Assessing Environmental Sanitation in Rural Area of Sukena Village, District - Nashik, Maharashtra

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Abstract: The aim of this study was to assess the environmental sanitation condition with regards to water, wastewater, solid waste management and hygiene of households of Sukena village, District - Nashik, Maharashtra. The proper disposal and management of solid, liquid and grey water waste should be done properly so as to keep away breeding mosquitoes and house flies from the Sukena village.

In this study, the physicochemical parameters such as pH, TDS, DO, BOD, Total Alkalinity, Total Hardness, Fluorides, Chloride, Nitrates, Iron etc. were analyzed to know the present status of the water quality during pre-monsoon & post-monsoon of 2013-14. Also contaminated water tested for various (pH, Total solids, BOD, COD, Salinity, Calcium, Magnesium, Sulphate, Nitrites, Total Organic Carbon, Surfactants, E. coli) parameters is collected from drainage line and some of the water samples affecting pesticides concentration like Atrazine, Aldrin; Dieldrin; 2, 4 – D; p, p DDT; o, p DDT; p, p DDE; o, p DDE; p, p DDD; o, p DDD; α Endosulfan; β Endosulfan; γ HCH (Lindane) in Sukena village.

Pollution of soil was checked by testing various (pH, Bulk Density, Porosity, Water Holding Capacity, Organic Matter, Total Nitrogen, Available Phosphorus, Available Potassium, Cation Exchange Capacity, Available Boron, Nitrite and Acidity parameters with addition of solid waste management study, the construction details and design of the drainage chamber, composting pits, design of sanitary block should be analyzed. Socio-economic and demographic characteristics of the head of households and respondents, Type of solid waste, domestic wastewater disposal used by households, Places where household members wash their hands, Places where household members take bath in Sukena Village, (n=300) field survey is to be done to check out the environmental hygienie condition of the Sukena villagers.

Keywords: Environmental sanitation, Domestic water, Waste water, Contaminated Soil, Solid waste, Physico-chemical parameters, Graph Analysis, Sukena village.

I. INTRODUCTION

Environmental sanitation is nothing but the sanitation system affected on the human lives, as it is a major public health issue in India. Most of the cities and towns in India are characterized by over-crowding, congestion, inadequate water supply and inadequate facilities of disposal of human excreta, wastewater and solid wastes. The environmental sanitation still remains an ignored issue mainly in rural areas of India.

In the present study, Environmental Sanitation Study on Sukena village in Nashik district (Maharashtra). In this, the Gondegaon well water, tap water, contaminated water and contaminated soil and the water affected by pesticides, collected from the Gondegaon well and Bhandare's well (farmer) has been collected and the testing is to be done in the laboratory. The main problems occurred are the quality of water supplied to the village for the utilization of water in domestic purposes and other resources and the proper disposed off of human excreta.

The main objective of the work described was to ascertain: Investigate the accessibility, availability and usage pattern of drinking water of households; Ascertain the accessibility and availability of environmental sanitation facilities; Examine the knowledge and practices of the households in relation to environmental sanitation and hygiene conditions; Identify factors contributing for the availability of environmental sanitation facilities in relation to household characteristics; Develop and maintain a clean, safe and pleasant physical environment in all human settlements and Promote the social, economic and physical well-being of all sections of the population.

II. METHODS AND MATERIALS

Village survey is done through all over the area so as to know the village population, supply of water to the villagers through Gondegaon well and Ban Ganga River, the disposal of waste water coming out from the households and sanitary blocks should be done properly and separately, with the help of Gram-Panchayat and PHC (Public Health Center), all the data's of Sukena village and the water borne diseases affecting on the villagers. The village is having population of about 11610. The water samples are collected from the tap water (pre-monsoon and post-monsoon) in 2013-14, Gondegaon well water, to check the quality of water, contaminated soil and water has been collected and testing is to be done in the laboratory to get the permissible values of the selective parameters. The experimentally calculated values are compared with the standard values of the water, contaminated water and soil by graphical means.

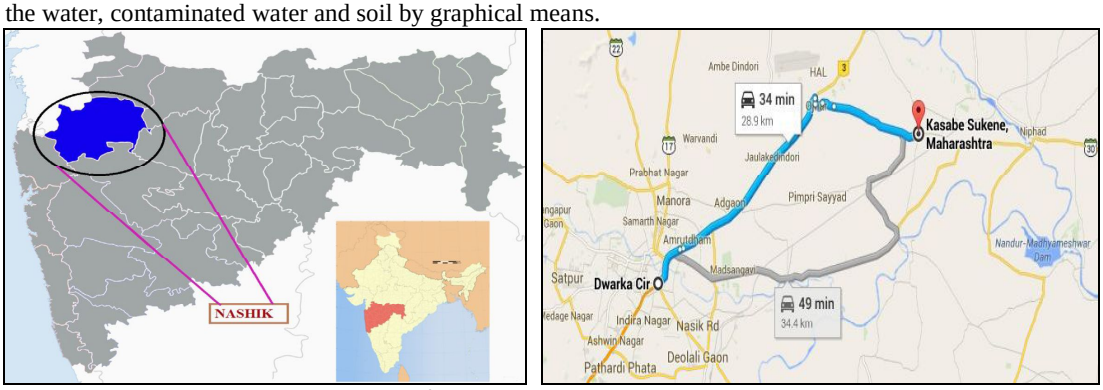

Figure 1. Location Map of Sukena village with Sampling Stations in Nashik District

The parameters for the drinking water analysis are: pH, Temperature, Alkalinity, Turbidity, Total Dissolved Solids, Dissolved Oxygen, Total Hardness, BOD, Fluorides, Chlorides, Nitrates and Iron. The parameters for the contaminated water analysis are: pH, Total solids, BOD, COD, Salinity, Calcium, Magnesium, Sulphates, Nitrites, Total Organic Carbon, Surfactant and E. coli and the parameters for the contaminated soil analysis are: pH, Bulk Density, Porosity, Water Holding Capacity, Organic Carbon, Total Nitrogen, Available Potassium, Available Phosphorus, Available Boron, Cation Exchange Capacity, Nitrites, Acidity.

The parameters for the water affected by the pesticides concentration, collected from the Gondegaon well and Bhandare well are: atrazine, aldrin, dieldrin, 2,4 – D; p, p DDT; o, p DDT; p, p DDE; o, p DDE; p, p DDD; o, p DDD; α Endosulfan, β Endosulfan, γ HCH (Lindane) respectively so as to check the concentration of pesticides present in the well water, whether it is harmful for the soil quality and water quality connected to the agriculture field.

The design and construction of drainage chamber is to be carried out with the help of Gram Panchayat and the accurate line out has been planned and the work is going on. The waste coming out from the house hold kitchens, basins, toilets etc. are being mixed, that should be segregated properly so that it can be easily disposed off. Next to that, the construction of manure pit (composting) with the detailed costing including number of bricks, material required. The contaminated soil and the contaminated water adversely affected due the close connections of main water pipe line and newly constructed drainage pipe line in one place. The calculation of per family solid waste disposed of by surveying in Sukena village and the costing for constructing a single toilet for the single family of the Sukena village. And while going through the survey, the major thing I have observed while constructing the drainage chamber, is that, the water pipeline allotted to the villagers for the utilization of domestic purpose are in the same place and parallel to the drainage pipeline. The main water pipelines should be located above the main drainage pipelines so as to avoid the mixing of waste water with the main drinking water.

Forecasting of Population:-

Table 5.2 Forecasting of population for further increase in population

Year	Population	Increase in population
1981	6865	
1991	8409	+1544
2001	10353	+1944
2011	11610	+1257
Average increase in population		+1582

By arithmetical methods,

Population in 2021=Population in 2011 + n * Average increase of population over 3 decades

= 11610 + 3*1582 = 16356

The solid waste are of mainly various types, such as paper, plastic bags, bottles, vegetables wastes, ashes, fruit pulp and residue, egg pulp etc. from the domestic areas, streets whereas the plastic bags, polythene wrap over the medicines, bottles, syringe, saline bottles, cotton balls, etc from the health care centre situated in the Sukena village. By approximate calculation for the solid waste disposed off per family in the Sukena village is 0.1 x 11610 = 1161 kg/day/capita = 1.161 tonne (approx.1-2 kg/day/capita). I am analyzing the solid waste collection of 14 days i.e. two weeks from one family. After analysis, the total solid waste collected is to be composting into the pit is 16.254 tonne and accordingly, the size of the composting pit will be 1 to 1.5 m long, 1 to 1.5 m wide and 1 m deep respectively.

Appropriate and safe excreta management is essential for the protection of human and environmental health, and also offers important social benefits to communities. Some of these benefits included in the elements described here under:-

1**. Human Health:** The impact of lack of basic sanitation is seen primarily in the area of health. Links between sanitation and health have long been established; health benefits of sanitation can be seen in the reduction of diseases in communities where sanitation facilities are present.

2. **Environmental Health:** The release of untreated excreta into the environment is a significant factor in the pollution and degradation of both water and soil quality. The effects of this can be seen in developing countries as most of the generated raw wastewater is discharged into surface water bodies.

3. **Poverty and Economy:** Sanitation related diseases exert a significant toll on the lives of people globally, it thus stands to reason that sanitation and related interventions will lead to an improvement in health, consequently productivity and ultimately poverty reduction. In addition to these positive effects of improved sanitation on individual livelihood, there are indirect potential (communal and national) economic benefits as well.

4. **Convenience, Privacy and Safety**: Beyond health, access to toilets, enhances privacy, dignity and safety particularly for women.

5. Justice and equity: Equity and justice are fundamental principles underlining a sustainable society and development. It basically recognizes the right to water and sanitation as a human right, which when lacking negatively affects life, and as such is a vital component of the right to life, health, housing and education among other rights.

III. RESULTS AND DISCUSSIONS

Table 1. Experimentally Calculated values for post monsoon Nov – 2013 of Water Quality Parameters

Sr. no.	Characteristic	Experimentally calculated values		Permissible Limits
		Tap water	Gondegaon well water	
1	Ph	6.5	6.3	6.5 to 8.5
2	Temperature	25	25	25
3	Alkalinity	525	500	200
4	Hardness (mg/L)	570	375	300
5	Turbidity (NTU)	5	5	5

6	Total dissolved solids	950	900	500
7	BOD	3.5	3.2	0
8	DO (mg/L) (max.)	4.5	3.9	6
9	Fluorides (mg/L) (max.)	1.0	0.5	1
10	Chlorides (mg/L) (max.)	420	300	250
11	Nitrates (mg/L) (max.)	45	10	50
12	Iron (mg/L) (max.)	0.1	0.3	0.3

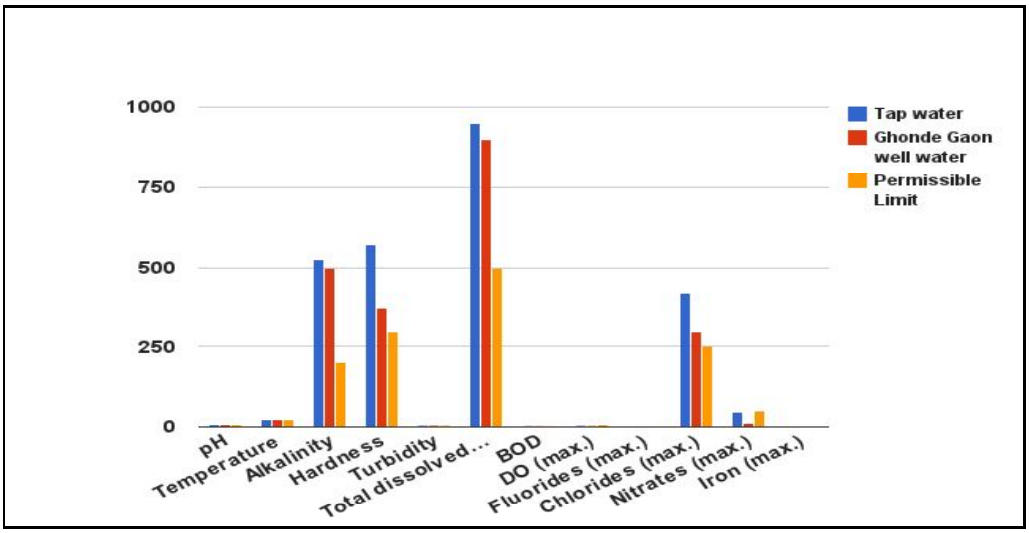

Figure 2. Graph Analysis on the Post monsoon (Nov 2013) Water Quality Parameters

The following parameters calculated from the experimental work with maximum values for post monsoon Nov – 2013 of Sukena village are explained as follows:-

TDS, D.O., Alkalinity and BOD are having maximum values as compared to the permissible limit.

Table 2. Experimentally Calculated values for Pre Monsoon of Water Quality Parameters

Sr. no.	**Characteristic**	**Experimentally calculated values**		**Permissible Limits**
		Tap water	**Gondegaon well water**	
1	pH	5.6	5.9	6.5 to 8.5
2	Temperature	25	25	25
3	Alkalinity	425	390	200
4	Hardness (mg/L)	380	255	300
5	Turbidity (NTU)	4	4	5
6	Total dissolved solids	800	700	500
7	BOD	2.8	1.9	0
8	DO (mg/L) (max.)	3.5	2.5	6
9	Fluorides (mg/L) (max.)	0.75	0.35	1
10	Chlorides (mg/L) (max.)	210	150	250
11	Nitrates (mg/L) (max.)	25	5	50
12	Iron (mg/L) (max.)	0.05	0.1	0.3

The following parameters calculated from the experimental work are of pre monsoon May – 2014 of Sukena

village are explained as follows:-

TDS, Alkalinity and Hardness are having maximum values as compared to the permissible limit.

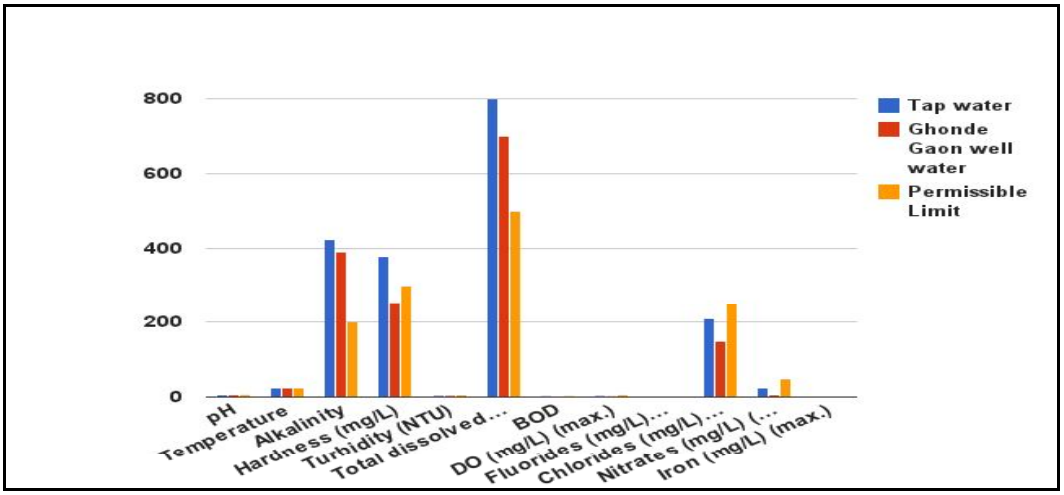

Figure 3. Graph Analysis on the Pre monsoon (May 2014) Water Quality Parameters

Table 3 Contaminated Soil analysis values from experimental work

Sr. No.	Parameters	Experimental Values	Permissible Limit	Units
1	pH	8.31	7.5	-
2	Bulk Density	0.83	1.4	g/cm^3
3	Porosity	31.5	60	%
4	Water Holding Capacity	74.8	25	%
5	Organic Carbon	2.36	0.4	%
6	Total Nitrogen	2697	280	Kg/ha
7	Available Phosphorus	435	150	Kg/ha
8	Available Potassium	6082	275	Kg/ha
9	Cation Exchange Capacity	14	30	Meq / 100g
10	Available Boron	8.4	12	mg/kg
11	Nitrite	0.34	100	mg/kg
12	Acidity	0	0	%

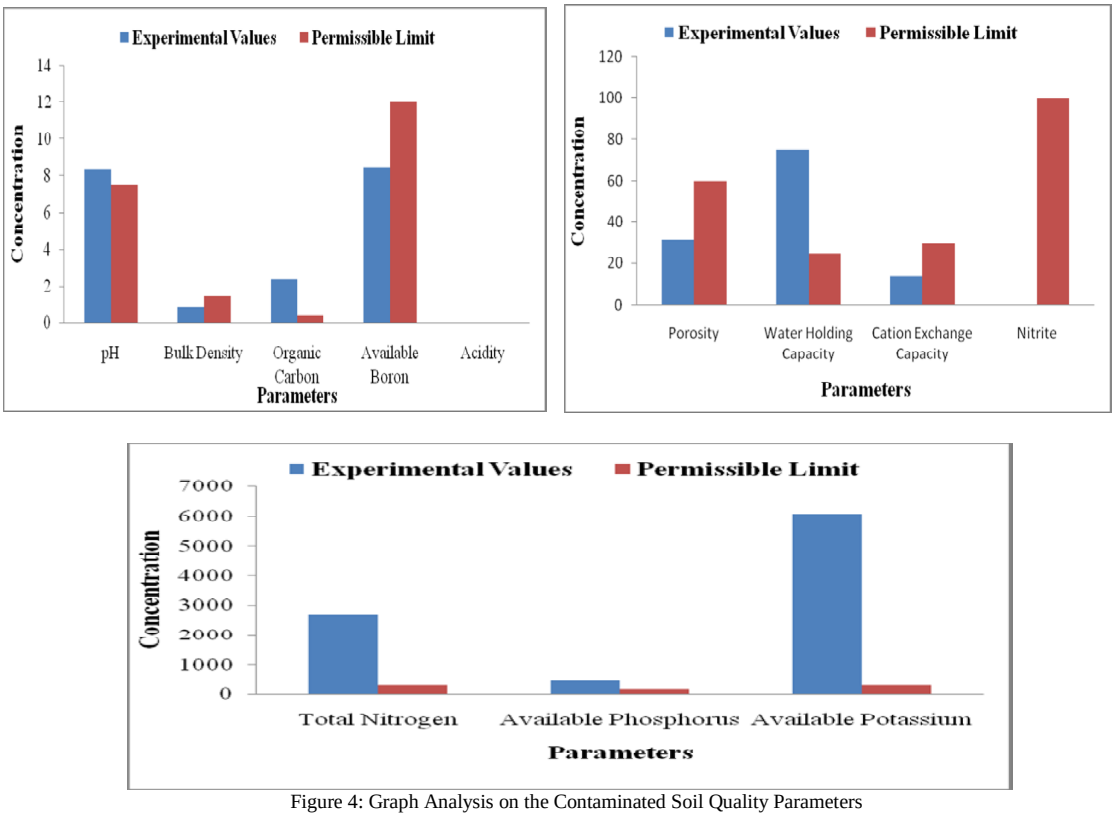

Figure 4: Graph Analysis on the Contaminated Soil Quality Parameters

The following parameters calculated from the experimental work of contaminated soil of Sukena village are explained as follows:-

Organic Carbon, Total Nitrogen, Available Phosphorus and Available Potassium are having maximum values as compared to the permissible limit.

Table 2: Contaminated Water analysis values from experimental work

Sr. no.	Parameters	Results	Permissible Limit	Units
1.	pH	7.52	5.5 – 8.4	-
2.	Total Solids	1614	500 – 2000	Mg/lit
3.	BOD (3 days, 27°C)	180	133	Mg/lit
4.	COD	536	29-71	Mg/lit
5.	Salinity	0.82	0.4 – 0.8	%
6.	Calcium (as Ca)	140	75 – 200	Mg/lit
7.	Magnesium (as Mg)	75.3	30 – 100	Mg/lit
8.	Sulphate (as SO_4)	63.2	>500	Mg/lit
9.	Nitrites (as NO_2)	< 0.02	>500	Mg/lit
10.	Total Organic Carbon	49	150	Mg/lit
11.	Surfactants	2.08	34	Mg/lit
12.	E. coli	220	>1000	MPN Index / 100 ml

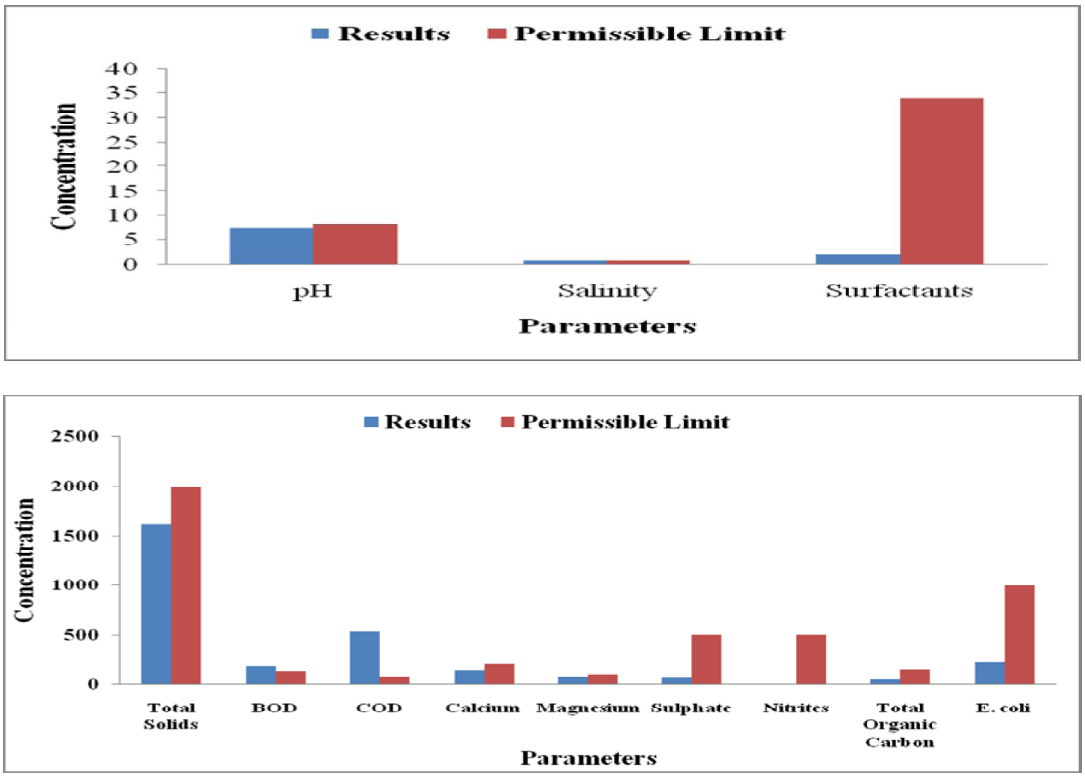

Figure 5: Graph Analysis on the Contaminated Water Quality Parameters

The following parameters calculated from the experimental work of contaminated water of Sukena village are explained as follows:-

BOD (3 Days, 27^{o}C), COD and Salinity are having maximum values as compared to the permissible limit.

Table 3: Pesticides Concentration Analysis present in the Ghonde Gaon Well and Bhandare's Well (Individual Well of the farmer)

Sr. no.	Pesticides	Calculated Results for Ghonde Gaon well water sample	Calculated Results for Bhandare's well water sample	Maximum Contaminant Level Observed Results	Units
1.	Atrazine	<0.05	<0.05	0.003	µg/L
2.	Aldrin	<0.05	<0.05	0.027-0.20	µg/L
3.	Dieldrin	<0.05	<0.05	0.1-0.195	µg/L
4.	2,4 – D	0.1	0.13	0.07	µg/L
5.	p, p DDT	<0.05	<0.05	0.025	µg/L
6.	o, p DDT	<0.05	<0.05	0.085	µg/L
7.	p, p DDE	<0.05	<0.05	0.12	µg/L
8.	o, p DDE	<0.05	<0.05	0.14	µg/L
9.	p, p DDD	<0.05	<0.05	0.090	µg/L
10.	o, p DDD	<0.05	<0.05	0.1	µg/L
11.	α Endosulfan	<0.05	<0.05	0.32	µg/L
12.	β Endosulfan	<0.05	<0.05	0.33	µg/L
13.	γ HCH (Lindane)	<0.05	<0.05	0.0002	µg/L

The following parameters calculated from the experimental work of water affected by the pesticides of Sukena village are explained as follows:-

Atrazine, 2, 4 – D, p p DDT and γ HCH (Lindane) are having maximum values as compared to the permissible limit.

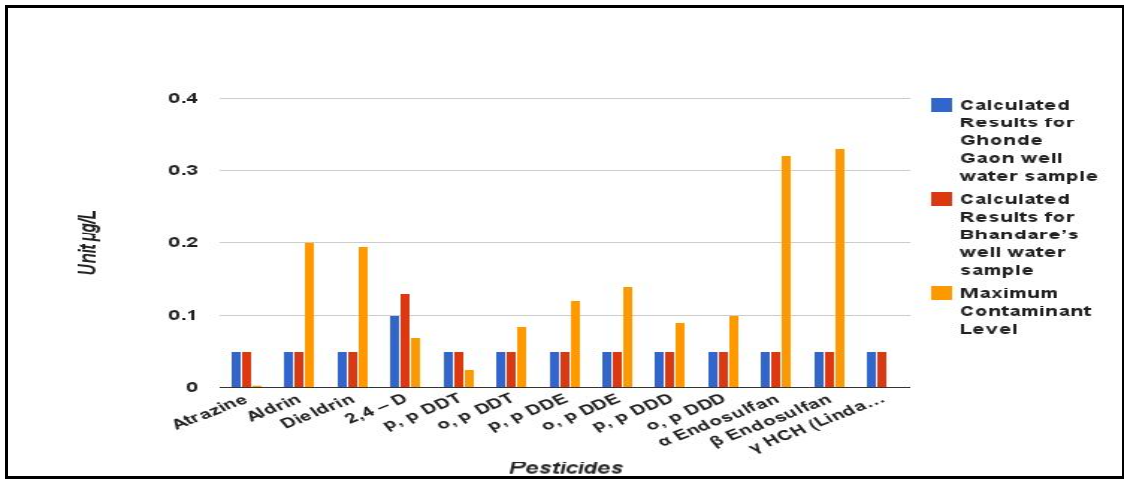

Figure 6: Graph Analysis on the Ghonde Gaon well and Bhandare's well Water Quality Parameter

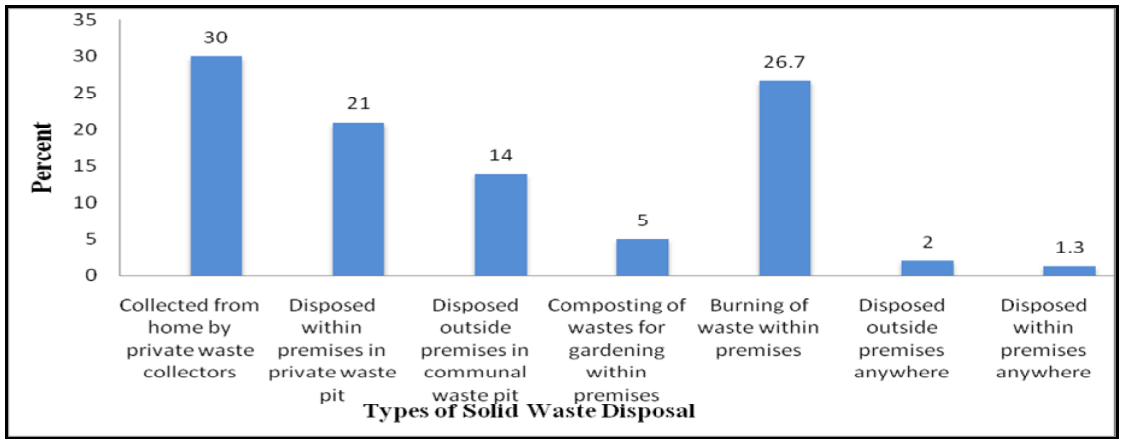

Figure 4. Type of household solid waste disposal method, Sukena Village, (n=300)

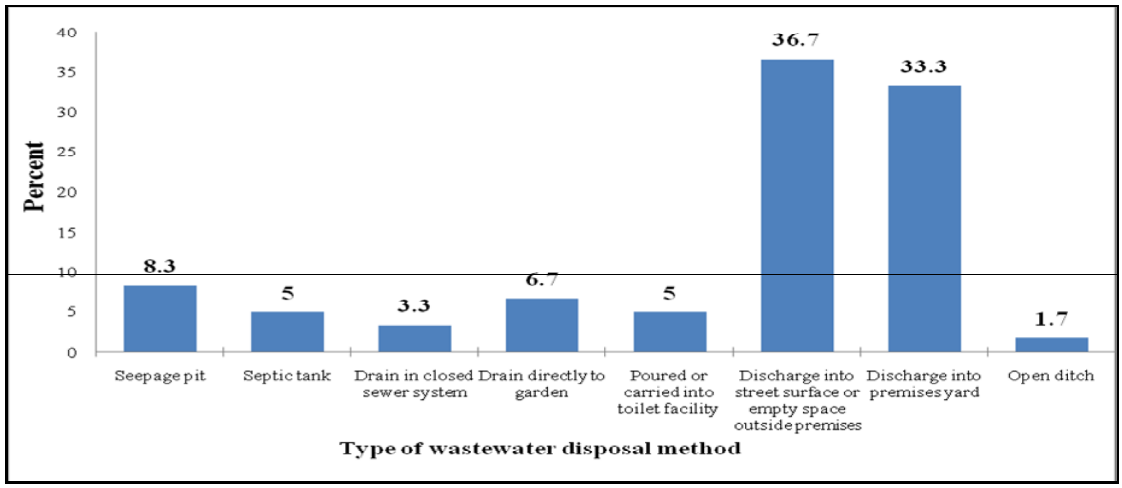

Figure 4.7 Type of domestic wastewater disposal method, Sukena Village, (n=300)

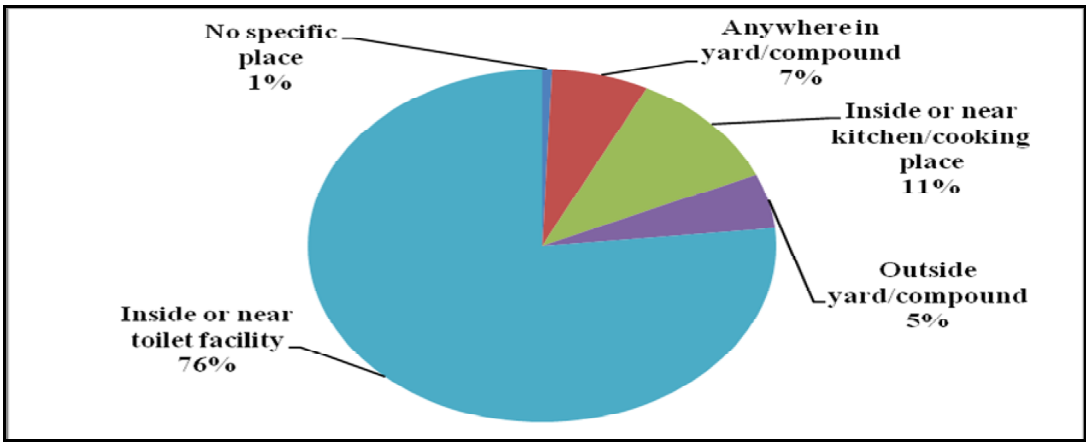

Figure 4.8 Places where household members wash their hands, Sukena Village, (n=300)

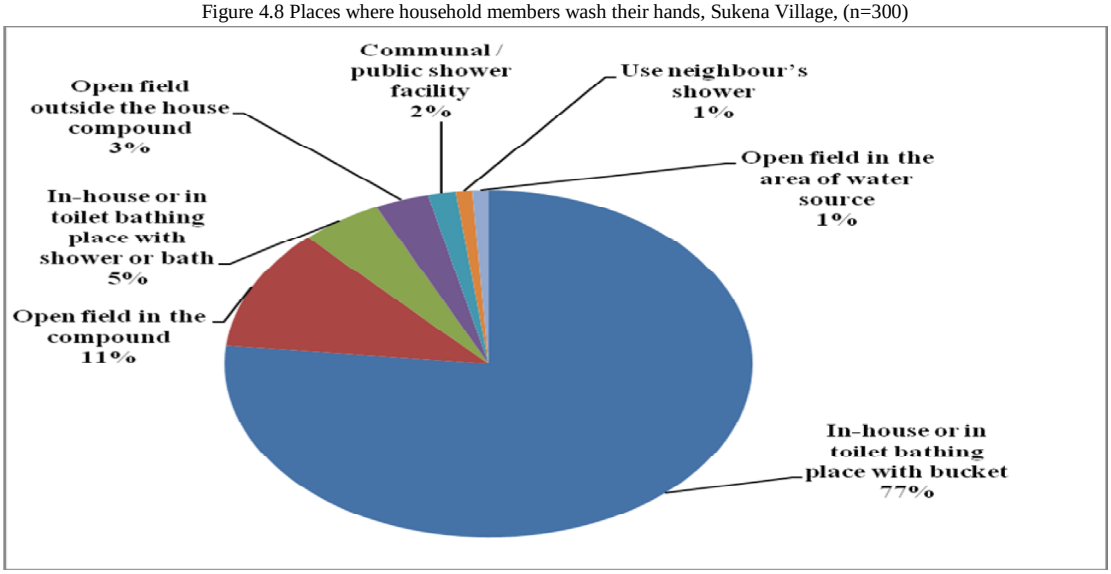

Figure 4.9 Places where household members take bath, Sukena Village, (n=300)

IV. CONCLUSION

1. From the outcomes it is found that parameters like alkalinity, hardness and total dissolved solids are remain continuously in excess even in pre-monsoon and post-monsoon.
2. Regarding the domestic waste water disposal, 40% of the households dispose their waste water in the open premises/yard, which is not good as per hygiene condition for the small children's and old people's especially. The surrounding premises get dirty and the stagnant water over the surrounding premises produces houseflies and mosquitoes breeding, due to which food contamination may occur and possibility of borne diseases. To avoid unhygienic conditions, proper collection and disposal of liquid waste is to be done.
3. In Sukena village, there is also higher percentage of people's, which are washing their hands and taking bath inside or outside the yard/premises, through which water gets stagnant in the same premises.
4. To avoid unhygienity through waste water, the underground drainage lines are necessary for the village, the work for the same is in progress now, where testing of wastewater is shown BOD, COD and salinity are slight exceeds the limits; in future it is possible to treat it with low cost treatment such as anaerobic lagoon which is possible way for the rural areas.
5. In Sukena village, the ground water also contains some pesticides like Atrazine, 2, 4-D, p, p- DDT and γ HCH (Lindane) are slight exceeds the limits. With the help of available references, these are not so harmful meant for the soil but it is essential to minimize it by using minimum pesticides which is possible through making awareness in farmers.

6. Soil in and around Sukena village, having good fertility with proper proportions of N, P and K; but showing certain content like organic carbon in excess, but which increases the Cation-exchange capacity (CEC) and water-holding capacity soils, holds a great proportion of nutrients cation's and trace elements that are of importance to plant growth means nearly soil is free from pollution.
7. For the solid waste disposal by the households of Sukena village, the results comes out to be for the unsafe disposal of waste, the burning of waste within the premises is 80 (26.7%) out of 90 (30%), which is not good for the villager's health. so as to avoid bad smell and unhygienic conditions. The dry and wet solid waste is to be segregated separately and the solid waste should be disposed off in proper way and no air pollution should be increased due to burning of the waste within the premises or outside the premises, so as to avoid asthmatic and respiratory problem among the villagers.
8. The Ghantagadi (vehicle), for the collection of solid waste i.e. dry and wet solid wastes separately, should be allotted in each lane every alternate day so as to minimize the direct dumping in open areas.
9. With consideration of all practices or problems in the Sukena villages, I comprised some solutions such as minimum cost required for the individual toilet blocks, design and costing of composting pit which is possible reference for the government schemes
10. Seminars/campaigns are conducted in the Sukena village and displaying various banners about the awareness about the utilization of water, hand washing and bathing habits, cleaning and maintaining of the toilet blocks in proper way.

REFERENCES

[1] Agrawal Anju, Pandey Ravi S., Sharma Bechan "Water Pollution with special reference to pesticide contamination in India". Journal of Water Resource and Protection, 2010, 2, 432-448 doi:10.4236/jwarp.2010. 25050 Published Online May 2010. Received December 29, 2009; revised March 7, 2010; April 21, 2010.

[2] Alit Wiel Shafran, Zeev Ronen, Noam Weisbrod, Eilon Adar, Amit Gross "Potential Changes in Soil Properties Following Irrigation With Surfactant-Rich Greywater". Ecological Engineering 2 6 (2 0 0 6) 348–354. doi:10.1016/j.ecoleng.2005.12.008, Received - 12 August 2005, Received in revised form - 11 December 2005, Accepted - 28 December 2005

[3] Annette Pruss Ustun, Robert Bos, Fiona Gore, Jamie Bartram "Safer Water, Better Health Costs, Benefits and Sustainability of Interventions to Protect and Promote Health". World Health Organization, Geneva, 2008. Environmental Health Perspectives, 110(5): 537–542, 2008.

[4] Aussie Austin "Health Aspects of Ecological Sanitation". Ecological Sanitation Response. 2002. Journal of the South African Institution of Civil Engineering, 43 (1).

[5] Bonu Shekhar and Hun Kim "The study Sanitation in India: Progress, Differentials, Correlates, and Challenges". Axis Development Bank, Series 18, Publication Stock No. ARM090755, water@adb.org. 2009.

[6] Dave R.S, Vedia S.D, Acharya D.G, Jani1 G.R and Machhar M.T "Water quality assessment studies with reference to nitrate contamination of Modasa Taluka of Sabarkantha district (North Gujarat)". Journal of Chemical and Pharmaceutical Research, 2011, 3(1):238-241.2011.

[7] Environment & Public Health Organization (ENPHO) "Solid Waste Management in Siddhipur". 343 – 0750 – 18866, 2007.

[8] Erlenbach Dave, Lachapelle Paul "Planning Guide for On-Site Greywater/ Wastewater Disposal Systems for Recreational and Administrative Sites". Publication No. 9523 1201-SDTDC April 1995.1998

[9] Friedler E. "Quality of Individual Domestic Greywater Streams and its Implication for On-Site Treatment and Reuse Possibilities". Environmental Technology, Vol. 25. pp 997-1008 © Selper Ltd, 2004, Received 6 May 2004; Accepted 6 June 2004. 2004.

[10] Glenn Pearce – Oroz "Water and Rural Sanitation Challenges in Latin America for the Next Decade". Water and Sanitation Program, Guidance Note, World Bank. 2011. www.wsp.org.

[11] Gunter Langergraber, Elke Muellegger "Ecological Sanitation—a way to solve global sanitation problems". Environment International, 31 (2005), 433–444, 2004. doi:10.1016/j.envint.2004.08.006, Received 22 January 2004; accepted 20 August 2004.

[12] Hannan Carolyn, Ingvar Andersson "Gender Perspectives on Ecological Sanitation". 2002 EcoSanRes.

[13] Ismail M, Murtaza Sayed, Hasan M Khan, William J Cooper "Analysis of Pesticides in Water Samples and Removal of Monocrotophos by γ-Irradiation". ISSN: 2155-9872 JABT, an open access journal, Journal of Analytical and Bioanalytical Techniques Volume – 5, Issue - 1, http://dx.doi.org/10.4172/2155-9872.1000181, 2014.

[14] Jain Pankaj "Manual on Operation and Maintenance of Rural Water Supply Scheme". New Delhi, 2013.

[15] Kuchta Hanns-Bernd, Dr. Jenny June Tigbao, Fe Crisilla Banluta "Integrated waste management systems for Bayawan city, Ecological sanitation experiences in pre-urban and rural communities". Sustainable Sanitation Alliance; February 2010; pages 11-2 and 12-2. 2010.

[16] Kadave Prakash, Pathak Prakash, Pawar Sadhana "Planning and Design of Green Village". Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) ISSN: 2319-2402, ISBN: 2319-2399. Volume 1, Issue 4 (Sep-Oct. 2012), PP 01-04 ISSN: 2277-9477, 2012.

[17] Kadave P.T, Bhor M.B, Bhor A.B & Bhosale M.S "Physicochemical Analysis of open well water Samples near Industrial Area of Niphad, Nashik District, (Maharashtra), India". IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) ISSN: 2319-2402, ISBN: 2319-2399. Volume 1, Issue 4 (Sep-Oct. 2012), PP 01-04, www.iosrjournals.org.

[18] Kalra Neerja, Rajesh Kumar, Yadav S. S. and Singh R. T. "Water quality index assessment of ground water in Koilwar block of Bhojpur (Bihar)". ISSN: 0975-7384, CODEN (USA): JCPRC5 Journal of Chemical and Pharmaceutical Research, 2012, 4(3):1782-1786. 2012.

[19] Kariuki Francis W., Kotut Kiplagat and Nganga Victor G. "The Potential of a Low Cost Technology for the Greywater Treatment", The Open Environmental Engineering Journal, 2011, 4, 32-39, Received: December 15, 2010 Revised: May 09, 2011 Accepted: May 13, 2011.

[20] Kazi Shamima Aktar, Md. Mafizur Rahman "Spatio Temporal Quantification and Characterization of Drought Patterns in Bangladesh". Journal of Water and Technology, Volume 10, No. 3, 2012. Received – October 23, 2011, Accepted June 14, 2012.