

Groundwater Contamination and its effect on health: Survey study of the Farmers in Manesar Industrial area, India.

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Abstract

The present study evaluated the effect of groundwater pollution on the health of the people specially farmers living near industrial area of Manesar. Several studies have shown the presence of contaminants in groundwater of many districts of Haryana state. Manesar is centre of industries and a busy economic and residential zone. An equal amount of area is covered by agricultural land also and crops are cultivated in the vicinity of industrial area. This makes this region likely to contaminate its groundwater resource. Water samples from 12 villages were collected, followed by online Questionnaire Survey on 306 people living nearby, in the industrial area of Manesar, which are dependent on ground water for drinking and domestic use. The health of the local people and their children was premeditated and correlated with consumption of contaminated groundwater following questionnaire-based methods. The focus of the study was to highlight impact of nitrate (NO_3^-) and (F^-) on the health of the people. Result of the study shows NO_3^- and F^- contamination beyond the safe limit prescribed by the WHO. Health of the farmers living nearby the industrial area was found to be affected by groundwater contaminants. This paper is an attempt to urge policy makers to pay special attention to such areas and adopt mitigation measures to safeguard the health of people living in such areas.

Introduction

Water is essential for living it is required by every creature for living due to its property of being universal solvent it is more prone to pollution. Water released from industrial discharge, toilets, sinks or from surface runoff from agriculture fields.

Rainwater leads to washing off oil, grease, road salts, chemicals from the ground and lead to mixing of it in the water ways. According to a US report most of the wastewater returns to the ecosystem without being properly treated or consumed. Urbanization and industrialization are the main cause of environmental pollution. Industrial and agricultural activities are the main source of pollution in the rivers, streams and in the groundwater. Second main reason of water pollution is the plastics from the widespread use of plastic pollution across the globe experts says that million tons of plastic entering resulting in polluting it after merging in water this plastic affects human health and marine life also. When this contaminated water is consumed it leads precursor of the several diseases like Diarrhoea, Cholera, Dysentery, Typhoid, Hepatitis A and Polio etc.

Pesticides like (DDT) which surface runoff from fields can cause groundwater pollution. If pesticides and fertilizers, heavy metals directly ingested from drinking water it causes serious health problems. A person who is ingesting chemical toxins in water can be at risk of cancer, hormonal disruption, altered brain function, damage to immune and reproductive system, cardiovascular and kidney problems. Sometimes the source of drinking water can get polluted due to mixing of sewage water into drinking water. Sewage leaking from the pipes can directly enters the groundwater system. People can get exposed to Sewage by hand to mouth or by direct contact this can happen while eating food, drinking, smoking, touching the face with contaminated hands exposure can also occur through cuts, secretes and penetrating wounds

etc. Sewage contains bacteria, fungi and virus causing intestinal, lung and other infections. Bacteria can cause fever, cramps vomiting, headache and other weaknesses. (1) These days fresh water sources are degraded by over exploitation, poor management and by ecological degradation sources of freshwater pollution are untreated waste discharge, dumping of industrial effluent and agricultural field runoff. Polluted drinking water having chemicals in it led to be a precursor of water borne diseases. (2)

Groundwater and surface water are contaminated with heavy metals like POP (Persistent organic Pollutants) which have adverse effect on health. Other cause of water pollution is water related health problems due to incompetent management of water resources. Fair and equal distribution of water is to be provided to all section of society. Urban areas have high coverage of safe drinking water than rural areas in villages people still drink directly from tube wells, hand pumps. Nutrients when their level increases in water bodies which results in algal bloom, dead zones and killing of fishes and causes Eutrophication.

NOCCOS (National Centre for Ocean Science) in collaboration with NOAA Northeast Fisheries Science centre has enlisted indigenous molluscs to help slow down or reverse the process of Eutrophication. (3)

Common Contaminants Found In The Groundwater Are

Nitrate - It comes mainly from fertilizers which are added in fields. The excess of Nitrate causes contamination of groundwater and result in causing a disease in infants known as methamoglobinemia (blue baby syndrome). Applying good agriculture practices can reduce nitrate level in the groundwater others are Synthetic compounds like POP (Persistent Organic pollutant) are most harmful for human health, Pesticides causes contamination of groundwater. Chemicals in drinking water introduced naturally or by humans causes serious health problems

Fluoride in water helps in protecting against dental carries and bone weakening higher level of fluoride in groundwater causes adverse effect on health. It can damage teeth may give dental fluorosis at a drinking water concentration between (0.9 to 1.2 mg/l) (Dean 1942) (4) Skeletal fluorosis which causes change in bone structure is observed in people drinking water between 3 to 6mg/l of Fluoride per litre. (WHO guidelines of water quality) (WHO.int) (5)

Arsenic - Exposure to arsenic for a long time in drinking water causes cancer and skin lesions. It can also cause cardiovascular disease and diabetes it can damage liver and nervous system also. Arsenic is used in industries specially in glass processing, textile, metal adhesive industry, paper industry in wood preservative industry and ammunition industry. This usage of arsenic in industries which leads to be a cause of groundwater contamination. (edu. green.teri.res.in) (6)

Study area

The present study was conducted in the Manesar area of District Gurgaon in State Haryana of India. Manesar is a fast-growing industrial town in the Gurgaon district of the State of Haryana in India and is a part of the National Capital Region (NCR) of Delhi. Geographically, Manesar is located at 28.57°N latitude and 77.23°E longitude. Industrial model Town (IMT) Manesar is developed in four phases on about 3,400-acre. Manesar has been developed by Haryana State Industrial Infrastructure Development Corporation (HSIIDC). Manesar lies in the Gurgaon district of the Haryana state in the Northern part of India. The average N.S level of the area is 200 - 220 mtr. above MSL and all towns/villages of districts are well interconnected by road network. More than 100,000 people go to work in Manesar from adjoining places. The Gurgaon-Manesar Master Plan projects a population of 37,000,000 by 2021. Manesar is 32 km from IGI Airport and is just 16-23 km from Gurgaon and has some of the best urban infrastructures in Northern India. Located on National Highway-8 is served by local buses and trains plying on this route. The area is well connected with Delhi, Rewari, Dharuhera, Jaipur, Ahmedabad, and Mumbai; air connectivity is equally good.

Method And Methodology

Study Design

To study the hypothesis of health effects of the presence of Nitrate and Fluoride in the Groundwater of Manesar Area, Gurgaon, an online survey was conducted in the concerned area in the times of Covid-19 by contacting school children and their families the Questionnaire was self completed by the participants. Around 309 students and their parents took part in this survey. Questions were mainly asked related to the people general health, their perception and their overall lifestyle. In total of 18 questions were asked in the questionnaire. The questionnaire comprises questions related to the family health history (A. Vantarakis et al. 2016) (7) family occupation, Age and Name of the person taking the survey, source of their drinking water, depth of the well if they are using well water, etc. We gathered meaningful information from this survey, which is depicted in this survey research paper in the form of tables and graphs.

Result

From the questions asked in survey study we gathered this information

Distribution of source of potable water in agricultural area under study

Source of water	Total
Handpump water	2
RO water	105
Tap water	36
Well water	19
Grand Total	162

Row Labels	Count of S. No.
Municipal water supply	57
Submersible	20
Well	4
Grand Total	81

The main source of irrigated water is groundwater from wells other sources can be surface water, drainage ponds rain and municipal water supply (ag.umass.edu) (8) in current times agriculture accounts for the use of 70% of all fresh water sources (worldbank.org). Water used in agriculture fields is used to grow crops and fruits and sustain livestock however water quality of water used in agriculture can get affected mainly by the poor planning of industrial sites and from the animal farms it depend on the type of source of water that how much it is at risk of contamination if the well is located near by a sewer pipeline and if it get leaked it can contaminate well water also thus if the quality of water is poor the quality of produced crops would be poor and who ever consumes such type of food will get sick and can have long term illness. Agriculture water comes from various sources such as rivers, streams, pond open canals, reservoir, lakes also groundwater from wells and rainwater. Along with this municipal water system used in cities and in rural areas can also be used for agriculture purposes. (cdc.gov) (9) Industries use freshwater during the production process for creating new products or it can be used in cooling equipment's. Water is also used by petroleum refineries and for producing chemical products also large amount of water is used by food, paper and chemical industries. (cdc.gov) We found out from our survey that in IMT Manesar area more people are practicing agriculture than industrial activities.

People dependence on well water in this case owner are totally responsible for protecting their drinking water. Private wells too can be found contaminated by human activities and from naturally occurring sources. People consuming microorganism containing water can experience gastrointestinal illness and infections. Water entering in well by surface runoff from rainfall or by seeping underground results in contaminating well other contaminants entering in well are Nitrate and Fluoride and can cause several diseases. (epa.gov)10

Many people living in urban areas specially in municipalities like cities, town and villages with services like water treatment plants and one of the advantages of living in municipality is potable water. If in any case municipal water gets contaminated results can be widespread. Bacteria and viruses can enter in groundwater and than in pipeline system which carries water into houses (encyclopidea.com) 11

When question was asked to mothers about what type of water she uses to formula feed her infant it was good to know that people are taking good care of their infants as most of the mothers use RO water more than tap water and any other source of water. This question was asked specifically to know the reason of Nitrate effects in infants as water sampling results showed Nitrate contamination in Manesar area.

Govt agencies also try to regulate tap water quality. Household water purification methods such as water filters, boiling or distillation use to treat tap water contamination to improve portability (Ahuja, Satinder. 2018).12

When questions related to Fluoride usage and product preference was asked it was found that People prefer Colgate toothpaste over any other herbal toothpaste .Colgate toothpaste contains 0.32% fluoride content .Fluoride toothpaste is effective in preventing tooth decay as it makes enamel of teeth's strong (colgate.com).13 People prefer to brush their teeth either once in a day or twice in a day. It was found that children are having yellow teeth which clearly indicates presence of fluoride in water they consume.

People depend mostly on agriculture in this area as we found out from the agriculture related question asked in survey study as most of participants were from villages. Pesticides and fertilizers used by farmers in fields results in contaminating ground and surface water(Naveen kumar et al.2021).(14) Farmers use fertilizers and animal manure in their field to provide crop with essential nutrients like nitrogen and phosphorus to grow, when nitrogen and phosphorus not fully utilized by the plant it can get lost from farm fields and can negatively affect groundwater and air quality. Excess of nitrogen and phosphorus reaches into waterways during rain or when snow melts it can also leach through soil and reaches ground water this high level of nitrate in water causes Eutrophication as already discussed above. (epa.gov)

The pesticides which runoff from agriculture fields and reaches water body it later on accumulates in the body of aquatic organisms thus posing risk to human health (Muhammad Syafrudin) et al. (2021) (15). Overuse of fertilizers has helped in increasing food production with the increasing use of fertilizers in the agriculture fields it has resulted in depletion of essential minerals of soil which lead to reduction of soil fertility .Pesticides cause chronic disease that can be fatal to human life (Pingali. P. L Hossain, M, Gerpacio R.V 1997) Pesticides affects the peripheral nervous system lack of knowledge leads to overuse of pesticides (Wang yang Lai (2016) Application of biofertilizers is an ecofriendly approach to replacement of fertilizers. Bio – fertilizers increases the fertility of soil without harming the environment by making availability of nutrients in the soil (Chisom Rachael Asoegwu, et al. (2020) 16

When question was asked to people regarding their preference between bio fertilizers or Synthetic fertilizers which are used in their fields to increase crop yield. People preferred using synthetic fertilizers

over bio- fertilizers reason behind this can be lack of awareness of people regarding the uses and benefit of bio –fertilizers.

Nitrate/nitrite exposure most commonly causes methemoglobinemia (blue baby syndrome) in infants. Methemoglobinemia it can cause infant skin to turn a bluish colour and thus it can result in serious illness or death of the infant on the other hand it cause decreased blood pressure, results in increased heart rate, headaches, stomach cramps, and vomiting. Other health effects includes increased heart rate, nausea, headaches, and abdominal cramps. Some studies also suggest an increased risk of cancer, mainly gastric cancer, which is in a link with dietary nitrate/nitrite exposure, but there is not yet scientific evidence on this. (Minnesota Department of Health)

Here in the following survey study we asked people the questions related their medical history we found out the following results as shown in the below graph

Exposure to fluoride can lead to skeletal fluorosis. In skeletal fluorosis, fluoride gets deposited in the bone over many years. The earliest symptoms of skeletal fluorosis may include stiffness and pain in the joints. In many cases, the bone structure will change resulting impairment of muscles and causes pain. Fluoride exposure may cause abdominal pain, excessive saliva, nausea and vomiting. Seizures and muscle spasms can also occur. (WHO website). Symptoms of acute arsenic poisoning may include vomiting, abdominal pain and diarrhoea. It can be followed by numbness and tingling of the extremities, muscle cramping and death, in extreme cases. (WHO website).

Discussion

Industrial pollution leads to environmental change impacting human health like prenatal disorders infant mortality, respiratory disorders, allergies, malignancies, cardio-vascular disorders, mental disorders causing death. Due to its wide range impact and lack of comprehensive study industrial pollution is causing adverse impact on human health. (Mohammad Mafizer Rehman, Khosrul Alam and Eswarn Velayutham (2021). (18) Not only on humans industrial pollution has negative impact on the health of insects, pests, crops, animals and natural resources this study was done in Gazipur, Bangalore in form of questionnaire survey and sample size of 50 persons. (M. Anwar Hossain et al. 2010) (19). There are thousands of pollutants causing contaminants present in environment at nano and micro-gram per litre per level (Rene P. Schwarzenbach et al. 2010) (20). Urbanization has destroyed the environment and threatened its survival chances. (Inyinbor Adejumo et al. 2018) (21). In a study carried out in China to study the effect of water pollution treatment on human health to carry out the study data was collected from China health retirement longitudinal study to study the relationship between health and water pollution it was found that the water pollution was negatively associated with the health outcomes and industrial waste water has impacts on health (Qing Wang et al. 2016) (22). Due to industrialization farmers living nearby the industrial areas are getting mostly affected with its ill side effects. In another study done in China villagers believe that water pollution in area is because of nearby industrial plants they contribute to deteriorate water quality of the river water. Tannery (Leather industry) releases untreated effluent in the

environment leather industry releases, Organo Chlorinated Phenol ,toxic Cr (VI) ,copper ,antimony, barium, lead, selenium ,mercury, zinc, arsenic, nickel, formaldehyde, resin, pesticides ,salts ,dyes ,grease ,oil Cr(VI) discharge causes acute toxicity, carcinogenic and high blood pressure affecting seed germination(Geremew Liknow Tadesse et al .2017)(23). Farmers having many acute chronic health conditions including cardiovascular ,respiratory disease, arthritis, skin cancer hearing loss and amputations even agricultural workplace can cause stress and adverse reproductive outcomes. In getting exposed to organic dusts grain processing and confines animal feeding operations lead to the cause of asthma (Steven Kirk horn, Marc –B – Schenker).

Due to industrialisation and uptake of fluoride through drinking water and the usage of fluorinated toothpaste result in accumulation .Fluoride in living organisms in (bones). The following research was carried out in animals as they are good bio-indicators for fluoride pollution the study was done to investigate the amount of fluoride in the tissue of vertebrates and invertebrates like fishes ,amphibians, reptiles and small mammals ,ungulates and predators .(Mirona Palczewska – Komsa.2016).(25)

Fluoride pollution caused many bio-chemical changes in the Haemo-lymph in silkworms. The aim of the study is to study the adverse health effects caused by Fluoride pollution on silkworm health.(Yun – gen Milao (2004)(26).It is said that excess of fluoride is harmful for animals and humans .Fluoride enters food chain when it starts getting accumulated in water thus impacting fish health which results in accumulating human health also.(Suvendu Ghosh et al .2019)(27).In an another study author selected a total of 20 sampling sites 15 out of 20 samples is found more than the prescribed limit by the WHO (1.2mg/l).It was conclude that 75% of water is unfit for human use .(Mamta Goyal et al.2006).(28)HF is the most dangerous gas emitted from the aluminium smelters the following study was conducted in Oman to model HF dispersion to make sure that the concentration doesnot cross threshold limit for the residents living nearby results showed that the concentration was found below the allowable concentration .(Sabh Abdul –Wahab eta al.2019).(29)

A fertilizer Phosphate Plant causes fluoride pollution this study was done to check its effect on children health living nearby plant it results in declining in growth and development of the children and increase in dental mottling (56.2%) incident. Other symptoms include headace, dizziness pain in joints and limbs phyrangeal congestion and folliculosis odour more frequently.(Junging Ding et al .1987)(30).Fluoride pollution caused by factories processing phosphate in South of Safi affecting animals and plants. Fluoride concentration in following study shows that Fluoride pollution in plants nearby factories is more than in plants which are in non- polluting areas In grass 700ppm ,In forge – 280 ppm ,straw – 75ppm ,barley 25-ppm water – 1.6 ppm therefore the ingestion of these polluted plants inhalation of Fluoride cause dust and gases results in daily high intake in animals which results in dental fluorosis.(M. Kessabi et al 1984).(31)

Increased Nitrate level lead to the growth of algae and also result in decrease of level of oxygen which is essential to support fish and other marine life .(Michel J Hills,1996)(32).Nitrate level exceeds in drinking water in many part of Southern Africa .High Nitrate level leads to infant Methemoglobinemia. Map shows

Nitrate occurrence in Botswana, Namibia and South Africa. Source of Nitrate Contamination it can be Natural or Anthropogenic. (G. Tredoux and Astalma. 2006)(33). Nitrogen Fertilizers application increases ground water pollution this was observed in a study conducted in Adimeshk and Susa Plains. The region is divided to 4 sub region A, B, C, D, 168 groundwater samples were collected from 42 water wells. A Questionnaire Survey procedure was used for collection N- fertilizer application rate data in NO_3 Concentration was found 44.27 mg/l. below WHO guidelines mean Nitrate concentration found from 4 regions 16.1, 19.5, 13.3, 7.9 mg/l. (AH Mahvi et al. 2005)(34). Nitrate and Nitrite pollution is most identified linked contaminant it is associated with Septic waste and Agricultural activities posing threat to human health. For studying Nitrate/Nitrite effect 4 rural areas of Lucknow were selected 15 samples from each areas were taken. Maximum nitrate 1.8998 both are high (Anjali Verma et al. 2014).(35)

Lot of work on Fluoride and Nitrate contamination is being done in Haryana which indicates presence of these contaminants in the Haryana groundwater. (Priyanka Yadav, Deppika Pandey et al. 2021) did a study on the groundwater of Manesar, Haryana and their study indicates presence of Fluoride and Nitrate contamination in the samples of groundwater of some villages of Manesar, Haryana. (Sucheta Yadav et al. 2019) studied the presence of Fluoride concentration in the groundwater samples of District Mahendergarh and found concentration of fluoride in the samples between 0.3 to 0.16 mg/l. (Bhupinder Singh, V.K Garg 2006) did study in Pataudi, Haily mandi and Harsaru village and reported Fluoride concentration between 1.68 ± 0.35 , 3.22 ± 1.18 and 1.78 ± 0.12 mg/l. In an another study done by (JP Yadav, S Lata et al. 2003) did study on Urinary fluoride samples and Drinking water in the Children of Jhajjar District, Haryana he found Fluoride concentration between $(1.48 \pm 2.14 \text{ mg/l})$. (Meenakshi et al. 2003) did some study on the ground water of Jind District and reported a change in Fluoride concentration (0.3 to 6.9 mg/l). A study was done in did study in Panipat District Haryana to know the non-carcinogenic human health risk caused due to intake of Fluoride and Nitrate contaminated water and results indicate that children are more health risk of non-carcinogenic than the adult population. (Lakhvinder Kaur et al. 2020). (VK Garg et al. 2009) did same kind of study on the groundwater of South western Haryana in Bhiwani District he studied Fluoride and he reported (86.0 mg/l) Fluoride concentration from one of the village under his study Motipura village having highest concentration of fluoride till now. In a study done in Jhajjar District and shows increase in Fluoride and Nitrate in the groundwater of Jhajjar District (Ruchi Gupta. 2018). In an another study done on the groundwater of Hisar District, Haryana reported Fluoride concentration between the range of (0.24 to 9.27 mg/l) in the groundwater samples. A study done on Markanda River of Kurukshetra District reported that High level of Nitrate content in the well water of Haryana (99.5 mg/l) (Rakesh K Watts et al. 2019). Study done by (Guru Premet et al. 2008) in the Farukhnagar area of District Gurgaon shows Nitrate level in the ground water of tubewells of Farukhnagar area (56.19 to 91.36) all of these study done in Haryana indicate presence of Fluoride and Nitrate in Haryana more than the prescribed limit of WHO (45 mg/l).

Conclusion

World is evolving everyday with the advancement in technology and industrialization it is quite disheartening but the effect of growing industrialization is having harmful effects on the human population .Its like a chain reaction a link between Industrial chemicals and their adverse effect on human health .This survey research was carried out to know about the underlying effect of industrialization on the health of people specially farmers living nearby the industrial areas. It is observed from this study that the people living in the villages coming under the study area are mostly drinking water from the well and the Municipal water supply. The activities taking place nearby the area people live in are mostly Agriculture activities followed by Industrial activities. For infants, people are using more RO water than well water that's why no severe case of Methamoglobinemia was reported in this area till now. People use toothpaste more than any other traditional method to clean their teeth's which means they are consuming fluoride through toothpaste.

Skin pigmentation which is a symptom of Arsenic exposure is reported in fewer people .There are cases of people suffering from a Lung infection, Cancer, Heart disease, Chest Pain, Nausea, Headache, Vomiting. (These are all symptoms of Nitrate exposure). People depend upon Bio fertilizers than Synthetic Fertilizers. (Synthetic Fertilizers lead to nitrate contamination in the groundwater).If use of N-Fertilizer management is improved and more of Bio fertilizers are used this will reduce Nitrate load on Environment (Bijay Singh et al.2007). Till now air pollution has received multiple attention from the people .Govt should ban disposing of waste on roadside it needs to develop effective waste management strategies to reduce water pollution further more Govt should set up dustbins that will encourage public to dump waste in the dustbins .There should be a weekly and monthly sanitation exercise .Media should play an important role to aware the people about sanitation practice and clean environment (Salisu abubakar et al 2020).

References

1. Referred from Delaware Health and social service (Division of Public health).
(<http://www.dhss.delware.gov>).
2. Referred from article written by Anna Smith,22 November 2020(medical news today.com)
3. Referred from National Ocean Service (<https://oceanservice.noaa.gov>)
4. Dean HT (1942) Epidemiological studies in United States In Moulton FR ed. Fluorine and dental health Washington DC, American Association for the advancement of Science (AAAS Publication no.19)
5. Referred from who.int website.
6. Referred from (edugreen.teri.res.in) website.
7. A.Vantarakis,S.Paparrotopoulos,P.kokkinos,G,Vantarakis,K.Fragoli and I. Detorakis (2016)Impact on Quality of Life when Living Close to Municipal Wastewater Treatment Plant.Journal of Environment and Public Health. Vol 2016 Article ID 847023 ,8 pages <http://dx.doi.org//10.1155/2016/8467023>
8. Referred from (ag.umass.edu) website.

9. Referred from (cdc.gov) website.
10. Referred from (epa.gov) website.
11. Referred from (encyclopidea.com)
12. Ahuja,Satinder(2018)Advances in water purification techniques: Meeting the needs of Developed and Developing Countries San Diego : Elsevier ISBN 978-012-8147917.OCLC 1078565849)
13. Referred from (Colgate.com).
14. Naveen Kumar, Arvind Kumar,Binny Marry Marwein, Daneshwar Kumar Verma, Ikakiya Jayabalan ,Agam kumar ,Duraishamy Ramamorthy (2021)Agriculture activities casusing water pollution and its Mitigation – A Review (International Journal of ModernAgriculture Vol 10 No .1 ,2021)
15. Muhammad Syafrudin,Risky Ayu, Adhi Yuniatro, Tony Hadibarata .Pesticides in Drinking water – A Review (2021) International Journal of Environmental Research and Public Health 18(2):468.
<http://doi.org/10.3390/ijerph18020468>.
16. Chisom Rachael Asoegwu,Chibueze Gospel Awuchi, Nelson –Kalu Chukwudi Timothy ,Chimaroke Gabriel Orji (2020) A Review on the Role of Bio fertilizers in Reducing Soil Pollution and Increasing Soil Nutrients.Himalayan Journal of Agriculture.
17. Referred from (Minnesota Department of Health) website.
18. Mohmmad Mazifer Rahman,Khosrul Alam and Eswarn Velyutham (2021). Is Industrial pollution detrimental to Public Health? BMC Public Health <http://doi.org/10.1186/s12889-021-11217-6>.
19. M.A Anwar Hossain,M. Khabir Uddin ,A.H Molla ,M.S.T Afrad ,M.M Rahman and G.K (2010).Impact of Industrial Effluent and Discharge and Degradation of Natural Resources and threat to food security (2010).The Agriculturists 8(2):80–87(2010).A scientific Journal of Krishi Foundation ISSN17295211
20. Rene P.Schwarzenbach, Thomas Egli,Thomas B .Hofsteller ,Urs von Gunten ,Bernhard Wehrli . (2010)Global water pollution and human health.The annual review of Environment and Resources .Environ. annual reviews.org.doi:10.1146/annual reviews.org.
21. Inyinbor Adejumo,Adebesin Babatunde O,Oluyori Abibola P,Adelani – Akande Tabitha A, Daba AdewumiO and Oreof Toyin A (2018).Water Pollution:Effect pollution and Climate Impact .doi/ 10.5772/intechopen.72018(Water challenges of an Urbanizing world.
22. Quing Wang,Zhiming Yang (2016). Industrial water pollution water environment treatment and health risks in China .Environmental Pollution Vol 218,Nov 2016 ,pg 358–365.<http://doi.org/10.1016/j.envpol.2016.07.011>
23. Geremew Liknow Tadesse,Tekaigh Kasa Guya (2017).Impact of Tannery effluent on Environment and human health .Journal of Environment and Earth Science ISSN-2224-3216Vol 7 No .3 2017
24. Mirona Palczewska-Komsa,Aleksandra Wilk ,Anna Stogiera ,Dariusz Chlubek ,Jadwiga Buckowska – Radlinska,Barbra Wyszniowska,Szczecin ,Poland (2016).Animals in Biomonitoring studies of Environmental Fluoride Pollution Research Review Fluoride 49(3Pt2)Λ279–292) July-September 2016.

25. Yun –gen Milao, Li – Jun Jiang, D. Bharathi, Hang Zhou, PR China (2004). Biochemical effect of Fluoride on Homolymph of silkworm, Bombyx Mori. Fluoride Vol 37 No .2117-124-2004.
26. Suwendu Gosh, Debosree Ghosh (2019). Impact of Fluoride toxicity on fresh water Fishes – A mini review. International Journal of advances and Innovative Research 6(2)2019.
27. Mamta Goyal, Durga Nath Dhar (2006). Fluoride pollution in some parts of District UNNAO, U.P, India Journal of Industrial Pollution Control 22(2) 2006.
28. Sabah Abdul Wahab, Ziyad Alsubhi (2019). Modelling and analysis of HF pollution from a aluminium smelter located in Oman. Sustainable Cities and Society 51, 101 802, 2019.
29. Junging Ding, Zeai Zheng, Dong ming Cao (1987). Fluoride Pollution caused by Phosphate Fertilizer and its effect on Children health. Fluoride 20(4), 154–161, 1987.
30. M. Kessabi, B Assami, JP Braun. Science of Total environment 38, 63–68, 1984. (book)
31. Michel J Hills CRC Press 1986 (book).
32. G. Tredoux, Astalma. Groundwater Pollution in Africa 2–36, 2006 (book).
33. A. H Mahvi, J Nouri AA Babaei, R Nabizadeh (2005). Agricultural activities Impact on Groundwater. International Journal of Environmental Science and Technology 2(1), 41–47, 2005.
34. Anjali Verma, Amit Kumar Rawal, Nandkishore More (2014). Extent of Nitrate pollution in groundwater of rural areas of Lucknow, U.P, India.. Current World Environment 9(1) 114, 2014.
35. Sucheta Yadav, Sudhir Kumar Bansal, Sanjay Yadav, Sunil Kumar (2019). Fluoride distribution in underground water of District Mahendergarh, Haryana, India. Applied Water Science 9(3) 1–11, 2019
36. Priyanka Yadav and Deepika Pandey (2021). Assessment of Fluoride and Nitrate contamination problem in the groundwater of Mansear Haryana, India – A case study Sodhsamhita UGC CARE GROUP – 1 ISSN 2277–7067
37. Bhupinder Singh, Shalini Gaur, V.K Garg. (2007), Fluoride in Drinking water and Human Urine in Southern Haryana, India. Journal of Hazardous Material 144(1–2) 147–151, 2007.
38. J.P Yadav, Suman Lata, Sudhir K Kataria, Sunil Kumar (2009). Fluoride distribution in groundwater and Survey of Dental Fluorosis among School Children in the villages of the Jhajjar District of Haryana, India, Environmental Geo Chemistry and Health 31(4) 431–438, (2009).
39. Meenakshi Arora, Kavita V.K Garg, Renuka (2003) Groundwater quality in some villages of Haryana India: Focus on Fluoride and Fluorosis Journal of Hazardous Material 106(1) 55–60.
40. Lakhvinder Kaur, Madhruvi, S Rishi, Azeem Uddin Siddiqui (2020), Deterministic and probabilistic health risk assessment technique to evaluate non – carcinogenic human health risk (NHHR) due to fluoride and Nitrate in groundwater of Panipat, Haryana. Environmental Pollution 259, 113711, 2020
41. V.K Garg, Surinder Suthar, Sushma Singh, Aleenjeet Sheoran, Sandeep Jain (2009). Drinking water quality in the villages of south western, Haryana, India assessing human health risk associated with hydrochemistry Environment Geology 58(6), 1329–1340, 2009
42. Rakesh K wats, Alka S. Grover, Ravinder Kumar and Meenu Wats. (2019). Status of Surface Water Quality in river Markanda and its correlation with ground water Quality and Health of residents of

Shahabad ,Kurukshetra ,Haryana ,India – A Case Study. International Journal of Health and Economic Development 5(1), 1–11 January 2019.

43. Ruchi Gupta, Anil Kumar Mishra (2008) Groundwater Quality of Quaternary Aquifers in the Jhajjar District ,Haryana, India. Focus on ground water Fluoride and Health implications .Alexendra Engineering Journal .2018, 57, 375–381.
44. Guru Prem, Raj Kumar Jorar ,Konrad Miegall, S.B Mittal. (2008). Nitrate occurrence in groundwater – A case study from Haryana ,India. Journal of Agricultural Engineering Vol 45 (1) Jan – March (2008
45. Bijay Singh, Praksha Rao, E.V.S, Yadvinder Singh, Puttana K, (2007) Nitrate pollution in groundwater vis a vis nitrogen fertilizer use in India .Agriculture Nitrogen use and its Environmental Implications (Eds).
46. Sasibu Abubakar, Mridul Dhawal ,Dipti Parashar et al .2020. Water pollution and effect on health of Dala LGA ,Nigeria. Materials today proceedings <http://doi.org/10.1016 /j.matpr.2020.10.9>

Figures

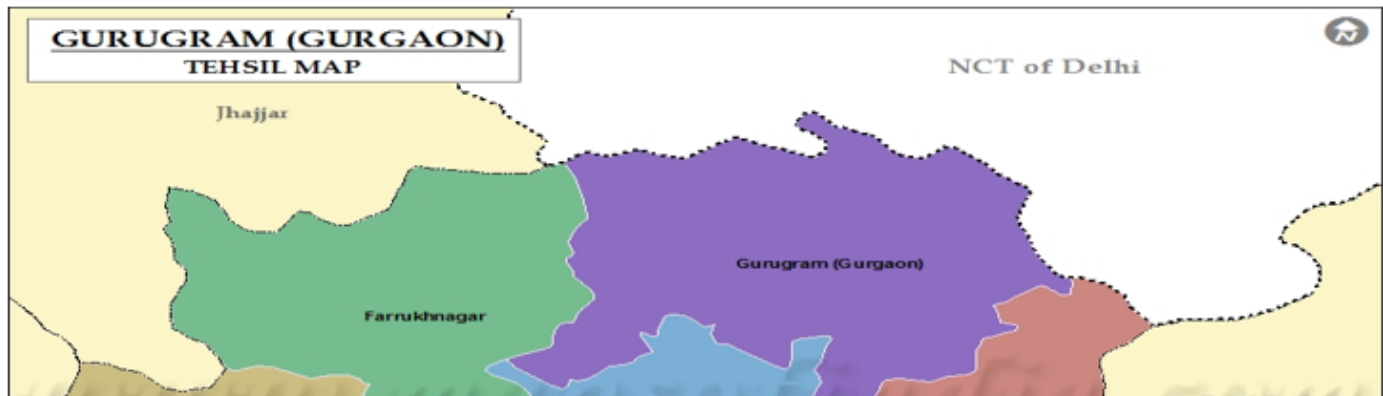


Figure 1

Source of water used in for the domestic purpose in agriculture area

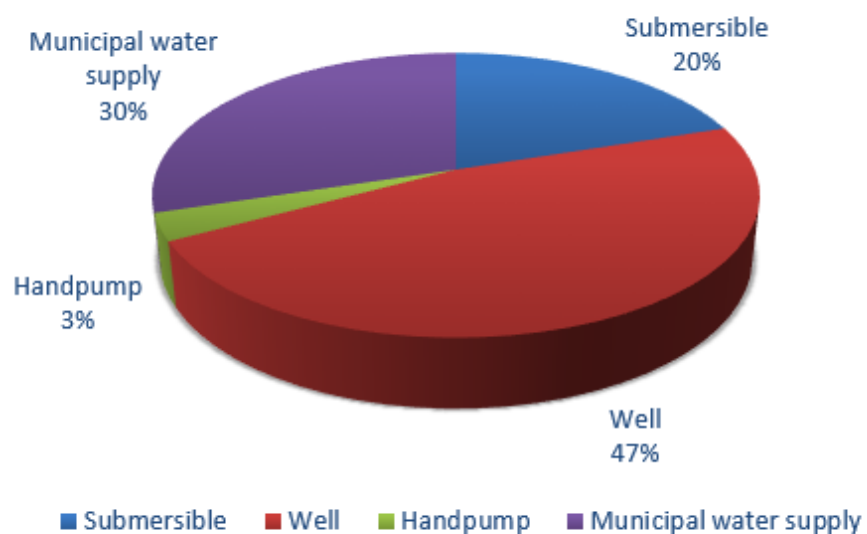


Figure 2

Source of water used in for the domestic purpose in industrial area

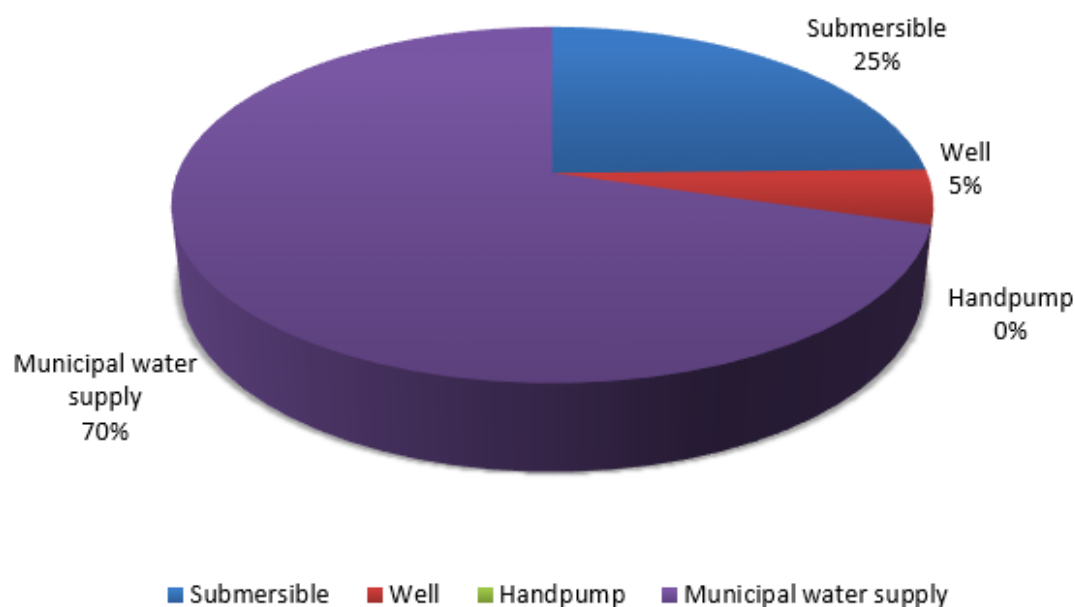


Figure 3

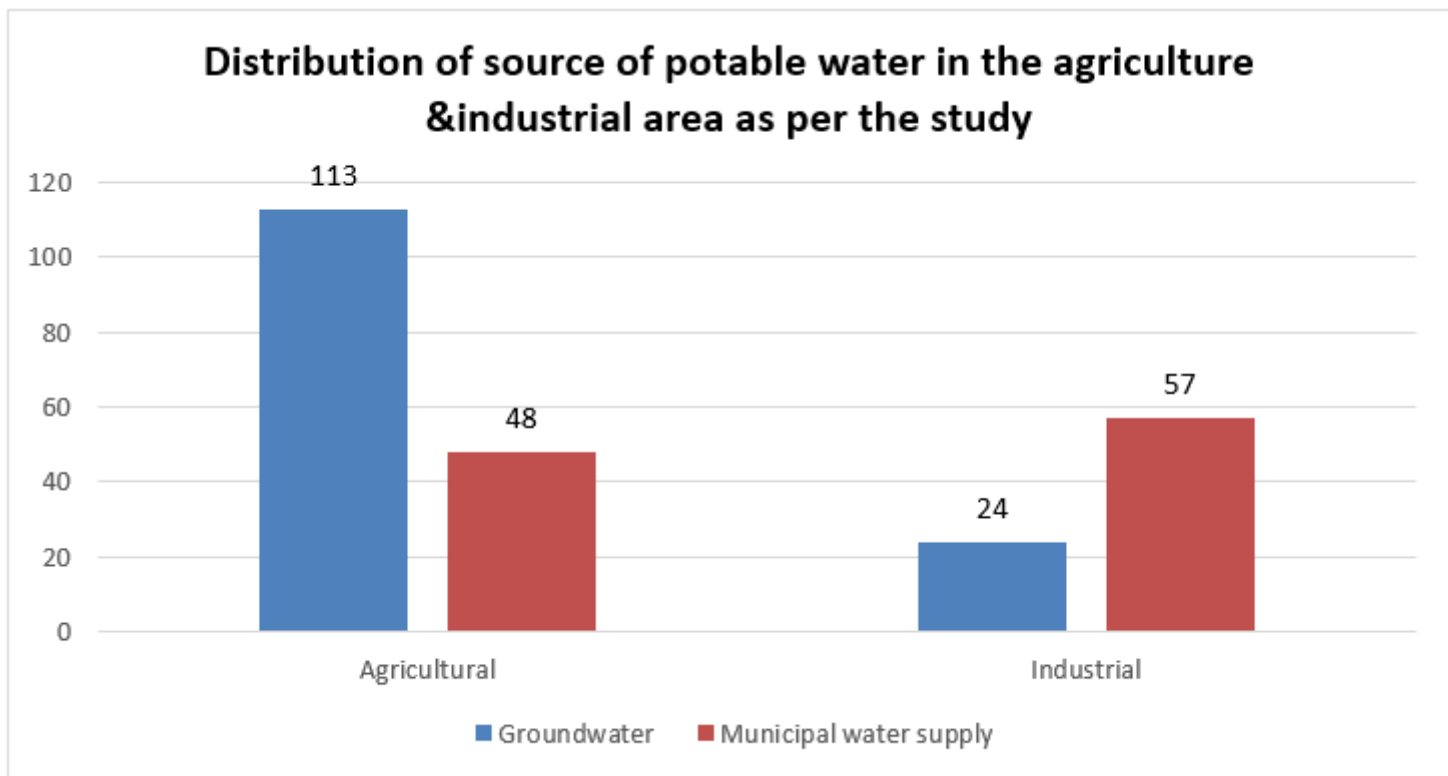


Figure 4

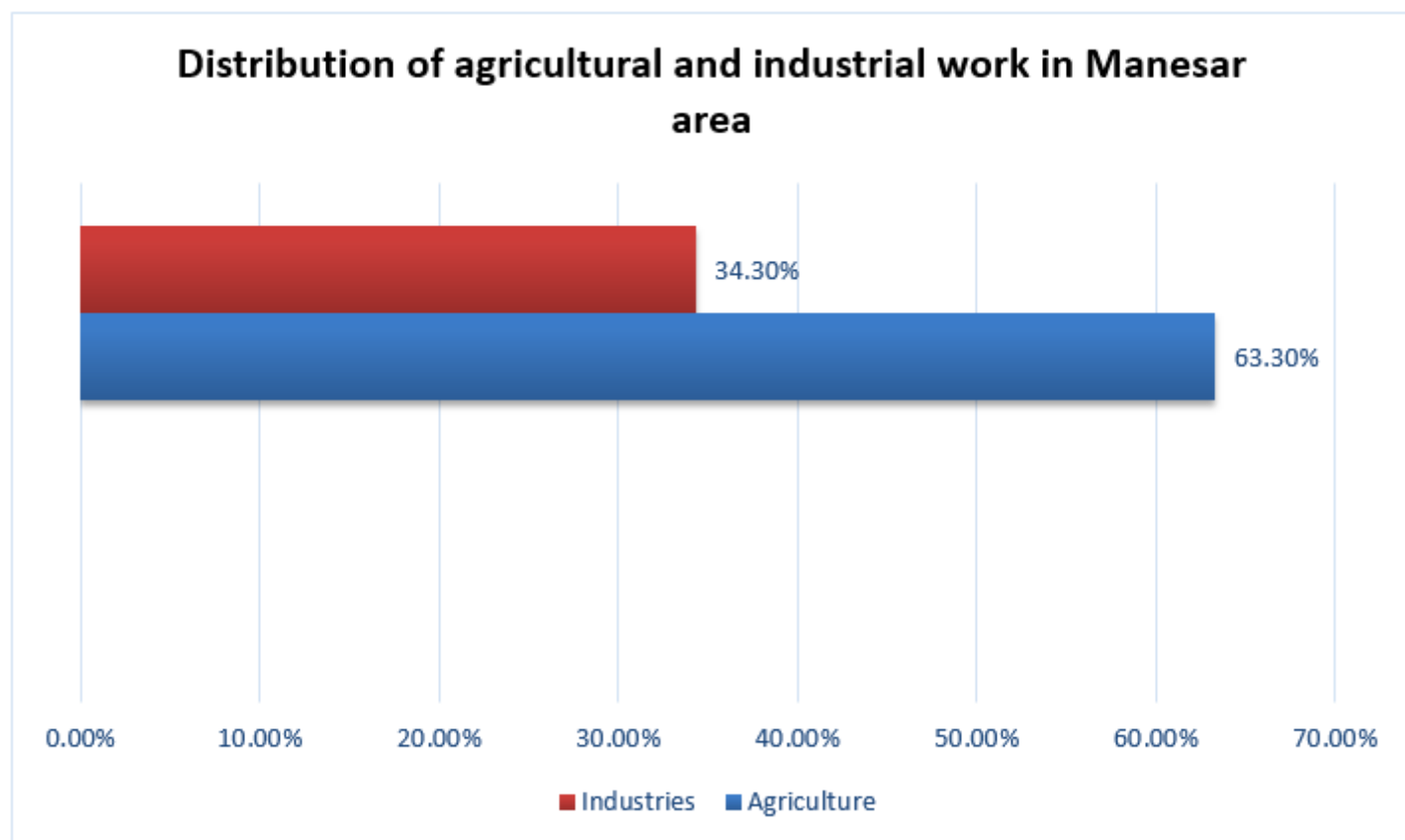


Figure 5

Following graph showing result of questions asked related with Fluoride usage

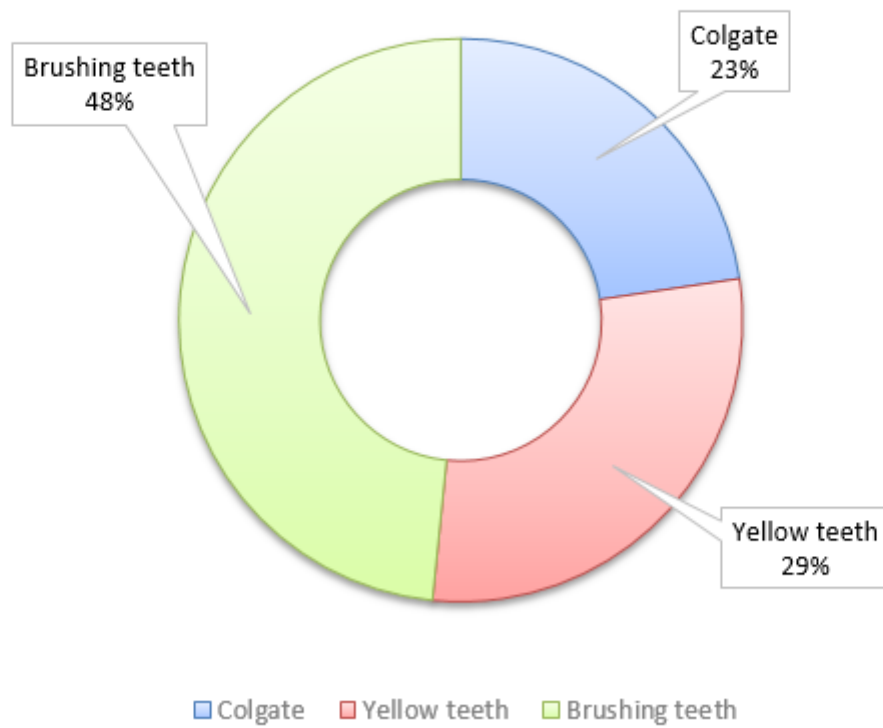


Figure 6

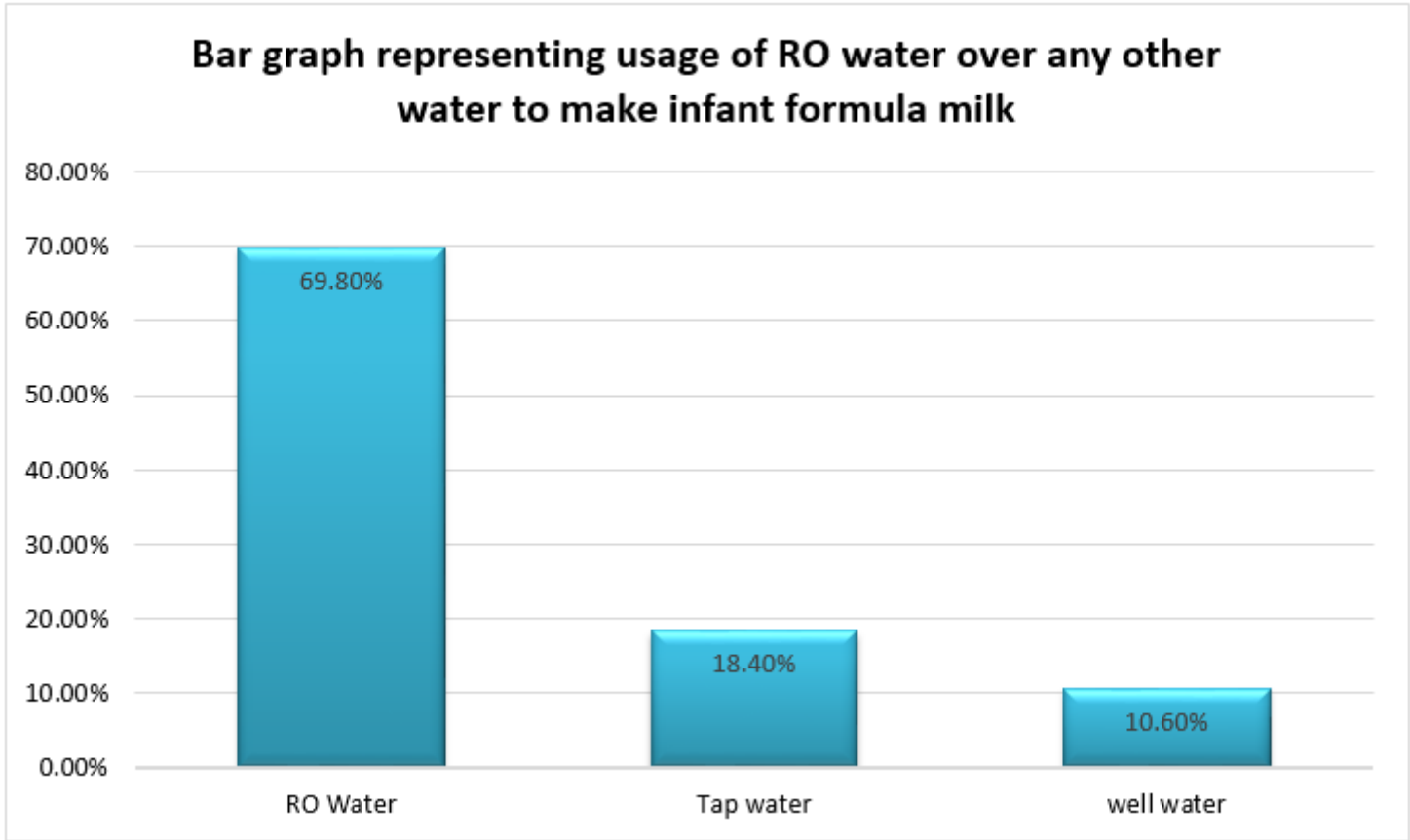


Figure 7

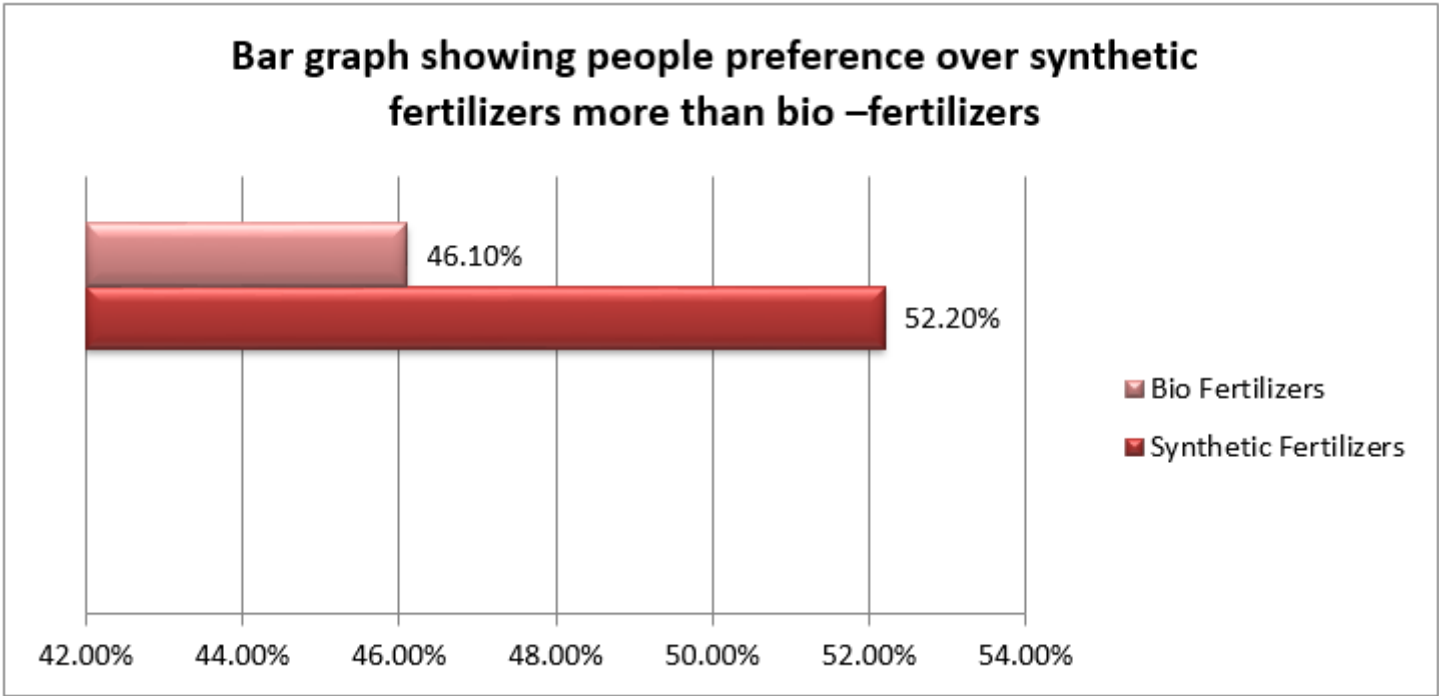


Figure 8

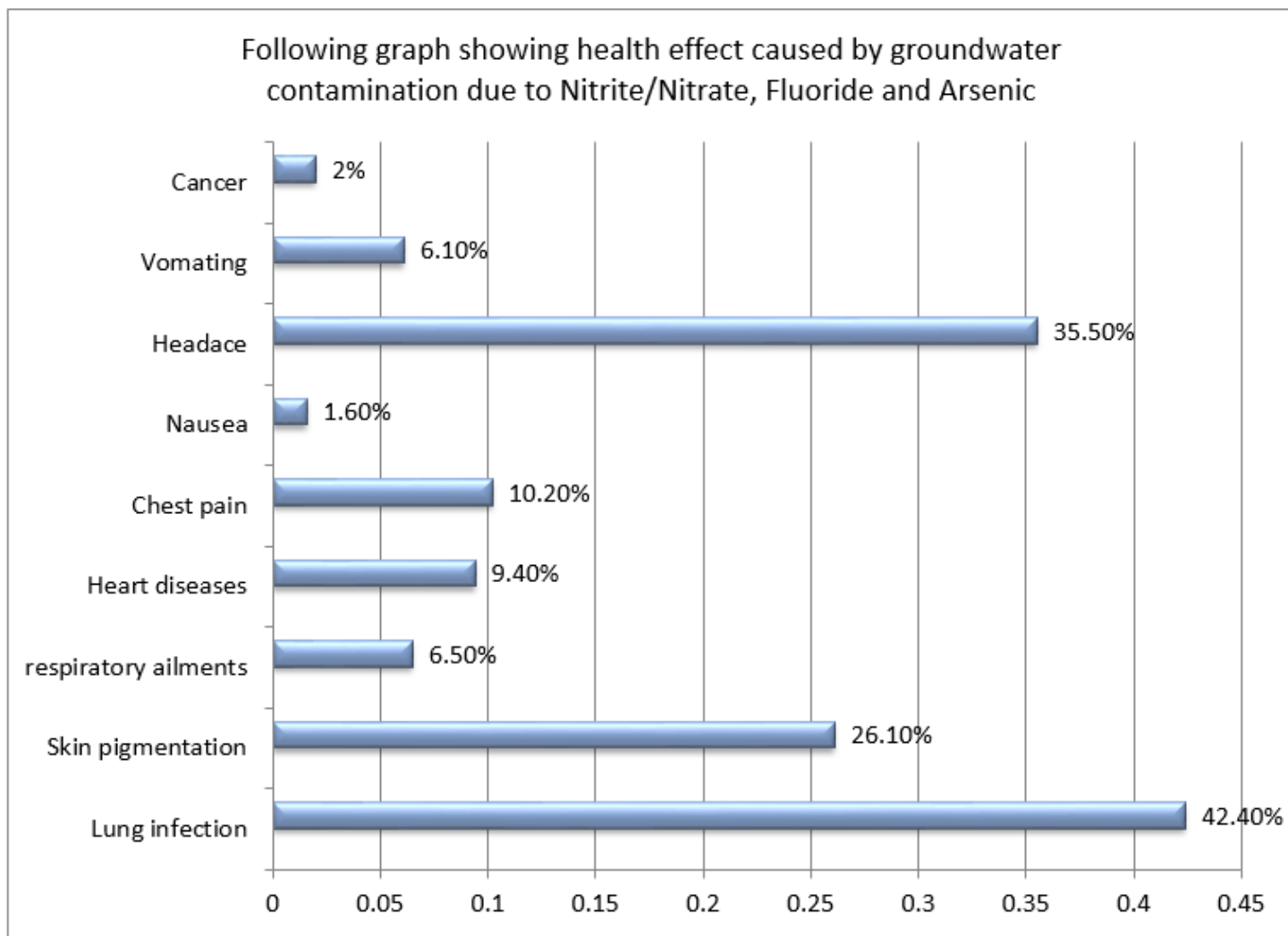


Figure 9