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Evaluation of Drinking Water Quality in Urban Areas of Ghaziabad: A Case Study of Modinagar

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Abstract

A study was carried out to evaluate the quality of water supplied inModinagar. A portion of modinagarwas selected for this purpose. Water samples from four different sources (tubewells) and eight house connections (two from each tubewell) were collected making a total of twelve sampling points. Two set of samples, one before monsoon and one after the monsoon were taken from each sampling point.

FOUR PHYSIOCHEMICAL PARAMETERS-

1) **Ph**
2) **Turbidity**
3) **Hardness**
4) **Total dissolved solids**

TWO BACTERIOLOGICAL PARAMETERS-

1) **Total Coliform**
2) **Faecal Coliform**

These are those parameters were tested for each sample and values compared with World Health Organization (WHO) guidelines for drinking water. The results of the study demonstrated that physicochemical and bacteriological quality of water at sources was satisfactory. In the distribution system, physicochemical quality of water was satisfactory while 50 to 62.5% of the samples contained bacteriological contamination before monsoon. This percentage rise to 75% after the monsoon. Possible causes of contamination were leaking water mains and cross connections between water mains and sewers due to close proximity. It is recommended to carry out compulsory chlorination at water sources while maintaining reasonable residuals at the consumers' end to eliminate the bacteriological contamination.

Key Words: Water quality; physicochemical characteristics; bacteriological characteristics

1. Introduction

Drinking water must be free from components which may adversely affect the human health. Such components include minerals, organic substances and disease causing microorganisms. A large portion of the population in developing countries suffers from health problems associated with either lack of drinking water or due to the presence of microbiological contamination in water(1) . Poor water quality is responsible for the death of an estimated 5 million children in the developing countries(2) The problem is further aggravated by rapidly increasing population which results in poor water-quality management(3)

In Modinagar, water supply coverage through piped network and hand pumps is around 66%(4) . It is estimated that, in Modinagar, 30% of all diseases and 10% of all deaths are due to poor water quality(5) .Diarrhoea, a water borne disease is reported as the leading cause of death in infants and children in the country while every fifth citizen suffers from illness and disease caused by the polluted water(6) . Unfortunately, little attention is being paid to drinking-water quality issues and quantity remains the priority focus of water supply agencies. There is a lack of drinking-water quality monitoring and surveillance programmes in the country. Weak institutional arrangements, lack of well equipped laboratories and the absence of a legal framework for drinking-water quality issues have aggravated the situation. Above all, the public awareness of the issue of water quality is dismally low(7) .

Intermittent water supply is common in urban areas and outbreaks of gastroenteritis and other water born diseases have become a normal feature(8) . Estimates indicate that more than three ThousandsPeople of Modinagar suffer from waterborne diseases each year of which more than 100 people die(9) ,Thus there is a need to find out where the actual problem lies; whether the water sources are contaminated or lapses occur in the distribution system. Presently, Modinagar has no national drinking water quality standards and WHO guidelines are followed(10-11)This research work was undertaken with the objective:

(1) To evaluate the drinking water quality in modinagar region both at the source and in the distribution system according to WHO guidelines

(2) To suggest preventive measures in case of any lapses

2. MATERIALS AND METHODS

2.1 PARAMETERS TESTED

Six water quality parameters; two physical, two chemical and two bacteriological were tested for the samples collected for this research work. Physical parameters testes were pH and turbidity. These two parameters play an important role in the disinfection of water. Turbidity should be less than 0.5 Nephelometric Turbidity Units (NTU) and pH should be less than 8 for effective disinfection(10) Chemical parameters chosen were hardness and total dissolved solids (TDS). Water with high hardness results in excessive use of soap for washing purposes in household use while water with high TDS may impart taste. High values of both these parameters alsoresult in scale deposition in pipes and utensils. Bacteriological parameters tested were Total Coliform (T.C.) and FaecalColiform (F.C.) . These parameters indicate the possibility of the presence of pathogenic bacteria in the supplied water. All the tests were conducted according to the procedures laid down in the Standard Methods(11) .

2.2 SAMPLING METHODS

Chemical analysis

The simplest methods of chemical analysis are those measuring chemical elements without respect to their form. Elemental analysis for dissolved oxygen, as an example, would indicate a concentration of 890,000 milligrams per litre (mg/L) of water sample because water is made of oxygen. The method selected to measure dissolved oxygen should differentiate between diatomic oxygen and oxygen combined with other elements. The comparative simplicity of elemental analysis has produced a large amount of sample data and water quality criteria for elements sometimes identified as heavy metals. Water analysis for heavy metals must consider soil particles suspended in the water sample. These suspended soil particles may contain measurable amounts of metal. Although the particles are not dissolved in the water, they may be consumed by people drinking the water. Adding acid to a water sample to prevent loss of dissolved metals onto the sample container may dissolve more metals from suspended soil particles. Filtration of soil particles from the water sample before acid addition, however, may cause loss of dissolved metals onto the filter. The complexities of differentiating similar organic molecules are even more challenging.Making these complex measurements can be expensive. Because direct measurements of water quality can be expensive, ongoing monitoring programs are typically conducted by government agencies. However, there are local volunteer programs and resources available for some general assessment. Tools available to the general public include on-site test kits, commonly used for home fish tanks, and biological assessment procedures.Anelectrical conductivity meter is used to measure total dissolved solids

The following is a list of indicators often measured by situational category:

- Alkalinity
- Color of water
- pH
- Taste and odor (geosmin, 2-Methylisoborneol (MIB), etc.)
- Dissolved metals and salts (sodium, chloride, potassium, calcium, manganese, magnesium)
- Microorganisms such as fecal coliform bacteria (*Escherichia coli*), Cryptosporidium, and Giardia lamblia;
- Dissolved metals and metalloids (lead, mercury, arsenic, etc.)
- Dissolved organics: colored dissolved organic matter (CDOM), dissolved organic carbon (DOC)
- Radon(Rn)
- Heavy metals
- Pharmaceuticals
- Hormone analogs

Environmental indicators

A) Physical indicators

- Water Temperature
- Specifics Conductance or EC, Electrical Conductance, Conductivity

- Total suspended solids (TSS)
- Transparency or TurbidityTotal dissolved solids (TDS)
- Odour of water
- Color of water
- Taste of water

B) Chemical indicators

- pH
- Biochemical oxygen demand (BOD)
- Chemical oxygen demand (COD)
- Dissolved oxygen (DO)
- Total hardness (TH)
- Heavy metals
- Nitrate
- Orthophosphates
- Pesticides
- Surfactants

C) Biological indicators

- Ephemeroptera
- Plecoptera
- Mollusca
- Trichoptera
- *Escherichia coli* (E. coli)
- Coliform bacteria

Biological monitoring metrics have been developed in many places, and one widely used measure is the presence and abundance of members of the insect orders Ephemeroptera, Plecoptera and Trichoptera. (Common names are, respectively, Mayfly, Stonefly and Caddisfly.) EPT indexes will naturally vary from region to region, but generally, within a region, the greater the number of taxa from these orders, the better the water quality. Organisations in the United States, such as EPA offer guidance on developing a monitoring program and identifying members of these and other aquatic insect orders.

Individuals interested in monitoring water quality who cannot afford or manage lab scale analysis can also use biological indicators to get a general reading of water quality. One example is the IOWATER volunteer water monitoring program, which includes a benthicmacroinvertebrate indicator key.

Bivalve molluscs are largely used as bio indicators to monitor the health of aquatic environments in both fresh water and the marine environments. Their population status or structure, physiology, behaviour or the level of contamination with elements or compounds can indicate the state of contamination status of the ecosystem. They are particularly useful since they are sessile so that they are representative of the environment where they are sampled or place.

Water quality standards and reports

World Health Organisation guideline

- World Health Organisation (WHO) guideline for Drinking Water Standards.(1)

Indian Council of Medical Research standards

- Indian Council of Medical Research (ICMR) Standards for Drinking Water.[2]

International standards

Water quality regulated by the International Organization for Standardization (ISO) is covered in the section of ICS 13.060 ranging from water sampling, drinking water, industrial class water, sewage water, and examination of water for chemical, physical or biological properties. ICS 91.140.60 covers the standards of water supply systems.

3. Results and Discussion

3.1 pH

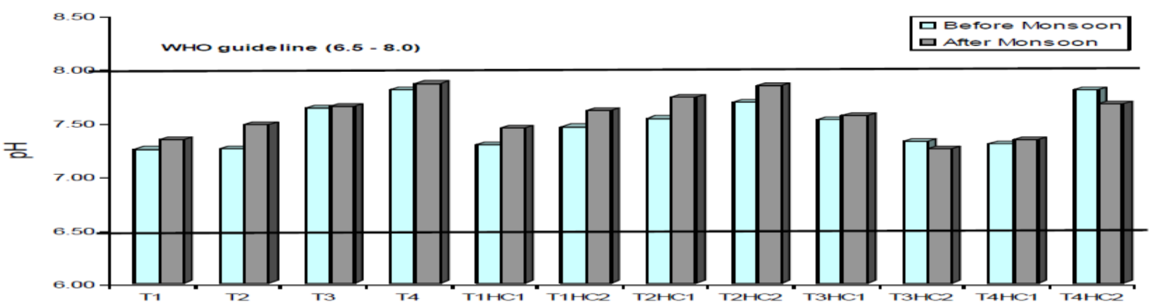

Fig.1

Sampling Location: The mean values of pH at twelve sampling points before and after the monsoon are shown in Fig.1. As a matter of fact, no health base guidelines are proposed by WHO for the pH of drinking water. However, it is one of the most important operational water quality parameters. pH values higher than 8 are not suitable for effective disinfection while values less than 6.5 enhance corrosion in
water mains and household plumbing system. Therefore, WHO proposes a desirable range of 6.5 to 8.0 for pH of drinking water. As can be seen in Fig.1, the pH values at all the sources and house connections are well within the WHO desirable limit both before and after the monsoon season.

3.2 Turbidity

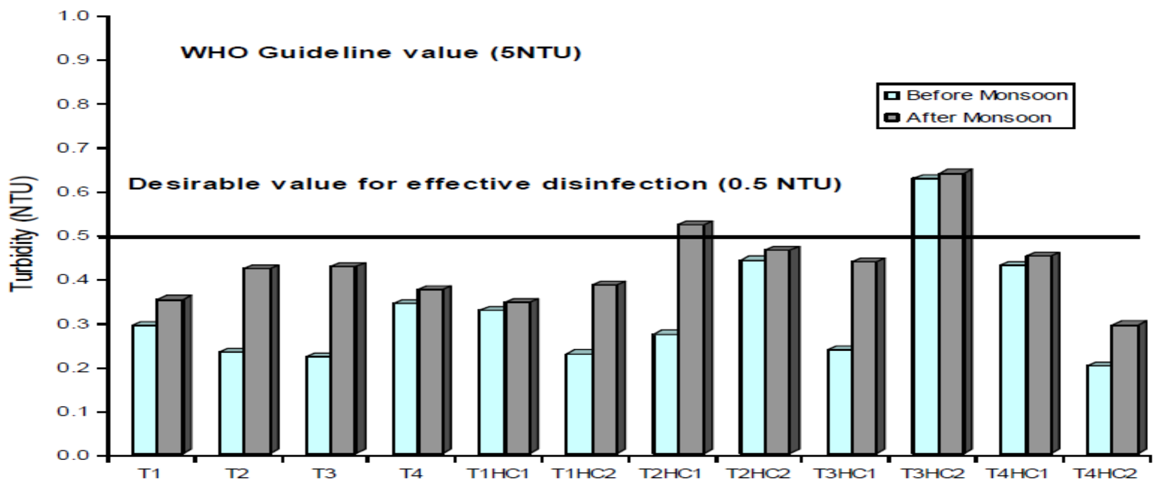

Fig 2

Sampling Location

Mean values of turbidity at all the sampling locations before and after the monsoon have been shown in Fig. 2. No health based guidelines are proposed for turbidity by WHO. Nevertheless, a value of 0.5 NTU is recommended for effective disinfection [3]. It is evident from Fig. 2 that at all the sources (T/W), the turbidity in water is less than the desirable limit of 0.5 NTU while it is more than 0.5 NTU before and after the monsoon at T3HC2. At T2HC1, it rose above 0.5 NTU after the monsoon. On the other hand a value upto 5 NTU is considered acceptable to the consumers [3]. It is evident from Fig. 3 that values of turbidity at all the sampling locations were well below 5 NTU. Values of turbidity rose in water samples obtained from all the locations after the monsoon. This difference was, however, very small. No apparent reason could be ascribed to this phenomenon on the basis of this study and further research is recommended to find out the facts. Values of turbidity and pH as measured for all the sources (Fig.1 and 2) suggest that disinfection of water can be carried out effectively.

3.3 Hardness

The mean values of hardness in the water samples at all the locations .It can be seen in the figure that hardness at all the sources (T/W) and house connections were less than the WHO guideline value of 500 mg/L as CaCO3 [3]. As a matter of fact, this guideline value is not proposed on the basis of health. Consumers can tolerate water hardness in excess of 500 mg/L. Water hardness above 500 mg/L needs excess use of soap to achieve cleaning. Hardness for sources (T/W) varied from 117 to 230 mg/L as CaCO3, before and after the monsoon. For house connections the variation was 130 to 333 mg/L as CaCO3 before and after the monsoon. This may be due to the dilution effect on the aquifer after the monsoon season.

If the hardness values at sources and respective house connections are compared then it is revealed that the hardness at house connections sometimes increased or decreased as compared to the hardness at the source. No reason could be ascribed for this effect on the basis of present research work. Further probe and investigations is needed on this issue.

3.4 Total Dissolved Solids (TDS)

The mean values of TDS in samples taken at all the locations before and after themonsoon . No health based guideline is proposed by WHO for TDS. Since TDS higher than 1000 mg/L impart taste to the water, therefore, a desirable value of 1000 mg/L is proposed by WHO. Furthermore, a value higher than 1000 mg/L results in excessive scales in water pipes, , boilers and household appliances . It can further be pointed out that TDS in the collected samples consistently decreased at all the sampling points after monsoon. This may be due to the dilution of underground aquifer after the monsoon season. TDS at some house connections increased as compared to the source .This may be due to the mixing of wastewater into the water mains due to faulty joints. However, further investigation on this aspect is needed0 100 200 300 400 500 600 700 800 900 1000

3.5 Total Coliform (T.C.)

The mean values of T.C at all the sampling locations before and after the monsoon . T.C group includes both faecal and environmental species. Their presence shows that water has come in contact with any of the materials like human faeces, soil, plants etc. . Similarly two house connections T2HC1 and T3HClwere free from T.C which clearly shows that water distribution system in that area is in good condition. T.C was not found at T1HC1 before monsoon; however, it appeared after the monsoon. Rest of the house connections, in addition to that mentioned above, had T.C contamination, both before and after the monsoon. Putting in other words 62.5% of house connections were contaminated with T.C., before monsoon and the percentage rose to 75% after the monsoon.

Various reasons of bacteriological contamination may be:

1. Intermittent water supply which allows entry of any wastewater in distribution system through poor joints during no flow conditions;

2.Layout of water pipes in close proximity to the sewer lines and

3.Overloading of sewage channels and sewers which in most cases remain blocked.

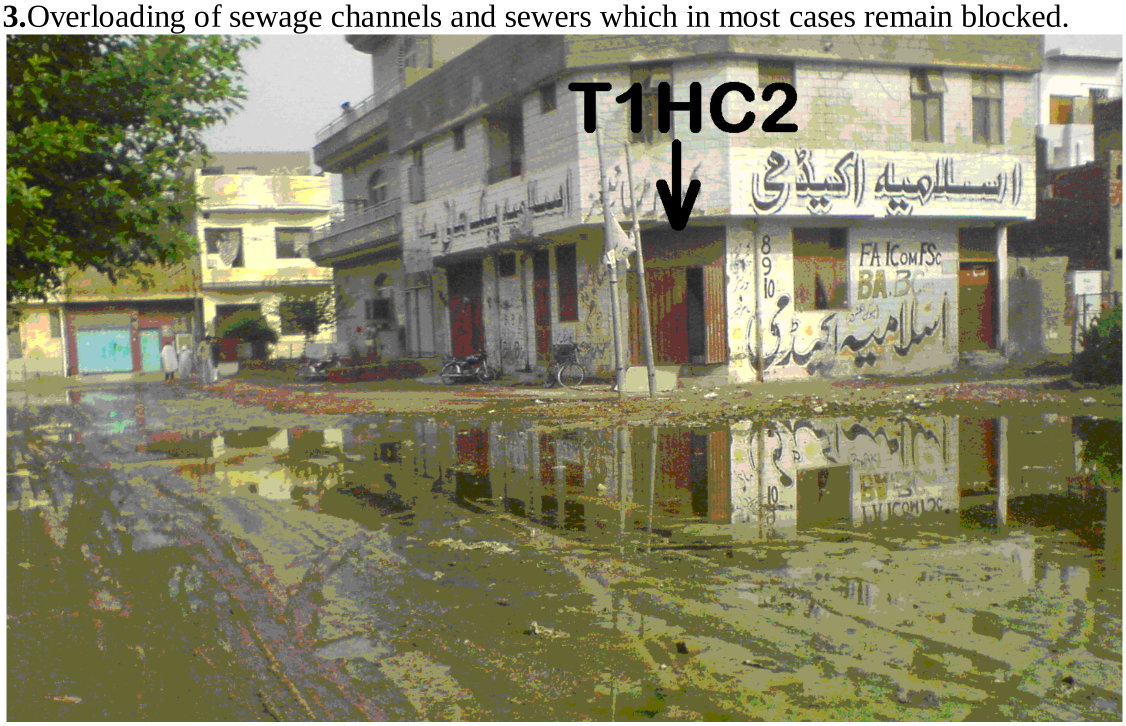

Fig 3 Stagnation of sewage in front of house connection T1HC2

Fig. 3 shows stagnant wastewater in front of house connection T1HC2 due to blockage of sewer line. Water sample from this house connection had both T.C and F.C before and after the monsoon.

3.6 Faecal Coliform (F.C.)

Mean values of F.C [3] at various sampling locations before and after the monsoon have been shown in

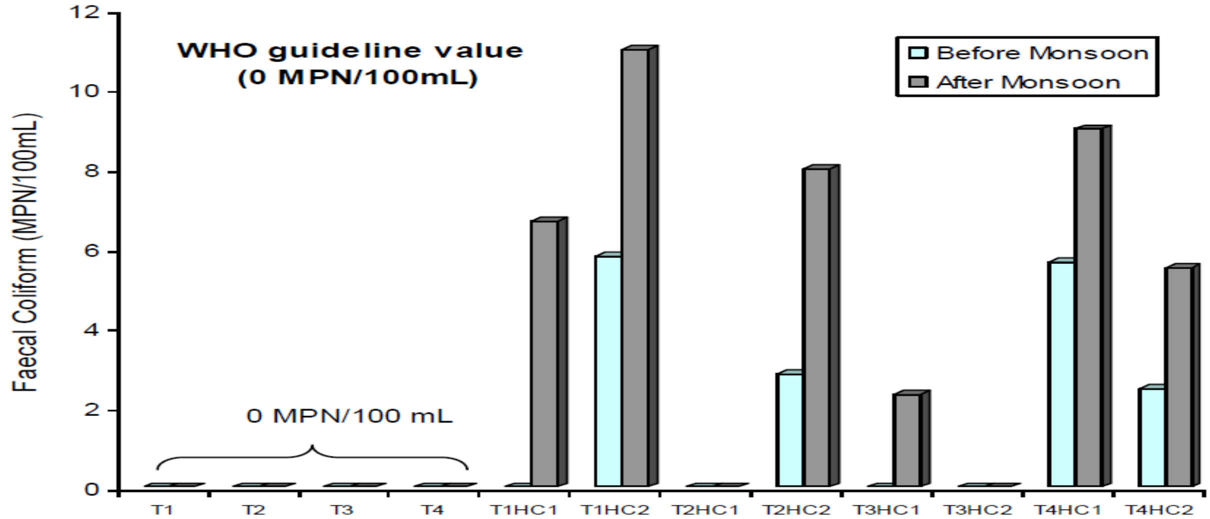

Fig. 4.

Faecal contamination shows that water has come in contact with human faeces. It is evident from Fig. 4 that all the sources (T/W) are free from F.C, both before and after the monsoon while only one house connection T2HC1 was free from F.C before and after the monsoon. At T1HC1 and T3HC1, F.C were not present before the monsoon and only appeared after it. Rest of the house connections in addition to those mentioned above were faecallycontaminated before and after the monsoon. Putting in other words, 50% of the house connections were faecally contaminated before the monsoon and this percentage rose to 75% after the monsoon. 02468 10 12 Faecal

In most of the cases where bacteriological contamination was found, it was observed that pounding of wastewater from blocked pipes or stagnation of rain water due to lack of proper drainage could be a cause. Pipe material used in the study area was galvanized iron and asbestos cement and was 30-35 years old. Water supply and sewer lines in some areas were laid side by side without any consideration of safe distance between the two. This situation is also one of the causes of bacteriological contamination in water distribution system. Intermittent nature of the water supply further aggravates the situation. A remedial measure may be the provision of over head reservoirs, which maintain a constant pressure in the lines despite disruption in pumping. Although all the sources were equipped with chlorination devices but none was functional or in regular use. WASA did not carry out any monitoring programme to evaluate the water quality on regular basis.

4. CONCLUSIONS & RECOMMENDATIONS

1. The physicochemical (pH, turbidity, hardness and TDS) and bacteriological (T.C and F.C) parameters at all the sources (T/W) in the study area were within the limits prescribed by WHO

guidelines for drinking water quality. It can, therefore, be concluded that the groundwater in the study area is suitable for drinking and other household purposes.

2. Physicochemical quality of the sampled water at all the house connections was within the limits prescribed by WHO guidelines.

3. Bacteriological quality at 50-62.5% house connection was unsatisfactory before the monsoon and percentage rose to 75% after the monsoon. Various causes of bacteriological contamination included old and rusted water mains, laying of water supply pipes close to sewer lines, intermittent water supply system, clogging of sewer lines and inadequate storm drainage in the study area.

4. To improve the bacteriological quality of water, it is recommended to make the installed chlorination devices functional. Tubewell operators must be trained to use these devices properly and to administer proper dose of chlorine.

5. Pounding of wastewater in the streets be avoided through effective wastewater collection system.

6. Water supply and sewer lines be laid on the opposite sides of the street to maintain safe distance between them in future.

7. Very old/leaking pipes need to be replace/repaired to avoid bacteriological contamination.

REFERENCES :

1. F. X. R Van Leeuwen; *Food and Chemical Toxicology*, 38(2000)51-58.
2. G. Holgate; *Environmental and Waste Management*, 3(2000)105-112.
3. G. H. Huang and J. Xia; *Journal of Environmental Management*, 61(2001)1-23.
4. India Millennium Development Goals Report, 2006., Government of India. Planning Commission., (2006)75. http://www.undp.org.pk/uploaddocuments/mdg2006.zip. (December 23, 2008)
5. Global Water Partnership, Draft South Asia - Water Vision 2025, Country Report – India, (2000).
6. M. A. Kahlown, M. A. Tahir, H. Rasheed and K. P. Bhatti; Water Quality Status, National Water Quality Monitoring Programme, Fourth Technical Report. India Council of Research in water Resources, (2006)5.
7. J. A. Aziz; *Eastern Mediterranean Health Journal*, 11(2005)1087-1098.
8. G. Bridges; Asian Water Development Outlook 2007. Country Paper India, Asian Development Bank,(2007)9. http://www.adb.org/Documents/Books/AWDO/2007/cr08.pdf (December 29, 2008)
9. Water and Sanitation Program. Managing Karachi's water supply and sanitation services: lessons from a workshop, (2005) 3.
10. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/11/28/000160016_20051128162902/Rendered/PDF/344430PK0Karachi0water0supply.pdf
11. Guidelines for drinking-water quality; 3rd edition, volume 1. World Health Organization (WHO), Geneva, (2004)143-220.
12. Guidelines for drinking-water quality, 2nd edition, volume 2. World Health Organization (WHO), Geneva, (1996)9