# CHAPTER – II

# REVIEW OF LITERATURE

# CONTENTS

Rapid urbanization, economic activity, and population growth have led to excessive groundwater extraction, resulting in a decline in groundwater level and a lack of water supply for future use. Despite India's abundant rainfall, runoff is rising in urban areas due to the construction of paved surfaces and storm water drains[32]. As a result, large towns, especially those which are situated on water divides, are experiencing saltwater intrusion beneath them, land subsidence, wells drying up, damaging ecosystems, and groundwater depletion. The best method for reducing surface runoff and recharging groundwater artificially is rainwater harvesting. In India's densely populated coastal regions, ground water is a huge resource of water for various application. It is now widely accepted that ground water quality is just as important as quantity in major cities and towns around the world due to the depletion and scarcity of ground water. Without reviewing prior work, innovations and ideas cannot be put into practice. The literature review that is presented here is divided into four sections[33].

1. Harvesting rainwater.
2. An improvement in water quality following rainwater harvesting.
3. An increase in water availability following rainwater harvesting.
4. Recharge of ground water using GIS and modelling methods.

## 2.1 HARVESTING RAIN WATER

Since rainwater harvesting is a tried-and-true alternative that is crucial to the local and regional hydrological cycle, many nations use it as a workable decentralized water supply. Direct infiltration, rainwater storage in ponds or reservoirs, and bore hole recharging of groundwater aquifers are other alternatives to individual rainwater harvesting systems in densely populated cities and coastal regions. To better understand the idea behind rainwater harvesting, the following academic works are examined[34]. In India's water-scarce regions, listed six significant difficulties in rainwater harvesting. Low local supply capacity as a result of high demand and unreliable supply, i.e. (ii) The cost-benefit analysis of rainwater harvesting lacks empirical support. (iii) Because of a good "trade-off," improved hydrological benefits, and financial efficiency. (iv) Maximizing the advantages of upstream water reaping and exploiting basin-wide advantages. (v) Water supplementation has less hydrological advantages than local water recycling. (vi) In hard rock environments, the capacity for artificial recharge is decreased by a lack of integration between ground water and surface water systems.

In addition to the laws and regulations, barriers, incentives, and other voluntary and regulatory systems, explained the policies and programmes for rainwater harvesting at the municipal, state, and national levels in the United States[35]. He also discussed how managing stormwater can help prevent combined sewer overflows, the benefits of collecting rainwater as a way to supplement water sources, and how to manage irrigation systems how to cut back on energy use, greenhouse gas emissions, and water withdrawals, among other things. The author provided a summary of the available research, current trends, potential advancements, and snow melt[36].

Julius et al[37]examined rainwater harvesting systems in India and around the world, including their processes, designs, implementation, and impacts. explained the policies and programmes. According to the author, the demand for clean drinking water increases along with the growth of the global population. Surface and groundwater bodies are detoriated very fast then they are reconstruction. The best solution is effective water resource management and education about how to use water resources most effectively, including proper water harvesting, recharging, and improving the water quality of water bodies.

Dakua et al[38]. calculated the power of rain water harvesting in small and large building in Dhaka as well as the economical advantages of rainwater harvesting, explained the policies and programmes. The paradig in Bangladesh was bringing the possibility of a permanent water shortage in the city of Dhaka's water supply scenario closer to reality. The surface water levels of Dhaka's peripheral rivers also prevented increased use of surface water because the subversive aquifers drop underneath the driving near or dry up. Given Bangladesh's heavy annual rainfall, the nation's entire demand for water could be satisfied by rainwater[39]. The users were unaware of its potential power.

Lokeshand and Rao[40] Conducted a study in parts of Chittoor district, Andhra Pradesh, to identify water harvesting structures described the policies and programmes (WHS). In order to raise and recharge ground water levels in Karvetinagaram Mandal, this research includes gathering rainfall data, cropping and irrigation information, identifying current water reaping constructions (WHS), and offering new WHS, among other things. The cost estimate for the twenty-four harvesting structures (WHS) is 56 lakhs. The storing size of the present and forthcoming WHS is 174.52 ha. With a capacity of 122.4 ham, percolation tanks (PT) have the highest capacity, followed by check walls (19.0 ham), check dams (16.2), mini-percolation tanks (MPT) (11.8 ham), and staggered percolation

tanks (SPT).

Netzer and Yakov[41] evaluated the history of rainwater collection and looked at how it affected the hydrological system in contemporary urban settings. There is discussion and comparison of various methods for collecting rainwater, including storing collected water in reservoirs and injecting collected water directly into aquifers. According to measurable samples from Tel-Aviv, Israel, rainwater group could play important role in the resident and area hydrological cycle and direct infiltration of gathered water into the aquifer is preferred for densely populated areas. To determine whether collecting and using rainwater is a financially viable, regional strategy[42] looked at the benefits and drawbacks of rainwater harvesting. The land use, terrain, and rainfall variability of the watersheds are used to assess different cistern sizes. Depending on the size of the cistern, the annual water recovered might be sufficient to satisfy the requirements of 13,345 to 31,138 single-family homelands. If water prices stay the same, only the smallest irrigation cistern is economically feasible. It has been established that rainwater collection for outdoor use saves the most water, power, and carbon by calculating the amounts of water, electricity, and carbon saved in two situations: outside only, and outside + non- drinking indoor application[43]. During a periodof 2–100 years, the RWH scheme decreases excess volume greatness by 145.95 to 333.06 through 24-hour rainfall, giving to the information. However, this quantity of decrease effect strength satisfy domestic ingesting needs ranging 202.50 to 462.11%, with an financial impact of 10,008.98 to 22,840.65. (USD).

Sepehri et al[44] hence investigated that how rainwater harvesting affected runoff volume and household water use. Using a well-known and effective flood hazard strategy, such as the SCS, the flood volume was calculated in the HEC-HMS model with various return durations. The biggest environmental risk in Hamadan is flooding. The data showed that over a period of 2 to 100 years, the RWH system reduced runoff volume magnitude with 24-hour precipitation by 145.95 to 333.06 percent. However, with an economic impact of between 10,008.98 and 22,840.65, this amount of the reduction effect might be enough to cover the 202.50 to 462.11% range of household consumption needs (USD). 5In most areas of the education area, precipitation gathering from roofs, space lots, and infrastructures could be vital in dropping the risk of submerging and provision everyday needs in the nonappearance of urban manure systems[45].

## 2.2 IMPROVEMENT IN QUALITY OF WATER AFTER RAIN WATER HARVESTING

Human activities affect the ecosystem, which is a undesirable effect on the quality of ground water. In industrial and coastal areas, intrusion of salt water is a major cause of contamination of potable ground water aquifers. Because groundwater has so many uses, the impact of contaminants on its quality in coastal areas is a crucial issue. The impact of rainwater reaping on crushed water quality in seaside and additional areas has been deliberated by the authors. Here is the main idea.

In Tarapur, Maharashtra MIDC[46] investigated the risk of pollution in an industrial area. The area is located along the Arabian Sea coast of India. The 131 samples for ground water chemical analysis were collected from borewells, dug wells, irrigation channels, effluent sumps, creeks, and the ocean. The analysis indicated that the region has hard water and a high salinity hazard. Other industrial areas along the Indian Ocean coast may also benefit from taking the corrective measures suggested by the study. It has been suggested to regulate and manage industrial emissions near Tarapur MIDC.

In two different areas of Chennai, Tamil Nadu, India, with various hydro-geological conditions for the quality and quantity of water[47] constructed rainwater harvesting systems. Site factors like hydrometeorology, lithology, and land use have an impact on the rainwater harvesting structures. The effect of rainwater harvesting for potential recharge is measured using the GEC standards 1997 water level fluctuation process. Several sample water were analyzed for quality checked parameter in accordance with IS-10500 1991. Water has increased the recharge and quality, as per the results of the implementation and analysis. This report is a follow up to a prior study that looked at roof harvested rainfall[48]. Through the use of rainwater harvesting[49] established useful and financially viable water supply alternatives for underdeveloped regions. By tracking the concentration of the selected pollutants over an extended period of storage, the study tracks compliance with drinking water standards over time. A recommendation for rainwater storage is being made. For small-scale, domestic applications[50] established practical and economically Observed the quality of rainwater harvested for roofs. Determining whether there is important difference in pollutant attentiveness and water features over extended aeras of packing was one of the goals, as was calculation out the belongings of any variations in water features (quality) in the growth of top water attention

and storing knowledges. Results for seven parameters, including pH, turbidity, phosphorus, zinc, copper, ferrous iron, total iron, nickel, and nitrate, are presented in this study. The study's findings can then be used to create suggestions for rainwater collection and storage as well as the layout of a system for collecting and storing rainwater[51].

To study the effect of rain water harvesting on the quality of ground water[52] constructed the rainwater harvesting structures at the Jamia Millie Islamia university campus in New Delhi, India. At many JMI locations, rainwater harvesting systems with a 20 m depth have been installed. Understanding more about the analysis, these data were processed and compared, and the results show a very intriguing figure in terms of ground water quality change, supporting the claim of quality improvement. Ground water samples were collected and analyzed throughout the months of February 2011, November 2011, and April 2012[53]. The study's findings and interpretations indicate that recharging with rainwater improves groundwater quality, but this depends on the amount of rainfall and the environmental factors that allow for rainwater collection and recharging.

Rainwater collected from galvanized roofing sheets of various ages was examined[54]. For three years straight, samples of rainwater were collected on a monthly basis. The samples were taken between July and September from roofs that ranged in age from 5, 10, and 15 years, and they were then examined using standard techniques for physical, chemical, and microbial parameters. The outcomes were then contrasted with three current drinking water standards: NSDWQ, 2007, WHO, 2011, and USEPA, 2012. The samples' pH ranged from 6.5 to 8.5, which is regarded as normal. The regulatory limit of 150 mg/L is well below the hardness measurement of 41.96 mg/L. The lead content is within the permitted range of 0.01 to 0.015 mg/L, ranging from 0.0033 to 0.0055 mg/L. The faecal coliform Escherichia coli level of 0 cu/mL is acceptable and does not suggest biological contamination. The harvested rainwater from GRS of various ages in Ogbomosho, Southwest Nigeria, does not exhibit any appreciable variation in the quality of the water or any adverse effects on health.

On a qualitative level[55] investigated the state of the groundwater in the Indian city of Bilaspur. Six strategic sampling stations were gathered over a six-month period in 2013[56], from March to August. As the seven main parameters for the study, pH, chlorides, sulphates, conductivity, TDS, nitrates, and fluorides were selected. The groundwater quality review's findings were appalling and fell far short of the standards set by various international organizations. The local government, community, and NGOs were urged to

take prompt preventative action. To prevent sewage and industrial discharges from contaminating groundwater supplies, the authority should promote rainwater harvesting and natural precipitation recharging of groundwater.

In Aligarh[57] assessed the impact of mining activities on ground water quality, and Khawajam Anwar and Vanita Aggarwal (2014)[58] examined the water quality of underground water for the year 2012 using 14 parameters. Various samples from various locations were gathered for the analysis. For the pre-monsoon and post-monsoon periods, the ground water quality status was evaluated using the Water Quality Index method. The water quality index, a useful tool for identifying the spatial and temporal variations in ground water quality, was used. In contrast to Goa, where water quality was observed to be in the very good category, ground water in Aligarh required some treatment before it could be consumed.

In order to increase groundwater level/storage and improve water quality by artificial recharge[59] concentrate on the detrimental effects of excessive groundwater diversion and rainwater harvesting potentials in Dhaka city. 85–90% of the city's water comes from groundwater, with the final 10-15% coming from filtered surface water. Groundwater levels were dropping at a rate of 2.5 meters annually as a result of over-abstraction**.** Additionally, the hydrogeology of the area is changing as a result of excessive groundwater abstraction. The main aquifer (Dupe Tile) has become unconfined in nature beneath the majority of the area because its uppermost portion is nearly dry. A substantial depression cone has grown. In order to address the problems with the sustainability of the groundwater supply and the vulnerability to contamination, immediate action is needed. Water quality is also being degraded by seepages from urban and industrial wastes[60].

## 2.3 IMPROVEMENT IN QUANTITY OF WATER AFTER RAIN WATER HARVESTING

Artificial groundwater recharge's main objective is to replenish aquifer sources that have been exhausted as a result of excessive groundwater extraction. The systematic application of data collection techniques, as well as data analysis and interpretation, are required for the study of ground water recharge[61]. In order to recharge groundwater aquifers with rainwater, a bore hole must be dug specifically for the purpose of rainwater harvesting. The following is a list of books that have addressed ground water recharge.

Explained[62] that improving ground water conditions like hydrodynamics and physiochemistry can be accomplished through artificial recharge from dams for water table aquifers. Additionally, it was stated that calculating soil infiltration rates is essential for maintaining sufficient permeability and the absence of polluted areas. Tunnels, shafts, and wells injected into aquifers may be used directly if the soil does not have permeability. The location of an unsaturated zone between the land surface and the aquifer must be known. The current unsaturated ozone layer aids in the proper design of a groundwater system for artificial recharge as well as the creation of basins, furrows, ditches, or other facilities for surface water infiltration into the soil.

When the reservoir filled with floodwater[63] used processing mode flow software to create a groundwater model to show how the area naturally recharged. Jordan's Wadi Bayer is a dry desert area with scant rainfall and poor water supplies. The groundwater table will rise by 0.33 to 1.5 m and 0.11 to 0.90 m, respectively, for both retention times. The surface runoff was determined using a home-made spread sheet model and a HEC-HMS model. It is a prime illustration of Jordan's historic water shortage. Due to harsh climatic conditions and high evaporation rates, ground water recharge is one of the long-term solutions to such water shortage situations. The Riham formation and alluvium deposits are the only rock unit groupings found in the study area. The permeability of the reservoir floor is 11.82x10-2 cm/sec. Seven boreholes were dug at the location, with depths ranging from 5 to 15 meters. Permeability tests were carried out at various depths, with results for 30- and 15-day retention cycles ranging from 7.331x10-6 to 1.805x10-3, respectively.

For the purpose of preserving soil moisture[64] created the sand ditch, a novel water harvesting technique. Water harvesting is a practical solution for agricultural production in semi-arid regions. The sand-ditch technique, which helps to reduce sediment losses and runoff while increasing soil moisture and infiltration, was tested in the field as opposed to managed or compacted plots. On a field measuring 10 m by 2 m, twelve plots with various soil depths and silt loam soils were constructed. Average runoff was 46% lower and sediment losses were 61% higher in the sand-ditch plots compared to control plots, with sediment losses 2.2 and 6 folds. It has been determined that, given the current climate, soil compaction was an ineffective method for collecting rainwater.

In their 2012 study[65] concentrated on the restoration of ground water through the use of rainwater recharge. For the factors governing the ground water discharge and

recharge in the area, the necessity of implementation and potential for ground water recharge were analyzed. Aquifer geometry and characteristics, ground water requirement, ground water level behavior, ground water quality, rainwater quality, rainfall intensity and distribution, ground water and rainwater potential. The quantitative potential of ground water was determined through mathematical calculations. Techniques for artificially replenishing ground water in the Dwarka sub-city would help to alleviate water shortages in the city and other urban areas. The relevant water supply agency is only providing Rs 2.8 MGD despite a demand of 10 MGD from a population of about 5 lakh. As a result, groundwater provides the majority of the residents' needs for both domestic and non-domestic uses of water. The depletion of the fresh water layer, a decline in the water table, and a water shortage have been brought on by the extraction of ground water by both public and private entities.

With the aid of a hydrogeological[66] focused on groundwater vulnerability analysis and created hydrogeological modelling (GIS). Water causes flooding and commotion in the community, which is a challenging problem for the environment. For the quantitative capacity of ground water, the technology of ground water recharge by rainwater collection was advocated. The land of Jamia Millie Islamia has been divided into ten zones for the installation of rainwater collection structures. The amount of ground water is replenished and increased by rainwater, which is also influenced by the climate where it is collected and the amount of rain.

By analyzing the time distributions and spatial variability of rainfall[67] were able to determine the intensities of rainfall and events of duration pattern of rainfall. Increased flooding results from the shortening of the rainy season and an increase in rainfall events' intensity. According to observations, more water will be directed into streams and rivers, causing a loss of water resources in the local environment, if the trend is allowed to continue and appropriate action is not taken. To cope with the frequent flooding, adaptation strategies to climate change are being developed. Hourly rainfall data can be improved by using hydrological models of water balance analyses and characterization of flow mechanisms instead of daily rainfall data.

Infiltration rates in the Florida basin were examined[68], who discovered that they significantly deviated from the intended infiltration rates (DRI). Forty infiltration basins in Florida were examined for this. Sand, loamy sand, sandy loam, and sandy clay loam were among the different soil textures that were clearly distinguished in the basin's soil. Based

on the DRI rates, there were fourteen basins (or 35%) with infiltration rates higher than their designed rates, sixteen basins (or 40%) with infiltration rates lower than their designed rates, and ten basins (or 25%) with infiltration rates equal to their designed rates. DRI rates for soils with greater coarseness exceeded design rates.

According to[69], a number of factors, such as seawater intrusion, dissolution, reverse ion exchange, water rock interaction, and agricultural impact, have an impact on the hydrochemistry of the coastal aquifer. In the post-monsoon season, ground water samples from 48 locations were taken from bore wells using standard methods for major ions and in-situ parameters. The methods used to analyses the water quality indices included ionic ratios, geochemical plots, geochemical modelling, and statistics. The EC was 7155 S/cm, and the pH ranged from 6.6 to 8.0. The saturation of Calcite during its evolution using hydrochemicals was primarily caused by the availability of Ca and $HCO_3$ ions using a saturation index. The water in the study area was suitable for agricultural use but not for drinking.

By maximizing the use of water resources[70] constructed a RWH system for a South Indian University (SIU) in order to transform the current campus into a green endeavor. The quantitative and qualitative facets of rooftop storm water discharge were examined in an integrated study. The SIU can assist in reducing water scarcity during the non-monsoon season by storing stormwater from rooftops, which totals 1,13,678.9 $m^3$ annually. These conclusions may have a significant impact on other public and private organizations as well as RTRWH programmes for long-term water management.

## 2.4 GROUNDWATER RECHARGE USING GEOGRAPHIC INFORMATION SYSTEM (GIS), REMOTE SENSING, AND MODELING METHODS

By combining traditional hydrogeological survey data with geographic information systems, it is possible to identify areas that are suitable for rooftop rainwater harvesting using GIS (geographical information system) and remote sensing. Different modelling techniques can be used to identify and analyse groundwater recharge zones and capacity. A methodology for sustainable water management was developed by several authors[71].

By combining remote sensing and geographic information systems[72] pinpointed the area for groundwater recharge and outflow in catchments that are susceptible to salinity. This method is being used in a dry area of southern Australia with a salinity-prone

unconfined basalt aquifer. The basalt aquifer spans 11,500 km2 within an area with a high concentration of farms. The past has made extensive use of bore data to identify the recharge and discharge zones (especially potentiometric surfaces and depth to groundwater data).

Thornthwaite and Mather (TM) model for rainwater harvesting was used[73] in the development of a water balance model at Jammu Himalaya using remote sensing and GIS techniques. The analysis is very helpful in identifying a watershed's moisture surplus and deficit. Only 11% of the Devak-Rui watershed site was suitable for rainwater harvesting out of the total runoff of 1,429.26mm, with the remaining 89% being unsuitable.

At the University[74] created SLUGGER-DQL, a piece of software that works with remote sensing and geographic information systems to help identify potential rooftop rainwater harvesting and artificial recharge sites. The use of conventional hydrogeological survey data allows for the determination of which locations are suitable for rooftop rainwater harvesting.

A conceptual framework for the long-term management of drinking water was provided[75] by assessing the current condition of the water supply system in Allahabad. We developed solutions for the current water supply problems by identifying various challenges and holes in the current system using a GIS framework. Various types of pertinent data have been stored in ArcInfo for use in other applications, analysis, and decision-making. In Allahabad, the rainfall recharge was calculated (Arc Info). Using data from 1997 to 2007, a comparative analysis of various hydrological parameters for pre-monsoon and post-monsoon ground water level, as well as water table variation, was carried out to better understand the changes that have occurred over the past ten years. In order to evaluate ground water recharge potential areas, the recharge regulating parameters were assessed and various groups of thematic maps were created. Each parameter has a unique impact and contribution when it comes to evaluation[76].

To estimate groundwater heads and the extent of intrusion from 2011 to 2020, Sindhu et al[77] developed a numerical model for groundwater flow and pollutant transport using Visual MODFLOW and SEAWAT. Predicted ground water heads in the vast majority of monitoring wells are decreasing. The coastal aquifers in Trivandrum are susceptible to saltwater intrusion due to the downward trend in groundwater heads that creates a gradient towards the land.

According to Lin et al.[78], the agricultural, aquaculture, manufacturing, and domestic sectors have placed enormous demands on water, leading to over pumping and, in some cases, steadily declining groundwater levels. Land subsidence and soil salinization have resulted as a result. Consideration should be given to regional pumping operations or costs in order to enforce effective water management. SWAT and MODFLOW are used and were run independently to accomplish this. SWAT simulated recharge rates and the spatial distribution of unconfined aquifer hydrological characteristics are used to establish the potential recharge zones. After that, the water balance method (WBM) was used to measure pumping rates for these components. The results of WBM and the official documents were compared to validate the proposed model. The artificial recharge is seen as an important method for alleviating and mitigating the subsidence. The proposed technique has been proved to be efficient by suggesting preferred recharge zones. A GIS-based framework for hydrologic modelling was proposed[79]. Using AGWA, the soil and water assessment tool's parameters were set (SWAT).

Simulations showed that changes in land use have increased surface runoff and decreased groundwater recharge. Observational data from the 1990s with high annual concordance were used to calibrate the SWAT model. Changes in land use and land cover in Kenya's Rift Valley have affected the hydrologic response of the River Njoro watershed by changing how extra rainfall is divided between surface discharge and groundwater recharge. An analysis of the hydrologic response to changes in land cover using a hydrologic model. Will give insight about land use and groundwater recharge relations The watershed also provides a significant amount of water to the surrounding communities and the city of Nakuru.

Using GIS and remote sensing methods[80] potential groundwater recharge sites were identified at India's Hirakud Canal. Due to poor and unscientific water management practises, extensive deforestation, and irrational irrigation water use, the western part of Odisha experiences a drinking water crisis almost every year. The GWPZI (groundwater potential zone index) map, which is influenced by numerous factors including land use, land cover, soil type, and geology, is being developed using the Analytic Hierarchy Process (AHP). Three zones have been established for the Hirakud command region: bad (18.79%), medium (45.59%), and strong (35.61%).

Zhang et al.[81] reported the use of SWAT (Soil and Water Assessment Tool) to evaluate how management practices and climate change affect the availability and quality

of water. The uncertainty analysis and calibration tool SWAT (CUT-SWAT) was employed based on the cloud. This is a challenging study because it requires a lot of model runs. Depending on the complexity of the model, the SWAT (CUT-SWAT) model accelerated uncertainty analysis and calibration processes by 21.7–26.6 times. Models are a perfect solution for addressing issues with computational demand in hydrological modelling because they can provide a fault- tolerant and adaptable environment.

Shashikumar et al.[82] developed a modal using GIS and visual MODELOW for growing flow in a hand work a qui for in the Kodaganar watershed. Groundwater recharge potential areas were found using the weighted index overlay method of GIS. For various thematic maps, soil type, geology, land use pattern, geomorphology, and slope were among the factors taken into consideration. Three categories were used to categories the groundwater recharge potential zone: strong (23%), moderate (54%) and bad (23%). There were good and moderate potential zones as well as bad zones because the pediment inselberg and charnockite hardness were present in the area. Because of this, more artificial recharge structures can be placed in the watershed's centre.

A numerical model for the sustainability of the groundwater aquifer system in Zhanjiang was presented by Zhou et al.[83]. The groundwater budget indicated that the coastal groundwater was overexploited (-3826 x 104 to -4502 x 104 m3/a). The simulation results predicted that under the current groundwater extraction schemes and mean sea level rise, the risk of sea water intrusion would rise in the future, especially for unconfined groundwater in coastal areas and Nansan Island.

Ibrahim et al.[84] Using ArcMap 10.4.1, I built a model builder and selected potential dam locations. The model made use of land use/cover, slope, runoff capacity, stream order, soil quality, and hydrology. Using Landsat image data from 2018, land use and land cover classes were determined. The slope mapping and drainage order were extracted using a digital elevation model, and supervised classification was carried out using ENVI 5 software. Interpolating the rainfall data spatially was done using inverse distance weighting (IDW). The results showed that the central and northern regions of the study areas, as well as heavily cultivated zones, are the best places to collect water. The most prevalent soil type in these suitable sites was loam, with rainfall ranging from 750 to 900 mm. The findings showed that 15% and 13%, respectively, of the study area are suitable for water harvesting in excellent and good ways. In addition, 21% and 27%, respectively, of the examined region were found to be moderately and poorly appropriate, with the

remaining 24% being unsuitable.

## 2.5 GEOGRAPHIC INFORMATION SYSTEM

Numerous researchers have discussed the various uses, advantages, and disadvantages of rainwater harvesting systems, as well as the difficulties they encounter. The strategies, systems, practices, architecture, and implementation of rainwater harvesting were also clarified. Review the history of RWH, cost-benefit calculations, and the impact on the hydrological cycle. It has been made several researchers established the potential of rain water harvesting mechanisms for small and large buildings, as well as the potential of RWH systems, using modelling techniques like HEC-HMS, GIS, and others. The amount of recharged precipitation as well as the environment for collecting and recharging rainwater are key factors in raising the quality and quantity of groundwater. The danger of pollution in an industrial area was investigated, with a focus on the detrimental effects of excessive groundwater diversion. The quality of rainwater collected from roofs for small-scale, domestic applications. observed and examined Among other parameters, pH, conductivity, TDS, chlorides, sulphates, nitrates, and fluorides were chosen as ground water quality indicate and for diagnostic purposes. The ground water quality status was determined using the water quality index approach, which is a great tool for analyzing temporal and spatial changes in ground water quality.

The researchers described how site conditions like hydrometeorology, lithology, and land use have an impact on the construction of rainwater harvesting structures. The researchers calculated rainfall recharge using the rainfall infiltration factor method and the water table fluctuation method after comparing a number of hydrological parameters (pre-monsoon ground water level, post-monsoon ground water level, and water table fluctuation)[85]. Many researchers developed various techniques, like sand ditches for soil conservation and moisture retention. Additionally, the hydrochemistry of the coastal aquifer was examined, along with the infiltration rates of the basin, and the HEC-HMS model was developed to calculate surface runoff. According to the literature review, it is demonstrated that artificial recharge is a workable solution for improving ground water conditions like physiochemistry and hydrodynamics[86].

Several researchers have identified potential areas for groundwater recharge using GIS and remote sensing. Geographic information system (GIS) databases are used to benefit hydrogeological modelling and groundwater vulnerability analysis[87]. This analysis

and decision-making programme can help with long-term water conservation. Several models, including a water balance model for rainwater harvesting based on Thornthwaite and the Mather (TM) Model, have been developed. A programme called SLUGGER-DQL can be used to locate potential rooftop sites for artificial recharge and rainwater harvesting[88]. To create a numerical model for groundwater flow and contaminant transport as well as to forecast groundwater heads and intrusion extent, visual MODFLOW and SEAWAT were used. Using hydrologic models like the Soil and Water Assessment Tool, researchers examined how management practices and climate change affected the quantity and availability of water (SWAT). Small spaces and places with limited access to information can also be used to simulate SWAT operations[89].

A thorough review of the literature revealed that while most researchers agreed that rainwater harvesting is important for the regional and local hydrological cycle, it has been neglected as a result of technological development, paved and built urban areas, and a reduction in groundwater recharge areas in many developed countries[90]. The quantity and quality of ground water both improve as a result of rainwater harvesting. Rainwater collection is a sustainable way to address the world's water shortage and could support various water management strategies.

The responsible authority should immediately take precautionary measures to stop sewage and industrial discharges from contaminating groundwater supplies[91]. Numerous indicators of the quality of ground water can be analyzed using the water quality index. It is possible to analyse the impact and improvement ground water quality. Pumping rates, hydrogeology, geology, ground water heads, and a sensible balance between freshwater and saltwater flow all have an impact on seawater intrusion in coastal areas. Ground water can be recharged by infiltration to solve this problem. The infiltration will have a different impact on recharging ground water for various areas, particularly in coastal areas[92]. The process is influenced by a number of variables, including groundwater hydrochemistry, rainfall, soil depth, soil hydraulics, geomorphology, and climatic characteristics.

To calculate groundwater recharge potential zones, a variety of classes of thematic maps can be built using remote sensing and GIS techniques. For the purpose of making decisions about groundwater management, different data sets can be analyzed convergently by using a GIS platform to combine remotely sensed data and field survey data. SWAT simulated recharge rates and the spatial distribution of the hydrological properties of unconfined aquifers can be used to evaluate the potential recharge zones[93].

## 2.6 QUALITY OF WATER

Ground water quality and ground water tables are continuously reducing because of the agriculture and urbanization wastes, industrial waste, raising the possibility of quality deterioration and contaminating the aquifers that supply potable ground water. Pesticides and insecticides have been overused and heavily applied, contaminating the subsurface environment and rendering many sources unusable. When contaminants spread over large areas of the aquifer, ground water becomes unfit for use in a variety of applications. Soil salinity is one of the most crucial elements that influences agricultural production, particularly in irrigated arid areas. Anthropogenic and geological processes are also to blame for the huge level of arsenic mineral and fluoride detected in the potable and ground water[94]. Complex system of planate with solid, liquid and gas. For all kind of biological activities, water is very necessary and essential things in universe and thus life is not possible without water. Water is very kin for the all kind of activities happened on the earth surface as it needed in complex formation, biological processes and individually for the existence of the life[95]. In the past it was indicated that the sagas of army may struggle for the fresh water and in Priests & Monarchs have worshiped and blessed for good health.[96]For food security and life security, water ranked first and looking to present scenario, it has been shown that consumption and need of water will increases day by day and also seasonal changes take place so it is everyone's responsibility to use it carefully. Among total quantity of available water, only 2.5 percentage water is useful as the potable water and this water is also available in the form of glacier in polar region[97]. Water in the glacial region is available in huge quantity. There only rare creature is available who survive without water but apart from that everyone need water for their survival[98]. Water is very significant in the development of living organism and crucial part to equipping them[99-101]. development of civilization, is based om water and its important can be retrived[102]. In the modern age it is till unanswered that the life is possible without water gets polluted result in to several disease such as cholera diarrhea etc, born sickness typhoid and many other so its very importance to use the fresh water for drinking purpose as its pollutant free[103-105]. Ain altogether it says that its responsibility of all peoples as well as government body to work on this challenge and various department are associated to work on this[106-109].

Gandy purposed "reasonable water condition, at a rational price'', is a reachable propositial[110]. If proper safety is not taken then there might be challenge penalty therefore the honors of all those company or associated body should turn out to be alert & take fast

action regarding this issue. It has been pointed out by many worker about the resposbility of parents of autism children to provide fresh and pollution free water to their chlidrens [111-113]. This article writer rather than having the capability in personality one should applicable the public skill as a great deal as probable so as to decrease the contamination such maintenance of purity, hygiene etc.[114]. Possibly main significant solitary step in a water-possess planned is to become its ongoing: in republics anywhere Hill[115]and Jackson[116] have recommended total quality management and organization framework based on information system. Close evolution is done by author of article how the technological factor can be cooperative to put into practice any of the plans that help in decreasing water pollution[117-119]. Extensive literature indicate that many areas are misplaced; but passable orientation and bibliographical works is assumed to allow the fitness measures to pursue out the essential to allow permit the sanitary or civil engineer to create strategies & mathematical projects for water-stream connections[120,121]. The thoughts offered in this article. Grown as a consequence knowledge composed from many areas of the universe. They are founded on the firm belief of the biographers as below:

1. Just by arranging a supply of ideal potable water more health benefits can be reached to common man rather than expending on other programs[122].
2. Without proper and adequate water supply large healthy benefit can be reached to population[123].
3. Water programmed can be rune very smoothly by a key factor called sanitary (or public health) engineer[124].
4. Health governments would take potent attention and to do required part in the elevation, accomplishment and organization of country water stock systems[125].

Authors of the articles have examined the water quality and have also closely examined the sanitization along with very good amount of data. They also have an expectation that the article can take place in WHO (31 monogram no), Composting & 39 No. Excreta discarding for local areas and tiny Societies as additional link in the shackle of capability being produce by the WHO to inspire conservational hygiene programs at the native level in associate States[126-128].

Mr. E. G. Wagner conscripted the initial text including specific features of country water-provisions, a short-term advisor to WHO, & was initiated in 1955 as a

mimeographed article. The whole article was completed scanned by 40 specialists in various area of world for their appreciated suggestions and comments. Out of 40 an escalating response was found from 38, & has been of prodigious support in the adjustment and alteration of the source 01[129,130]. The assessors were acknowledged by the WHO[131]. The Servitor special de sazide pziblica of Brazil & the organization of inter American. Airs & operates were also acknowledged by the WHO for creation obtainable their vast knowledge & for their forthright & obliging censure of the solid[132]. Water is the most valuable offerings of the Mother Nature to mankind; the terrestrial ecosystem cannot function without it. All life and tangential potency are possible with no water[133]. More over to portable & individual health, water is compulsory for industrial, agricultural crop and manufacturing method, hydroelectric power production, recreation, waste assimilation & wildlife etc.[134, 135] when a source is applicable for so more diverse things, it is key that its growth & applicable sensibly and professionally. From very initial, man fills the potency and requirement of water for their routine life for this water is known as life & it has been recognized as nectar[136]. Water is extremely elementary to life. One cannot imagine a form of life that might exist without water. On the surface of the earth, water, in the form of oceans, seas, glaciers, freshwater bodies, rivers, wells, lakes, etc. occupies about 71.00 per cent of the area while, the landmass occupies about 29.00 per cent of the area[137, 138]. Assuming that 71% is as 100% then 97% is the seawater that is salty, while remaining 3% is portable fresh water. Polar ice possesses approximate 2% water & less than 1% water is detected in the appearance of groundwater and lakes. If we move from side-to- side data of water applicable 79% is applied for irrigation, 23% water for company & approximate 8% is applied for domestic things[139]. Groundwater is key source but unluckily prone to infectivity by materials harmful to human health[140]. In many areas of the world, infectivity is so high that the water is in poor condition even for agricultural use. Pollution levels of the ground water in densely populated are reached so high because of continuously withdrawn of ground water and formation of absorption pit. As this resource becomes more contaminated and scarcer, demand for high quality water will continue to grow making groundwater even more valuable and protection more important[141, 142]. Water sources are there for drinking and various journal uses must have high degree clarity free from all types of pollution[143]. The source and quality of bore well water is a clip resource and easily available source of our life. Is getting polluted due to population increase and industrial use[144]. Majority of the remote residential group of people i.e. group of people residing far gone from the urban region i.e. advise region mainly not receiving safe

portable water. They don't have safe water provide so the citizens are compiled to take water from other source that have close to their town. In the majority of isolated tribal region bore well water is taken for portable water & other things. Bore well water is clean & it is not probable to blemish it but the chief production of bore well water's contamination is the application of fertilizers, chemicals, pesticides, lime; manure etc.[145-147].

Bore well water is normally applicable for drinking & other application in this region. The application of fertilizers, chemicals, lime, manure, 10 refuse dumps etc. are the major source of bore well water's contamination. There is no clean water provide for the populace livelihood in this region, so it applicable bore well water for its general & drinking things. We have noted the physico-chemical analysis of bore well drinking water considering water at some amount. Fluoride is present in all-natural water at some amount. In spite to life form small and big concentration of $F^-$ can happen reliable upon the kind of rocks & the incidence of the $F^-$ possessing raw materials in surface water. Widespread of steamy climates one more name of fluorosis has been explained. The major sources of $F^-$ intake are water. Many inherited problems like cancer and goiter have been related with attendance of high level of a chemical or its derisory resource of water. Opinya et al. have cited that high or low level of $F^-$ ions level in water as the main reason for dental fluorosis. Low concentration of iodine in Homo sapiens results in goiter. Little children have been noted as a potential high-risk group to the toxic effects a sodium for drinking water. Now a days about 18% of the world population do not gate pure drinking water and more than 4.5 million people lose their lives every year from illness connected with pure drinking water and scarcity sanitation services. If everybody acquires secure drinking water & high-quality cleanliness amenities there would be 198 million less harms of diarrhea & 2.0 million deaths happen by diarrheal problem per year. Biofilms are including of inorganic and organic substances in piping that can water front, defend and permit the explosion of various bacterial pathogens, covering legionella & mycobacterium avium compounds (MAC). Sources infuriate bacterial progress on Biofilms have water temperature altered sterilizer and remaining concentration, ecofriendly animal C level, degree of pipe deterioration and kind of circulation system chloramines are meaningfully powerfully operative than chlorine for monitoring legionella in Biofilms distribution system deficiencies linked to a number of water born disease outbreaks**.** The advantage of an optimal neural channel model for prediction of water quality parameters based on few

known parameters is implemented in this work. The empirical formula was taken from the Department of Natural Resources, New South Wales (NSW), and Australia**.** The conclusion of the model was encouraging. The comparison of the NSW model, actual experimental results and regression models are also appended. These replicas are working by the expert whichever since it is imperfection in terms of period and/or area to collect evidence to kind the estimates than to cover the material round the occurrence itself, or, additional prospective, since the incident to be prophesied will take place in some impending time. Abundant of the western United States is semi-arid, requiring significant irrigation to grow common crops. Improvements in pump technology during the 1960s made groundwater wells easy solution for satisfying crop requirements. However, by 1989 significant groundwater level reductions of up to 30.5-m (100-ft) were observed in parts of the High Plains aquifer (also referred to as the Ogallala aquifer for its geologic formation) underlying the states from South Dakota to Texas. Reductions in stream flow have had negative impacts on aquatic habitat resulting, in some cases, in the extirpation of fish species from western rivers. In Colorado, his disappearance of habitat is threatening the Brass Minnow (Hybognathushankinsoni), throughout the Arikaree River which is a stronghold for this species particularly along the Nature Conservancy's Fox Ranch property along the Arikaree River.

Groundwater models often are used to investigate water rights or to estimate habitat recovery. The assumptions made during the modeling process are very different depending on which of these goals the modeler is trying to achieve. Modeling for habitat recovery projections requires the modeler to assume conservative estimates of flow recovery (under estimation) because over estimation could mean habitat is actually not available where projected. If a given species were to require the area of habitat recovery projected in the model for survival and it were not available, there may not be enough time to remedy the situation. Conversely, underestimation of stream depletion causes legal problems when modeling to establish water rights because a user may be imposing on a senior right held by another user. The distinction is important and the purpose of a model must be established before it is used for any work.

## 2.7 CONCEPTUALIZATION

One of the main contributions of this thesis was to derive a conceptualization of the Shedhi and Vatrak rivers water cycle and groundwater system. River water is important surface water sources which obtains water from rains water. This water and ground water

gets contaminated by an industrial waste so, the ratio of ions and dissolved Oxygen which is supposed to be present in the Ground Water and Surface water change abruptly and is the serious problem for human beings as well as water bodies leading to water borne diseases. People in developing countries are so aware of such quality of the water of these water bodies and deterioration of soil, fast creating social, economic and technological problems. The different physical and chemical standard methods were used for water samples analysis. Specification of drinking water, Bureaus of Indian standard and practical method of water analysis was studie also as prescribed by APHA (1998) adopting physico chemical analysis of water, metal concentration and organic compounds.

## 2.8 BACKGROUND OF STUDY

The present level of nitrate obtained from surface water sample collected during monsoon and the same process had been done after monsoon season and was found below the safety limit in the remote aquifer which was used for drinking water. Yet, total dissolved solids are more than potable limits with increasing trend nearby bank. The reasons for inherent salinity was attributed to sea water intrusion. These water pollution problems of ground water distribute them in different way in the localities because of recent social in equities. For example, rural people used some hand pump has failed, there for, they had to get lower quality water from open wells. The practice of water clearance system and the awareness for using the pure water are highly variable ranging from homely rivers osmosis system used by rich urban people and NRI donated society based in village area to simple filtration spread acidly in rural areas. Developing the methods of monitoring of the water source will increase awareness in society people will get pure water in this area.

Nowadays, the eco-friendly defense agency controls more than 80 downing water chemicals and the enormous people get consumption of water afterward. Governments are required consider the health issues related to pure water quality in the light of following points.

1. Current treatment may not be sufficient.
2. Populations are increasing and shifting geographically.
3. Speculation in study & progress has weakened.

Water is important for the existence of humans, animals & plants. Water is too home-based to a very broad range of micro vegetation & micro wildlife, generating a charming setting of dangerous organic significance. This entices too petite courtesy. Drinking water is evolving as one of the most serious issues which may finish humanity. Water is, accurately, the spring of lifespan on terrain. The human body is 70% $H_2O$. Human existences can endure for solitary a few days when deprived of fresh water. In future till 2025 however 45 countries are believed to fight with scarcity related round about 2.7 billion people, 34 % of worlds estimated population. Ethiopia, India, Kenya, Nigeria and four more are among the countries which can face the shortage of water in coming 25 years. There are few large nations like China, now a day suffers from ardent water problems. Hazardous public hygiene problems come out from dirty water, improper west disposal and improper water administration in most parts of the world. Every year lot many people lost their lives due to water born disease like typhoid, cholera and schistosomiasis harm. Wastage and spoil of water supplies also are heavy burden and the original environment, all pose increasing danger for many aspects life. The excellence and the amount of water are failing internationally as a consequence of fast population progress, urbanization & development. Most countries however currently are aware of the necessity of fresh water as a requirement for survival. Fresh water needs to occupy highest priority, on the international agenda. In addition to this the source of fresh water which is available to mankind is shrinking in effect because majority of fresh water supply have been near to extant or ended.

In number of countries, water bodies like ponds and rivers are used as container for very low level storage of wastes, untreated dump, poisons industrial wastes and dangerous chemicals that spread on the surface and same community depends on ground waters from farming. Many growing countries fight problematic assortment. The shortage of the fresh water is obviously to be unique of the protuberant influences, decelerating monetary progresses in future, officiating the ecosphere. Unclean and rare water goods are serious public health difficulties in abundance of the World. Poisoned water, aquatic scarcities & contaminated living situations slay over 12 million persons per year. Pollution is ubiquitous but certain industrialized republics have correctly pure water excellence and achieved water dis contamination. Many states don't have recited laws to mange water contamination correctly while others cannot place to perform water excellence level. International growth society requirements for the evolving systems need to pay additional

courtesy to except and progress water transparency. To maintain the water base economic development and the quality of life, the well to do world also must use more energy.

In 1974, the Global Environment Monitoring System, GEMSIWATER program was introduce to boost up and to coordinate the all Elion of Environmental data, count wise, region wise and globally. While a EMS has established its goal to assist governments to develop system for their personal use and its other purposes are to make improvement in the validity and comparability of Environmental data globally and to make these data available for the collation and check the environmental data. Prior program was found one for climate related monitoring, monitoring of natural scares, monitoring of seas and monitoring related to us given in GEMS, WHO, UNESCO, WMO, and UNEP established GEMST water quality projects? The goals of the projects are to combine with member nations in the planning of new water monitoring systems and to empower present ones to improve the validity and comparability of water quality informality. Among nine nation members which were to judge the incidence and longtime ways of water pollution by chosen persistent risky substances.

The open up idea of the global water quality monitoring project is that the member states take active participation and regularly keep an eye on the quality of in hygienic substance in water resources at selected local place and find out the information for global synthesis and broadcasting. Wherever possible, the location for the global channel was chosen from present national or local channels. New locations were founded where such locations did not exist. Water bodies (rivers, ponds and ground water aquifers) were of main concern. Which is meager source of water supply for industry, animal's agriculture and people. So many locations were also added to monitor global rives and lacks, seas and water bodies not affected by human activity till now. The goal for the first part of the project (1977-1984) was the abolishment of a complex network of approximately 300 monitoring stations on rivers, ponds and an ground water qualities. At the same time, it was decided that total of about 1200 locations might ultimately necessary to cop up with representative global coverage. Drinking of water quality may vary at these locations, inclined natural, and a tropogenic constituents. The period between 1977 to 1979 was a primary please during that time guidelines, specialists were trained in various areas, universal centers were introduced. In collaboration with government, national institutes were identified and named as the focal points for EMST water activates, within each country. Laboratories were established to do the regular sampling and analysis at the

chosen monitoring sites. WHO implemented GEMS water Geneva with the guidance of WHO regional office WHO regional centers for environmental hygiene also provided technical supports more over institutes have been founded as regional reference laboratories for using the analytical quality assurance component of the project. The global data center is situated at the Canada center for the in-land waters, Burlington. Surface and ground water quality and a UNEP GEMS combining center for clean water all serration and checking. The Environmental observation and help laboratory Cincinnati of the U.S, Environmental protection agency serves as the global center for analytical quilter control. UNESCO has taken part in the field of training and assessment mythology. WHO has aimed network design criteria and hydrological monitoring system. The primary phase of project has indicated to the fulfillment of a basic monitoring channel. General operations above intimation flow was found for mast locations during 1978 to 1979. The GEMSNATER provided required technical formalities. In carnations to operate used in all laboratories and organizations as the prime insertions for their monitoring programs. As a certain level of general monitoring and information reporting achieved, it was considered timely to combine project ends in the form of three publications all which were found out in 1983.

1. GEMSNATER Directory of Participating Institutions (1983).

2. GEMSNATER Data Summary 1979- 1981.

3. GEMSIWATER Data Evaluation Report 1983.

Nutrient Contamination Agriculture methods, the largest supplier for water contamination even supplementary to municipalities and industries. Effectively in all nation, where agricultural manures and insecticides are applied, it was observed that infections of ground water possess well surface waters. Another source of contamination in few areas is by subconscious trashes. The spinal water in to rivers & coils are afterward utilized for agriculture is frequently of deprived superiority with more presence of nutrient, pathogens, salinity and residues. America and Europe face countless water contamination higher than 87 % of Europe's rivers with high nitrate from insecticides & 6 % of which possess round nearby 198 times more than nitrate levels that occurs in clean rivers**.** Most of the Europe's ponds are entropies from full of farming and municipal nutrients. It we want to know what eutrophication is them it is a method that occur when additional nutrients block the development of algae which once die & decay, raid the

water of oxygen. Although mineral salts of low pollution relevance are the most common constituents found in ground water, some serious pollutants and pollution levels also can be detected. UNEP (1998) noted that 80% of ground water samples in Sri Lanka contain nitrate levels above the drinking water standard of 10 mg liter. The primary source of $NO_3$-N in ground water is leaching from soils. Shrivastva et al. and Saxena have reported the leaching of nitrate ions from the soil into ground water. Nitrate itself is relatively nontoxic but when ingested with food or water it may be reduced to nitrite ($NO_2$) by bacteria present in mouth and gut. If nitrite containing water is utilized for drinking purposes it can react with secondary arsines present in the human body, and may form carcinogenic nitrosamines. High levels of nitrates poses a health problem and can cause infant methemoglobinemia (blue baby disease) and cancer. Nitrates affect young babies (less than three months old) by depriving them of oxygen. Health problems due to nitrates present in water foundations have achieved a thoughtful state practically in all nations. In overview, about 145 nations have problems of nitrates from manures. Elusive concentrations of phosphates and nitrates in water create progress of blue green algae, causing to eutrophication (deoxygenating). Oxygen is needed for the breakdown of the bacteria that help as cleansers, which break down organic matter infecting the water. Therefore, the quantity of oxygen controlled in water is a key gauge of water excellence. The use of agricultural chemicals (nitrate -nitrogen fertilizers and pesticides) and their occurrence in groundwater. Showed be probably monitored time to time. The concern over the toxicological hazards caused due to pesticides is growing over the last three decades.

The extent of groundwater contamination from both nitrate - nitrogen and from a range of pesticides has been discussed on the basis of numerous surveys throughout U.S.A. Technologies available for removing these chemicals, to acceptable drinking water levels are outlined. Several different drinking water treatment methods, involving both centralized treatment and individual household point of entry devices, were evaluated through case studies and field - scale research projects in Suffolk country, New York, and in California. Processes available for the removal of nitrate from drinking water were reviewed presenting their strengths and weaknesses. The processes were ion exchange, reverse osmosis, electrolysis and biological denitrification. A combination of biological denitrification and electro dialysis is available offering such benefits as conversion of nitrates to nitrogen in continuous operation. It is suitable for flows above 300 m3 per day and with a nitrate concentration of 50 - 100 mg/L. Ground water Pollution has been found

in many areas of the world where groundwater is the primary drinking water source. Many factors affected quality of ground water such as physico chemical characters of the rocks through which the water is circulating, geology of the location, climate of the area, role of microorganisms that operate for the oxidative and reductive biodegradation of organic matter, intrusion of saline waters as in coastal areas, etc. Ground water constitutes an important part of many water resource systems, supplying water for domestic use, for industry and for agriculture. At present, nearly one-fifth of all water used in the world is obtained from groundwater resources about 14.5% of world's crop land is irrigated by groundwater. The present irrigated area in India is 60 million hectares (Mha.) of which about 38% is irrigated from groundwater**.** Surface water acts as a source due to of long pore interplanetary in earth supplies, as a channel that can carriage water, completed a long detachment, & as a powered filter that recovers water superiority by eliminating deferred solids & bacterial adulteration (Sharma, 1996). In Europe the delinquent of surface water pollution is deteriorating. Approximately, 58,000 square kilometers of surface water aquifers in cowboy movie & dominant Europe are intended to be polluted with insecticides and manures. Of Hungary's 1,500 area wells patter surface water, 550 of them are previously polluted, widely with cultivated chemicals (Havas- Szilagyi, et a1. 1998). In the Czech Nation 70%-of all external waters are severely contaminated, typically with civic and manufacturing wastes. About 28% of the nation's streams are so contaminated with impurities that no angle endured (Nash, 1993). In US, 38% of all external waters are not appropriate for swim or trawling, and 50% of all pools are emaciated (US EPA, 1998).

Germany has accorded high priority to ground water protection where over 80 per cent of the public water supply was taken from groundwater, including artificial recharge and bank infiltration. However, despite legislation, groundwater pollution was increasing, particularly in agricultural areas. Hence limits have been introduced for pesticides levels and new rules have been ~introduced governing dumping and storage. River Contamination higher than partial of the World’s main rivers are extremely useless and contaminated, humiliating the nearby ecosystem, therefore intimidating the persons who utilize the identical water for irrigation, consumption & commerce for the fitness and maintenance.

Pollution is multifaceted in emerging nations, where the people are swelling fast, growth required are snowballing, & establishments have different outlay urgencies. Nearly 73 % of all manufacturing dump & 91 % to 94 % of all national manure are probably

water which people for pollution free water. In Malaysia and Thailand, water contamination is so high that streams often comprise 31 hundred times higher pathogens weighty metals & toxic materials from business and other anthropogenic activities. In China, the 50,000 km long rivers of length 33000 km are so contaminated that fish cannot live in. In 1992, Porcelain's businesses distributed 36 billion metric tons of administered natural sewage in to water ways of coastal & lakes water. In 1986, the Liao River, transitory to very extremely developed north part of China in which virtually each water animal indoors at 100 km was perished when over 1.1 billion tons of manufacturing dumps were discarded in to the stream within 3 months. In higher Saopaulo, Brazil, 259 ton of natural wastes from 1200 industry were dumped in to Tiete River everyday & the river is dead. Accordingly, the river possesses very high limit of cadmium, lead other heavy metals. The city too heaves few 900 metric tons of junkyards in the streams daily of that only 11% is measured. Pakistan's biggest town Karachi has completely out-dated manure method plants so the urban is whelmed over with the junkyard. These florae now & they function less than 14% of volume because of disruption down & ploughed pipes. Most of all the drains water seepages out were hooked on the nearby soil, pampering the bores water utilized by folks for drinking purposes.

More than this, toxic materials such as $SO_2$, $NO_2$ which in the atmosphere reach to form in the farms of acid rain and create negative effect on both, drinking water and soil Ecosystem. Acid rain decreases the pH of rivers and streams. If do not buffered by calcium acidified waters kill many types of fish, man and trout. Synthetic chemicals behaved like a very dangerous material. Throughout the world, about 65.000 various chemicals are in regular use. Per annul an estimated, 1000 new substance are found out. Many of them go in to rivers, ponds and ground water aquifers. More than 650 substances have been found out in fresh water, 125 of them were highly poisonous in U.S. alone. Many synthetic chemicals, are recognizing as persistent organic pollutants among halogenated H.C, dioxins and organochlorines such as DDT and PCBS, they live long and are very poisonous. They cannot he controlled easily by natural process and consequently accumulate in the biological tool sequence, until they create danger to man kinds hygiene.

Water based epidemic creates tragedy for mankind. They kill so many of people every year, they prevent more people from living healthy lives and resist development efforts. About 2 billion people have diseases that are due to polluted water. More than 54 % children's life is concern with infections and parasitic diseases which are water related

diseases. In both, aged people and children, water related diseases creates a high proportion of all illness in some coronaries. Whereas water-based epidemics substantially in their nature, traveling effect and negative health effects based on water can be managed by three ways, water related disease including those due to both, fecal-oral organisms and those because of poisonsous substance. Water related disease and water related vector diseases. Produce another level water-scarce disease, that creates where pure drinking water is not available. Water borne diseases are "polluted – water" diseases those because of the water which has been polluted by mankind, industrial wastes and creatures. In the whole world, there is no system of sanitary derange disposal and viability of pure drinking water is not there which causes for over millions if deaths water borne epidemics are like cholera, typhoid, polio, meningitis and hepatitis A and B. The bacterial, viral or protozoa organisms becomes guest in human beings and make reasons for these diseases. Most of the people don't have any way to sanitary derange disposal or to cure water for personal hygiene. More than 1.3 billion people are under the risk area from health view point as they don't have pure drinking water. Water borne diseases grow fast because there are no proper sanitation facilities. The limit to which epidemic organism take place in pure water source depend on the population, waste disposal, etc. that they have. Disease is present in those countries where more improper sewage process is are there. It is believed that 4.1 billion cases of diaries disease take place every year, causing lot many deaths, mostly among children.

Epidemics of disease like cholera are spread out because of using contaminated dump as fertilizer. For example, in early 1991, unrefined manure water that was moistened to improve plant produced cholera in Peru & Chille. An employee community in Buenos arias, (Argentina) confronted gratified unhealthy of hepatitis, cholera & meningitis because only 5% of house had pure water or good toilets. Alongside, indecorous food & less handiness of medical facilities irrupted the cleanliness. Water -borne illnesses are all around, due to materials that discover their way into lake. Progressively, chemicals, agricultural, fertilizer, pesticides, and manufacturing wastes are actually detected in freshwater materials. Few chemicals, uniform in low level, can produce over spell & therefore can give are root peril diseases like tumor amongst publics that usage the water. In agricultural Insecticides such as DDT & heptachlor are applied, which were applied in undeveloped, often current hooked on the irrigations water. In Bangladesh, (Dhaka), heptachlor remains in aquatic sources have touched as tall as 0.789 micrograms per liter-

22 times higher than WHO- counseled highest of 0.03 micrograms/liter. Throughout the rainy period in Venezuela, the aquatic system was polluted with a several insecticides. The leakage of toxic contaminants into crushed and superficial water pools applied for ingestion and national utility produced health difficulties in manufacturing countries. Health of plump near 450 million persons is in the danger in Europe & Russia because of water contamination.

Water pollution possesses heavy metals, a repetition that assistant to clarify high child mortality rates and widespread diarrhea 1 and duodenal diseases connected there. In Northerly Russia, half of a million persons on the Peninsula, Kola, from downstream & upstream site in the Hanford reach, Columbia, Washington, are affected. Rivers, were inspected and found twelve water excellence variables for the period 1951-1953 & 1963-1988 to identify any important fluctuations that have befallen over a 35- year interval. 1951 - 1953 period's higher beta radioactivity and water temperatures were observed arising from 5 single-purpose production, 26 reactors which operated until 1971. In the early period, sulphates and dissolved oxygen (DO) were also meaningfully lower downstream throughout. The beta-radiation and aquatic temperatures were alike for downstream and upstream through 1986-1988, but nitrate, nitrogen had become meaningfully developed downstairs. Phosphates had diminished suggestively finished the 35-year pauses, though DO, BOD & nitrate nitrogen had amplified by a trivial gradation.

Industrial wastes are the supplementary source of arsenic pollution. In sewages from the manufacturing, ceramic and glassware trades, pesticide and dye engineering businesses, firewood sanitizing, rare earth business & other inorganic and organic chemical businesses, arsenical and arsenic complexes are originated. Maximum pollutant level for arsenic in water has remained set 50 mg/L by Joint States presently. Canada has previously dropped the supreme pollutant level to 25 mg/L; due to the tumor risks. Numerous handlings systems have been implemented to eliminate arsenic from drinking water. Government of west Bengal has given permissible limit (0.05 mg/L) of arsenic in groundwater, but it was found above the maximum in six districts, in India; 30 million people reside in these six districts have an area of 33,000 km. Based on a survey of these affected. Areas of arsenic toxicity districts, it was estimated that at least 750,000 people could be drinking water high in arsenic with more than 175,000 people showing arsenical skin lesions which are at the advanced stages. Major source of arsenic pollution is geological.

## 2.9 OBJECTIVES OF WORK

1. To estimate the quality of underground water of some representative areas of two taluka such as Ankleshwar and Bharuch of Bharuch district.
2. To characterize the different types of waters in terms of pH, hardness, total alkalinity, Fluoride, Phosphate, Chloride, Calcium, Magnesium, and Nitrate, COD, BOD, total alkalinity, Temperature, dissolved oxygen (DO) total dissolved solid (TDS). etc.
3. To establish inter-relationship between different parameters of same regions in during three seasons, such as winter, monsoon and summer.

## 2.10 IMPORTANCE AND FUTURE SCOPE OF RESEARCH WORK

In the proposed research work, 30 stations of two taluka (**Ankleshwar and Bharuch**) were selected as given below.

Entire thesis covers the physicochemical analysis of ground water collected from 15 stations of Ankleshwar taluka such as Sarthan, Telva, Piludra, Umarwada, Jetali, Piprod, Avadar, Pardi Mokha, Sangpor, Kosamadi, Panoli, Kharod, Motali, Andala and Utiyadara.

The presenct work also covers the physicochemical analysis of ground water collected from 15 stations of Bharuch taluka such as Adol, Amdada, AmLeshwar, Bambusar, Bhuva, Cholad, Dabhali, Ghodi, Haldar, Karela, Kelod, Osara, SamLod, Segva and Shahpura.

Above analysis can also create opportunities for the researchers to enhance their work to improve the quality of ground water of the mention area.

## 2.11 APPLICATION OF STUDY TO SOCIETY

- Bharuch district is in between Vadodara and Surat industrial city so analysis of physical parameters of water is necessary to health point of view.
- Community is facing so many problems related to digestive system, cancer, lung irritation due to drinking of poor quality water so it provides scope for monitoring quality of water.
- Investigation of physico-chemical analysis of ground, surface and river water of Bharuch region in terms of concentration of ions like phosphate, chlorides, calcium, magnesium and nitrate, COD, BOD, total alkalinity, temperature, pH,

dissolved oxygen (DO) and total dissolved solid (TDS).

- All the parameters were measured in Winter, Summer and Monsoon seasons.
- All data were compared with standard data and our target is to make peoples of these regions aware about quality of water they are using and perform some need base work to improve the quality. Water analysis of different places was carried out with respect to different seasons and to check data variation in accordance with previous one. After assessing the water sample for their quality, the research may also be enhanced by modifying the different techniques to purify the water sample.

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