

# **Urban Solid Waste and Health Implications in Guwahati, Assam India**

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Guwahati is the biggest and fastest growing city in North East India, with a population of 8.04 lakh and a growth rate of 38.6 percent according to 2001 census. The population density in Guwahati is 2695.43 persons per sq km. and there is a growing problem of waste disposal within the city.

We notice that the environment influences many aspects of human beings, and many diseases can be initiated, sustained or exacerbated by environmental factors. Therefore a study was carried out in Guwahati to understand the challenges faced both by the community and the management and the shared responsibility they both have. This study has been made in the light of the fact that we all affect the environmental health, through our individual and collective decision.

In this research paper an attempt has been made to show the vulnerable pockets within the city, through a series of maps. The method used is the random sampling technique for the collection of primary data ,and questionnaires were designed to extract relevant information from the community and management.

The findings reveal that there are certain diseases and infections like eye, skin, respiratory, malaria, dysentery and back pain which are found to be high.

Key Words: Urban, solid waste, management, health.

## **Introduction**

As urbanization continues to take place, the management of solid waste is becoming a major public health and environmental concern in urban areas of many developing countries. The rapid pace of urbanization would presuppose an increase in the provision of infrastructure. But this has not been the case as many cities are unable to provide the basic infrastructure. The problems are likely to become even more pronounced as the cities continue to grow rapidly causing a strain on municipal infrastructures like water supply, sewage and solid waste disposal causing grave public health problems.

Solid waste disposal poses a greater problem because it leads to pollution of various kinds. Land pollution directly if thrown and dumped openly, water pollution if

dumped in low-lying area and air pollution if burnt. To elucidate the various processes involved in producing the patterns of socio-economic and environmental health in a city, one needs to concentrate both on the natural as well as built up environment. The environment influences many aspects of human beings, and many diseases can be initiated sustained or exacerbated by environmental factors. Therefore a study was carried out in Guwahati, Assam to understand the challenges faced both by the community and the management and the shared responsibility they both have. In this research paper an attempt has been made to show the vulnerable pockets within the city that affect human health especially because of municipal /solid waste and water contamination.

The ever-growing amount of municipal solid waste is disposed here and there in the city and ultimately it stands as a problem to the society. The water contamination is directly linked to the human health and causes different types of water borne diseases in the city.

#### Objectives:

- Find out the disposal pattern of municipal solid waste
- Examine the type of ground water contamination in Guwahati city.
- Identify vulnerable pockets within the city where Arsenic, Fluoride, Selenium are found.
- Effect on human health.

#### Methodology:

The study was based on both primary and secondary information. The primary data were collected randomly from the field by adopting a participatory approach. A total of 60 wards and 5336 numbers of family members have been taken into account.

The data so collected has been processed and mapped using Geographic Information System (GIS) software namely ARC View 3.2. The results obtained have been discussed below. A questionnaire was designed for collecting the primary data. The secondary data

were collected from Census of India, Assam Remote Sensing Application Center, Guwahati Municipal Corporation Office. A total of 32 ground water samples were collected across the different wards and tested in the laboratory.

#### STUDY AREA:

Guwahati city, the capital of Assam is located on the south bank of river Brahmaputra towards the southeastern side of Kamrup district. The absolute location of the city extends from  $91^{\circ} 38' E$  to  $91^{\circ} 51' E$  longitudes and from  $26^{\circ} 5' N$  to  $26^{\circ} 12' N$  latitude. In the northern side, the city is bounded by mighty river Brahmaputra and in the southern side; the city is surrounded by hillocks, which is the extension of Khasi hills. In the west and the south west there is the Rani Reserve Forest, Deepar Beel wet land and the alluvial tracts of the Brahmaputra plain. The city is situated on an undulating plain with varying altitudes of 49.5 m to 55.5 m above mean sea level. The topography of the city is made up of both high land and low land. At present the city municipal corporation area consists of 60 wards covering an area of 216 sq. km with 809,895 populations according to 2001 census. . Guwahati is the biggest and fastest growing city in North East India, with a growth rate of 38.6 percent according to 2001 census. The population density in Guwahati is 2695.43 persons per sq km. and there is a growing problem of waste disposal within the city. The quantity of municipal solid waste generated in Guwahati has been consistently rising over the years. As per the primary survey, it is found that garbage generated in the city is 634.52 tons /day. This can be attributed to the rapid population growth, mass migration of population from rural to urban areas, increase in economic activities in general within the city and the change in lifestyle and food habit of the people, have changed. The tempo of accelerated settlement growth and resultant pressure on land has caused mushroom growth of settlements on the slope of the hills and low-lying areas in the city. The physical configuration and the pattern of drainage and sewerage system of the city are such that excess water hardly finds any effective drainage outlet, particularly when the water level of Brahmaputra river exceeds the average elevation of the low lying areas of the city. All these problems give birth to various environmental health hazards.

## SOLID WASTE DISPOSAL AND WATER POLLUTION

The most serious problem due to indiscriminate disposal of solid waste in Guwahati is ground water contamination. Rapid growth of population, changing lifestyles of human beings, the increasing use of disposable materials and excessive packaging are all contributing to an increase in the amount of municipal solid waste. Based on primary survey it may be said that the people of the city dispose their solid waste without any processing. Some people throw their waste into the municipality waste bins, some dispose it on roadsides, open drains, within their campus etc. Of course some of the people dispose their waste through private party by paying an amount of money.

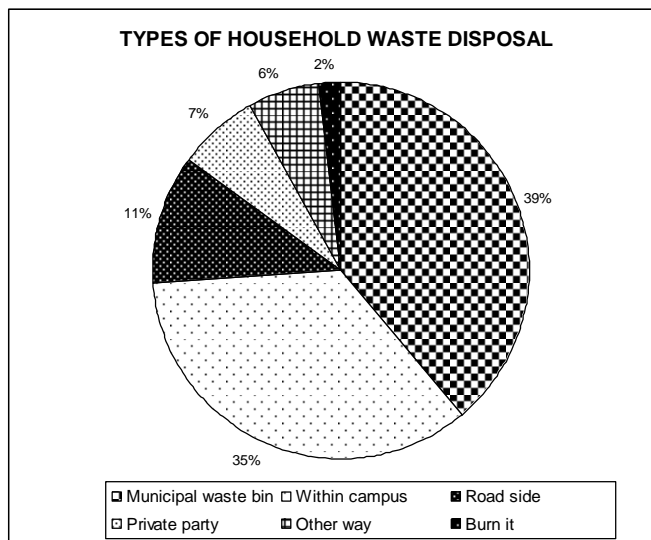


Fig. No.1

From the figure 1, it is seen that 39 % of the people dispose their wastes in the municipality waste bin, which is the highest. Out of the rest 35% dispose it in the campus, 11 % in the road side, 7 % give it to the private party, 6% adopt other methods and 2 % burn it.

When water filters through waste and disposed material, chemicals in the material may dissolve in the water, a process called leaching. Contaminated water can have a serious impact on all living creatures especially on human health. The people generally use water from different sources. It is generally assumed by the people that the water collected from ground is safe because it is not exposed. If ground water is contaminated by different types of attributes it is unknown by the users. They think that colorless and odorless water is safe and so they use it, without a thought about bad effects of it. In 2007 the contaminated water caused cholera in Padumpukhuri of Uzanbazar area, which is located in the central part of the city. More over, in some places incidence of water borne diseases has been frequently heard of. Some times these disease emerges through the use of supply water and sometimes tube wells or other sources of ground water.

The study evaluates the water quality of Guwahati city based on primary survey of 5336 respondents in the 60 wards within Guwahati Municipal Corporation. In the core area of the city comprising the old municipal area, treated tap water is available. In the periphery area of the city, neither the Guwahati Municipal Corporation water or any other source of piped water is available, nor hence most of the people use ground water.

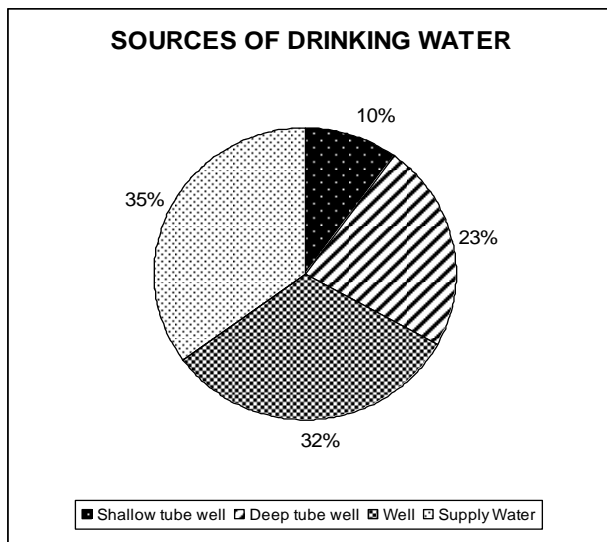


Fig.No.2

Sources of drinking water in the city are both - own sources and public water supply (Fig No. 2). The own sources are well, shallow tube well, deep tube well and spring water. The public water supply of the city depends on both surface water from river Brahmaputera and ground water. There are five different authorities that cater to a total quantity of 109.97 million liters of water per day for the city people.

Water Supply	Surface Water in	Ground	Total Piped Water (MLD)
GMC	72.2	7.8	80
PHED	13.39		13.39
UWSSWB	12.6		12.6
NF Railway	3.45	0.0068	3.46
Gauhati Refinery	0.52		0.52

Table 1: Sources of Water Supply in Guwahati City

Source: Various Water Supply Agencies.

Out of the respondents only 35% of household uses the municipal water. 32 % household use well water, 23 % people use deep tube well and 10 % people use shallow tube well. The water provided by GMC is treated water and the health risks are comparatively lower if there is no leakage of pipes, than the contaminated ground water. The people of various pockets of the city have suffered different types of water borne diseases. In Guwahati 92.1 % of households are aware about the water borne diseases. They assume that municipal solid waste affect their water quality and result in water related diseases that may be occurring in their places (figure number 3 a, b, c)

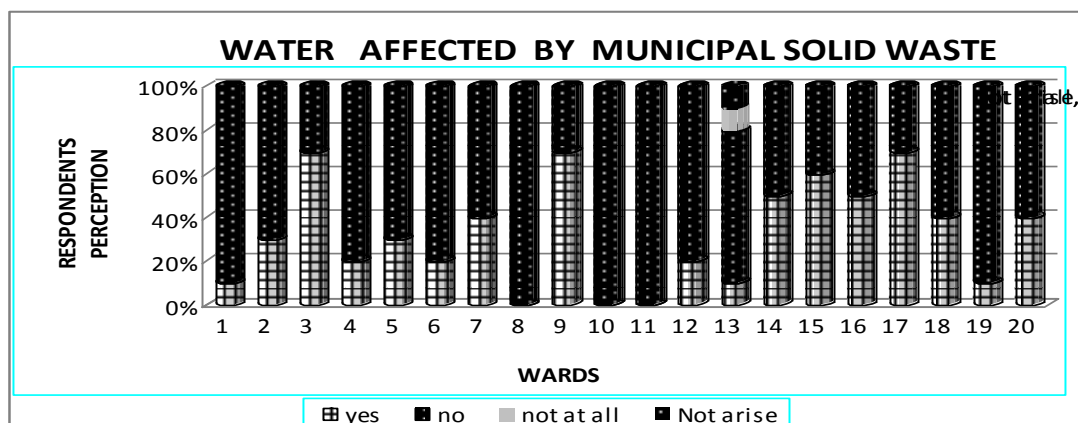


Fig. No.3 (a)

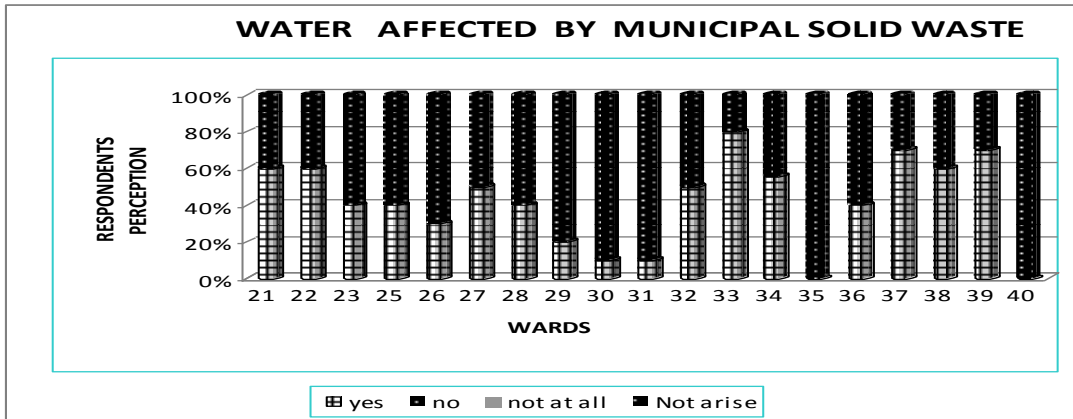


Fig. No.3(b)

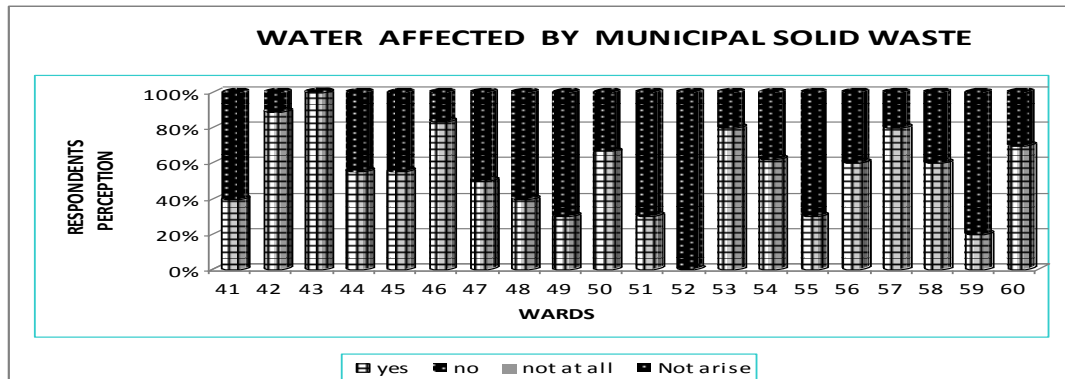


Fig. No.3(c)

From the primary survey, water contaminated area were identified based on the responses and what they could sense (sensory data) .The people felt that water used is some times unsafe, as the incidence of certain water borne disease is high. Figure 4 shows the area where water borne disease could prevail due to contaminated water according to people’s perception. This has been given due weight age because sensory data acts as pointers to ground realities.

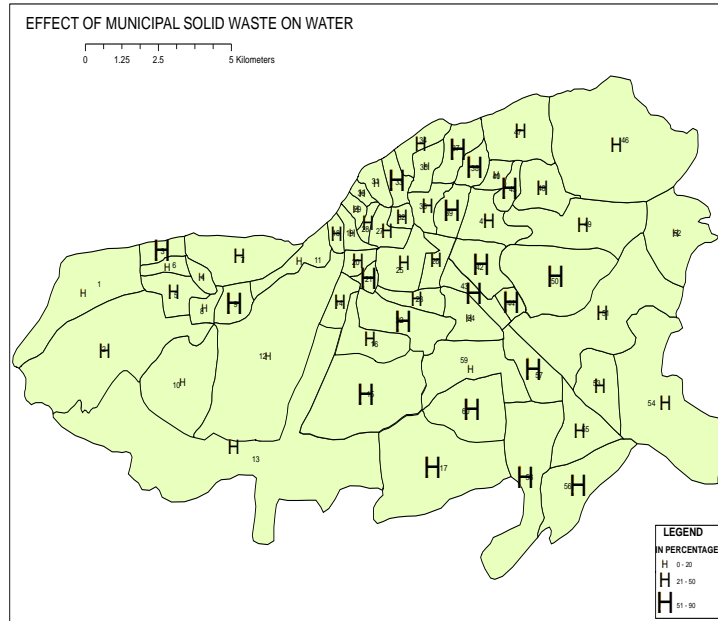


Figure No.4

The area identified here is only based on primary survey and found that ward number 3,9,15,17,35,37,38,39,42,43,44,50,56,57,58,60 have highly affected areas according to the respondents. Due to improper disposal of municipal solid waste the percolating surface water contaminate the ground water in the city. Based on the primary survey, pockets identified as ground water contaminated area, water samples were tested to find the presence of arsenic fluoride, and chromium.

#### ARSENIC CONCENTRATION IN GROUND WATER AND ITS EFFECTS:

Arsenic is a naturally occurring poisonous chemical element and always present as compound. It is widely distributed in the soil profile as component of different minerals and found in nominal amounts in all organisms. Arsenic poisoning affects essential



metabolic enzymes and destroys them, which may lead to organ failure. More precisely this poisoning affects the brain, causing neurological disturbances and death.

Drinking water rich in arsenic, over a long period leads to arsenic poisoning or arsenicosis. The health effects are generally delayed and hence people do not see the ill effects of it.

In the natural environment, Arsenic occurs in soils at an average concentration of about 5 to 6 mg/kg. Geological process release arsenic into ground water. As per WHO standards, permissible limit of arsenic in drinking water is 0.01 ppm. Consuming high levels of inorganic arsenic can result in death. Small levels of arsenic can cause nausea and vomiting. Arsenic ingestion can cause blood disorders, and breathing low levels of arsenic for a long time can cause skin problems. So the health threat of arsenic cannot be ignored.

The arsenic concentration was found to be a major threat in Guwahati. Out of the 32 samples, arsenic in groundwater above the permissible limit was found in 25 samples. In some part of the city the high concentration of arsenic pose as a health risk to the people. Analysis report shows that arsenic concentration in groundwater exceeds the permissible level in certain areas. These areas and ward numbers are Narangi (52), Satgaon (54), Rukminigaon (57), Beltola (58) and west Boragaon (12) .In some places arsenic is not found within detectable level (Fig.No: 6.)

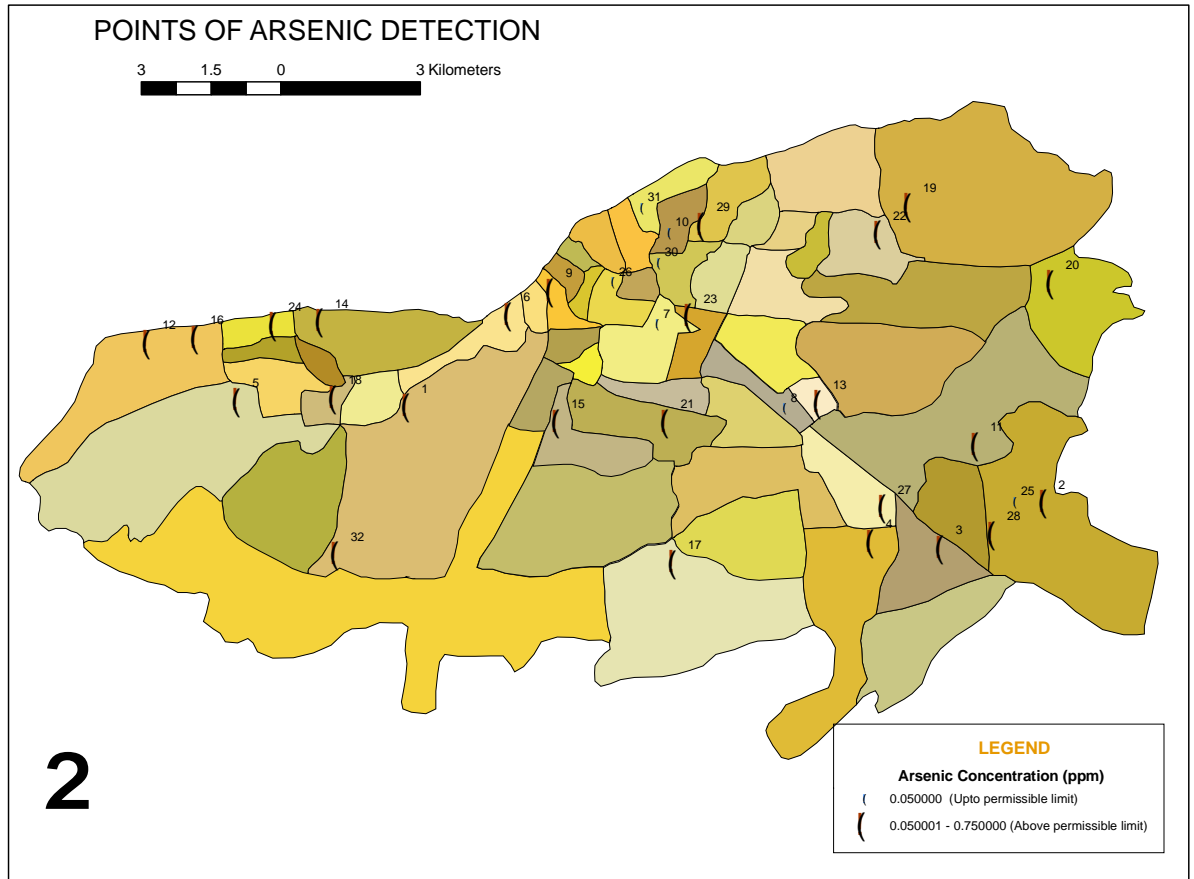


Figure 6: Arsenic Concentration in Guwahati.

In Guwahati the concentration of arsenic varies from 0.05 ppm to 0.75 ppm. It is also seen that concentration differs from season to season. The concentration of arsenic is found to be high in summer compared to winter.

Any form of arsenic compound is toxic to human. Its toxicity is more than four times higher than that of the toxic trace element mercury. The toxic effect of arsenic species depends mainly on their chemical form, route of entry, age, sex, doses and duration of exposure.

Arsenicosis is the effect of arsenic poisoning, usually over a long period such as from 5 to 20 years. Drinking arsenic-rich water over a long period results in various health effects including skin problems (such as colour changes on the skin, and hard patches on the palms and soles of the feet), skin cancer, cancers of the bladder, kidney and lung, and diseases of the blood vessels of the legs and feet, and possibly also diabetes, high blood pressure and reproductive disorders. Skin diseases are the common effects of arsenic poisoning. Long-term exposure to excessive arsenic causes changes in skin pigments and hyperkeratosis; promotes development of ulcerations of skin; and accelerates the risk of cancer in liver, bladder, kidney and skin.

#### FLUORIDE CONCENTRATION IN GROUND WATER AND ITS EFFECTS:

Some elements are essential in trace amount for human being while higher concentration of the same often cause toxic effects. Fluoride is one of them. It is a conclusive fact that concentration between 0.6 to 1.2 ppm is essential to protect teeth decay, while higher concentration (beyond 1.5 ppm) can cause teeth molting and still higher concentration of fluoride may lead to different major health hazards. Presence of fluoride in ground water poses a problem in some areas in Guwahati. Due to structure of rocks, improper disposal of municipal solid waste help to increase the fluoride concentration in the city because concentration of fluoride is not constant in all seasons (Fig7a).

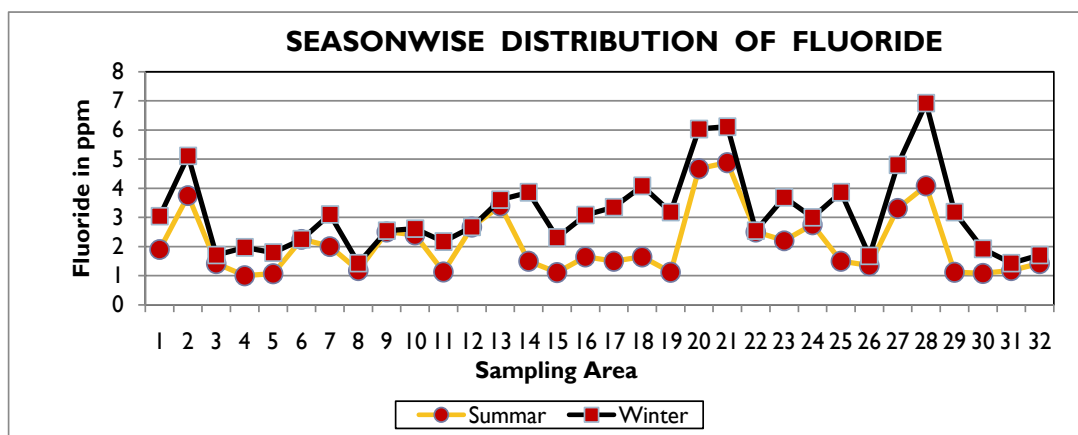


Fig 7a

It is now well known that the fluorosis disease caused by the consumption of excess fluoride from drinking water is a major health problem in some parts of Guwahati. Fluorosis is a dangerous disease, which is characterized by mottled teeth in dental fluorosis brittle bones in severe skeletal fluorosis. The fluorosis is caused by oral intake of fluoride when drinking water contains more than permissible values.

Recently the presence of fluoride up to 5.00 ppm in drinking water was found in samples from various parts of the capital city of Guwahati.. Fluoride in high concentration is not a common constituent of surface water, but they may occur in detrimental concentrations in ground water. In the study area fluoride level varies from 0.00 to above than 6.92ppm. If the fluoride level is found to be more than 1.5 ppm it may cause mottling of the teeth and skeleton fluorosis problem.

Fluorosis is a crippling disorder due to entry of Fluoride in the body, which affects every organ, tissue, cells in the body, and results in health complaints having overlapping manifestations with several other diseases like gout and osteoporosis. In short, it causes Dental Fluorosis, Musculo-Skeletal Fluorosis. Fluoride damages the Pineal Gland, which secretes melatonin hormone in the brain. It also affects the reproductive systems and intelligence. Many symptoms of Fluorosis are somewhat alike with other diseases such as Arthritis, osteoporosis etc. Evidence of extensive fluoride contamination in ground water and instances of fluorosis reported from several localities of Guwahati, has become a matter of grave concern. As the endemic area is spreading day by day, a scientific intervention towards a suitable and practicable solution to the problem has become imperative.

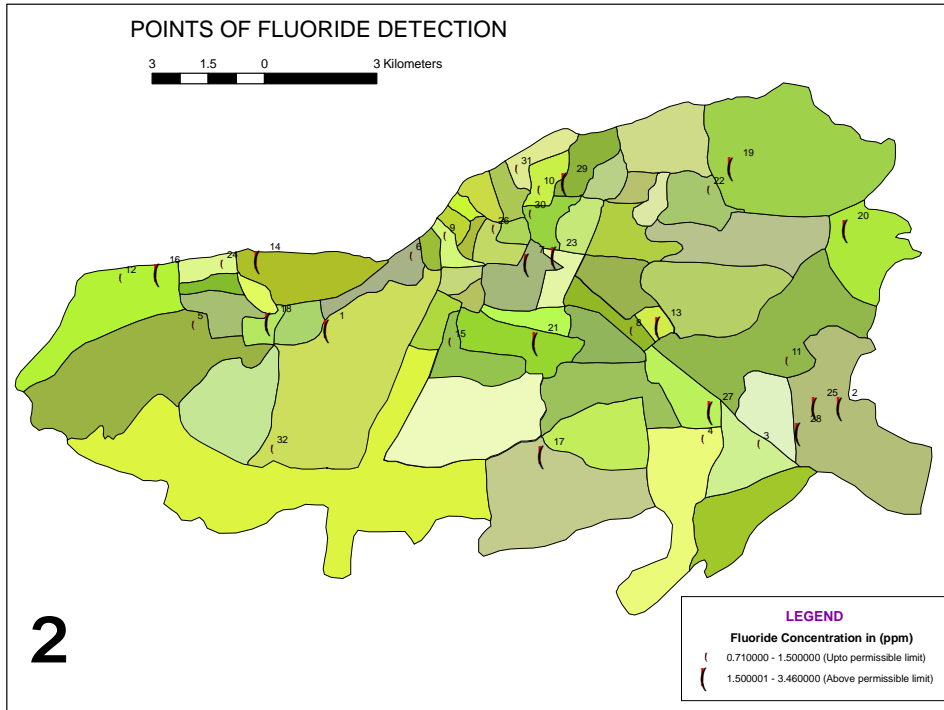


Fig.7 (b)

The fluoride concentration was found highest in the southeast part of the city, in ward number 22 covering the area of junction between Pahartolly road, hotel VIP, near 4<sup>th</sup> APBN and fish market area where highest amount of fluoride is found. The south east part of the city covering the area and ward number of Bagharbari (54), Panjabari (54), Satgaon (54), and Hengerabari road near Borbari (51) highest amount of fluoride is prevalent which is more than the permissible limit. This is followed by the area Lankeswar (1), Hundarbari (1), Pandughat (3), Kamakhyagate (7), Lokhorachariali (17), Silpukhuri (37), Birubari (25), Padumbari (26), Mathgharia(46), near Pragjyotish College(12) with 2.6-4.8 ppm concentration. The least concentration of fluoride was found in the area and ward number Bhangagarh (26), Rehabari (27), Uzan bazaar (34), Ganeshguri (43), Beltola chariali (58), and Basistha chariali (56). The seasonal variation of concentration of fluoride was observed in the sampling points. The fluoride

concentration becomes high in the summer season than winter. The 1.5-ppm, guide line value of WHO, is found in certain areas whereas in some areas the concentration of fluoride in winter samples are deficient (below 0.6 ppm)

High fluoride concentration has been found in the southeastern plains in the city. The eastern part of the southeastern plains has highest fluoride affected area that has an average elevation of 55 msl and is made up of horizontal beds of clay and sand. It is noticed that fluoride concentrations of the ground water in this area gradually decrease from the east toward the west. The ground water samples of the southwestern part of Guwahati are mostly deficient in fluoride content. It indicates that the source of fluoride is present in the eastern part of the southern plains. It is noticed that the causes of fluoride generation in ground water is due to mainly dumping of municipal solid waste.

#### SELENIUM CONCENTRATION IN GROUND WATER AND ITS EFFECTS

Selenium is a non-metallic chemical element, extensively used in electronics, such as photocells, light meters and solar cells and glass industries. It is also used for applications in photocopying, in the toning of photographs. In the modern society the uses of selenium is very high but problem arises when disposed unsafely. People use selenium to fulfill their different kinds of need but they use it without thinking about the toxic effect of selenium. If the empty source of selenium is disposed with the municipal solid waste it affects the environment. Sometimes it may be occupational health effect and some times environmental health effects.

The selenium concentration in Guwahati is shown in figure 8 (a) .The concentration of selenium is from 0.4mg/liter to 3.85mg/liter in Guwahati. The highest concentration of

selenium is found in Mathgharia region in ward number 46 and the lowest amount of selenium is found in Guwahati Club area in ward number 35(Figure no 8 b).

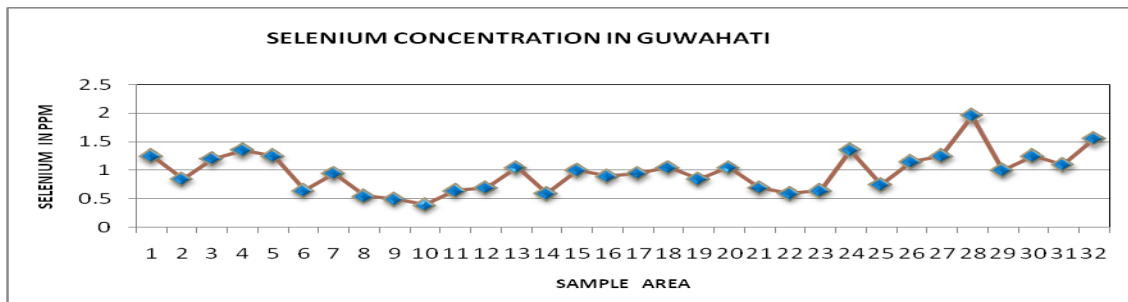


Fig.No.8(a)

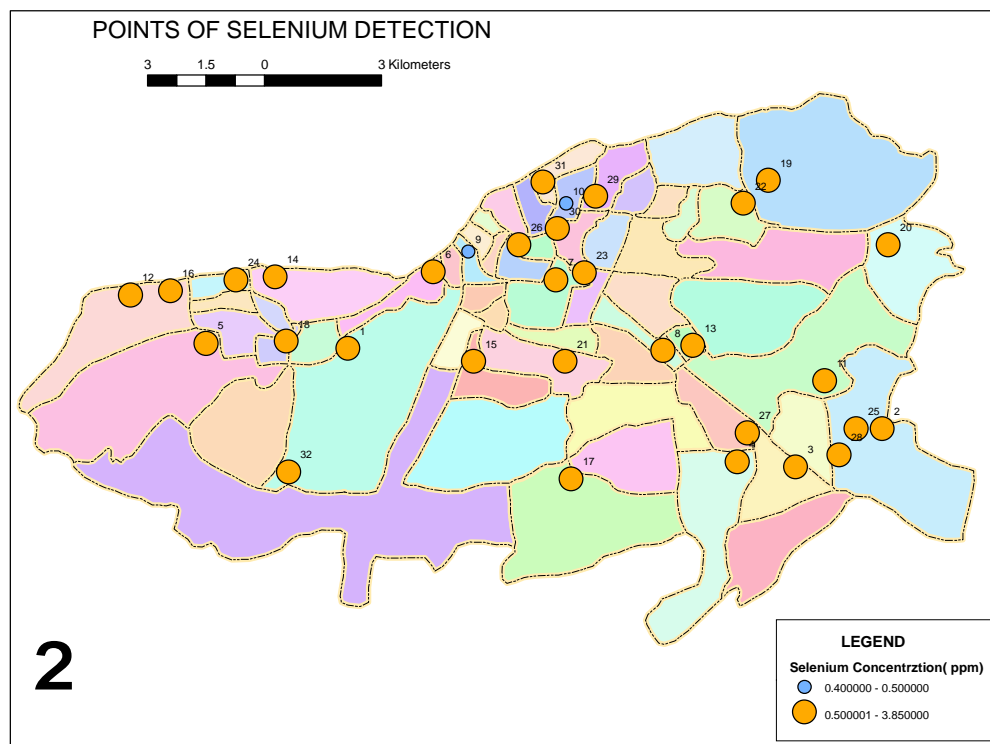


Fig.No.8(b)

The maximum concentration of selenium was found in the summer season than the winter season. The study shows that the selenium ranges in the city between 0.30 to 2.42 ppm. According to WHO the permissible limit of selenium in drinking water is 0.01 ppm. In some areas in the city, the selenium is found more than permissible limits. It is noticed that selenium concentration is very low or found undetectable in winter (fig

no. 7 c). The highest amount of selenium is found in the area of Satgaon (54), West Boragaon (32), Pandughat (3), Lalganesh (16), Bhangagarh (26), Beltolachariali (58) and near Pragjyotish College (12). The low amount of selenium is found in the Ganeshguri (43), Gosala (19), Guwahati Club (35), Hengerabari (51), Noonmati (48) and Padumbari (2). Areas.

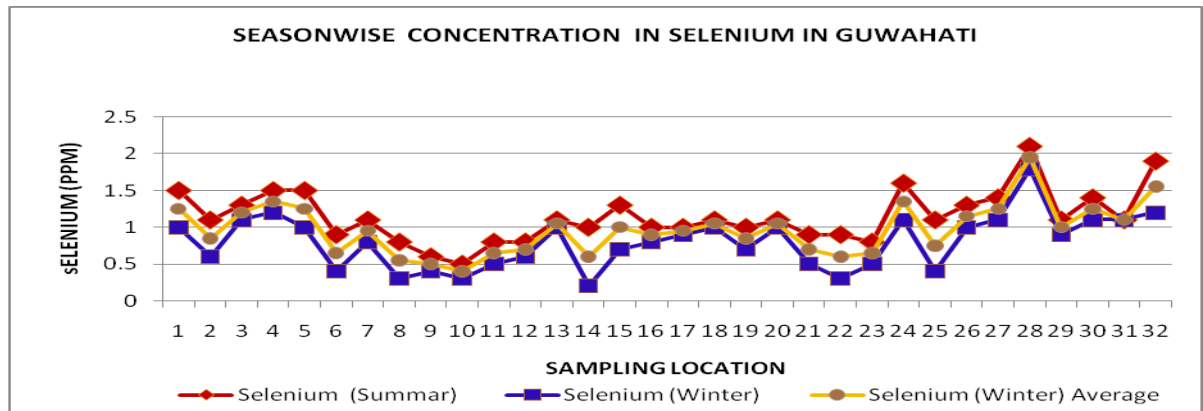


Fig No. 8 (c)

Health effect of selenium is very significant for human health. People may be exposed to selenium in several different ways. Selenium exposure takes place either through food or water. The permissible limit of selenium is required for human health. When shortage of selenium occur, people may experience heart and muscle problems, and intake is too high health effects will be likely to come about. The seriousness of these effects depends upon the concentration of selenium in the food and how often this food is eaten. The health effects of various forms of selenium can vary from brittle hair and deformed nails, to rashes, heat, swelling of the skin and severe pains. Over exposure of selenium fumes may produce accumulation of fluid in the lungs, garlic breath, bronchitis, pneumonities, bronchial asthma, nausea, chills, fever, headache, sore throat, shortness of breath, conjunctivitis, vomiting, abdominal pain, diarrhea and enlarged liver. Selenium poisoning may become so severe in some cases that it can even cause death.



## SUMMARY AND CONCLUSION:

Access to safe drinking water is a basic human right and a component of effective policy for health protection. Addressing specific areas of concern together will tend to support better health protection and highlight the value of interventions directed at sources of pollution, which may otherwise be undervalued. This study has been performed in some severely affected pockets of Guwahati where contamination of groundwater with Arsenic, Fluoride and Selenium are found.

Based on people's perceptions and testing of water quality, severely affected areas are identified as vulnerable points in Guwahati as shown in figure 13. The vulnerable Index of the city is calculated by adding the concentration of trace elements found in the water. All the elements mentioned above have been ranked. The ranked indicators have been clubbed together so as to get the vulnerable index. On the basis of vulnerability index some area were identified as vulnerable areas in the city.

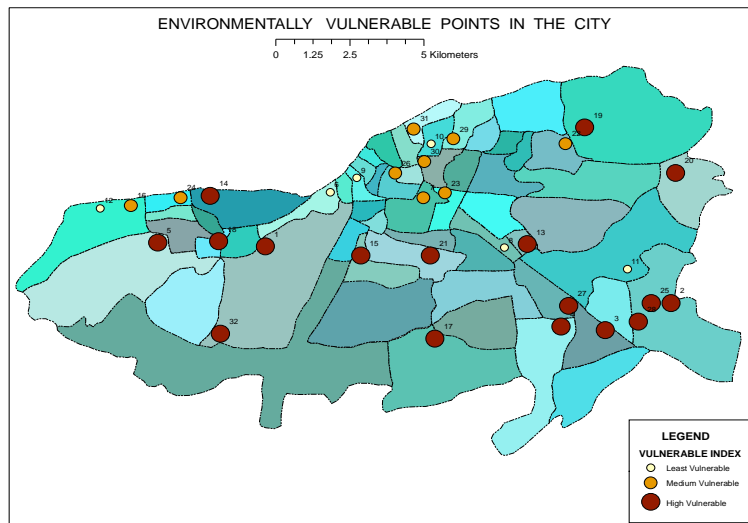


Figure No.13

Based on the findings, it is found that the area Near the Pragjyotish college (12), Bagharbari (54), Basistha (56), Beltola Chariali (58), Bhangargarh (2), Japorigog (44), KamakhyaGate (7), Lalganesh (16), Lokhora Chariali (17), Maligaon

(8). Mothghoria(46), Narangi(52), Near 4<sup>th</sup> APBN( Kahilipara, 22), Panjabari(54),Rukmini Gaon(57),Satgaon(54),West Boragaon (12)are more vulnerable to environmental health problems. The sample area Birubari (25), Lankeswar (1), Noonmati (48), Pandughat (3), Padumbari (2), Rehabari (27), Silpukhuri (37), Ullubari (36) and uzanbazar (34) on the other hand are moderately vulnerable. The least vulnerable group to health hazards includes sample area Bhutan (11), Ganeshguri (43), Gosala (19), GuwahatiClub (35), Hengerabari (51), Hundarbari (1).

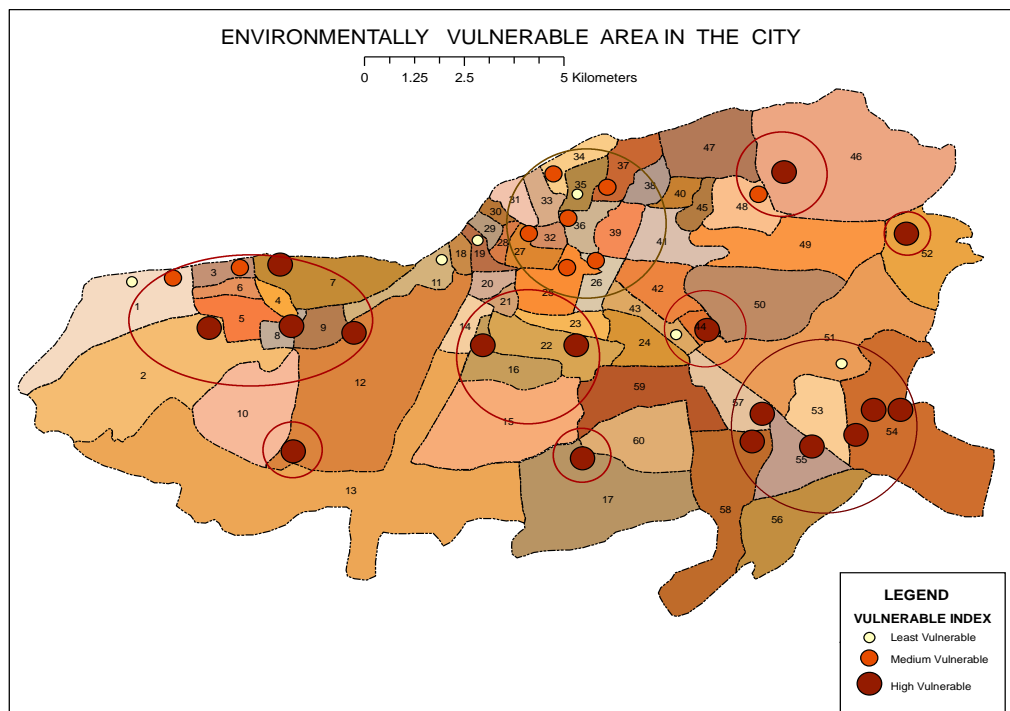


Figure No.14

From the figure 14 it is clear that most of the vulnerable pockets are located in the outer core area of the city. Wherever people have sufficient amount of places to dispose their municipal solid wastes, it has been seen that in the periphery area lack of proper waste management by the producer or cleaning by the municipal corporation is not satisfactory. People of these places throw their wastes some times in open spaces,

sometimes road sides and some times in the open drain. They are not aware about the ground water pollution and related diseases that can occur through the wastes.

Conclusion Prevention of water borne diseases is possible. There should be a minimum standard of hygiene practiced at an individual level. Depending on the understanding and accessibility, these practices may vary from individual to individual and place to place. Proper disposal of Municipal Solid waste is one of the most important requirements for prevention of water borne diseases. Disposal of different wastes must be in such a manner that it is away from the source of drinking water. This will prevent contamination of the water with disease causing organisms. So, people of the study area should practice and ensure the proper disposal of waste to prevent the health hazards, as prevention is better than cure.

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