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Ensuring Drinking Water Safety in Nirmal Gram Panchayats In Rajasthan, India - A Major Challenge

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ABSTRACT

A research was undertaken to assess the key parameters which impact the drinking water quality at household and community level in Nirmal Gram Panchayats (fully sanitized and open defecation free village councils) in ten districts of Rajasthan, the largest State by area in India. Five key parameters of water safety were rapidly assessed utilizing household survey questionnaire, structured-observations, visual inspections and testing bacteriological quality of water. The results of the research reveal that three out of five key parameters scored between 50 and 60 percent and two parameters scored between 60 and 70 percent. The State water safety index is 60.26 percent. All the Nirmal Gram Panchayats in Rajasthan needs to develop and implement the water quality surveillance and monitoring plan of actions with the technical and financial support from the state water and sanitation mission and respective district water and sanitation missions to ensure hundred percent water safety in all the Nirmal Gram Panchayats.

INTRODUCTION

Government of India (GOI) initiated the total sanitation campaign (TSC) in the year 1999 in rural areas to eliminate the practice of open defecation. To add push to the TSC in June 2003, GOI initiated an incentive scheme for fully sanitized and open defecation free (ODF) Gram Panchayats, Blocks and Districts called the “Nirmal Gram Puraskar” (Clean Village Award). Eligible Gram Panchayats, Blocks, and Districts are those that achieve (a) hundred percent sanitation coverage of individual households, (b) hundred percent school sanitation coverage, (c) free from open defecation and d) clean environment maintenance (SACOSAN II 2006). By 2013, 28590 Gram Panchayats were awarded Nirmal Gram Puraskar (NGP) after becoming Nirmal Gram Panchayats (fully sanitized and open defecation free village councils) out of which 326 Gram Panchayats in 28 districts were from Rajasthan (GOI 2016). Rajasthan, the largest State by area in India is situated in the north-west of the country and comprises of total 33 districts with 248 blocks and 9177 Gram Panchayats. ODF is termination of faecal-oral transmission, defined by: a) no visible faeces found in the environment/village; and b) every household as well as public/community institution using safe technology option for disposal of faeces. Solid and liquid waste management is also an important component of Swachh Bharat. This includes management of both organic and inorganic waste in villages and management of grey water from kitchen and bathrooms for which Ministry of Drinking Water and Sanitation provides technical and financial assistance to the States (SACOSAN VI 2016). With the launch of Swachh Bharat Mission-Gramin (rural) to make all Gram Panchayats, clean and sanitize by 2019, the award of NGP was discontinued after 2013.

Availability of water is a factor that influences the demand for sanitation as hand-washing after defecation and flushing excreta require a sufficient quantity of water. In turn, sanitation can impact the quality of water. There is a scope to establish linkages between sanitation and water quality and quantity through convergence of GOI flagship rural water programme. An appropriate technology, especially for pit latrines, is a must to prevent groundwater contamination (SACOSAN III 2008). A Nirmal Gram Panchayat should ensure availability of 55 litres per person per day potable water for each inhabitant of Gram Panchayat and the water source for each household should be within 100 metres, with arrangement for regular testing of water quality of all water sources (GOI 2012). A safe and sustainable water supply, basic sanitation and good hygiene are essential for healthy, productive and dignified life (IFAD 2009). Basic sanitation facilities are those that effectively separate excreta from human contact, and ensure that excreta do not re-enter the immediate household environment. A pit latrine with a superstructure, and a platform or squatting slab constructed of durable material, composting latrines, pour flush latrines, ventilated improved pit latrines, flush toilet connected to a septic tank or sewer come under the category of basic sanitation facilities.

The main causes of human enteric diseases are the bacteria, virus, protozoa and helminths. Failure to ensure drinking water safety may expose the community to the risks of outbreaks of intestinal and other infectious diseases (WHO 2006). Globally, 1.5 million annual diarrheal deaths occur among children under five years of age. In India, more than 1000 children under five years die every day due to diarrhoea and 80 percent of these children is under two years of age (UNICEF 2011). About 88% of all diarrheal deaths are caused by unsafe drinking water, poor sanitation and insufficient hygiene (UNICEF/WHO 2009).

Sustainable Development Goal 6 aims to "ensure availability and sustainable management of water and sanitation for all, and places new emphasis on countries to improve services beyond access, which includes measures to improve quality and availability of drinking water and ensures safe management of faecal waste (UN Water/WHO 2015). Safely managed drinking water services consistently supply water which meets household needs and does not present very much risk to health (WHO/UNICEF 2014). Improper disposal of human excreta can cause diarrhoea and intestinal worm infections such as hook worm and round worm (World Economic Forum 2011). As per the multi district assessment on water safety (MDAWS) conducted by UNICEF in all 47 districts of Madhya Pradesh and 13 other districts spread over 11 States including Rajasthan, overall 47% of water sources were found polluted with faecal coliform. The main anxiety of villagers is the availability of sufficient quantity of water, not the availability of safe water and they do not differentiate between clean water and safe water. In cases where sufficient water is available villagers want that the source is near and reachable (UNICEF 2011).

For those who have sufficient quantities of water, but whose water is poor or uncertain bacteriological quality, an alternate is to treat water at home. Water treatment at household level reduces the risk of waterborne diseases arising from recontamination during collection, transport, storage and use at home (Wright et al. 2003). The research has concluded that simple and affordable water treatment methods at household and community level can improve the microbial quality of household water and decrease the risks of diarrheal diseases and death in the developed and developing countries (Sobsey 2002). Boiling is the most common method of household water treatment with 21 percent households practice boiling, 5.6 percent households use chlorine, 4.3 percent households practice filtration and only 0.2 percent households use solar disinfection (Rosa & Clasen 2010).

The assessment study carried out by Centre for Media Studies (CMS), Delhi in 2011 on impact and sustainability of 664 Nirmal Gram Panchayats in 56 districts of 12 states reveal that provision of sustainable water supply, ensuring safe distance (minimum 10 metres) between leach pit and nearest water source, exposure of Nirmal Gram Panchayats to various low cost options for sanitation, and disposal of solid waste and liquid waste are major challenges in ensuring sustainability (CMS 2011). An evaluation study on total sanitation campaign carried out by the planning commission in 2013 in 20 states including Rajasthan reveals that water tap is the major source of drinking water for 36.7% houses, hand-pumps for 41.2% houses, wells for 11.4% houses and other sources for 10.7% houses. Rajasthan was ranked 12th among 20 states based on its performance in total sanitation campaign (Planning Commission 2013).

There is an urgent need for regular surveillance and monitoring of water quality at the household and community level as well as protection of drinking water sources to prevent them from getting polluted from septic tank/leach pit effluent and faecal waste littering around them. Once the bacteria and viruses reach the water table, they can be carried over considerable distances in the direction of groundwater flow. Although pit latrines have potential for groundwater contamination, but are used on large scale for onsite human excreta disposal. The pit latrines are basic sanitation option for low-income countries to decrease the rate of open defecation and increase access to improved sanitation. Areas with shallow groundwater and low lying areas prone to flooding present the greatest risks of contamination because required vertical separation is necessary between the base of latrine pits and the saturated zone to prevent pollution of groundwater (Graham et al. 2013).

To minimize the pollution risk, the distance between the bottom of the pit and the maximum groundwater level should be two meters or more. The minimum horizontal distance of separation between water source and the leach pit should be 3 metres for fine sand, clay and silt, if the distance between the bottom of the pit and the maximum groundwater level is less than 2 metres, the minimum horizontal distance of separation should be 10 metres for fine sand, clay and silt. In case of coarse sand, 500 mm envelope of sand of 0.2 mm effective size is provided all round the leach pit and bottom of the pit is sealed to ensure the water safety (TAG-India 1985).

Septic tank needs sludge removal at regular intervals in accordance with its design and capacity. But mostly when a septic tank is filled beyond its holding capacity and overflows, the sludge removal is carried out. The overflow from septic tank enters into the nearest water sources, land surface, water bodies and pollutes them. This results in saturation of surface soil and water bodies with nutrient posing a threat of eutrophication to surface waters. The animals and human beings coming in contact with the polluted areas are susceptible to infections. The groundwater gets polluted when sludge percolates near the water source (CSE 2011).

Managing small community water supplies, including those serving rural villages, is a concern worldwide in both developed and developing countries. Experience shows that small community water supplies are more at risk of breakdowns and contamination resulting in outbreaks of waterborne diseases and decrease in their functionality and service (WHO 2012). The present approaches to monitoring rural water supply focus on coverage measured in terms of the number of systems installed and population served. But many system breakdown within a few years of installation due to lack of proper operation and maintenance and population which was shown as served is left for want of reliable service (IRC 2011). The financial sustainability of community water system is a big challenge and rural habitations, which are dispersed and difficult to reach cannot afford to pay the cost of operation and maintenance of water supply system, and it is almost impossible for them to pay the capital costs (IFAD 2009).

The extensive literature review and field experiences reveal that improving quality and availability of drinking water at the household and community level for rural water supply systems is a major challenge. Therefore, a research was undertaken to assess the extent to which the drinking water safety was ensured at household and community level in Nirmal Gram Panchayats in Rajasthan.

MATERIALS AND METHODS

The following five key parameters of water safety were assessed through rapid assessment at household and community level in ten randomly selected Nirmal Gram Panchayats in 10 districts to find out the extent to which the drinking water safety was ensured in Nirmal Gram Panchayats in Rajasthan:

1. Toilet use: Toilet used by all family members of the household.
2. Toilet location: Safe distance (minimum 10 metres) between toilet pit and water source ensured.
3. Safe water at home: Drinking water free from bacteriological contamination at home.
4. Safe water source: Community water source free from bacteriological contamination.
5. Clean water source: No faecal waste accumulation around community water source.

The following research methods were utilized in undertaking rapid assessment of five parameters.

- Household survey questionnaire (in Hindi language) was utilized to collect information at household level. The questionnaire covered all the relevant questions regarding use of toilet by all the family members, proper collection, storage and handling of water, and distance between water source and toilet pit. The questionnaire was completed at each household through interaction with family members present at the time of survey. Face-to-face contact is important for engaging with the family members, building rapport and gaining their confidence which helps in informally assessing the validity of responses given by them (Denscombe 2014).
- Structured-observations were carried out to correlate and check the reliability of information collected through household survey questionnaire as well as to assess the extent to which the hygiene behaviours were practiced by all family members. The structured-observation was utilized as a tool which was best suited to the measurement of hygiene behaviours (Curtis et al. 1993). Observing water handling and storage practices and interviewing community members provided useful information on the actual causes of poor water quality (UNICEF 2008).
- Visual inspections and assessments of water and sanitation facilities were carried out at household and community level utilizing a checklist to assess the environment around water sources, toilet use and distance of toilet from water sources.
- H_2S (hydrogen sulphide) strip vials were utilized to test the bacteriological quality of drinking water source at community level and drinking water stored and used at the household level. The water was collected in H_2S strip vial directly from water source/storage tank/storage container and kept covered in vial for 48 hours. If the colour of water turned black, it indicated bacteriological contamination and if the colour of water in the vial remain unchanged after 48 hours the water was free from bacteriological contamination. The test is based on measuring bacteria that produce hydrogen sulphide. The test measures the presence of H_2S by its reaction with iron to form an insoluble black precipitate. The test is simple and affordable and used for drinking water management and health education in water and sanitation sectors (WHO 2002).

The rapid assessments were carried out for all the five parameters in 15 randomly selected households utilizing the above research methods in 10 randomly selected Nirmal Gram Panchayats in 10 districts- one each in each district. Each parameter was assigned a maximum score of 100 if it was fully met. The average actual scores of all the 15 households and randomly selected community water sources for each parameter in terms of percentage achievement indicated the extent to which that parameter was achieved in that Nirmal Gram Panchayat. The average score of all the five parameters represent the district water safety index of that district. Equal weightage was given to all the five parameters of water safety because all of them are interrelated and equally impact the water safety at household and community level. The average of water safety indices of 10 districts represent the water safety index of Rajasthan State of India.

RESULTS AND DISCUSSION

District-wise scores of water safety parameters/index are given in Table 1. The State water safety index of Rajasthan State is 60.26 percent.

A bar chart showing percentage achievement for five parameters of water safety in ten districts and Rajasthan State is shown in Fig. 1. The district-wise water safety index for ten districts and state water safety index for Rajasthan State are presented in a spider diagram in Fig. 2.

In 69.7 percent households in Rajasthan all the family members use toilet and in the remaining 30.3 percent households one or more members of the family go for open defecation in fields, near water bodies, close to water sources posing threat to the contamination of water sources and water bodies. In 59.2 percent households toilet pits are rightly located and the minimum distance of 10 metres is maintained between the toilet pit and water source viz., underground water storage tank, rain water harvesting tank, open well, hand-pump etc. In remaining 40.8 percent households the minimum distance of 10 metres has not been maintained between the water source and toilet pit. The H_2S strip vial test reveals that in 54.9 percent households the drinking water was free from bacteriological contamination and in remaining 45.1 percent households the bacterial contamination was found in drinking water.

Sixty four percent water sources were found safe on testing with H_2S strip vials, and bacteriological contamination was found in 36 percent water sources. The environment around 53.5 percent community water sources was found clean and in the remaining 46.5 percent water sources accumulation of faecal waste and stagnant wastewater around water source was found. The results of rapid assessment reveal that drinking water safety has been ensured at 64 percent community water sources and at 54.9 percent households. The community water sources get contaminated from faecal waste accumulated around them due to open defecation, effluent from septic tanks, drains, leach pits, and improper disposal of solid and liquid waste. Drinking water gets contaminated at household level due to improper storage and handling of water and not maintaining safe distance between water source and toilet pit in the house.

The factors which contributed to low district water safety index in Churu, Hanumangarh and Karoli districts are as follows:

- The water storage tanks in Nirmal Gram Panchayat Somiasar (Churu district) do not get water from the safe water source, being the tail end village of the regional water supply scheme, due to which the villagers are compelled to fetch contaminated water in water tankers from the nearby polluted canal and store it in the water tanks at their houses for drinking and other uses. There is no other alternate source of safe water in the village. The safe water is available at a distance of 21 km from the village and fetching water in a tanker from that source costs Rs. 800 per trip due to which only 10 percent households are fetching water from that distant safe source and remaining 90 percent households are using contaminated water of canal without any home treatment to make it safe. Although the environment around 27 percent community water tanks was clean, but the safe water was not reaching to any of the

Table 1: District-wise scores of water safety parameters and water safety index.

S.No.	Name of district	Name of Nirmal Gram Panchayat	Toilet use	Right toilet location	Safe water at home	Safe water source	Clean water source	District water safety index
1	Ajmer	Jamola	33	73	87	87	67	69.4
2	Bundi	Basoli	67	53	85	60	90	71
3	Churu	Somiasar	73	53	10	27	10	34.6
4	Hanumangarh	Mulsisar	67	60	25	33	25	42
5	Jaipur	Mahlana	67	60	75	87	60	69.8
6	Jhunjhnu	Mohanbari	73	60	50	80	50	62.6
7	Karoli	Sakarwada	87	73	25	53	33	54.2
8	Pali	Jhoontha	83	40	67	73	75	67.6
9	Rajsamand	Piplantri	80	73	50	67	50	64
10	Sikar	Magloona	67	47	75	73	75	67.4
11	Whole Rajasthan		69.7	59.2	54.9	64	53.5	60.26

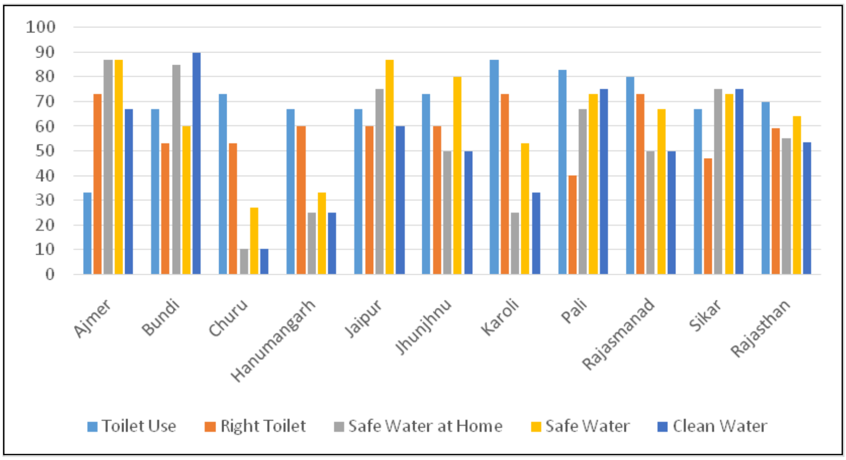

Fig. 1: Water safety parameters for ten districts and whole Rajasthan state.

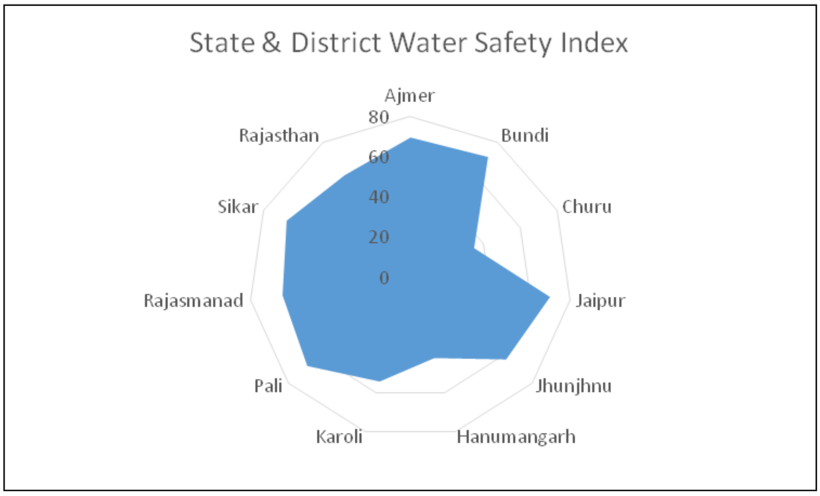

Fig. 2: Water safety index by district and whole Rajasthan state.

tanks from the regional scheme, and in remaining 73 percent water tanks neither the water was reaching from regional scheme nor the environment was clean around them.

- In Nirmal Gram Panchayat Mulsisar (Hanumangarh district) there are two diggies (open reservoirs) for supplying drinking water, but water in both the diggies is contaminated. Villagers fetch water from the contaminated diggies, store it in the water tanks/containers at their houses and use it for drinking and other purposes. The environment around both the diggies is not clean. There are two hand-pumps in the Gram Panchayat and households living close to those hand-pumps are taking water from the hand-pumps. The environment around one hand-pump was clean, but there was accumulation of faecal waste around other hand-pump. In a few households rain water collected in underground tanks during rainy season was used for drinking and cooking. The availability of safe water is ensured only in 25% households and the remaining 75% households are using contaminated water. Water is not treated at household level before use.
- In Sakarwada (Karoli district) at 25 percent households, water was found free from bacteriological contamination. The water is supplied for one hour in the morning through the piped water system from a government tube-well to only 25 percent households. Seventy five percent households get water from private tube-wells located in the fields through water connection and pay water charges to tube-well owners. The water is also supplied through public stand posts (PSPs) connected to private tube-wells/piped water system. The environment

around 33 percent public stand posts was clean and faecal waste and wastewater stagnation was found around 67 percent PSPs. In summer season, villagers do not get water from the piped connections and PSPs and fetch contaminated water from a pond about half kilometre from the Gram Panchayat for drinking and other uses.

There is an urgent need to upgrade/improve the water supply schemes in Churu, Hanumangarh and Karoli districts to enhance the score of district water safety index in these three districts.

CONCLUSION

The results of the research reveal that three out of five parameters scored between 50 and 60 percent and two parameters scored between 60 and 70 percent. Thus achieving hundred percent score of all the five key parameters to ensure water safety in Nirmal Gram Panchayats is a major challenge. The State water safety index of Rajasthan is 60.26 percent. The district water safety indices of Churu, Hanumangarh and Karoli districts are very low and less than the State water safety index. Nirmal Gram Panchayats in all the 28 districts need to develop, implement and monitor the water quality surveillance and monitoring plans of action with technical and financial support from the State Water and Sanitation Mission (SWSM) and in partnership with the community based organizations with active involvement of the community. All the Nirmal Gram Panchayats need to develop, implement and maintain the solid and liquid waste management systems with technical and financial support from SWSM. The District Water and Sanitation Missions (DWSMs) and SWSM need to review the effectiveness of water supply schemes in all the Nirmal Gram Panchayats and undertake the up-gradation/improvement of water supply schemes wherever necessary giving priority to Churu, Hanumangarh and Karoli districts to ensure the availability of 55 litres per person per day potable water for each inhabitant and the distance of safe water source from each and every household should not exceed more than 100 metres.

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