglobin**	8-14	-	9.3 to 12.8
3	ESR (Erythrocyte sedimentation Rate)	12-51	-	8 to 48
4	**Serum Uric Acid**	3.5-7.53	2.81-7.17	2.01 to 7.21
5	**Serum Calcium**	7.32-11.2	5.81-6.85	6 to 10.5
6	**Alk Po4/ ALP** (Serum alkaline phosphatise)	31.57 -181.92	-	32.57 -162.02 only 2 patients having high 216.26, 324.16 (1M & 1F)

It was observed that in post intervention there was improvement in Haemoglobin status in most of patient and the shift ranged from mild anaemia to normal HB level is due to motivation towards using green leafy vegetables. RBS was done to rule out osteoporotic changes due to diabetics mellitus and it was observed that except in 3 cases all persons were having normal blood sugar. Post interventions ESR and S. Uric acid results are showing declining trend. One of causes for increased ESR and Uric acid levels is chronic stress over body. It is observed that with decreased in urine fluoride concentration pattern blood sample tested for ESR and uric acid are also showing decreasing trend. Uric acid tests have also been done to rule out skeletal problems due to gouty bone formation. And it was observed that there was marginal increase in uric acid only in two cases and 4 at the border line, rest all were within normal limits. We found that 2 persons in home ALP has increased in sample study they are suffering with other diseases also like D.M. type-II, hyper tension, tumour in kidney in a male (216.26 u/l) and female treated for abdominal tuberculosis and suffering with chronic virginities. Huang et al, 2007 (Med. Sci., 42:55-57) studied fluoride exposure on the ALP activity in human stated that ALP activity in increases with exposure on fluoride but prolonged exposure decreased the ALP level probably due to the enzyme binding by fluoride.

X-ray

X-rays were taken to observe the impact of excess fluoride on the bones of the villagers. The bones or joints for which X-rays were taken were decided on the basis of the basis of health survey of villagers, so that a clear picture could be drawn on the seriousness of skeletal fluorosis in the region.

Osteoporosis, osteopenia, sclerosis and osteophytes formation along with bone deformations with restricted mobility were observed. Previous studies have shown that these are can occur due to deposition of fluoride. Studies have shown that ingestion of calcium, vitamin C, and vitamin D is effective for protection from fluorous toxicity.

In September 2021, X-rays of 20 people, that is, 14 study participants and 6 controls, were taken. In November 2022, total 19 persons X-rays are taken out of these 6 new persons having skeletal problem are included. The observations based on the X-rays are given in the table below.

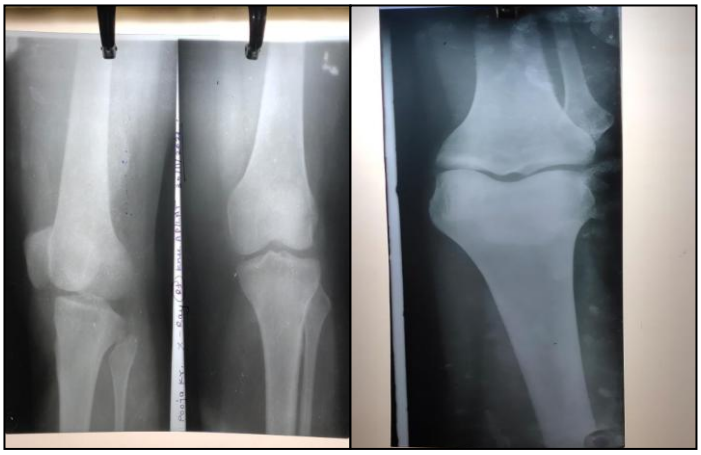
Table10: Observations of X-ray of study participants and control

SN	Name of persons	Village	Sex	Age	Position of X-ray test	Observations - X-ray 2021	Remarks	Observations - X-ray November 2022
1	Radhe Krishna	Govindpur	M	48	Right side AOV (solder joint)	Head of humerous and distal end of clavicalosteoporite	Due to low calcium level	X-ray of right shoulder is within normal limit
2	Chameli	Govindpur	F	40	Knee joint AP	Osteopenic and patellar erosion	Deposition of fluoride in soft tissues	X-ray of knee is within normal limit
3	Fallu	Govindpur	M	62	Knee joint AP	Osteophytes formation of left knee joint and sclerosis of distal femur bone	Sclerosis and Entheshmophytes-due to deposition of calcium fluroapetiite in soft tissues	Mild Improvement in sclerotic changes
4	Chun kunwar	Govindpur	F	55	Elbow AP and lateral + Pelvis AQL	Osteoporosis of humerous bone and proximal end of radio-ulna bone	Fluoride deposition in soft tissues	Marked osteoporosis of knee joint bones with osteophytes
5	Chedi Ram	Kushmaha	M	50	Knee joint AP	Tibial head is eroded and osteopenic knee joint	Deposition of fluoride in soft tissues	sclerosis of distal end of femur and tibia has improved, bone density has improved
6	Sukumari	Kushmaha	F	48	Knee joint	Tibial head is eroded and osteopenic knee joint	Due to deposition of fluoride	Erosion of head of Tibia and osteopenia of knee joint as improved.
7	Fulwa	Kushmaha	F	55		Osteopenic and some osteophytes	Due to the fluoride deposition	Bone density is improved, osteophyte of

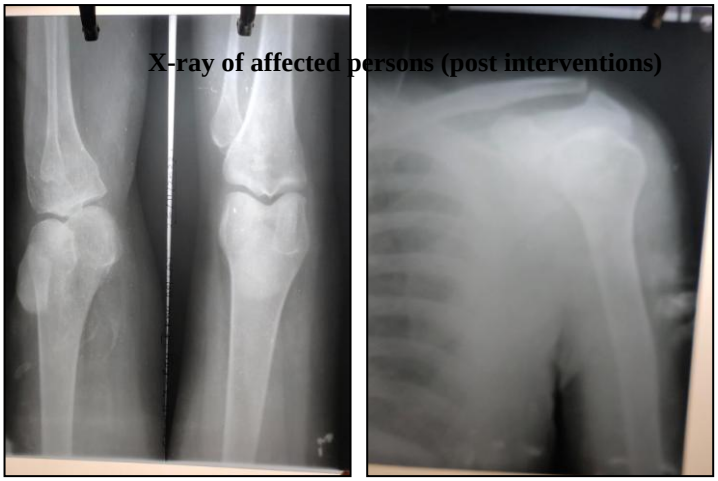
SN	Name of persons	Village	Sex	Age	Position of X-ray test	Observations - X-ray 2021	Remarks	Observations - X-ray November 2022
8	Sunita	Kushmaha	F	35	Knee joint AP	Patella osteoporite and eroded knee joints and osteopenic	Due to the fluoride deposition	Bone density is improved
9	Control 1 Santoshi	Govindpur	F	25	Knee joint AP	Normal	-	Sign of sclerosis started
10	Control 2 Puja	Govindpur	F	20	Knee joint AP	Noormal	-	Sign of sclerosis started
11	Control 3 Ram naresh	Kushmaha	M	62	Knee joint AP	Normal	-	Normal
12	Control 4 Devkaran	Kushmaha	M	60	Knee joint AP	Normal	-	Normal
13	Control 5 Utkarsh	Govindpur	M	7	Knee joint AP	Normal		marked sclerosis of knee joints
14	Ramashankar		M					Increasing sclerosis of knee joint and shoulder joints with brooding of bone with osteophytes and enthesophytes
15	Meera	Kushmaha	F	45				Sclerosis of ankle jonts with calcium spur and TA insertion osteophtes, signs of sclerosis
16	Arti Kumar		F					Sclerosis of knee joint started
17	Urmila Devi	Govindpur	F	42				Marked osteoporosis of knee joint with osteophytes, and enthesophytes
18	Prabha	Govindpur	F	48				Osteoporosis in knee joints with osteophytes of patellar region
19	Vibha	Govindpur	F	21				Sclerosis of knee joint, elbow joint

Observations:

Out of 8 repeat X-rays of study cases done it came to our notice that 5 person's X-rays are showing improvement out of them 2 are nearly normal. However out of 5 control cases 3 are showing beginning of mild sclerotic changes in their joints. It shows that each and every individual living in endemic area of fluorosis should take preventive measures (safe drinking water, diet rich in calcium, vita. D, C & E.



X-ray of control (unexposed) persons



X-ray of affected persons (post interventions)

Samples of villagers whose X-rays were taken is a small sample, however the sign of improvement in skeletal fluorosis indicates that the interventions taken have not only preventive impact, but also it seems that can cure mild to moderate skeletal fluorosis. Thus, it is very promising and further research on these needs to be carried out.

Vibha is one of the residents of Govindpur who has severe bone deformities due to fluorosis. Photo of her legs given in Figure 20

Photo of her legs given in Figure 20 .

As can be seen from Table 10, it can be seen that of the 8 whose X-rays are repeated in October 2022. The x-rays of five of the 8 whose x-ray was repeated shows signs of improvement. 2 of the control show signs that fluoride is starting to affect their bones, and 1 of them shows signs that fluoride is affecting their bones. Skeletal fluorosis is one of the diseases for whom there is still no definitive treatment, as the damage caused by fluoride to the bones has to be reversed. The sample of villagers whose x-rays were taken is a small sample, however the signs of improvement in skeletal fluorosis indicate that the interventions taken have not only preventive impact, but also cure skeletal fluorosis.Thus, it is very promising and further research on this needs to be carried out.

Health survey

In the second year, health survey of 86 residents of the two villages was carried out. 27 from Govindpur and 59 from Kushmaha. The observations are summarised in the following table:

Present status on health of our selected people with respect to fluorosis symptoms:

S. No.	Affected people	Basis of selection	Pre interventions	Post interventions	Inference based on the post survey report
1	17	Skeletal-Serious	5 people unable to move and bedridden, 12 people have bent issues, body joints pain and difficulty to move	15 people have used regular filter water more than 15 months while 2 people used the filtered water regularly for 13 months. All of them have Nutrition Garden and have availed our remedial interventions time to time.	5 bedridden people still on bed and unable to move but their indigestion issues slowly- slowly improved. 12 people have felt little bit easiness in body movements.
	40	Dental - Serious	Completely affected enamel surfaces, pitting teeth, all the teeth either discrete or run together	28 people have used filter water regularly for more than 15 months while 10 people used for 13 months. 2 people used the filter water for 7 months only. 38 people Nutrition Garden and used our remedial interventions	28 people shows significant decrease of enamel scrap on teeth which can be seen during survey. While rest did not show any remarkable changes but they all said that joint pain problems were improved and even gastric issues were also be decreased.
	17	Nonskeletal-Serious	Frequent Gastro-intestinal complaints and repeated indigestion problems	1 people have used filter water regularly for more than 15 months, 10 people used it for 13 months and 6 people used the filter kit regularly for 7 months. All of these people have Nutrition garden and following healthy life styles.	We observed that peoples getting relief in their indigestion issues if they used the filtered water regularly for more than 6 months. Medical and nutritional supplements helped them to get relief in frequent joint pain in knee region.

During survey, we included all the family members of the selected HHs as well as few neighbouring HHs where we did not install the fluoride removal kits. We are summarizing the observations below:

Survey of persons from selected 74 HHs (310 people):

Table 11:

S. No.	No HHs	Dental Fluorosis 182 people			Skeletal Fluorosis 81 people			Symptoms other than Dental/skeletal issues 47 people		
		serious	medium	Not observable	serious	medium	Not observable	serious	medium	Not observable
Pre Implementation	74	101	76	5	11	70	-	8	28	11
Post Implementation	74	92	71	19	10	60	11	7	23	17

This table shows that the number of "not observable cases" have increased after our remedial interventions in the selected households. It indicates that by using the fluoride free water and nutritional supplements with the aid of healthy living styles there is significant decrease in the prevalence of Fluorosis

Status of Neighbouring 31 HHs where we did not installed Fluoride Removal Kits (total 155 Family members):

Table 12:

S. No.	Number of HHs	Dental Fluorosis 105 people			Skeletal Fluorosis 18 people			Symptoms other than Dental/skeletal issues 32 people		
		serious	medium	Not observable	serious	medium	Not observable	serious	medium	Not observable
Pre Implementation	31	40	45	20	2	15	1	3	29	-
Post Implementation	31	39	41	25	2	13	3	1	28	3

According to the data shown in this table number of "not observable cases" are increased and there is a decreasing trend in serious and medium cases. These people had just followed the remedial guidelines during our awareness campaigning in villages. They have actively supported the mitigation program. They all have established The Nutrition garden seasonally and drink water from the secured sources which we marked in both the villages as a "SAFE sources". That's the reason we observed slight but significant improvement in health of these people.

Advocacy:

BSA has been continuously working on the issue of fluorosis and engaging with district and state governments on the issue of fluorosis. Village level meetings were carried out to plan a village level fluorosis mitigation plan.

Interactions with the villagers on the issue of fluorosis, mitigation, and need for preparation of a long-term plan for fluoride mitigation was carried out. Advocacy with the District Magistrate on the issue of fluorosis and its health impacts and the need for health supplements that were to be provided as per the NGT order has been continuously done. Advocacy with Uttar Pradesh Jal Nigam has led to installation of solar fluoride removal plants in two hand pumps in Kushmaha and Govindpur each.

Figure 20: solar fluoride removal plants of Govindpur

क्षेत्रीय ग्राम स्वराज्य सम्मेलन में फ्लोरोसिस के प्रति किया गया जागरूक

लोकल न्यूज आफ इंडिया, म्योरपुर। ग्राम पंचायतों को आदर्श बनाने का लिया गया संकल्प। बनवासी सेवा आश्रम के ग्राम निर्माण केंद्र खैराही प्रांगण में गुरुवार को क्षेत्रीय ग्राम स्वराज्य सम्मेलन का आयोजन कर दस सितंबर से दो अक्तूबर के बीच संदेश यात्रा के दौरान ग्रामीण क्षेत्रों में आई मुख्य समस्या को लेकर उसके निदान और आगे की रणनीति पर चर्चा की गई।क्षेत्रीय अध्यक्ष शीतलराम गोंड की अध्यक्षता में आयोजित।

सम्मेलन में फ्लोरोसिस जैसी गंभीर बीमारी पर विस्तार से चर्चा किया गया। फलोरोसिस निवारण कार्यक्रम के संयोजक प्रदीप सिंह द्वारा कुस्महा व गोविन्दपुर हुए फ्लोरोसिस से किए स्थानीय स्तर पर बचाव के उपाय व मिली सफलता पर विस्तार से चर्चा किया गया। सामुदायिक विकास कार्यक्रम पर चर्चा करते हुए देवनाथ भाई, ने बताया की ग्राम पंचायत सरकार के रूप में विकसित

कर गांधी जी के सपनों को हम सब मिलकर पूरा करेंगें।

उन्होंने सामुदायिक विकास कार्यक्रम खैराही, कुस्महा, गंम्भीरपुर, किरवानी, व रनटोला पर विस्तार से चर्चा किया। उन्होने समुदाय द्वारा किए गये सामूहिक कार्यों को सभी के समक्ष रखे। जगत भाई पर्यावरण की समस्या और जल कल योजना पर अपनी बात रखते कहा हमें रिहन्द जलाशय का पानी मिलने वाला जो प्रदूषण है उससे बचाव पर सम्मेलन में तय किया गया कि हम कनहर की पानी के गांव गाव से मांग करेगें। कलस्टर प्रभारी शिवनारायण भाई ने संदेश यात्रा से मिले अनुभवोन को सभी साझा किया।सम्मेलन को विमल भाई, केवला भाई, रामवृक्ष, रामविचार गौतम आदि वक्ताओं ने संबोधित किया। इस अवसर पर ग्राम प्रधान करमडाड मंजूदेवी, सीताराम, मनोज कुमार, कृष्णा कुमार, दीपचन्द, संगीता, आदि उपस्थित रहे। संचालन अशोक कुमार ने किया।

सम्मेलन में फ्लोरोसिस के प्रति किया जागरूक

चिंता

- फ्लोरोसिस बीमारी पर चर्चा किया गया
- समुदाय की ओर से किए गए कार्यों को बताया

म्योरपुर, संवाददाता। बनवासी सेवा आश्रम के ग्राम निर्माण केंद्र खैराही प्रांगण में गुरुवार को क्षेत्रीय ग्राम स्वराज्य सम्मेलन के दौरान फ्लोरोसिस जैसी गंभीर बीमारी पर विस्तार से चर्चा किया गया। उसके निवारण कार्यक्रम के संयोजक प्रदीप सिंह ने कुस्महा व गोविन्दपुर हुए फ्लोरोसिस से किए स्थानीय स्तर पर बचाव के उपाय व मिली सफलता पर विस्तार से चर्चा की।

सामुदायिक विकास कार्यक्रम पर चर्चा करते हुए देवनाथ ने बताया की ग्राम पंचायत सरकार के रूप में विकसित कर गांधी जी के सपनों को हम सब मिलकर पूरा करेंगें। उन्होंने समुदाय की ओर से किए गए सामूहिक कार्यों को सभी के समक्ष रखे।

जगत ने पर्यावरण की समस्या और जल कल योजना पर अपनी बात रखते कहा कि हमें रिहन्द जलाशय का पानी मिलने वाला है जो प्रदूषित है, उससे बचाव पर सम्मेलन में तय किया गया कि हम कनहर की पानी की मांग गांव -गाव में करेंगे। कलस्टर प्रभारी शिवनारायण ने संदेश यात्रा से मिले अनुभव को सभी ने साझा किया। सम्मेलन को विमल, केवला, रामवृक्ष, रामविचार गौतम आदि वक्ताओं ने संबोधित किया। इस अवसर पर ग्राम प्रधान करमडाड मंजूदेवी, सीताराम, मनोज कुमार, कृष्णा कुमार, दीपचन्द, संगीता, आदि उपस्थित रहे। संचालन अशोक कुमार ने किया।

ग्राम णिर्माण केंद्र खैराही में आयोजित क्षेत्रीय सम्मेलन में फ्लोरोसिस बीमारी की जानकारी देते प्रदीप सिंह ।

Figure 21: Village level meeting on fluorosis mitigation and sharing of results of BSA work on fluoride mitigation

Survey of fluoride kits in hand pumps in schools which were installed in 2013 by a company who was given contract for 5 years, showed that after 2018 they have never came for monitoring and hence they all are defunct at present. Due to constant pressure & advocacy time to time from BSA team, now solar RO plants have been installed in 40 villages by Jal Nigam, and a plan has been passed to install solar RO kits in 142 school hand pumps out of which for 54 schools the money has already been sectioned from the coal mining CSR fund, the work will start from January 2023 itself.

Nigam and presently, 42 hand-pumps in schools in – villages have been fitted with solar fluoride removal plants, and a plan to install – more solar de-fluoridation plants has been passed.

A large meeting with villagers from across the district and district officials and elected representatives was carried out, in which observations of fluorosis mitigation programme were shared. The interventions

carried out and the impacts of the interventions were presented using Powerpoint presentation and charts.

ग्राम पंचायतों को सुदृढ़ और सशक्त बनाने से आएगा ग्राम स्वराज्य

लोकल न्यूज ऑफ इंडिया, म्योरपुर। सामाजिक संस्थान बनवासी सेवा आश्रम गोविंदपुर के विचित्रा महा कक्ष में रविवार को दो दिवसीय ग्राम स्वराज्य सम्मेलन का उदघाटन आश्रम के अध्यक्ष अजय शेखर और पहले सत्र के मुख्य अतिथि बीएचयू के प्रो आलोक कुमार पाण्डेय आदि ने दीप प्रज्वलित कर किया।अपने संबोधन में मुख्य अतिथि प्रो पांडेय ने कहा कि पंचायती को सुदृढ़ और सशक्त बनाने से ही ग्राम स्वराज्य की नीव मजबूत होगी।उन्होंने कहा कि वैदिक काल में भी गावो के मजबूती के लिए सहभागिता की बात कही गई है।भारत की पहचान गावो की व्यवस्था और संस्कृति के रूप में है।और मंगल काल के पहले तक गांव स्वावलंबी थे।मंगल काल से लेकर अंग्रेजों के शासन काल में जागीरदारी और जमीदारी से गांव बिखरते गए। गांधी ने ग्राम स्वराज्य की बात की और उसे बनवासी सेवा आश्रम क्षेत्र में लोगो को स्वावलंबी , बनाने के साथ विकास और रोजगार के साथ लोगो के प्रतिभा निखार का काम कर रहा है।कहा कि पंचायतों को 29 कार्य करने की जिमेवारी है।जिसमे शिक्षा स्वास्थ्य,पर्यावरण संरक्षण , स्थानीय संसाधनों के बल पर रोजगार तकनीकी ज्ञान से खड़े किए जा सकते है।

हेजार्ड सेंटर दिल्ली की वसुधा ने कहा की सोनभद्र सिंगरौली में प्रदूषण की समस्या गंभीर रूप ले चुकी है यहां के हालात दिल्ली से कम नहीं है।उन्होंने कहा कि कोयला जलाने से निकले सूक्ष्म धूल कण से मनुष्य के फेफड़े प्रभावित हो रहे है और लोगो में काम करने की क्षमता घट रही है।आकलन में पाया गया की एक परिवार में अब तक 35 लाख का आर्थिक नुकसान फेफड़ों में आई कमजोरी से हो रहा है। कहा की वायु और जल प्रदूषण पर रोक के लिए ठोस कदम उठाए जाने चाहिए। डा विभा प्रेम और प्रमोद शर्मा ने आश्रम द्वारा किए गए फ्लोरोसिस कम करने के प्रयोग की जानकारी दी और बताया की शुद्ध पानी के प्रयोग से यूरीन में फ्लोराइड की मात्रा में कमी आई है।बताया कि गांव में52 फीसदी दंत फ्लोरोजिस21 फीसदी हड्डियों सहित 98 फीसदी लोग पीड़ित है।अहवाहन किया कि लोग सुरक्षित स्रोतों के पानी के साथ हरी साग सब्जी,तिल आदि का प्रयोग करे।

Figure 22: Presenting fluorosis mitigation data in convergence meeting in presence of many village people and representative of Govt.

Presently under the Har GharNal Yojana piped drinking water is to be provided throughout the villages of the district, and pipelines are being laid. The source of the water for this scheme is planned to be the Govind Ballabh Pant reservoir formed by the Rihand dam. However previous studies of BSA as well as other agencies have found that the water in the Pant reservoir is heavily polluted due to the presence of industries surrounding it. The industries have pumped ash pond

water into the reservoir over decades, and high levels of fluoride, as well as heavy metals like mercury, lead, chromium, arsenic have been found in its water. BSA and nearby villages are engaging with the Jal Nigam to test the water that is to be supplied, especially mercury and fluoride, and supply of safe water for villagers.

Figure-23: Training of qualitative test of Drinking water source to village voluntary health workers

शुद्ध पानी पीने से घटने लगती है शरीर में फ्लोराइड की मात्रा

संवाददाता। सोनभद्र

बनवासी सेवा आश्रम के आरोग्य केंद्र के माध्यम से गोविंदपुर और कुसम्हा गांवों में फ्लोरोसीस पीड़ितो पर किए गए प्रयोग से पता चला है कि भले ही इसका इलाज संभव नहीं है लेकिन शरीर से धीरे धीरे फ्लोराइड की मात्रा कम होने लगती है। इसके लिए जरूरी है की पीड़ित व्यक्ति पोषक तत्वों वाला भोजन ले और शुद्ध पानी का प्रयोग करे। बनवासी सेवा आश्रम आरोग्य केंद्र की चिकित्सिका डॉ. विभा प्रेम और लोक विज्ञान संस्थान देहरादून के विशेषज्ञ प्रेम नारायण ने बताया की दोनों गावों में सर्वेक्षण और पेशाब जांच के बाद 74 लोगों को फ्लोराइड रिमूवल कीट दिया गया जिसमें वे पानी को रख कर नियमित पानी पीने इसमें से जिन 44 लोगों ने नियमित कीट के माध्यम से पानी पिया उनमें पच्चास फीसदी तक फ्लोराइड की मात्रा कम हुई। जबकि जिन 30 मरीजों ने नियमित कीट का पानी सेवन नहीं किया उनमें दस से बीस फीसदी की ही कमी आई। बताया की दो साल पूर्व उपरोक्त दोनों गांव के पीड़ितो की यूरीन जांच में 8 से 16 मिली ग्राम फ्लोराइड पाया गया था। अब वह घट कर आधा हो गया। गांव में कुस्महा ग्राम प्रधान रजिया देवी व गंभीरपुर ग्राम पंचायत प्रतिनिधि मनोज कुमार के अगुवाई में बैठक कर इसकी जानकारी ग्रामीणों को दी गई और तय किया गया कि जिस कुआ या हैंडपंप के पानी फ्लोराइड मुक्त है उसी पानी को पिया जाए। इसके लिए ग्राम पंचायत में भी प्रस्ताव लाने पर सहमति बनाई गई। साथ ही लोगो को इसके लिए घर घर जाकर इन दोनो गांव के लोगो को शुद्ध पानी पीने के लिए प्रेरित भी करेंगे। प्रेम नारायण ने बताया कि फ्लोराइड का मानक पर लीटर 1.5 पीपीएम है। पानी में इसकी मात्रा ज्यादा होने पर फ्लोरोसिस नामक बीमारी होती है। जो हड़ियो को प्रभावित कर दिव्यांग बना देती है। डा. विभा ने खान पान में पोषण युक्त सब्जी तिल व आवला के प्रयोग करने पर बल दिया। शुध्दपेय जल के लिए ग्राम सभा में प्रस्ताव लाने की बात चर्चा किया गया। शुभा बहन ने बताया कि इस फ्लोरोसिस की चपेट में जिले के पांच ब्लॉक के लगभग साढ़े तीन सौ गांव के हजारों लोग प्रभावित है। यह सफल प्रयोग अन्य गांवों में किया जा सकेगा। देवनाथ भाई ने कहा सभी परिवार सौ वर्ग मीटर खेत में पोषण वाटिका लगाए जिससे पूरे वर्ष सब्जी मिलता रहेगा। इस अवसर पर देवनाथ भाई प्रमोद कुमार आदि मौजूद रहे।

Sandesh Yatra:

Sandesh Yatra "Rally" was organized for awareness building about fluorosis & its presentation in which students,teachers of both village schools, heath team andvillagers participated. Many flip cards and handbills were exhibited showing massages related to fluoride mitigation. A meeting was organized with all the participants.

Figure-24:

शुद्ध जलापूर्ति के लिए लोगों को किया गया जागरूक

फ्लोराइडयुक्त पानी के खिलाफ निकाली रैली

ब्योरपुर, हिंदुस्तान संवाद। बनवासी सेवा आश्रम के आरोग्य केंद्र की ओर से सोमवार को फ्लोराइडयुक्त पानी के खिलाफ रैली निकाली गई। लोगों को शुद्ध जलापूर्ति के जागरूक किया गया। शिक्षा निकेतन गोविंदपुर और कुरमहा के शिक्षकों, विद्यार्थियों और स्वास्थ्य कर्मियों ने रैली निकाल कर ग्रामीणों को जागरूक किया। इससे बचने के लिए शुद्ध पीने पर जोर देने के साथ ही साथ पौष्टिक भोजन करने पर जोर दिया। रैली में बैनर और तख्ती लिए विद्यार्थियों ने फ्लोराइड जागरुकता की नारे लगाए। गांव में घूम-घूम कर ग्रामीणों को फ्लोराइड की अधिकता से होने वाली बीमारी से होने वाले नुकसानों के बारे में बताया। इससे बचने के लिए पोषण युक्त भोजन और शुद्ध पानी के सेवन का आह्वान किया। इस दौरान बनवासी सेवा आश्रम के आरोग्य केंद्र की डॉ. विभा आगेस्टिन ने कहा कि फ्लोराइड की अधिकता से दांतों में पीलापन, हड्डियों में दर्द और पाचन की समस्या आती है। यदि समय रहते इस पर ध्यान न दिया जाए तो शरीर की हड्डियां तक टेढ़ी हो जाती हैं और पीड़ित व्यक्ति कुछ सालों में पीड़ित खाट पकड़ लेता है। इससे बचने के लिए पीने वाले पानी की समय-समय पर जांच कराते रहना चाहिए। साथ ही तिल , तीसी, आवला और मौसमी साग-सब्जी का प्रयोग करना चाहिए। इसके लिए घर -घर में पोषण वाटिका लगाने पर उन्होंने बल दिया। बताया कि यदि घर में किसी सदस्य में फ्लोराइड के लक्षण दिखे तो सबसे पहले पीने के पानी को बदल दें और खान -पान पर ध्यान दें तो बीमारी वहीं रुक सकती है। रैली में मौके पर डॉ., राहुल यादव, मोती लाल, नेहा,बिट्टू ,गंगा राम आदि मौजूद रहे।

बनवासी सेवा आश्रम की ओर से सोमवार को निकाली गई रैली में शामिल लोग।

Figure-25:

Impact of Covid 19

The project was carried out between September 2020 and October 2022 during the Covid-19 pandemic. Nationally, infections peaked around September 2020 and then started going down. In the beginning of first phase of project, public meetings for awareness could not be held, and individual interactions could only be carried out. As infections came down, public meetings could be carried out. Then in March 2021, the Delta wave began, further delaying the completion of the first phase of the project. BSA staff as well as villagers fell ill.

Closing observations

Sonbhadra district has endemic fluorosis, with villages across the district having fluoride in water sources. Fluoride is released by the multiple thermal power plants as well as other industries such as aluminium smelting plants in the region. It is estimated that upto 30,000 kilos of fluoride are released into the environment daily only by the thermal power plants. Thus, residents of Sonbhadra are exposed to fluoride both through the air as well as water. Previous monitoring by BSA has found 1-3 ng/m^3 of fluoride in the atmosphere, and groundwater in Kushmaha and Govindpur has been found to contain fluoride between 0.6-7.26 mg/l and 0.8-6.76 mg/l, respectively.

Due to this, residents of villages across the district are affected by fluorosis. This study was carried out in the villages of Kushmaha and Govindpur. 97.11% of residents of Kushmaha and 88.65% of residents of urinary fluoride above 1.5 mg/l.

Only 0.61% of residents both villages showed no signs of dental fluorosis, and 1.72% of residents showed no signs of skeletal fluorosis. 77.06% and 78.62% of residents showed mild, medium or serious symptoms of dental and skeletal fluorosis respectively.

This pilot project was carried out to establish a model for fluorosis mitigation. Various interventions such as providing defluoridated water, nutritional and medical supplements, as well as encouraging villagers for better nutritious diet were carried out with a sample of 74 villagers. Regular interactions with these villagers to follow these practices, and to observe impacts of the interactions over a period of 2 years was carried out. It was observed that median decrease in urinary fluoride levels was greatest amongst those using defluoridated water regularly. Better nutrition for those who show symptoms of fluorosis indicates a symptomatic relief of skeletal fluorosis, as shown by the X-ray observations, however more long-term follow up of these practices would give a better indication of effectiveness. In older residents who have been chronically exposed to increased levels of fluoride there will be damage, however if younger children can be provided access to good quality water then deformities amongst them can be prevented.

The initial results of this pilot project are promising, however if it can be extended for a year the trends observed canbe strengthened and the villagers can be further mobilized to follow these practices. Supplements can only be provided short term, the residents themselves have to access nutritious food, for which their social and economic status also needs to be strong. A village level fluoride mitigation plan can be implemented to ensure all residents of village are able to access fluoride free water. Advocacy with state and district administration to follow these practices is being done. follow these practices. Pressure also needs to be exerted to ensure that further pollution of the region does not take place that would undo the impacts of fluoride mitigation efforts, and cause remaining sources of water also to have high levels of fluoride.

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