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A study on comparative appraisal of ground water superiority status of Kanchipuram coastal stretch in Tamilnadu, using Remote Sensing and GIS

M. Sathish Kumar (Ph.D)

Research Scholar, Department of Geography, Madurai Kamaraj University, Madurai

Abstract :*Water is one of the main natural's resources in the world and it's very essential for all human livings not only for human, animals, and agricultural purpose and other activities. Kanchipuram district lies adjacent to Chennai in the state of Tamil Nadu in India. It is bounded in the west by Vellore District and Thiruvannamalai District, in the north by Thiruvallur District and Chennai District, in the south by Viluppuram District and in the east by the Bay of Bengal. Study area was generated all along the coast with a width 15 km. A total of 171 villages were within the total area of 1678 sq.km. A detailed investigation on ground water quality status for ground water sample (71 locations) along Kanchipuram Coast was taken up for pre and post monsoon data for the years 2011 - 2015 in ArcGIS software. Ground water variables such as pH, EC, TDS, Total Hardness, NO_3, SO_4, Cl, F, CO_3, HCO_3, Na, Ca and Mg were analyzed for statistics in MS Excel for pre and post monsoon seasons. Graphs were plotted for each parameter across all years separately for pre and post monsoon to understand parameter variability between seasons and years. Spatially interpolation tool followed by kriging techniques exhibited spatial spared values based on environmental conditions of pre and post monsoon were analyzed graphically. Results of the analysis enumerated that post monsoon value or higher then pre monsoon value for the all the 13 variables. Critical variable such as chloride, floride, nitrate, sulphate, responses was higher in both pre and post monsoon values. Spatial map of these variables responded for higher concentration of the northern coast of the study area and lower concentration on the middle and southern part study area.*

Key words *- pH, EC, TDS, Total Hardness, Remote sensing and GIS*

Introduction

Water is an important to life sustaining substance. It is the most common and yet the most precious resource on earth without which there would be no life on earth. Groundwater is the water that exists below the surface of the ground in the spaces between particles of rock or soil, or in the crevices and cracks in rocks. Most groundwater is within 100 meters of the surface of the Earth. Groundwater can contain many constituents including microorganisms, gases, inorganic and organic materials. Industrial and agricultural activities are major sources of contamination. These activities can lead to contamination of well water, municipal drinking water sources and the environment. Polluted groundwater is less visible, but more difficult to clean up, than pollution in rivers and lakes. Groundwater pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, industrial waste lagoons, tailings and process waste water from mines, industrial frocking, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems. Water derives its unique properties of being universal solvent. Today quantity of water on our planet is nearly constant and it keeps circulating through what is called the water or hydrologic cycle. Water is thus strictly a fixed resource and we cannot really destroy it on any significant scale we can only spoil it; yet it will keep purify itself. The earths water resource is

referred to as a hydrosphere consisting of oceans, ice and snow in the polar and other regions, mountain glaciers, lakes streams, rivers, swamps, water in surface soils and in underground strata of the total quantity of water on our planet almost 97% is in the oceans. Of the balance that is fresh water, only 0.7% water is in liquid form. 0.6% as Groundwater and 0.1% is in lakes, rivers and vapor in the air. (M.Sathish Kumar, et al., 2017), (I. Ameeth Basha, et al., 2016), (S. Packialakshmi, et al., 2015), (Ramesh Pandian R. et al., 2013). The main aim of the study is to utilize the remote sensing and GIS technologies for the sustainable development of ground water quality analysis in the coastal zone of Kanchipuram district in Tamil Nadu.

Study Area Description

Kanchipuram district is the northeast district in the state of Tamil Nadu in India. It is bounded in the west by Vellore District and Thiruvannamalai District, in the north by Thiruvallur District and Chennai District, in the south by Viluppuram District and in the east by the Bay of Bengal. It lies between 11° 00' to 12° 00' latitudes and 77° 28' to 78° 50' longitudes. The district has a total geographical area of 4,432 sq.km (1,711 sq mi) and coastline of 87.2 sq.km. The town of Kanchipuram is the district headquarters. It is the third most populous district of Tamil Nadu (out of 32), after Chennai and Coimbatore. The Chennai International Airport is located in Tirusulam in Kanchipuram district. The district produces over 15,000 engineering graduates every year, same as Gujarat state. Kanchipuram district is situated on the North East coast of Tamil Nadu. It is bound by the Bay of Bengal in the East, Vellore and Thiruvannamalai districts in the west, Thiruvallur and Chennai districts in the north, and Viluppuram district in the south. The district has a total geographical area of 4, 432 hectares and a coastline of 87.2 km. The table below shows the maximum and minimum temperatures experienced in the district during different seasons. There are only a few hills of considerable elevation in the district on the southern part of Maduranthakam taluk contains small hills. The total forest area in the district is 23,586 hectares.

Methodology

Groundwater Data Description

A total of thirteen water quality parameters were selected because of its quality issues on drinking water of Kanchipuram district, Tamil Nadu. All water quality data were collected from Institute for Water Studies (IWS), Public Works Department (PWD), Taramani Chennai. Water quality data consists of pre monsoon coinciding in the month of June and post monsoon data in the month of December/ January for the corresponding or the preceding year. Ground water collection is well distributed widely spread among seventy one villages extending all the four corners of the district. Data are collected periodically for pre monsoon and post monsoon season. Such collected data are analysed in laboratories for water quality parameters. Water Quality parameters like pH, Electrical Conductivity (E.C.), Total Dissolved Solids (TDS), Total Hardness, Calcium, Magnesium, Bi carbonate, Sodium, Chloride. Water Quality data pertaining for a period of 5 years (2011-2015) was used for this study.

Collection of Water Quality Data

Water quality data are preliminary screened for contiguity in data collection, cross check for abnormal error due to typing, manipulation of data in case of inconsistency at short interval in MS Excel software. These data were filtered according to year, season are made as a separate spread

sheet. Such data are manipulated to get the consistency of data flow. It could be observed that during the year 2011 they maintained 71 permanent observation wells and the same were maintained for the year 2015. The specific characteristics and properties of drinking water quality are verified for established WHO 2011: BIS 10500 standards. Later, to process the information statistical techniques was applied to determine the maximum, minimum, mean and standard deviation of each parameter for each season and each year.

Compilation of Water Quality Data

Water quality parameters such as pH, Electrical Conductivity (EC), Total Hardness (TOT HARD), Total Dissolved Solids (TDS), Calcium (Ca), Magnesium (Mg), Bicarbonate (HCO_3), Chloride (Cl),Na, SO_4,CO_3,NO_2,NO_3,F, and are used throughout our study period. Statistical analysis on each variable as minimum value, maximum value, mean and standard deviation are arrived in MS excel format for each year for a period of five years was considered for pre and post monsoon analysis respectively.

Pre Post Monsoon Data Description

Filtering techniques is supplied for the data of sample collection to understand the pre and post monsoon values are corresponds to June and July month of every year.post monsoon values corresponds to December and January for the year. Thus of initial filtering techniques is applied to extract the pre monsoon values of 2011-2015 all the extracted values are made as a separate input file in another excel file. Consequently Post monsoon values are also filtered and made as a separate worksheet.

Ground Water Quality Analysis

Ground water data of Kanchipuram district comprising the year 2011-2015 is collected from state ground and surface water resources data centre, Taramani, Chennai in Tamil Nadu. All the data are given in ms excel format. The data in Ms Excel format has nearly 4 worksheets considering for each year. Each year had detailed information on wells, block names, village names, co ordinates (latitude and longitude) and water quality parameters such as Tds,No2+No3,ca,Mg,Na,cl,so4,co3,hco3,F,ph general, Ec general Hat total, These data are checked further for gaps if available during the analysis. Each parameter or each variable is filtered to identify the lower and upper values. In case of discrepancy among the values the proper verification id taken up with standards. All the parameters are manipulated according to the standard levels.

Statistical Analysis

Ms excel software has the capability of determining the statistical values of the parameters that can be derived through a functional tool available within the software. Statistics such as minimum, maximum, average, Standard Deviation (SD) are calculated for all the observation wells and for the parameters. The same table is created for the year 2011-2015 for the pre and post monsoon data. A preliminary analysis has been taken up to plot each variable of the year 2011 in a linear graph exclusively for pre and post values. This study enables us to understand the abnormal values corresponding to the village. The same exercise has been taken up for all the parameters for all the years (pre and post monsoon). The data corresponding to a single parameter ex. TDS is selected for pre and post monsoon for the year and plotted in Line graph. This graph shows the variability of the

parameter between 2 seasons.

Gis and Data Base Creation and Spatial Interpolation

The GIS database may include computer images, hardcopy maps, statistical data or any other data that is needed in study. Successful GIS implementation typically includes two major steps. 1. Data input 2. Analysis. Data input involves collecting the necessary data layers with the image database. In the analysis phase, these data layers will be combined and manipulated in order to create new layers and to extract meaningful information from them.In the present study, the data set of spatial & non spatial were prepared by using Arc GIS & Arc View, GIS Software. The data sets obtained from various GIS software, brought under Arc GIS core software and GIS data base was created for all the thematic maps. Arc GIS is a modular vector based software and is versatile for creation, organization, storage, retrieval, analysis, display and Query. It is also good tool for making cartographic quality outputs in the form of maps and generation of statistical tabular reports. The spatial data is organized using topographical data model. While the non-spatial data attribute is stored using database management software. The database is organised collections of attribute data file containing information on the feature attribute codes of several features which includes river, road, village boundary, settlement, lineament, control wells etc. The database consists of description on the attribute code for each spatial data elements. Topology was built up for each theme for automatic creator of database such as length, area and perimeter.

Spatial Interpolation

Toposheet corresponding to the district of Kanchipuram of 1:50000 scales are scanned and imported into open source ERDAS IMAGINE software. All the toposheets are geo referenced using 1st polynomial order equation. Referenced toposheets are checked for the Root, Mean, Square, and Error (RMSE) considering the fact, if the RMSE is less than 20% then final georeferenced file as geo was created in GIS environment. Thus all the toposheets are geo referenced moasicked in GIS software. Area of Kanchipuram district is approximately 1637.82 sq km. which lies above the Chennai district. This district is very near to Chennai and also to the influence of urban development, industrial development within Kanchipuram. The detailed methodology is as follows. All the toposheets numbers 66C/4, 66C/8, 66D/1, 66D/2, 66D/3, 66D/4, 66D/5, 66D/6, 66D/7, 66D/8 corresponding to Kanchipuram Coast are made as input layers in GIS considering the values of latitude and longitude with positional accuracy and mosaic king and made as a single layer. A shape file is created in GIS environment having input of projection parameters using Mount Everest 1984 projection (UTM projection). Universal Transverse Mercator, WGS 84 datum for all the toposheets as well as the digitization of Kanchipuram district a polygon layer is created and digitization is being carried out for the boundary of Kanchipuram and Kanchipuram Coast. Considering the over shoots and undershoots rectification within the polygon.

Water Quality Data Compared With International Standards:

Water quality levels for all the parameters are judged based on the national international standards. National standards refer to BIS (bureau of Indian standards). International standards refer to W.H.O (World Health Organization) for drinking water quality. All the data within min and max values comparing 2011-2015 are compared with standards to understand the quality of water that are

very poor that cannot be taken for drinking.

Result and Discussion

Kanchipuram coast is approximately 1637.82 sqkm comprising 8 taluks in namely Sholinganallur, Tambaram, Chnagalpet, Maduranthagam, Cheiyur, Thirukalukundram, Thiruporur, Uthiramerur in (2001 censes) and 71 villages. Ground water quality data for the study area is obtained from Ground and Surface Water Resource Data Centre, Taramani, Chennai. They usually collect data from reference wells regularly for pre monsoon and post monsoon seasons. These observation wells are well distributed throughout the study area.

Pre and Post Water Quality Parameter 2010 – 2015

The detailed note on water quality parameter (all parameters) of pre and post monsoon data between the years 2010 to 2015 or detailed below relevant tables corresponding to the study period

pH

pH is influenced by a number of factors including rock and soil composition and the presence of organic materials or other chemicals. Higher pH results in higher alkalinity by the presence of two common minerals, calcium and magnesium, affecting the hardness of the water. pH is principally controlled by the balance between the carbon dioxide, carbonate and bicarbonate ions (alkaline nature) as well as compounds such as humic and fulvic acids (acidic nature) in the ground water. Lower values are pronounced in dilute waters high in organic content especially 7.3 and 7.4 for pre and post monsoon respectively. Likewise post monsoon maximum 9.4 and 9.0 for pre monsoon was observed for the study area. Average pH of pre and post was of 8.25 and 8.11 respectively. Standard Deviation of (pre 0.32) (post 0.39). High pH levels are undesirable since they may impart a bitter taste to the water. High pH levels depress the effectiveness of disinfection by chlorination, thereby requiring the use of additional chlorine or longer contact times. Pre monsoon pH of the study area showed that lower concentration of pH was observed on the northern part of the study area. Southern part of the study region exhibited higher concentration and middle region showed moderate pH. Higher concentration at the lower part might be sea water intrusion (figure 1). Post monsoon pH of the study area showed that lower concentration of pH was observed on the northern part of the study area. Southern part of the study region exhibited medium concentration and middle region showed higher pH. Higher concentration at the middle region might be influence of transition of higher to lower concentration through diffusion process.

Total Dissolved Solids

Ground Water Quality data obtained from Surface and Ground Water resources (Tharamani), were used for the water quality parameters analysis for the pre and post monsoon. The study period include 2011 to 2015 including pre and post monsoon data. The observation of data include district name, taluk name, block name, village name, Ground Control Points (GCP) comprising latitude, longitude, well number and the water quality parameters. There were seventy one (71) observations for both pre and post monsoon period. These data were organized in a systematic manner and made a input in MS excel and plotted as line graphs. The results of the pre and post monsoons values for TDS showed that pre monsoon values are greater than post monsoon values. Most of the pre monsoon values are greater than 1000. Maximum values were in the range of 2562 and minimum of 192 and average value of 618.6 and SD 386.3 was observed. Post monsoon minimum values was 182.0;

maximum 2810 and average 673.1 And 441.6.

Calcium

Calcium is present in all waters as Ca^{2+} and is readily dissolved from rocks rich in calcium minerals, particularly as carbonates and sulphates, especially limestone and gypsum. The cation is abundant in surface and groundwater. The salts of calcium, together with those of magnesium, are responsible for the hardness of water. The major source of Ca_2+ in the groundwater is due to ion exchange of minerals from rocks of this area. Further, this may also be due to the presence of $CaCO_3$, $CaSO_4$, Ca Mg $(CO_3)_2$ minerals and soils by water. Most of the pre monsoon values Ca are greater than 50. Maximum values were of 328 and minimum of 10 and average value of 64.09 and SD 49.33 was observed. Post monsoon minimum values was 12, maximum 180 and average 57.86 and SD 32, 42. Pre monsoon Ca of the study area showed that lower concentration of Ca was observed on the northern part and southern part of the study area. Middle region of the study area exhibited higher concentration which might be attributed to calcium contain rocks such as gypsum. Post monsoon Ca of the study area showed that lower concentration of Ca was observed on the middle part of the study area. Southern part and northern region showed higher Ca. Higher concentration at the southern and northern part might be influence of calcium, rocks and its dissolution rock minerals in the ground water.

Sodium

All natural waters contain sodium since sodium salts are highly water soluble and it is one of the most abundant elements on earth. It is found in the ionic form (Na^+), increased concentrations in surface waters for pre and post monsoon may arise from sewage and industrial effluents or coastal influence may result in sea water intrusion result in higher concentrations. The WHO guideline limit for sodium in drinking water is 200 mg/l However, ground-water concentrations frequently exceed 50 mg/l. Sodium is commonly measured where the water is to be used for drinking or agricultural purposes, particularly irrigation. Most of the pre monsoon values Na are greater than 100 for the years 2011-2014 and for the year 2015 values were found to be less than 100. Pre monsoon Maximum values were of 449 and minimum of 9 and average value of 99, 24 and SD 74.80 was observed. Post monsoon minimum values were 2; maximum 961 and average 130.30 and SD 138.80. Pre monsoon Na of the study area showed that lower concentration of Na was observed on the northern part, Southern part and middle region of the study region exhibited medium to low concentration of Na. Isolated patches exhibited higher concentration. Post monsoon Na of the study area showed that lower concentration of Na was observed on the middle part of the study area. Southern part and northern region showed higher Na. Higher concentration at the southern and northern part of study area.

Nitrate

Pre monsoon and Post monsoon NO_3 of the study area showed that lower concentration of NO_3 was observed on the Southern part and middle region of the study area whereas northern isolated patches exhibited a relatively high to very high NO_3 concentration, Higher NO_3. Concentration at northern part might be influenced by the disposal of waste all along the buckhingham canal of the study area. Nitrate-N concentrations of pre monsoon ranged from 0.1 to 37 mg/l. Nitrate-N concentrations of Post monsoon ranged from 1.0 to 31 mg/L, with a mean of 64.09 and 7,53mg/L of pre and post monsoon respectively. Aggregated clay thickness above well screen had statistically significant relationships to nitrate-N. Average value of 7.07 and SD 6.70 was observed for pre monsoon in lieu post monsoon average 7, 53 and SD was of 6, 34.

Magnesium

Magnesium arises principally from the weathering of rocks containing ferromagnesium minerals and from some carbonate rocks. Most of the pre monsoon values Mg are greater than 25 for the years 2011-2015. Pre monsoon Maximum values were of 204 and minimum of 4.86 and average value of 40.96 and SD 29.63 was observed. Post monsoon minimum values were 3.64; maximum 80.19 and average 37.42 and SD 18.96. Higher values of Mg were occurred in many organ metallic compounds and in organic matter, since it is an essential element for living organisms. Pre monsoon Mg of the study area showed that higher to very high concentration of Mg was observed on the northern part of the study area. Middle and southern region of the study area exhibited low to very low concentration which might be attributed to calcium contain rocks such as gypsum or dolomite. Post monsoon Mg of the study area showed that higher concentration of Mg was observed on the one patch of the northern part of the study area. Southern part and middle region showed lower Mg.

Chloride

Pre monsoon Cl of the study area showed that higher to very high concentration of Cl was observed on a single location of northern part of the study area. Middle and southern region of the study area exhibited low to very low concentration Post monsoon Cl of the study area showed that medium values of for the entire study area. Most of chlorine occurs as chloride (Cl) in solution. High concentrations of chloride can make waters unpalatable and, therefore, unfit for drinking seems to be prominent 1375 for pre 1078 for post monsoon period for Coastal villages of Kanchipuram district, large contents of chloride in freshwater is an indicator of pollution. In addition to the adverse taste effects, high chloride concentration levels in the water contribute to the deterioration of domestic plumbing, water heaters and municipal water works equipment is due to domestic wastages and/or leaching from upper soil layers in dry climates. High chloride concentrations in the water may also be associated with the presence of sodium in drinking water. Chlorides are harmless at low levels as 18 for both and post monsoon but at levels higher than 250 mg/l, it causes odour and salty taste apart from aggravating heart problems and contributing to high blood pressure. Average Cl values were of 204.4 and 206.5 and 222 and 207 for pre and post monsoon respectively.

Sulphate

Pre monsoon SO4 of the study area showed that higher concentration of SO4 was observed on the northern part of the study area. Middle and southern region of the study area exhibited medium to lower concentration. Higher concentration in the northern part might be attributed to calcium contain rocks such as gypsum associated with sulpahate salts as rock bearing minerals and its dissolution in the Ground Water. Post monsoon SO4 of the study area showed that lower concentration of SO4 was observed on the southern part of the study area. Northern part and middle region showed higher SO_4 .The concentration of sulphate in the study area ranged for pre monsoon ranged from 2 to 265mg/l average 44,66 and SD 37.46. The sulphate concentration of recommended limit is from 200-400 mg/l. The concentrations of sulphate in all the sites are under the desirable limit. It is concluded that water are highly alkaline, pH above 8.5 were recorded and natural alkaline water may be due to the lime deposits at the source of water. Post monsoon min value is of 1 to maximum 176 with average of 42.53 and SD of 32.82.

Fluoride

Pre monsoon F of the study area showed that higher concentration of F was observed on the southern and middle region of the study area. Northern region of the study area exhibited medium to lower concentration. Higher concentration in the southern part might be attributed to F bearing

minerals. Whereas Post monsoon F of the study area showed that invariably the entire region exhibited higher concentration of F was observed on the study area. One of the main trace elements in groundwater is fluoride which generally occurs as a natural constituent. Bedrock containing fluoride minerals is generally responsible for high concentration of this ion in groundwater. Fluoride normally accumulates in the bones, teeth and other calcified tissues of the human body. Excess of fluoride in water causes serious damage to the teeth and bones of the human body, which shows the symptoms of disintegration and decay, diseases called dental fluorosis, muscular fluorosis and skeletal fluorosis. Higher intake of fluoride may change the metabolic activities of soft tissues (brain, liver, kidney, thyroid and reproductive organs). The permissible limit of fluoride in drinking water is 1.5 mg/l as per BIS standards. The fluoride concentration in the study area varies from and 0.01-1.69 mg/l in post monsoon 0.05-1.13 mg/l in pre monsoon season. Ground water containing more than 1.5 mg/l of fluoride cause mottled tooth enamel in children and are not suitable for drinking purpose. Average F values were of 0.39 and 0.36 and 0.26 and 0.33 for pre and post monsoon respectively.

Electrical Conductivity

Electrical Conductivity is a measure of the ability of water to conduct an electric current. It is sensitive to variations in dissolved solids mostly mineral salts, related to the concentrations of total dissolved solids and major ions. High Conductivity, 4510 and 4980 observed among the villages for and pre and post monsoon may arise through natural weathering and anthropogenic sources. The conductivity of most freshwaters ranges from 10 to 1,000 $\mu S\ cm^{-1}$ but may exceed 1,000 $\mu S\ cm^{-1}$, especially in polluted waters. This ability depends upon the presence of ions, their total concentration, mobility, valence and temperature. Although the large variation in EC is mainly attributed to geochemical process like ion exchange, reverse exchange, evaporation, silicate weathering, rock water interaction, sulphate reduction and oxidation processes. Pre monsoon Maximum values were of 4510 and minimum of 280 and average value of 1002 and SD 696.6 was observed. Post monsoon minimum values were 360; maximum 4980 and average 1207 and SD 782.5. Pre monsoon EC of the study area showed that higher concentration of EC was observed on the northern region of the study area. Southern region of the study area exhibited medium to lower concentration. Higher concentration in the northern part might be attributed to higher soluble salts particularly anions availability was higher in the ground water. Post monsoon EC of the study area showed that northern part exhibited higher concentration of EC was observed on the study are.

Total Hardness

The hardness of natural waters depends mainly on the presence of dissolved calcium and magnesium salts. The total content of these salts is known as general hardness, which can be further divided into carbonate hardness (determined by concentrations of calcium and magnesium hydro carbonates), and non carbonate hardness (determined by calcium and magnesium salts of strong acids). Low values of hardness 110 for pre monsoon and 105 for post monsoon was observed and higher values 1360 and 720 of pre and post monsoon was observed respectively. Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions. The principal hardness causing ions are Calcium, Magnesium Bicarbonate, Carbonate, Chloride and Sulphate. Average and SD values for Total Hardness values were of 328.7 and 298.7 and 217.6 and 137 for pre and post monsoon respectively. Pre monsoon Total Hardness of the study area showed that higher concentration of Total Hardness was observed on the northern region of the study area. Southern region of the study area exhibited medium to lower concentration. Higher concentration in the northern part might be attributed to higher availability of

Cations and anions in the northern part. Whereas. Post monsoon Total Hardness, of the study area showed higher concentration in the middle region of the study area.

Conclusion

Ground water quality data of both pre and post monsoon pertaining to year 2011 to 2015 was used for this analsysis. All the data were analysed for the variation between the pre and post monsoon values across all the years. The parameters such as pH, EC, TDS, Total Hardness, Ca, Mg, SO4, NO3, Cl, F, CO3, HCO3, In most of the cases post monsoon data were comparatively higher than the pre monsoon values. Water Quality Values which are considered significant for droning and irrigation such as No3, SO4, Cl, F are at higher levels during the post monsoons season. Spatial interpolation was carried out to understand the distribution of each variable all along the Kanchipuram Coast. This study signifies that Northern part seems to posses the higher contribution all variables compared to the middle and the southern region. Such higher level will pose a deleterious effect on the human health for consumption. Reason for such higher concentration are due to the fact that congregation of residential and industrial building in the northern region they let quite a lot of waste such as sewage and sludge into the buckhingham canal that leads to the percolation of toxic nutrients into the groundwater resulted in the increase of higher levels of water quality parameters. The status of ground water quality in the study area is found to be critical. The presence of high TDS and hard water occurs in most of the locations. The water quality index shows the quality of the ground water is moderate to very poor and it is not suitable for drinking purposes. Further the study emphasis the continuous seasonal assessment of groundwater quality. Even though treatments like reverse osmosis, distillation, activated carbon etc. can eliminate the prevailing contamination, the present scenario needs consideration on rainwater harvesting, waste water reuse and water treatment techniques. This will reduce the augmentation of fresh water needs considerably. Finally the present study draws the following recommendations for meeting the present as well as future water demands.

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