GRDOUN WATER QUALITY IN SHALLOW AQUIFER OF JAMMU & KASHMIR UT

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INTRODUCTION

Water is a vital component for living organisms. Without water life cannot exist. About 71 percent of the Earth's surface is water-covered. Oceans store the maximum water approx. 96.5 percent of all Earth's water. The rest can be found in glaciers, rivers, lakes, springs, groundwater etc. Since most of the water is found in oceans, it is not suitable for human beings as it consists of large quantities of chemical components. Thus groundwater becomes the major source of water. The water present in aquifers below the surface is known as groundwater. In India groundwater is lifeline of the people. Majority of the population depends upon the groundwater for their domestic use such as drinking, irrigation and other usages. Ground water is particularly important as it accounts for about 90% safe drinking water in rural areas, where population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist and hence safe resource of water is groundwater. Ground water plays an important role in India with context to increase in pollution of surface water resources. Groundwater is considered to be the largest fresh water resource and considered to be the safe for drinking purposes among all water resources. It is of excellent natural quality, usually free from pathogens, colour, odour, turbidity and can be consumed directly without treatment. Ground water is widely distributed and can be frequently developed at lower costs at points near the water demand, thus avoiding the need for large scale storage, treatment and distribution system thus being cost effective.

Besides meeting the drinking demand, Ground water also plays an important role in agriculture, for both watering of crops and for irrigation of dry season crops. It is estimated that about 45% of irrigation water requirement is met from ground water sources. Industrial demands for ground water are also very high these days, as many of the qualities which make ground water a preferred source of water such as low salinity, low turbidity, lack of pathogens etc. available at low cost is very useful in various industrial processes.

However, Ground-water quality is being increasingly threatened by agricultural, urban & industrial wastes, which leach or are injected into underlying aquifers. Many anthropogenic activities have led to addition of pollutants in groundwater, thus deteriorating its chemical quality. It is well known fact that once pollution has entered the subsurface environment, it may remain concealed for several years, becoming dispersed over wide areas of ground water aquifer and thus rendering ground water supplies unsuitable for consumption and other uses. This polluted groundwater on consumption will have an adverse effect on human health.

In current scenario of Jammu and Kashmir, issues related to ground water quality is not of much concern but with the increasing economic and industrial development ground water quality may deteriorate especially in and around human habitats. The main concerns of ground water quality problems are related to geo-genic and to some extent anthropogenic activities in the form of unregulated disposal of village sewages in open water bodies resulting into contamination of ground water aquifers. A close monitoring of quality of both surface and ground water resources of Union Territory of Jammu and Kashmir is essential as the major parts in the UT are hilly and implementation of aquifer remedial measures is very difficult. The prime aspect of this report is to synthesize, organize and depict the chemical quality data of various studies carried out by Central Ground Water Board till date and analyzing the same in terms of its deterioration due to human activities. Priority is also given to analyze the data in term of ground water suitability for different uses like drinking and domestic uses, irrigational requirements and industrial uses. Thus, the scope of this report is to interpret the quality of ground water from various shallow ground water and its suitability and pollution aspects. The limitations faced are mainly in the form of huge chemical data available and proper interpretation in terms of its variation spatial as well as temporal has become very difficult. In spite of these limitations, an effort has been made to present the data in proper form with best interpretation.

Jammu and Kashmir is the northern most UT of India after Ladakh. It lies within latitudes of 32°17′ and 36°08′ N and longitudes of 73°23′ and 76°47' E. The UT has a total geographical area of 42,241 Sq. Km. The Union Territory has international border with Pakistan in the west. The States of Punjab and Himachal Pradesh form its southern border and UT of Ladakh forms the northern and north eastern border. Major parts of the J&K UT represent high and rugged mountainous terrain. The Jammu & Kashmir is divided into two administrative divisions' viz. Kashmir Division and Jammu division. NHS monitoring is being done for valley parts (Alluvium area) of 6 districts in Jammu region (Jammu, Samba, Kathua, Rajouri, Reasi and Udhampur) and 7 districts of Kashmir Region (Kupwara, Baramulla, Budgam, Srinagar, Pulwama, Anantnag, Srinagar). Therefore, the ground water estimation is computed by the rainfall infiltration method only. There are total 22 districts in J&K UT. The administrative map of the UT is shown in figure 1.1.1.

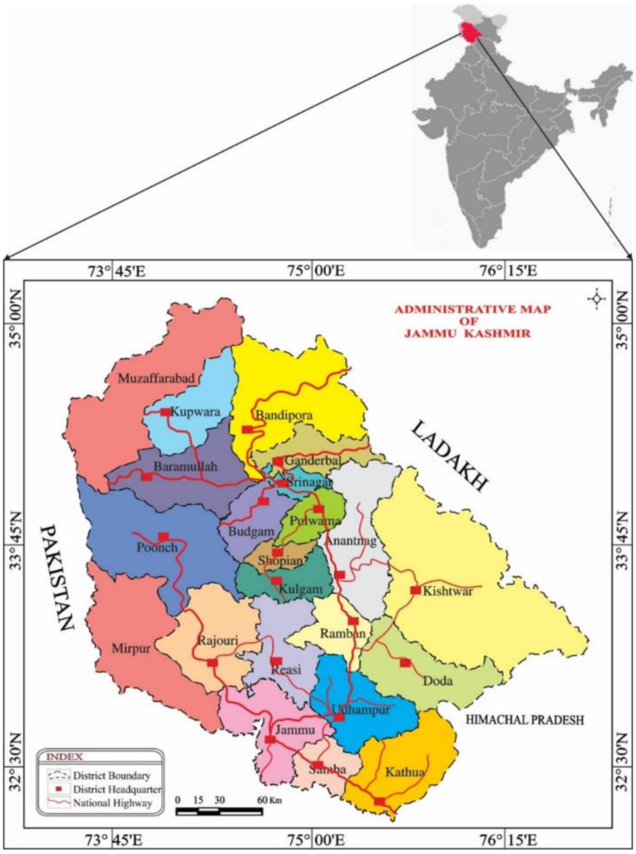

Fig. 1.1.1: Administrative map of the J& K UT

1.1 PHYSIOGRAPHY

Physiography of the Jammu & Kashmir UT is highly varied with highest mountain ranges of the world, extensive plateau, enormous valleys, deep gorges and large canyons in Middle and Trans-Himalayan Regions. The individual ranges have characteristic steep slopes towards south and much gentle slope towards north. The northern slopes are covered with thick and dense growth of vegetation. While the southern slopes are mostly bare, with thin sparse forest cover. The Zanskar range separates Ladakh Region with Kashmir Valley while Pir Panjal range divides Jammu Region and Kashmir Valley. The UT can be divided into six distinct physiographic units as discussed below.

Sirowal Belt: The Sirowal belt covers an area of about 1000 km^2 and has an average topographic gradient of 1:250 to 1:300 in southwest direction. The land elevation of Sirowal belt above mean sea level is normally within 320 m. Southern parts of Jammu Samba and Kathua Districts fall in this belt.

Kandi Belt: The elevation of Kandi belt ranges between 320 m and 400 m above mean sea level (m amsl). The average topographic gradient varies between 1:60 and 1:100. Kandi belt covers an area of about 1500 km^2 and occupies parts of Jammu, Samba and Kathua Districts imperceptibly north of Sirowal belt. Kandi belt in Jammu & Kashmir UT runs in northwest - southeast direction as a narrow strip between rivers Munnawar Tawi in the northwest and Ravi in the southeast. The belt is occupied by reworked Siwalik debris, which has master slope towards south-west.

Siwalik Region: Land elevation of Siwalik region ranges between 400 m and 750 m above mean sea level. Ridges and small independent valleys are the prominent features of Siwalik region which covers parts of Kathua, Jammu, Udhampur and Rajouri Districts.

Kashmir Valley: The elevation of valley floor above mean sea level ranges between 1500 m and 2000 m. Kashmir valley is spread over an area of 5600 km , covering all ten districts in Kashmir valley, Budgam, Pulwama, Srinagar, Anantnag, Baramulla, Kupwara, Bandipora, Ganderbal, Shopian and Kulgam Districts.

Hilly Mountains: The high mountain ranges have the elevation between 2000 m and 5000 m above mean sea level and form parts of Udhampur, Anantnag, Baramulla, Srinagar and Kupwara Districts.

1.2. GEOLOGY

Geological formations ranging in age from Pre-Cambrian to Recent are found in the UT. These formations can broadly be classified into three categories. Hard or consolidated- rocks comprising granites, slates, quartzite, Panjal traps, limestone etc. Semi-consolidated rocks comprising of claystone, siltstone, sandstone etc. Unconsolidated formations from Quaternary to Recent age are comprised of Clay, Silt, Sand, Gravel, pebbles, Boulder etc. The brief geological setting of the UT is given in Table-1.

Table 1.2.1: Geological Setting in J&K UT

Age	**Formation**
Recent to Sub-recent	Alluvium
Pleistocene	Karewas
Middle Pliocene to Pleistocene	Siwaliks
Miocene	Murees
Unconformity	
Eocene	Subathu Formation
Cretaceous/ Eocene	Volcanics/ Basic Intrusives
Cretaceous	Flysch Beds
Jurassic	Punch-Mandi Formations
Triassic	Mandi& Infra-Triassic Formations
Palaeozoic	Panjal Traps/ Tanwal
Carboniferous / Permian	Agglomeratic Slates

	Fenestella Shales Gondwana Formations Zewan Beds
Silurian-Devonian	MuthQuartzites
Upper Pre-Cambrian to Lower Cambrian	Dogra Slates
Lower Pre-Cambrian	Salkhala Series
Pre-Cambrian	Granite & Basic Intrusives

The Salkhala out crops have been traced in the form of hairpin bend around the northwestern end of the Kashmir Valley. The salkhala group comprises of succession of Carbonaceous Shales, Schists, graphitic phyllites, carbonaceous limestones, dolomites, marbles, quartzites. The Salkhala group is statigraphically overlain by Dogra Saltes, which conformably grades into the lower paleozoic succession. In southern part of Kahmir, the Dogra Slates are conformably overlain by a succession of phyllites, sand stones, massive qurtzites, grits and conglomerates known as Tanawals and suggested that the succession bridges the gap between Dogra Slatea and upper Paleozoic rocks in south and south western Kashmir.

The Paleozoic formations of Kashmir exposed along the pir-panjal range and great Himalayan ranges rest either over Dogra slates or pre-Cambrian crystalline rocks of the Salkhal group. A succession of white quartzites, Shales, siltstones and dolomitic limestones exposed around Kashmir synclinorium has been reffered as Muth formation. In Northern part of the Kashmir, the Muth Qurtzites is conformably overlain by Syringothris limestone, a succession of Grey and dark blue limestone with a few interbedded shales, quarzites and traps. The formation exposed along the southern slopes of Pirpanjal near Banihal.

Agglomeratic slate series is well exposed in the Pir Panjal range Baramulla district, Liddar valley, Anantnag District and Kistwar in Doda district. The polymioctites consists of rock fragments derived from glacial erosion as well as from volcanic outburst. It is a succession of slates, sandstone, quartizite and with a few bands of conglomerates. The Agglomeratic slate series is overlain and often intermixed with thick succession of Andesitic and basaltic traps known as Panjal volcanics. The volcanics occupy the steep slopes and high peaks of the pir panjal ranges and higher reaches of liddar valley. The volcanic activity seems to have persisted in Kashmir from late carboniferous to late Triassic epochs.

Permian rocks of Kashmir are conformly overlain by thick succession of limestones and shales known as zeewan formation.

The out crops of Jurassic rock have restricted distribution in Kashmir. A major part of the rock is buried beneath the quarternary sediments and reported in northern slopes of Pir Panjal range Baltal and Joji-la areas. The cretaceous rocks have not been reported from the Kashmir Himalayas.

The Murres extensively exposed on the Jammu-Srinagar highway around batote consists of basal conglomerate bed overlain by intercalations of bright red purple clay and green sand stones and is overlain by Siwalik group rock formations.

Most of the Kashmir valley is occupied by this gravel-sand and mud succession known in Indian Stratigraphy as 'Karewa formation'. There are different opinions about the deposition of Karewa formations. But based on detailed geological mapping Bhatt (1978, 1982) proposed that sedimentation of karewa deposits took place in a lake basin, but suggested that during deposition of Lower Karewa lake occupied the whole Kashmir valley floor, but during Upper Karewa time the lake was localized only in the north-eastern flank of the basin.

Karewas cover an area of about 5600 Sq.Km in Kashmir Valley. Karewa group is defined to include the more or less unconsolidated layered sedimentary succession deposited in fluvio-lacustrine environments in the Kashmir valley, overlying the Precambrian-Mesozoic basement and overlain by Holocene alluvium of modern rivers etc'. Karewa group is divided into two formations viz., Lower Karewa and Upper Karewa. The Lower Karewa formation is characterized by plastic grey to bluish grey clay, light grey sandy clay, lignite and lignitic-clay, coarse to medium grained sand and conglomerates. It is about 1200-mt thick formations.

The Upper Karewa formation is characterized by brown, grey sandy clay, medium to coarse-grained sand, cream coloured marl, conglomerate and loam (loess) sediments. In this upper Karewas lignitic shale and grey bluish shale are absent. Thickness of this formation is about 50 to 200 mt. The loamy sediments are present throughout the valley making the top of the Karewa Plateau. The Upper Karewa formation sediments are exposed extensively on the Pir Panjal flank due to uplift of Pir Panjal range along with its Karewa sediments.

The top of Karewa terraces are capped by a fine grained mostly silty succession without any bedding structures. These mainly loam or loess formation. The formation is in some places extremely muddy, silty or rather sandy. In some cases, sand layers are intercalated.

1.3 HYDROGEOLOGY

The hydrogeological set up in the UT is very complicated owing to varied geological settings and ground water conditions. All the three regions of Jammu & Kashmir UT represent entirely different ground water regimes. Based on geology and aquifer characteristics, the area of the UT can be divided into two broad hydrogeological units. These are Porous and Fissured formations.

Porous Formation

Porous formations are best suitable for the exploration and development. Potential zones are encountered in these formations. Region wise porous formations are described here under: -

Jammu Region

In Outer Plains of Jammu Region, extending between River Ravi in the east to Munawar Tawi in the west, the ground water occurs in piedmont deposits belonging to upper Pleistocene to Recent age. The deposits comprise unconsolidated sediments in the form of terraces and coalescent alluvial fans developed by the streams debauching out of Siwalik Hills. The sediments consist of coarse clastics ranging in size from boulder to gravel in the loose clay matrix and occasionally alternating bands of clay of varying thickness. Kankar is also intercalated with these sediments at different intervals and in variable quantity.

These deposits are graded into finer sediments from north to south in that order. Down south it comprises alternate bands of sands of all grades and clay with subordinate peck of gravels and pebbles.

Kandi Formation

Kandi formation comprises very coarse material with little clay but in the Outer Plain of Jammu & Kashmir UT, the typical Kandi formations are not seen. Instead, they comprise boulders, gravels, pebbles and coarse sand with substantial amount of clay sometimes hard and sticky of varying thickness. The clay proportion increases towards southwest. Occurrence of perched water bodies is a common phenomenon in the Kandi belt of Jammu & Kashmir UT. The ground water generally occurs under unconfined conditions in Kandi formation.

Sirowal Formation

The Kandi formation coalesces into Sirowal formation in the south, finer outwash of Siwalik debris, brought by streams. Ground water occurs under both confined as well as unconfined conditions in Sirowal formation. A spring line demarcates the contact between Kandi and Sirowal formations because the ground water oozes out along this line causing marshy conditions. The spring line has undergone deformation due to decline of water level resulting from development of ground water in Sirowal area. However, the base flow could be seen in streams south of this line, which also in the Sirowal formation is the existence of auto-flow conditions in the deeper aquifer system.

The Dun Belt separates the Siwalik hills from the middle Himalayas and runs as a series of river terraces between Basohli (32°30', 76°49'30") in the east to Riasi (33°05', 74°50') and beyond in the west. The sediments are in the form of isolated Sub-

Recent to Recent valley fill deposits ranging in thickness between a few metres to a few tens of metres. These deposits are often dissected as a result of the present day drainage pattern. The deposits comprise of coarse clastics such as boulders, cobbles, pebbles etc. inter-bedded with lenticular clays.

1.4 CLIMATE

HYDROMETEOROLOGY

The UT of Jammu and Kashmir has great diversity in its temperature and precipitation. Excepting the plain, south of the Siwaliks of the Jammu Division, the climate over the greater parts of the UT resembles that of the mountainous and continental parts of the temperate latitudes.

1.4.1 Climate of Jammu Division

Climate of Jammu division is sub-humid to sub-tropical. It is divisible into two parts namely (i) the plain region, lying to the south of the Siwaliks and (ii) the mountainous region, stretching over the Middle and the Greater Himalayas in the districts of Doda, Rajouri, Poonch and Udhampur. The climate of the plain region and Middle Himalayas including the Pir Panjal is characterized by a rhythm of seasons which is caused by the reversal of winds in the form of south-west and north-east monsoons. The reversal of pressure takes place regularly twice a year. This region has sub-tropical climate with hot and dry climate in summer and cold climate in winter. It lies in the northern hemisphere above the tropic of Cancer. The Minimum and Maximum temperature of the district varies between 4°C to 47°C and the monsoon starts from the beginning of July to the first week of September. From October to June the precipitation and temperature patterns resemble closely the valley temperature zones. However, the summer rainfall and temperature resemble the precipitation pattern in the sub-tropical zone. The region receives an average annual precipitation of 1070 mm mainly in the form of rainfall. Snowfall occurs in high mountainous parts of Jammu region due to south-west monsoon from July to September and contributes about 80% of the total rainfall. The temperature in plain areas of Jammu region goes up to 45ºC during summer and drops to as low as 3º C during winter season. Average number of Annual rainy days in Jammu region is 59.

1.4.2 Climate of Kashmir Division

The weather and climate of Kashmir Division are intrinsically linked with the weather mechanism of the subcontinent in general. The location of the Kashmir Valley at a high altitude (about 1600m amsl) in the north–western corner of the subcontinent, surrounded by high mountains on all sides, gives it a unique geographical character with distinctive climatic characteristics. It experiences Temperate-cum-Mediterranean type of climate. The average annual precipitation is 660 mm. In winters, rainfall occurs from the western disturbances (temperate cyclones). These disturbances have their origin in the Mediterranean Sea. The rainfall generated by these cyclones is fairly widespread locally known as *Alamgir*. About 65% of the precipitation occurs in the form of snow tail during winter season, i.e. December to February. March and April are the months of rainfall. May to September are relatively dry months. The mercury drops between -8ºC and 12ºC during winter and attains a moderate temperature of around 35ºC during summer.

CHAPTER-2

HYDROCHEMISTRY

The branch of science that deals with the chemistry of water in the natural environment is termed as hydrochemistry. The application of chemical characteristics in water is to provide information about the distribution of water qualities. This can help us to characterize the chemical constituents of water at regional level and thus helping in tracing the archives of water. The hydrochemistry can helps us in yielding information about the environment through which water has been circulated and thus knowing about its residence times, flow paths and aquifer characteristics as the chemical reactions occurring in that water system are time and space dependent. The hydrological cycles plays an important role in the nature. To better understand the water system, it is essential to study the entire atmospheric water(rainwater), surface water and ground water are studied simultaneously in evaluating their hydrochemistry and pollution effect.

2.1 The Hydrological Cycle

Earth's water is always in motion, and the natural water cycle is known as the hydrologic cycle. Hydrological cycle can be defined as the continuous process of exchange of water from the earth surface to the atmosphere or vice versa by the influence of solar radiation or solar heat. It describes the continuous movement of water on, above and below the surface of the Earth. Water is always changing states between liquid, vapor, and ice.

Hydrological cycle is a closed system where the water gets transformed either from one place to other or from one form to other under the action of sun heat. Whatever be the process, the total water in the whole system remains constant. The representation of the hydrological cycle is represented in the figure-2.1.1.

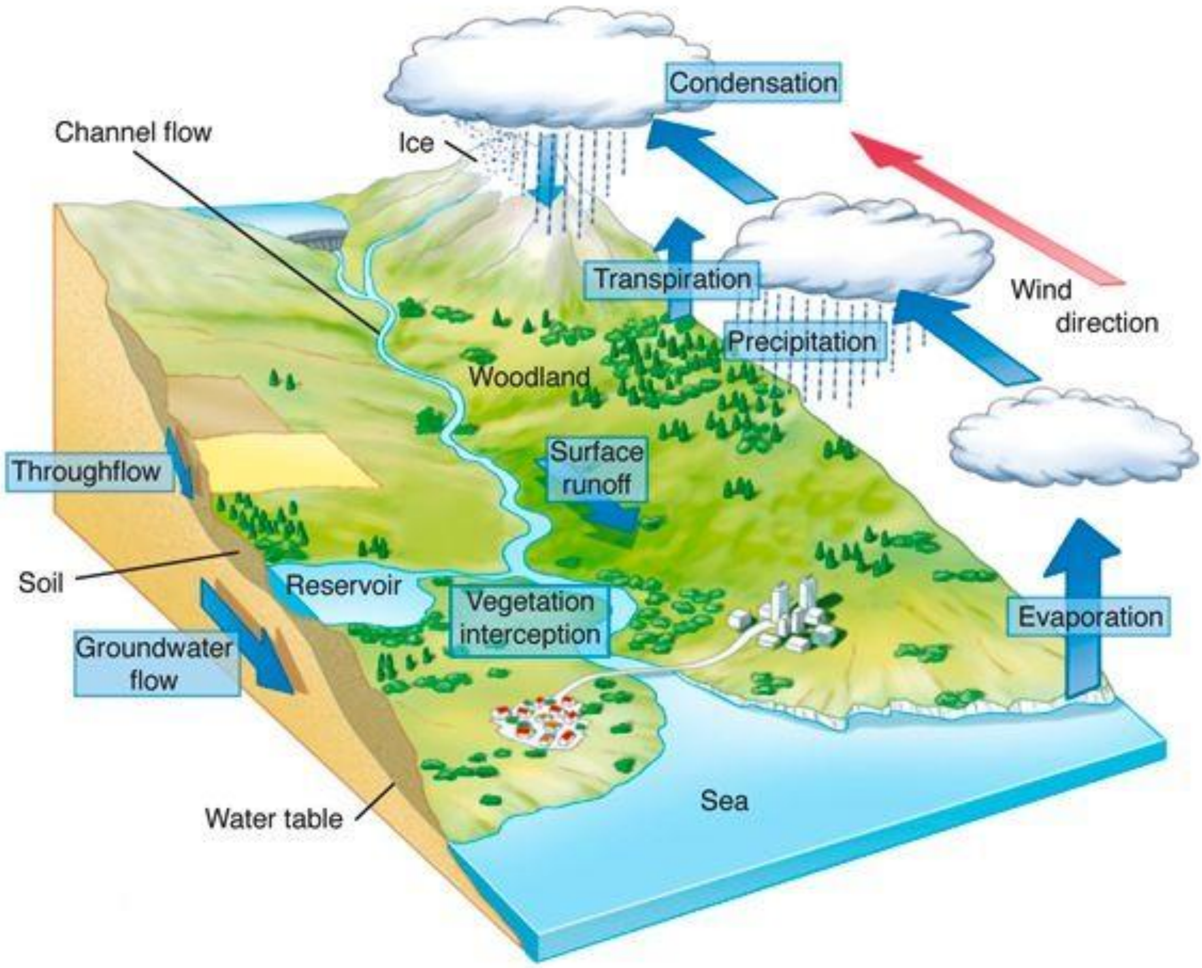

Fig.2.1.1 Hydrological Cycle

The basic components of a hydrological cycle constitute of Precipitation, Runoff, Evaporation, Condensation, Transpiration, Evapotranspiration, Infiltration, Depression Storage and Interception. The process of the hydrological cycle starts with oceans. Water in oceans, gets evaporated due to heat energy provided by solar radiation and forms water vapor. This water vapor moves upwards to higher altitudes forming clouds and these condense and precipitate in any form like rain, hail, snow. The part of clouds is driven to land by winds. Even during the process of precipitation, some parts of water molecules may evaporate back to atmosphere.

The Portion of water that reaches the ground enters the earth's surface infiltrating various strata of soil. This process enhances the moisture content as well as the water table. Vegetation sends a portion of water from the earth's surface back to the atmosphere through the process of transpiration. Once water percolates and infiltrates the earth's surface, runoff is formed over the land, flowing through the contours of land heading towards river and lakes and finally joins into oceans after many years. Some amount of water is retained as depression storage.

Further again the process of this hydrological cycle continues by blowing of cool air over the ocean, carrying water molecules, forming into water vapor then clouds getting condensed and precipitates as rainfall. Similarly, the water percolates into the soil, thus increasing the water table and also the formation of runoff waters heading towards water bodies. Thus, the cyclic process continues.

Water balance Equation

According to the water balance equation, the sum of inflow water = sum of outflow water. Out of the three processes precipitation, runoff, and evaporation, inflow is precipitation. Runoff and evaporation come under outflow, then the water balance equation can be written as,

Precipitation – runoff = Evaporation

Or

Precipitation (P) = Evaporation (E) + Runoff (R)

2.2 RAINWATER CHEMISTRY

Rainwater is major component of the hydrologic cycle. The atmosphere consists of water vapours, dust particles and various gaseous components such as N_2, O_2, CO_2, CH_4, CO, SO_x, NO_x etc. Rainwater serves as a source of many essential nutrients in terrestrial and aquatic ecosystems. It has a complex chemical composition that varies from place to place, and from shower to shower in the same place. Rainwater contains some chemical constituents of local origin, and some that have been transported by winds from elsewhere such as pollutants. Pollutants in the atmosphere can be transported far away through wind. These pollutants are mostly washed down by precipitation and settled in the earth thus causing problems. Composition of rainwater is determined by the source of water vapours and by the ion, which are taken up during transport through the atmosphere. In general, chemical composition of rainwater shows that rainwater is only slightly mineralized with low electrical conductance (EC) contaminated with dust. The concentration of sulphates and nitrates in rainwater may be high in the areas near industrial hubs due to pollution emission. Rainwater acidity is one of the issues many parts of world are facing. Acid rain, or acid deposition, is a broad term that includes any form of precipitation with acidic components, such as sulfuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail. It was first measured century ago due to increase in pollutants in atmosphere as a result of industrial revolution.

The illustration of the pathway of acid rain is given below:

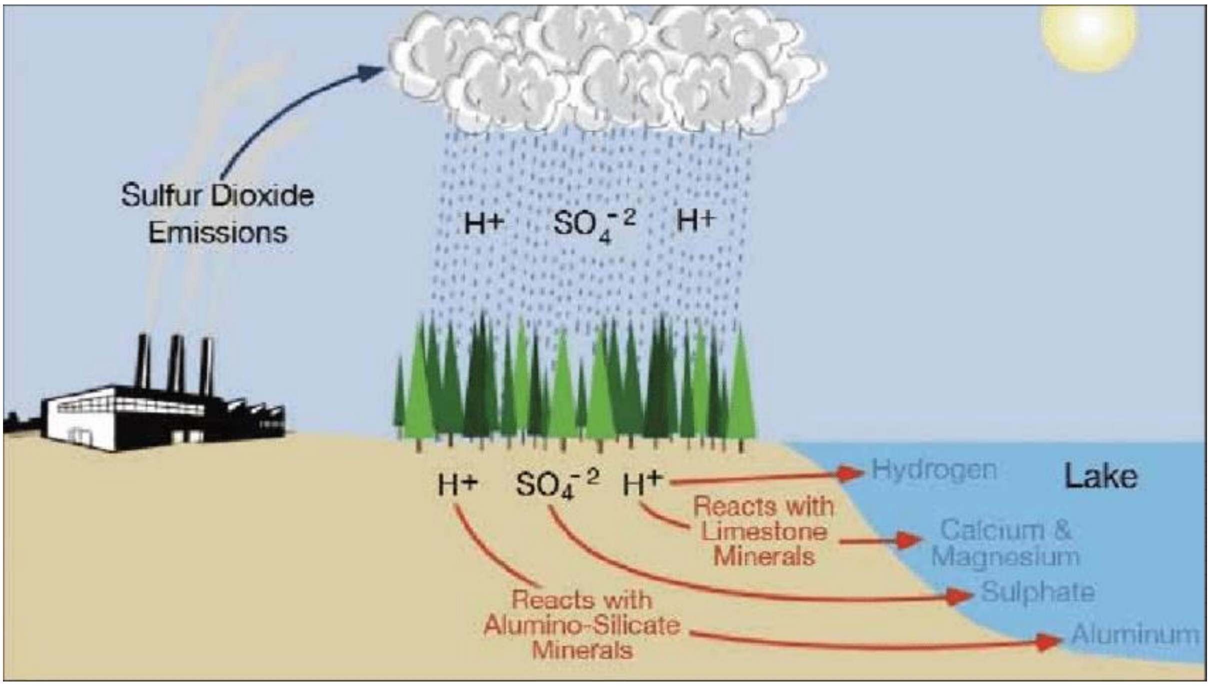

Figure 2.2.2 Illustration of the pathways of acid rain

2.3 CHEMISTRY OF SURFACE WATER

As we know, 71 percent of the Earth's surface is water-covered. The Oceans hold about 96.5 percent of all Earth's water which is saline. Rest of the world's water is non-saline freshwater. However, 75%of all freshwater is bound up in glaciers and ice caps. Only 1% of freshwater is found in lakes, rivers, and soils, and 24% is present as groundwater. About 70% of this water is used in the agricultural sector, 20% by industry, and 10% for domestic purposes. Thus the source of freshwater is very less and it's difficult to find the freshwater with good quality and in adequate amount to cater the need of growing population. As majority of the source of water in world is ocean but it is no use as water is saline. Surface water has extremely variable chemical composition due to variations in contributions of ground water and surface water sources. The discharge of city wastewater, industrial waste and mixing of waters can also affect the nature and concentration of minerals in surface water. The mineral content in river water which also varies usually bears an inverse relationship to discharge. The mineral content of river water tends to increase from source to mouth, although the increase may not be continuous or uniform. Generally, in anion part, bicarbonates constitute a major portion. In case of cations, alkaline earths or normally calcium predominates but with increasing salinity and mixing of the water it has change to mixed cations. The surface water of good chemical quality is required as it is used in household supplies in drinking purpose and other purpose.

2.4 CHEMISTRY OF GROUND WATER

Ground water is the lifeline of the people in India. Major part of population is dependent on groundwater for their water requirements. The primary use of the groundwater is for drinking purpose. Groundwater is considered to be the largest fresh water resource and considered to be the safe for drinking purposes among all water resources. The water that is present in aquifers below the surface is known as groundwater. An **aquifer** is a geologic material such as sand, rock capable of delivering water in usable quantities. It is a stratum of rock or sediment that is saturated and sufficiently permeable to yield economically significant quantities of water. To be considered an aquifer, the rock or sediments must be at least partially saturated, where its open spaces are filled with water, and be permeable, i.e. able to transmit water. Aquifers vary dramatically in scale, from spanning several formations to being limited to a small area on the side of a hill. Aquifers adequate for water supply are both permeable and porous. For drinking water aquifers, the water must also be **potable.**Since groundwater is used for drinking purpose it should be of good quality and free from any harmful substances. Therefore, the chemical composition of groundwater is vital parameter to be understood.

The composition of ground water varies from place to place as it depends majorly on the type of rock or sediment representing the aquifer. The chemical composition also depends upon the frequency of rain which will leach out the salts and that will mix with the groundwater, time of stay of rain water, presence of organic matter etc. The movement of percolating water through larger pores is much more rapid than through the finer pores. All these factors combined effects the composition of ground water and results in its variation from time to time and from place to place. The percolating water reacts with oxygen and carbon dioxide before going in to saturated stage. The CO_2 associated with the percolating water gets gradually exhausted through interaction of water bearing minerals.

$$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3$$

The oxygen that is present in this water is utilised for the oxidation of organic matter and this generates CO_2 to form H_2CO_3. This process goes on until oxygen is fully consumed of organic matter is decayed.

$$CH_2O + O_2 = CO_2 + H_2O \text{ (Organic matter)}$$

For example, the bicarbonate present in most waters is derived mostly from CO_2 that has been extracted from the air and liberated in the soil through biochemical activity. Some rocks serve as sources of chloride sulphate, iron etc. through direct solution.

Apart from these reactions, there are several other reactions including microbiological reactions, which tend to alter the chemical composition of the percolating water.

CHAPTER-3

WATER QUALITY

3.1 WATER QUALITY CRITERIA

The water has excellent property to absorb substances in soluble forms from land resource, the biological processes and from human activities. The rapid urbanization, agricultural development (increase in usage of insecticides, fertilizers etc.) and discharges of municipal and industrial waste into the water resources significantly alter its attributes. The climatic change, topography, geological formations and use and abuse of this vital resource have significant effect on the characteristic of the water, because of which its quality varies with locations. The constant growing demand for potable water for human civilisation has encouraged in assessing its physico-chemical and biological attributes of water. The characteristic of water required for human consumption, livestock, irrigation, industries etc., have different quality parameters and are analysed separately based on the requirement of water. The term water quality criteria may be defined as the "Scientific data evaluated to derive recommendations for characteristics of water for specific use". The term `standard' applies to any definite rule, principle or measure established by any statutory Authority. The distinction between criteria and standards is important, as the two are neither interchangeable nor they become synonyms for the objective or goal. Realistic standards are dependents on criteria, designated uses and implementation as well as identification and monitoring procedure. The changes in all these factors may provide a basis for alteration in standards. In formulation of water quality criteria, the selection of water quality parameters depends on its end use. Sayers *et.al.* (1976) identified the key water quality parameters according to its various uses (Table 3.1.1).

Table 3.1.1: Water quality criteria parameters for various uses (Sayers et. al., 1976)

Public Water supply	Industrial Water supply	Agricultural water supply	Aquatic life & wild life water supply	Recreation and Aesthetics
Coliform bacteria Turbidity colour, Taste, Odour TDS,CI, F, SO_4 NO_3, CN, Trace Metals, Trace Organics Radioactive substances	**Processing** pH, Turbidity Colour, Alkalinity, Acidity, TDS, Suspended solids, Trace metals, Trace Organics **Cooling** PH, Temp, Silica, AI, Fe, Mg, Total hardness, Alkalinity / Acidity Suspended solids, Salinity	Farmstead Same as for public supply Live-stock Same as for public supply Irrigation TDS, EC, Na, Ca, Mg, K, B, CI and Trace metals	Temp, DO, pH, Alkalinity, Acidity, TDS Salinity, pH, DCOs, Turbidity Colour, Settleable materials, Toxic substances, Nutrients, Floating materials	Recreations Tem, Turbidity, Colour, Odour, Floating Materials, Settable Materials Nutrients, Coliforms Aesthetics Same as for Recreation and Substances adversely affecting wild life

3.2 WATER QUALITY CRITERA FOR DRINKING PURPOSE

To safeguard the water from degradation and to establish a basis for improvement in water quality, different standards/guidelines/regulations have been laid down by various national and international organisations such as; Bureau of Indian Standards (BIS), World Health Organisation (WHO), European Economic Community (EEC), Environmental Protection Agency (EPA), United States, and Inland Waters Directorate, Canada. The Bureau of Indian Standards has laid down the standard specification for drinking water during 1983, which has been revised and updated from time to time. In order to enable the users, exercise their discretion towards water quality criteria, the maximum permissible limit has been prescribed especially where no alternative, sources are available. These national water quality standards describe essential and desirable characteristics required to be evaluated to assess suitability of water for drinking purposes. The important water quality characteristics as laid down in BIS standard (IS-10500) are summarized in Table 3.2.1

Table 3.2.1 Drinking water characteristics (IS:10500:2012)

S. No.	Parameters	Acceptable limits mg/l	Permissible limits mg/l(in absence of any other source)
Essential Characteristics			
1.	Colour Hazen unit	5	15
2.	Odour	Agreeable	Agreeable
3.	Taste	Agreeable	Agreeable
4.	Turbidity (NTU)	1	5
5.	pH	6.5 - 8.5	No relaxation
6.	Total Hardness as $CaCO_3$ mg/L	200	600
7.	Iron (Fe)	1.0	No relaxation
8.	Chloride (Cl)	250	1000
9.	Residual Free Chlorine, Minimum	0.2	-
10.	Fluoride (F)	1.0	1.5
Desirable Characteristics			
11.	Total Dissolved Solids	500	2000
12.	Calcium (Ca)	75	200
13.	Magnesium (Mg)	30	100
14.	Copper (Cu)	0.05	1.5
15.	Manganese (Mn)	0.1	0.3
16.	Sulphate (SO_4)	200	400

17.	Nitrate (NO_3)	45	No relaxation
18.	Phenolic Compounds	0.001	0.002
19.	Mercury (Hg)	0.001	No relaxation
20.	Cadmium (Cd)	0.003	No relaxation
21.	Selenium (Se)	0.01	No relaxation
22.	Arsenic (As)	0.01	0.05
23.	Cyanide (CN)	0.05	No relaxation
24.	Lead (Pb)	0.05	No relaxation
25.	Zinc (Zn)	5.0	15
26.	Hexavelant Chromium	0.05	no relaxation
27.	Alkalinity	200	600
28.	Aluminium (Al)	0.03	0.2
29.	Boron (B)	1.0	5.0
30.	Pesticides	Absent	0.001

NTU- Nephelometric Turbidity Unit

3.3 BACTERIOLOGICAL STANDARDS

The coliform group of bacteria such as *E. coli* is the principal indicator of suitability of a water for its potability and other uses. The density of coliform group bacteria is the criterion for the degree of contamination and has been the basis for bacteriological water quality standard. In ideal situation all the samples taken from the distribution system should be free from coliform organisms but in practice, it is not attainable always and therefore, following standard for water has been recommended by Bureau of Indian Standard (IS-10500:2012).

Table 3.3.1 Bacteriological Standards as per BIS 10500: 2012

Sl No.	Organisms	Requirements
1	All water intended for drinking: a) E. coli or thermotolerant coliform bacteria	Shall not be detectable in any 100 ml sample
2	Treated water entering the distribution system: a) E. coli or thermotolerant coliform bacteria b) Total coliform bacteria	Shall not be detectable in any 100 ml sample
3	Treated water in the distribution system: a) E. coli or thermotolerant coliform bacteria b) Total coliform bacteria	Shall not be detectable in any 100 ml sample

However, for bacteriological attributes, the objectives should be to reduce the coliform count to less than 10 per 100 ml and more importantly the absence of faecal coliforms should be ensured which cause many diseases.

If the bacteriological presence is detected in water, then as per BIS, immediate investigative action must be taken if either E. Coli or Total coliform bacteria are detected. The minimum action in the case of Total coliform bacteria is repeat sampling; if these bacteria detected in the repeat sample, the cause must be determined by immediate further investigation. Although E. Coli is the more precise indicator of faecal pollution, the count of thermo-tolerant, coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of the water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies. It is recognized that, in the great majority of rural water supplies in developing countries, faecal contamination is widespread. Under these conditions, the national surveillance agency should set medium-term targets for the progressive improvement of water supplies

3.4 WATER QUALITY CRITERIA FOR IRRIGATION PURPOSE

The characteristic of water plays a vital role in agriculture. Many problems arise during inefficient management of water for agriculture purpose especially, when it carries high salt loads. The effect of total dissolved salts in irrigation water measured in terms of electrical conductance on crop growth is extremely important. The most damaging effects of poor-quality irrigation water are excessive accumulation of soluble salts and/or sodium in soil. High soluble salts in the soil make soil moisture more difficult for plants to extract, and crops become water stressed even when the soil is moist. When excessive sodium accumulates in the soil, it causes clay and humus particles to float into and plug up large soil pores. This plugging action reduces water movement into and through the soil, thus crop roots do not get enough water even though water may be standing on the soil surfaceThe safe limits of electrical conductivity for crops of different degrees of salt tolerances under varying soil textures and drainage conditions are presented in Table 3.4.1.

In addition to Salinity, sodicity and ion toxicity are major problems in irrigation waters. In arid areas, where rainfall does not adequately leach salts from the soil, an accumulation of salts will occur in the crop's root-zone. Thus, periodic testing of soils and waters is required to monitor any change in salt content. Sodicity, the presence of excess sodium, will result in a deterioration of the soil structure, thereby reducing water penetration into and through the soil. Toxicity refers to the critical concentration of some salts such as chloride, boron, sodium and some trace elements, above which plant growth is adversely affected by those salts.

In addition to problems caused by total amount of salts, some of the specific ions like sodium, boron and trace elements, if present in water in excess, also render it unsuitable for agricultural use.

Table 3.4.1 Safe limits for Electrical conductivity (EC) for irrigation water

Sl. No.	Nature of soil	Crop growth	Upper permissible safe limit of EC µmhos/cm at 25°C
1.	Deep black soil and alluvial soils having clay content more than 30% soils that are faily to moderately well drained.	Semi-tolerant	1500
		Tolerant	2000
2.	Having textured soils having clay contents of 20-30% soils that are well drained internally and have good surface drainage system.	Semi-tolerant	2000
		Tolerant	4000
3.	Medium textured soils having clay 10-20% internally very well drained and having good surface drainage system.	Semi-tolerant	4000
		Tolerant	6000
4.	Light textured soils having clay less than 10% soil that have excellent internally and surface drainage system.	Semi-tolerant	6000
		Tolerant	8000

Sodium Adsorption Ratio

The sodium hazard of irrigation water is expressed as the 'sodium adsorption ratio (SAR)'. Although sodium contributes directly to the total salinity and may also be toxic to sensitive crops, such as fruit trees, the main problem with a high sodium concentration is its effect on the physical properties of soil (soil structure degradation).

The clay minerals in the soil adsorb divalent cations, like calcium and magnesium ions from irrigation water. Whenever the exchange sites in clay are filled by divalent cations, the soil texture is conducive for plant growth. Sodium reacts with soil to reduce its permeability. In case, the irrigation water is sodium dominant, the clay lattice is filled with sodium ions due to ion-exchange. Such soils becomes impermeable, and sticky and as such the cultivation becomes difficult to support plant growth. However, the cation exchange process is reversible and can be controlled either by adjusting the composition of water or by soil amendment by application of gypsum, which releases cations (Calcium) to occupy exchange position. The tendency of water to replace absorbed calcium and magnesium with sodium can be expressed by the Sodium Adsorption Ratio (SAR), where all the ion concentration/s are in milli-equivalents per litre (meq/l).

$$SAR = \frac{Na}{\sqrt{\frac{Ca^{+2}+Mg^{+2})}{2}}}$$

Residual Sodium Carbonate

When total carbonate levels exceed the total amount of calcium and magnesium, the water quality may be diminished. When the excess carbonate (residual) concentration becomes too high, the carbonates combine with calcium and magnesium to form a solid material (scale) which settles out of the water. The end result is an increase in both the sodium percentage and SAR. The USDA has established guidelines for modifying water quality classifications based on residual sodium carbonate (RSC) expressed in units of milliequivalent (meq). Residual carbonate levels less than 1.25

meq are considered safe. Waters with RSC of 1.25-2.50 meq are within the marginal range. These waters should be used with good irrigation management techniques and soil salinity monitored by laboratory analysis. Risk is lowest with waters for which the RSC is at the low end of the range and which are being applied to permeable, well-drained, coarse-textured soils in high rainfall areas. RSC values of 2.50 meq or greater are considered too high making the water unsuitable for irrigation use. Modification of RSC by soil applied gypsum may permit use of waters with RSC values above the safe level. It is expressed as:

$$RSC\ (meq/l) = (CO_3 + HCO_3) - (Ca + Mg)$$

(Where all the ions' concentrations are in milli equivalents/litre)

The quality of water is commonly expressed by classes of relative suitability for irrigation with reference to salinity levels. The recommended classification with respect to Electrical Conductivity, Sodium content, Sodium Absorption Ratio, and residual sodium carbonate, under customary irrigation conditions has been depicted in Table 3.4.2.

Table 3.4.2 Guidelines for evaluation of quality of irrigation water

Water class	Sodium (Na) %	Electrical conductivity µmhos/cm at 25⁰C	Alkalinity hazards	
			SAR	RSC (meq/l)
Excellent	< 20	< 250	< 10	< 1.25
Good	20 - 40	250 - 750	10 - 18	1.25 - 2.0
Medium	40 - 60	750 - 2250	18 - 26	2.0 - 2.5
Bad	60 - 80	2250 - 4000	> 26	2.5 - 3.0
Bad	> 80	> Very 4000	> 26	> 3.0

3.5 EFFECTS OF WATER QUALITY PARAMETERS ON HUMAN HEALTH AND DISTRIBUTION FOR VARIOUS USERS

It is essential to ensure that various constituents are within prescribed limits in drinking water supplies to avoid impact on human health (Table 3.5.1). The living organisms are affected by alteration in water quality due to natural or anthropogenic reasons. The effect of these substances depends on the quantity of water consumed per day and their concentration in water.

Table 3.5.1 Effects of water quality parameters for drinking purposes

S. No.	Parameters	Prescribed limits IS:10500, 2012		Probable effects
		Desirable limit	Permissible limit	
1.	Colour (Hazen unit)	5	15	Makes water aesthetically undesirable.
2.	Odour	Agreeable		Makes water aesthetically undesirable.
3.	Taste	Agreeable		Makes water aesthetically undesirable.
4.	Turbidity (NTU)	1	5	High turbidity indicates contamination/Pollution.
5.	pH	6.5-8.5	No Relaxation	Indicative of acidic or alkaline waters, affects taste, corrosivity and the water supply system.
6.	Hardness as $CaCO_3$ (mg/l)	200	600	Affects water supply system (Scaling), Excessive soap consumption, calcification of arteries. There is no conclusive proof but it may cause urinary concretions, diseases of kidney or bladder and stomach disorder.

7.	Iron (mg/l)	0.3	No Relaxation	Gives bitter sweet astringent taste, causes staining of laundry and porcelain. In traces it is essential for nutrition.
8.	Chloride (mg/l)	250	1000	May be injurious to some people suffering from diseases of heart or kidneys. Taste, indigestion, corrosion and palatability are affected.
9.	Residual Chlorine (mg/l) Only when water is Chlorinated	0.20	1	Excessive chlorination of drinking water may cause asthma, colitis and eczema.
10.	Total Dissolved Solids (mg/l) (TDS)	500	2000	Palatability decreases and may cause gastro-intestinal irritation in human, may have laxative effect particularly upon transits and corrosion, may damage water system.
11.	Calcium (Ca) (mg/l)	75	200	Causes encrustation in water supply system. While insufficiency causes a severe type of rickets, excess causes concretions in the body such as kidney or bladder stones and irritation in urinary passages. (Essential for nervous and muscular system, cardiac functions and in coagulation of blood.)
12.	Mg (mg/l)	30	100	Its salts are cathartics and diuretic. High conc. may have laxative effect particularly on new users. Magnesium deficiency is associated with structural

				and functional changes. It is essential as an activator of many enzyme systems.
13.	Cu (mg/l)	0.05	1.50	Astringent taste but essential and beneficial element in human metabolism. Deficiency results in nutritional anaemia in infants. Large amount may result in liver damage, cause central nervous system irritation and depression. In water supply it enhance corrosion of aluminium in particular.
14.	SO_4 (mg/l)	200	400	Causes gastro intestinal irritation Along with Mg or Na, can have a cathartic effect on users, concentration more than 750 mg/l may have laxative effect alongwith Magnesium.
15.	NO_3 (mg/l)	45	No Relaxation	Cause infant methaemoglobinaemia (blue babies) at very high concentration, causes gastric cancer and affects adversely central nervous system and cardiovascular system.
16.	F (mg/l)	1.0	1.50	Reduces dental carries, very high concentration may cause crippling skeletal fluorosis.
17	Cd (mg/l)	0.003	No Relaxation	Acute toxicity may be associated with renal, arterial hypertension, itai-itai disease, (a bone disease). Cadmium salt causes cramps, nausea, vomiting and diarrhoea.

18.	Lead (Pb) mg/l	0.01	No Relaxation	Toxic in both acute and chronic exposures. Burning in the mouth, severe inflammation of the gastro-intestinal tract with vomiting and diarrhoea, chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anaemia etc.
19.	Zinc (Zn) mg/l	5	15	An essential and beneficial element in human metabolism. Taste threshold for Zn occurs at about 5 mg/l, imparts astringent taste to water.
20.	Chromium (Cr^{+6}) mg/l	0.05	No Relaxation	Hexavelant state of Chromium produces lung tumours can produce cutaneous and nasal mucous membrane ulcers and dermatitis.
21.	Boron (B) mg/l	0.5	1.00	Affects central nervous system its salt may cause nausea, cramps, convulsions, coma etc.
22.	Alkalinity mg/l $CaCO_3$	200	600	Impart distinctly unpleasant taste may be deleterious to human being in presence of high pH, hardness and total dissolved solids.
23.	Pesticides µg/l	Absent	0.001	Imparts toxicity and accumulated in different organs of human body affecting immune and nervous systems may be carcinogenic.
24.	Phosphate (PO_4) mg/l	No guideline		High concentration may cause vomiting and diarrhoea, stimulate secondary

				hyperthyroidism and bone loss.
25.	Sodium (Na)	No guideline		Harmful to persons suffering from cardiac, renal and circulatory diseases.
26.	Potassium (K) mg/l	No guideline		An essential nutritional element but its excessive amounts are cathartic.
27.	Silica (SiO_2) mg/l	No guideline		-
28.	Nickel (Ni) mg/l	No guideline		Non-toxic element but may be carcinogenic in animals can react with DNA resulting in DNA damage in animals.
29.	Pathogens (a) Total coliform (per 100 ml) (b) Faecal Coliform (per 100 ml)	Absent	-	Cause water borne diseases like coliform Jaundice, Typhoid, cholera etc. produce infections involving skin mucous membrane of eyes, ears and throat.

Chapter- 4

4.1 GROUND WATER QUALITY MONITORING

For ensuring the water is potable for general requirement ground water quality monitoring is essential. The programmed process of samplings, measurements and subsequent recording or signalling or both, of various water characteristics, often with the aim of assessing, conformity to specified objectives is termed as Monitoring. It includes monitoring network design, preliminary survey, resource estimation, sampling, analysis, data management & reporting. Monitoring of ground water quality is an endeavour to derive the information on chemical quality through representative sampling in different hydro geological units.

Ground Water is commonly tapped from dugwells in a major part of the country and through springs and hand pumps in hilly areas. The main goal of ground water quality monitoring programme is to get data and information about the distribution of water quality on a regional scale as well as create a background data bank of different chemical constituents in ground water. Central Ground Water Board has been monitoring the chemical quality of ground water in the country since 1974. The chemical quality of shallow ground water is being monitored by Central Ground Water Board once in a year (May/June) through a network of thousands of observation wells located across the country.

Central Ground Water Board monitors the ground water quality in the UT of J & K in the month of May/June of every year. Apart from this, different ground water quality studies are being taken up as part of ground water management studies. Special studies are also being taken up for pollution studies in parts of the UT. A total of 546 (273 for Basic and 273 for Uranium analysis) water samples from shallow aquifer system for the year 2022 were collected. Data was interpreted for preparation of this report. Details of the locations of the Shallow wells is shown in figure 4.1.1

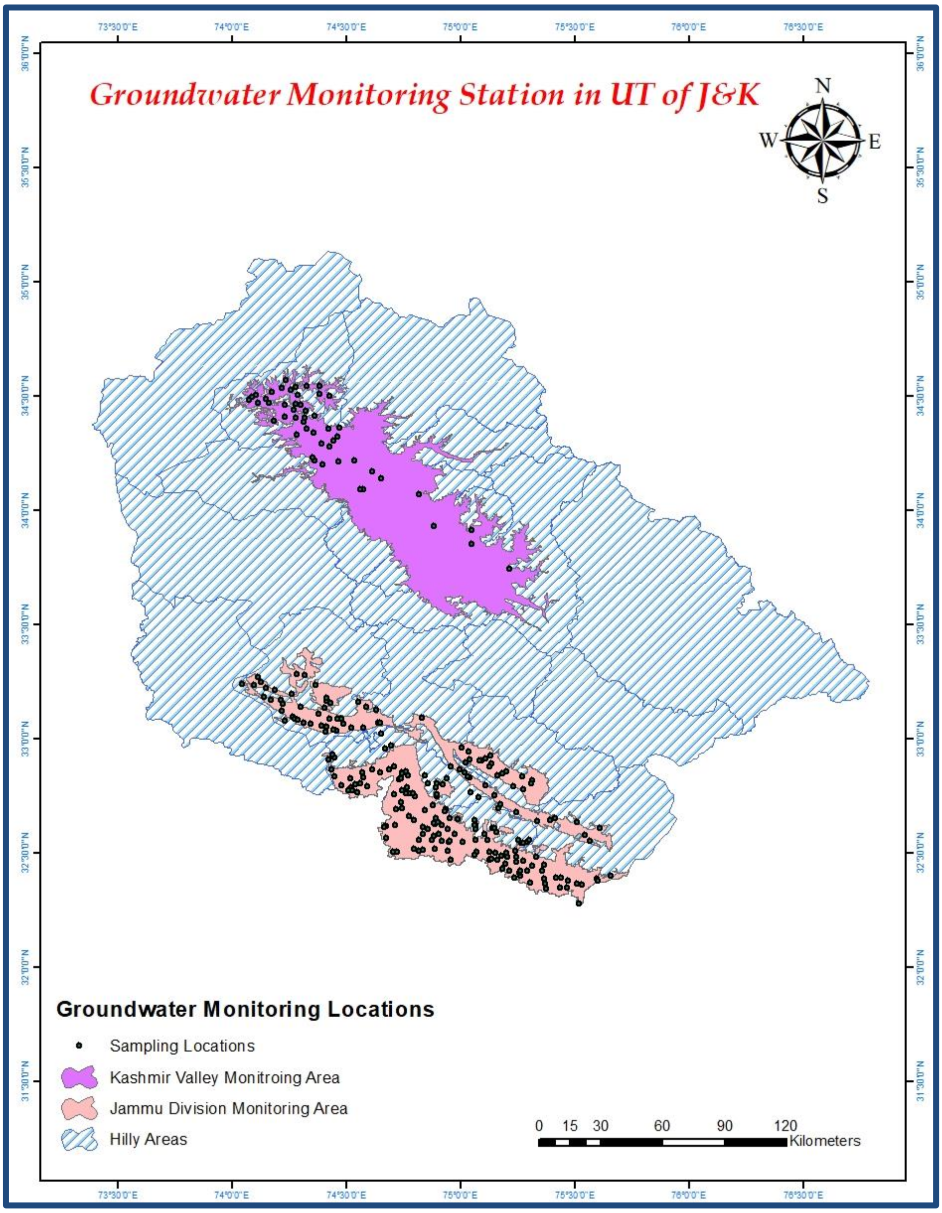

Figure 4.1.1 Sampling Locations of the shallow aquifer wells in the Jammu and Kashmir UT

4.2 General Water Quality of Jammu and Kashmir

Jammu and Kashmir UT is a predominantly hilly state with scattered settlement pattern. Ground water development is still in initial stage and issues related to large scale ground water over-exploitation and pollution are not of much concern at this level. But there are problems of ground water contamination which is mostly geo-genic like fluoride contamination in localized area, marshy gasses in ground water and to some extent nitrate and pesticides contamination due to use of fertilizers in agriculture/horticulture is reported from different parts of the UT by different studies carried out by UT government and central government agencies. There are few studies where ground water pollution is observed in fast developing urban and industrial areas. There is lack of proper sewage and sanitation in the state resulting into ground water and surface water contaminations. The undesirable change occurring in physical, physiological, chemical and biological characteristics of natural waters, directly or indirectly as the result of human activities, leads to water pollution and making less useful and harmful affecting human life, affecting the water resources and ultimately the living conditions of desirable biotic species. In this chapter an attempt has been made to summarize the data on ground water pollution, both anthropogenic and geo-genic with a view to give proper remedial measures.

The summarized results of groundwater quality ranges are given in **Table – 4.2.1**

Table 4.2.1 Ground Water Quality during May 2022

S. No.	Parameters	Samples Analyzed	Permissible limit	Ranges	No. of Samples	Percentage %
1	Electrical Conductivity µs/cm at 25^{o}C	273	3000 µs/cm	<750	161	59
				750-2000	109	40
				2000-3000	3	1
				>3000	0	0

2	Chloride (mg/l)	273	1000 mg/l	<250 250-1000 >1000	272 1 00	99.6 0.003 0
3	Fluoride (mg/l)	273	1.50 mg/l	<1.50 >1.50	271 2	99.3 0.7
4	Nitrate (mg/l)	273	45 mg/l	<45 >45	245 28	89.7 10.3

4.3 District wise Water quality of Jammu Kashmir UT:

District Jammu

76 numbers of Chemical samples were collected from different locations to determine the chemical quality of water in the district. The samples were analysed for numerous parameters including Uranium. The chemical data of the district is interpreted below for drinking and irrigation purpose. From the interpretation of the data the chemical quality based on the value of TDS is good and potable for human consumption. Although 10.50% samples have nitrate concentration greater than the permissible limit (45 mg/l).

Table 4.3.1: General range of water quality parameters in the Jammu district

Parameter	Max	Min	Avg.
pH	**7.9**	6.63	**7.15**
EC (µs/cm) at 25° C	1890	210	798
TDS	1172	130.2	494.80
CO3 (mg/l)	0	0	0
HCO3 (mg/l)	815	122	416
Cl (mg/l)	94.70	0	21.66
NO3 (mg/l)	167.80	1.90	21.75

F (mg/l)	1.16	0	0.30
SO4 mg/l	194.4	5.10	36.24
PO4 (mg/l)	2.13	0	0.098
Ca (mg/l)	249.70	28.20	70.6
Mg (mg/l)	81.70	3.60	27.63
Na (mg/l)	115	0.13	26.54
K (mg/l)	186	0	12.13
Total Hardness as CaCO3 (mg/l)	856	118.60	367.93
U (µg/l)	26.10	0	3.74
RSC	3.48	-6.43	-0.52
SAR	2.25	0.003	0.57

Electrical conductivity

Analytical data reveals that samples collected from different monitoring station of Jammu district is low mineralised. It ranges from 210 micro mhos/cm (Upper Ban) to 1890 micro mhos/cm (Bishnah). All the samples collected from the area are having Electrical conductivity value less than 2000 micro mhos /cm.

Chloride

The concentration of chloride in ground water varies from 0 mg/l to 94.70 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Jammu district ranges from 1.90 to 168 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 10 samples out of 76 samples (10.50%) are greater than the permissible limit of 45 mg/l.

Fluoride

Fluoride is an important water quality parameter for accessing the water quality for drinking purpose. In ground water of Jammu district, it ranges from traces to 1.16 mg/l.

Sulphate

Water samples collected from Jammu district, sulphate value ranges from 5.10 to 194.40 mg/l. All the samples are well below the permissible limit for sulphate in ground water (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Jammu district have Calcium concentration ranging from 28.20 mg/l to 249.70 mg/l. Only one sample has calcium concentration above 200 mg/l.

Magnesium

It is observed that the concentration of Magnesium varies from 3.60 mg/l to 81.70 mg/l in Jammu district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l.

Sodium

Sodium is also important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 0.13 mg/l to 115 mg/l in Jammu district. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Jammu ranges from traces to 186 mg/l. For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 118.60 mg/l to 856 mg/l.

District Samba:

The chemical data of 33 number of water samples of Samba district were processed for interpretation. The water quality of Samba district is generally good, however rapid industrialisation and urbanisation can lead to deterioration in the water quality. The district has highest value of Nitrate in Jammu Division. The range of various water quality parameters are shown in the following table.

Table 4.3.2: **General range of water quality parameters in the Samba district**

Parameter	Max	Min	Avg
pH	7.39	6.60	7.02
EC (µs/cm) at 25° C	2200	340	903
TDS	1364	211	560
CO3 (mg/l)	0	0	0
HCO3 (mg/l)	790	187	425.90
Cl (mg/l)	213.20	0.32	37.39
NO3 (mg/l)	397.80	2.80	51
F (mg/l)	1.60	0.14	0.39
SO4 mg/l	154	6.80	38.53
PO4 (mg/l)	3.80	0.00	0.26
Ca (mg/l)	235	58	109.54
Mg (mg/l)	113	4.74	29.54
Na (mg/l)	165	2.46	38.85
K (mg/l)	54.70	0	9.72
Total Hardness as CaCO3 (mg/l)	998.50	168.50	394.26
U (µg/l)	15.60	0.00	3.84
RSC	4.39	-10.49	-0.87
SAR	3.84	0.07	0.85

Electrical conductivity

Analytical data reveals that samples collected from different monitoring station of Samba district is low mineralised. It ranges from 340 micro mhos/cm to 2200 micro mhos/cm (Mothian Kalan). The average value is 903 µs/cm.

Chloride

The concentration of chloride in ground water varies from 0.32 mg/l to 213.20 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Samba district ranges from 2.8 mg/l to 397.8 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 08 samples out of 33 (24%) are greater than the permissible limit of 45 mg/l and also average value is 51 mg/l which is an alarming situation. This District reports the highest value of Nitrate in whole of Jammu division.

Fluoride

Fluoride is an important water quality parameter for accessing the water quality for drinking purpose. In ground water of Samba district, it ranges from 0 mg/l to 1.60 mg/l. Except one place (Dhora), all the samples have concentration well below the acceptable limit of 1.5 mg/l by BIS.

Sulphate

Water samples collected from Samba district, sulphate value ranges from 6.8 to 154 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Samba district have Calcium concentration ranging from 58 mg/l to 235 mg/l. All the samples are well below the permissible limit of 200 mg/l by BIS except one sample.

Magnesium

It is observed that the concentration of Magnesium varies from 4.74 mg/l to 113 mg/l in Samba district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. Except one place (Gho-Brahmana), all the samples are under the permissible limit.

Sodium

Sodium is also important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 2.46 mg/l to 165 mg/l in Samba district. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Samba ranges from traces to 54.70 mg/l. For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 168.50 mg/l to 998.50 mg/l.

District Kathua

The quality of Kathua district interpretated on observation of chemical quality data of 47 locations of the district. The district has maximum electrical conductivity value of 2400 µs/cm which is highest in Jammu Division. The minimum and maximum values of water quality parameters are shown in the following table.

Table 4.3.4: **General range of water quality parameters in the Kathua district**

Parameter	Max	Min	Avg
pH	7.61	6.53	7.07
EC (µs/cm) at 25° C	2400	250	702
TDS	1488	155	435.60
CO_3 (mg/l)	0	0	0
HCO_3 (mg/l)	971	112	349
Cl (mg/l)	326	0	31.08

NO3 (mg/l)	313.80	2.30	27.56
F (mg/l)	1.71	0.11	0.33
SO4 mg/l	197.10	6.58	35.60
PO4 (mg/l)	0.47	0.00	0.022
Ca (mg/l)	240	23	81.91
Mg (mg/l)	139	2.70	23.36
Na (mg/l)	212	3.80	36.06
K (mg/l)	227.60	0.30	13.04
Total Hardness as CaCO3 (mg/l)	943	101	297.08
U (µg/l)	12.13	0.00	2.25
RSC	8.75	-9.98	-0.18
SAR	3.66	0.14	0.79

Electrical conductivity

It ranges from 250 micro mhos/cm to 2400 micro mhos/cm (Chakara). All the samples collected from the area is having Electrical conductivity value less than 2000 micro mhos /cm except one sample which has highest value in Jammu division.

Chloride

The concentration of chloride in ground water varies from traces mg/l to 326 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS except one location which also have highest EC value.

Nitrate

Nitrate concentration in ground water of Kathua district ranges from 2.3 mg/l to 313.80 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 3 samples out of 47 samples (6.4%) are greater than the permissible limit of 45 mg/l.

Fluoride

Fluoride is an important water quality parameter for accessing the water quality for drinking purpose. In ground water of Kathua district, it ranges from 0.11 to 1.71 mg/l (Londi). This is the highest value of fluoride in Jammu division.

Sulphate

Water samples collected from Kathua district, sulphate value ranges from 6.58 to 197.10 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Kathua district have Calcium concentration ranging from 23 mg/l to 240 mg/l. The highest value is observed at same location where EC is high. Except this location, all other have values within the permissible limit of 200mg/l.

Magnesium

It is observed that the concentration of Magnesium varies from 2.70 mg/l to 139 mg/l in Kathua district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. Except one place , all the samples are under the permissible limit.

Sodium

Sodium is also important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 3.80 mg/l to 212 mg/l in Kathua district. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Kathua ranges from 0.30 mg/l to 227.60 mg/l. For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 101 mg/l to 943 mg/l.

District Udhampur:

The chemical data of 22 number of water samples of Udhampur district were processed for interpretation. Overall water quality of Udhampur district is safe for drinking and irrigation purpose based on TDS value. Only one location Rakh Badali have nitrate concentration (67.2 mg/l) greater than permissible limit (45 mg/l). The range of various water quality parameters are shown in the following table

Table 4.3.4: General range of water quality parameters in the Udhampur district:

Parameter	Max	Min	Avg
pH	7.64	6.51	7.09
EC (µs/cm) at 25° C	860	300	598
TDS	533	186	371
CO3 (mg/l)	0.00	0.00	0.00
HCO3 (mg/l)	488	122	319
Cl (mg/l)	63.90	7.70	22.33
NO3 (mg/l)	67.20	2.34	16.03
F (mg/l)	0.69	0.09	0.21
SO4 mg/l	82.80	8.50	22.93
PO4 (mg/l)	0.23	0.00	0.025
Ca (mg/l)	145	36.80	90.45
Mg (mg/l)	21	7	14.66
Na (mg/l)	71.80	4.90	21.13

K (mg/l)	5.2	0	0.59
Total Hardness as CaCO3 (mg/l)	448	151	287.80
U (µg/l)	5.90	0.00	1.88
RSC	2.04	-2.32	-0.45
SAR	1.93	0.15	0.55

Electrical conductivity

Analytical data reveals that samples collected from different monitoring station of Udhampur district is low mineralised. It ranges from 300 micro mhos/cm (Jhakkar) to 860 micro mhos/cm (Garhi) All the samples collected from the area are having Electrical conductivity value less than 2000 micro mhos /cm.

Chloride

The concentration of chloride in ground water varies from 7.70 mg/l to 63.90 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Udhampur district ranges from 2.34 mg/l to 67.20 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 1 sample out of 22 samples (4.5%) is greater than the permissible limit of 45 mg/l.

Fluoride

Fluoride is a important water quality parameter for accessing the water quality for drinking purpose. In ground water of Udhampur district, it ranges from 0.09 to 0.69 mg/l All the locations are within the permissible limit of Fluoride in ground water (1.5 mg/l)

Sulphate

In water samples collected from Udhampur district, sulphate value ranges from 8.50 to 82.80 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Udhampur district have Calcium concentration ranging from 36.8 mg/l to 145 mg/l. All the samples are well below the permissible limit of 200 mg/l by BIS.

Magnesium

It is observed that the concentration of Magnesium varies from 07 mg/l to 21 mg/l in Udhampur district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. All the samples are under the permissible limit.

Sodium

Sodium is also important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 4.90 mg/l to 71.80 mg/l in Udhampur district. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Udhampur ranges from traces to 21 mg/l . For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 151 mg/l to 448 mg/l.

District Reasi:

The composition of hydrochemical faces is safe and good for all purposes in the district of Reasi. The chemical data of 8 number of water samples of Reasi district were processed for interpretation. The range of various water quality parameters are shown in the following table

Table 4.3.5 General range of water quality parameters in the Reasi district

Parameter	Max	Min	Avg
pH	7.43	6.92	7.11
EC (µs/cm) at 250 C	1230	640	824
TDS	763	397	511
CO3 (mg/l)	0.00	0.00	0.00
HCO3 (mg/l)	580	390	473.80
Cl (mg/l)	73.80	4.90	25.44
NO3 (mg/l)	80.90	2.10	22.42
F (mg/l)	0.26	0.12	0.19
SO4 mg/l	47.50	7.30	21.14
PO4 (mg/l)	0.65	0.00	--
Ca (mg/l)	194.50	91.40	133.11
Mg (mg/l)	39.80	17.20	21.36
Na (mg/l)	72	1.90	21.36
K (mg/l)	1	0	0.32
Total Hardness as CaCO3 (mg/l)	560	339	426.42
U (µg/l)	13.8	0.75	4.71
RSC	0.08	-1.70	-0.71
SAR	1.32	0.038	0.41

Electrical conductivity

Analytical data reveals that samples collected from different monitoring station of Reasi district is low mineralised. It ranges from 640 micro mhos/cm (Dhannu canal) to 1230 micro mhos/cm (Bhmbla). All the samples collected from the area are having Electrical conductivity value less than 2000 micro mhos /cm.

Chloride

The concentration of chloride in ground water varies from 4.90 mg/l to 73.80 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Reasi district ranges from 2.10 mg/l to 80.90 mg/l. BIS limit for nitrate in ground water is 45 mg/l. Thus one sample show high nitrate values

Fluoride

In ground water of Reasi district, it ranges from 0.12 to 0.26 mg/l. All the samples have concentration well below the limit of 1.5 mg/l by BIS.

Sulphate

Water samples collected from Reasi district analysed for sulphate ranges from 7.30 to 47.50 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Reasi district have Calcium concentration ranging from 91.40 mg/l to 194.50 mg/l. All the samples are well below the permissible limit of 200 mg/l by BIS.

Magnesium

It is observed that the concentration of Magnesium varies from 17.2 mg/l to 39.80 mg/l in Reasi district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. All the samples are under the permissible limit.

Sodium

Sodium, an important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 1.90 mg/l to 72 mg/l in Reasi district.

Potassium

The concentration of Potassium in ground water of Reasi ranges from nil mg/l to 1.0 mg/l.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In Reasi district, the value of total hardness varies from 339 mg/l to 560 mg/l.

District Rajouri:

38 water samples of Rajouri district were analysed and processed for interpretation. The water quality of entire district is good for all purposes according to the TDS and other parameters. There is nitrate problem in three locations of the district. The highest pH value 8.98 of Jammu division comes from this district. The range of various water quality parameters are shown in the following table:

Table 4.3.6 General range of water quality parameters in the Rajouri district

Parameters	Max	Min	Avg
pH	8.98	6.97	7.28

EC (µs/cm) at 250 C	1540	340	814.50
TDS	955	211	504.99
CO3 (mg/l)	0	27.90	--
HCO3 (mg/l)	490.00	158.00	311.94
Cl (mg/l)	154	5.80	33.23
NO3 (mg/l)	125.70	2.40	21.89
F (mg/l)	1.17	0.136	0.288
SO4 mg/l	103	6.56	28.30
PO4 (mg/l)	0.66	0.00	0.033
Ca (mg/l)	152	19.8	106.98
Mg (mg/l)	71.1	3.75	21.93
Na (mg/l)	233	3.97	39.57
K (mg/l)	7.60	0.10	0.70
Total Hardness as CaCO3 (mg/l)	607	65	356.30
U (µg/l)	18.73	0.00	4.75
RSC	5.82	-3.74	-0.166
SAR	12.56	-2.06	0.11

Electrical conductivity

Analytical data reveals that samples collected from different monitoring station of Rajouri district is low mineralised. It ranges from 340 micro mhos/cm (Nariyan) to 1540 micro mhos/cm (Seri). All the samples collected from the area are having Electrical conductivity value less than 2000 micro mhos /cm.

Chloride

The concentration of chloride in ground water varies from 5.80 mg/l to 154 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Rajouri district ranges from 2.40 mg/l to 125.70 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 03 samples out of 38 samples (7.90%) are greater than the permissible limit of 45 mg/l.

Fluoride

In ground water of Rajouri district, fluoride concentration ranges from 0.136 to 1,.17 mg/l All the samples have concentration well below the acceptable limit of 1.5 mg/l by BIS.

Sulphate

Water samples collected from Rajouri district, sulphate value ranges from 6.56 mg/l to 103 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Rajouri district have Calcium concentration ranging from 19.8 mg/l to 152 mg/l. All the samples are well below the permissible limit of 200 mg/l by BIS.

Magnesium

It is observed that the concentration of Magnesium varies from 3.75 mg/l to 71.1 mg/l in Rajouri district. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. All the samples are under the permissible limit.

Sodium

Sodium is also important parameter for quality of ground water for irrigation purpose. The concentration value of sodium varies from 3.97 mg/l to 233 mg/l in Rajouri district. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Rajouri ranges from 0.10 mg/l to 7.60 mg/l. For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 65 mg/l to 607 mg/l.

Kashmir Valley

Analysed of 22 number of water samples of Kashmir Valley were processed for interpretation. The water quality of entire Kashmir Valley is good for all purposes according to the TDS and other parameters. There is nitrate problem in some areas of the district. The range of various water quality parameters are shown in the following table:

Table 4.3.7 General range of water quality parameters in the Kashmir Valley

Parameter	Max	Min	Avg
pH	7.85	6.27	7.01
EC (µs/cm) at 25˚ C	1520	150	621.70
TDS	942	93	385.40
CO_3 (mg/l)	0	0	0
HCO_3 (mg/l)	579	67	289.70
Cl (mg/l)	179	4.33	40.22
NO_3 (mg/l)	120	2.48	16.43
F (mg/l)	0.46	0.09	0.18
SO_4 mg/l	72	3.20	20.29

PO4 (mg/l)	2.70	0.00	0.16
Ca (mg/l)	193	19.20	82.42
Mg (mg/l)	48	4.10	18.47
Na (mg/l)	68.30	0.96	21.29
K (mg/l)	39	0	2.36
Total Hardness as CaCO3 (mg/l)	680.5	68.5	282.34
U (μg/l)	8.64	0	1.17
RSC	1.40	-4.12	-0.86
SAR	21.61	0.029	0.52

Electrical conductivity

Analytical data of the Kashmir Valley reveals that samples collected from different monitoring station are low mineralised. It ranges from 150 micro mhos/cm to 1520 micro mhos/cm (Lolipora). All the samples collected from the area are having Electrical conductivity value less than 2000 micro mhos /cm.

Chloride

The concentration of chloride in ground water varies from 4.33 mg/l to 179 mg/l. All the samples have concentration well below the acceptable limit of 250 mg/l by BIS.

Nitrate

Nitrate concentration in ground water of Kashmir Valley ranges from 2.48 mg/l to 120 mg/l. BIS limit for nitrate in ground water is 45 mg/l. 4 samples out of 50 samples (8%) are greater than the permissible limit of 45 mg/l.

Fluoride

Fluoride is an important water quality parameter for accessing the water quality for drinking purpose. In ground water of Kashmir Valley, it ranges from 0.09 to 0.46 mg/l. All the samples have concentration well below the acceptable limit of 1.5 mg/l by BIS.

Sulphate

In water samples collected from Kashmir Valley, sulphate value ranges from 3.20 mg/l to 72 mg/l. All the samples have the concentration under the permissible limit (200 mg/l) by BIS.

Calcium

It is observed that samples collected from Kashmir Valley have Calcium concentration ranging from 19.2 mg/l to 193 mg/l. All the samples are well below the permissible limit of 200 mg/l by BIS.

Magnesium

Magnesium concentration in the water samples varies from 4.1 mg/l to 48 mg/l in Kashmir Valley. BIS prescribed permissible limit of magnesium in ground water is 100 mg/l. All the samples are under the permissible limit.

Sodium

Sodium is an important parameter for irrigation water . The concentration value of sodium varies from 0.96 mg/l to 68.3 mg/l in Kashmir Valley. There is no prescribed limit for sodium by BIS.

Potassium

The concentration of Potassium in ground water of Kashmir Valley ranges from 0 mg/l to 39 mg/l. For potassium also, there is no prescribed limit by BIS.

Total Hardness

Hardness of water is the capacity to neutralize soap and is caused by carbonates and bicarbonates of calcium, magnesium. In study area the value of total hardness varies from 68.5 mg/l to 680.5 mg/l.

4.4 Uranium concentration of Jammu & Kashmir UT:

Uranium occurs naturally in groundwater and surface water. Being a radioactive mineral, high uranium concentration can cause impact on water, soil and health. Uranium has both natural and anthropogenic source that could lead to the aquifer. These sources include leaching from natural deposits, release in mill tailings, and emissions from the nuclear industry, combustion of coal and other fuels and the use of phosphate fertilizers that contains uranium and contribute to ground water pollution. Uranium enters in human tissues mainly through drinking water, food, air and other occupational and accidental exposures. Intake of uranium through air and water is normally low, but in circumstances in which uranium is present in a drinking water source, the majority of intake can be through drinking water.

Water with uranium concentration above the recommended maximum permissible concentration of 30 ppb (BIS,10500:2012) is not safe for drinking purposes as it can cause damage to internal organs, on continuous intake. Elevated uranium concentrations in drinking water have been associated with many epidemiological studies such as urinary track cancer as well as kidney toxicity.

Uranium concentration in the shallow ground water varies primarily due to recharge and discharge, which would have dissolved or leached the uranium from the weathered soil to groundwater zone. High uranium concentrations observed in groundwater may be due to local geology, anthropogenic activities, urbanization and use of phosphate fertilizers in huge quantity for agriculture purpose.

To assess the Uranium concentration and distribution in the ground water, Uranium sampling was done in J&K UT. All the samples were having uranium concentration below the permissible limit of 30 ppb prescribed by the World Health Organization and BIS.

4.5 Suitability of ground water for Irrigation:

The chemical quality of water is an important factor to be considered in evaluating its usefulness for irrigation purposes. Plants grown by irrigation absorb and transpire water but leave nearly all the salts behind in the soil, where they accumulate and eventually prevent plant growth. Excessive concentrations of solute interfere with the osmotic process by which plant root membranes are able to assimilate water and nutrients. In areas where natural drainage is inadequate, the irrigation water infiltrating the root zone will cause water table to rise excessively. In addition to problems caused by excessive concentration of dissolved solids, certain constituents in irrigation water are especially undesirable and some may be damaging even when present in small concentrations.

The suitability of ground water for irrigation in generally access considering salinity express as EC, Sodium in relation to Calcium and Magnesium in terms of SAR, sodium in relation to carbonate in terms if RSC. Waters having high values of EC and SAR causes salinity and sodium hazards respectively when used for customary irrigation.

Alkali Hazard

In the irrigation water, it is characterized by absolute and relative concentrations of cations. If the sodium concentrations are high, the alkali hazard is high and if the calcium & magnesium levels are high, this hazard is low. The alkali soils are formed by the accumulation of exchangeable sodium and are characterized by poor tilt and low permeability. The U.S. Salinity laboratory has recommended the use of sodium adsorption ratio (SAR) as it is closely related to adsorption of sodium by the soil.

SAR is derived by the following equation:

$$\boldsymbol{SAR} = \frac{Na^{+}}{\sqrt{\frac{Ca^{2+}Mg^{2+}}{2}}}$$

The water with regard to SAR is classified into four categories

- S_1 – Low Sodium Water (SAR <10)

Such waters can be used on practically all kinds of soils without any risk or increase in exchangeable sodium.

- S_2 – Medium Sodium Water (SAR 10-18)

Such waters may produce an appreciable sodium hazard in fine textured soil having high cation exchange capacity under low leaching.

- S_3 – High Sodium Water (SAR >18-26)

Such waters indicate harmful concentrations of exchangeable sodium in most of the soil and would require special management, good drainage, high leaching and addition of organic matter to the soil. If such waters are used on gypsiferrous soils the exchangeable sodium could not produce harmful effects.

- S_4 – Very High Sodium Waters (SAR >26)

Generally, such waters are unsatisfactory for irrigation purposes except at low or perhaps at medium salinity where the solution of calcium from the soil or addition of gypsum or other amendments makes the use of such waters feasible.

In Jammu & Kashmir UT, average SAR values in groundwater samples is 0.704. Only one sample has SAR value greater than 10, rest all the water samples have value less than 10 indicating that water is S1 class i.e. Low Sodium water.

Residual Sodium Carbonate (RSC)

If the enriched carbonate (residual) concentration becomes relatively high, carbonates get together with calcium and magnesium to form precipitates. The relative abundance of sodium in comparison to alkaline earths and the quantity of bicarbonate and carbonate in excess of alkaline earths also influences the suitability of water for irrigation. This excess is represented in terms of "Residual Sodium Carbonate" (RSC). The highly soluble sodium carbonate known as residual sodium carbonate (RSC) is defined as;

$$\boldsymbol{RSC} = (\boldsymbol{HCO_3^-} + \boldsymbol{CO_3^-}) + (\boldsymbol{Ca^{2+}} + \boldsymbol{Mg^{2+}})$$

Waters with high RSC produces harmful effects on plant development and are not suitable for irrigation. Waters associated with RSC < 1.25 are of excellent irrigation quality and can be safely applied for irrigation for almost all crops without the risks associated with residual sodium carbonate (Wilcox et al.,1954). If the RSC values lie between 1.25 and 2.5, the water is of an acceptable quality for irrigation. Waters associated with RSC values higher than 2.5 are not acceptable for irrigation.

In Ut of J&K, out of 273 samples, 250(91.57%) samples have RSC value less than 1.25 , 09 samples (3.29%) have RSC values between 1.25 and 2.5, and 11 samples (4.03%) have RSC values higher than 2.5. Thus, majority of the groundwater in J&K UT is fir for irrigation purpose.

US Salinity diagram:

Plot of USSL diagram based on EC and SAR, it is observed that ground water in the UT falls under C2S1 and C3S1 classes of irrigation waters. It indicates that most of these waters are suitable for irrigating semi-salt tolerant crops on all soils. Ground water mostly from the of Jammu & Kashmir UT falls under C2S1 and C3S1 classes of irrigation classification.

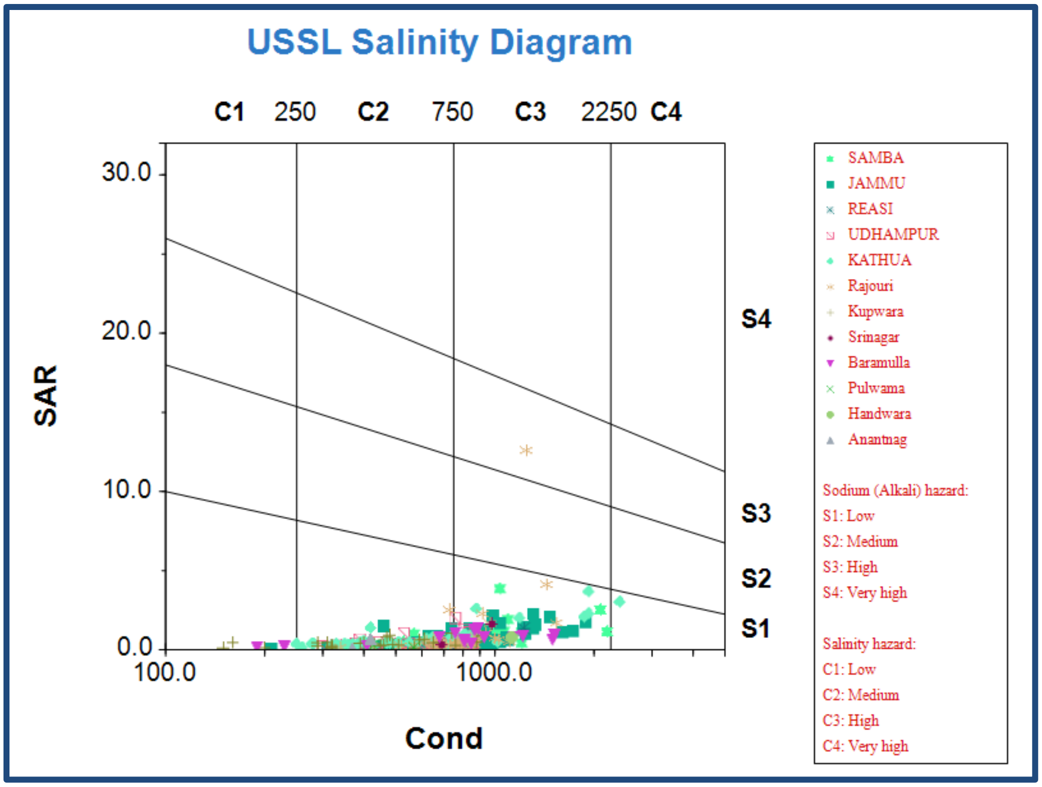

Fig. 4.5.1: USSL Diagram for groundwater samples in UT of J&K

4.6 HYDROCHEMICAL FACIES

Piper diagram (Piper 1944) describes the process responsible for the evolution of hydrogeochemical parameter in groundwater. Based on the major cation and major anion content in the water samples and plotting them in the trilinear diagram, hydrochemical facies could be identified. Hydro-chemical facies are very useful in investigating diagnostic chemical character of water in hydrologic systems. Different types of facies within the same group formations are due to characteristic ground water flow through the aquifer system and effect of local recharge. The types of facies are inter-linked with the geology of the area and distribution of facies with the hydrogeological controls. Hydrochemical facies are delineated by plotting percentage reacting value of major ions on tri-linear diagrams know as Piper Diagram

The hydrochemical facies are utilized to differentiate the chemical characteristics of water in various hydrologic systems. The difference in hydrochemical facies in the same group of formation maybe caused by characteristics ground water flow and dilution effect of local recharge.

In general, the hydrochemical facies at places are influenced by geology of the area and distribution of facies by the hydrogeological controls.

Hydrochemical facies or hydro-chemical zonation for the present study has been carried out by plotting percentage reacting values of major ions in Trillinear diagrams. Trilinear diagram (Hill piper) which adds to the original two triangles is a diamond shaped area in which two points plotted with triangles are projected into diamond and plotted a single point.

The Chemical composition of ground water from dugwell and hand pumps of J&K UT area is mixed facies (Fig. 8). Such as Ca-Mg- HCO_3, Ca-HCO_3, Ca-Mg-Na-HCO_3, Ca- Mg-HCO_3-Cl type. It can be clearly seen that Ca and HCO_3 are major dominating cations and anions.

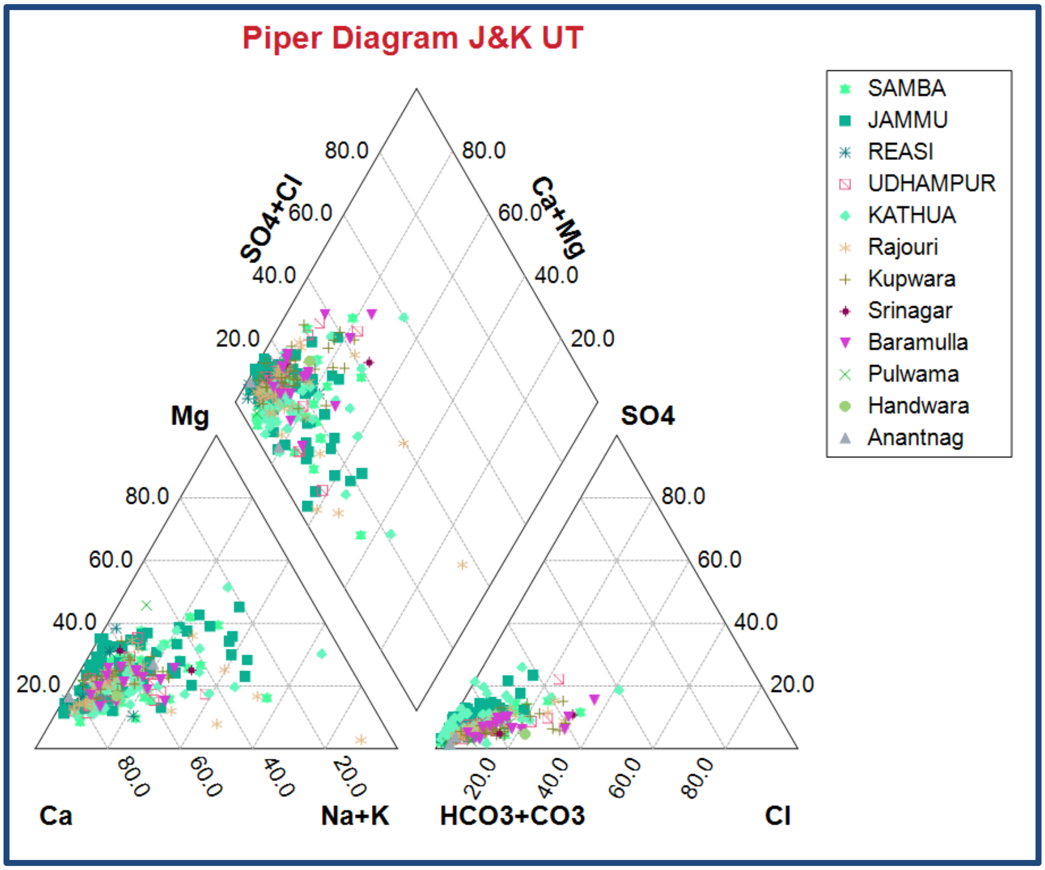

Fig. 4.6.1 Piper Diagram for groundwater samples in UT of J&K

4.7 GROUND WATER QUALITY HOT SPOTS IN UNCONFINED AQUIFERS OF JAMMU AND KASHMIR

Unconfined aquifers are extensively tapped for water supply across the UT therefore; its quality is of paramount importance. The chemical parameters like TDS, Chloride, Fluoride, Iron, Arsenic and Nitrate etc are main constituents defining the quality of ground water in unconfined aquifers. Therefore, presence of these parameters in ground water beyond the permissible limit in the absence of alternate source has been considered as groundwater quality hotspots.

Groundwater quality hot spot maps of the UT have been prepared depicting two main parameters based on their distribution shown on the separate maps. These maps depict the spatial distribution of the following constituents in ground water tapping the unconfined aquifers.

I. Fluoride (>1.5 mg/L)

II. Nitrate (>45mg/L)

Table 4.7.1 Percentage of wells having fluoride >1.5mg/L

S. No	UT	No. of Samples collected (NHS	No. of Samples (F >1.5 mg/l)	% of Samples (F >1.5 mg/l)
1.	Jammu & Kashmir	**273**	**02**	**0.73**

Table 4.7.2 Districts showing localized occurrence of Fluoride (>1.5mg/L) in Groundwater in UT

Sl. No	State	Parts of Districts having F > 1.5mg/L
1.	Jammu & Kashmir	Samba, Kathua,

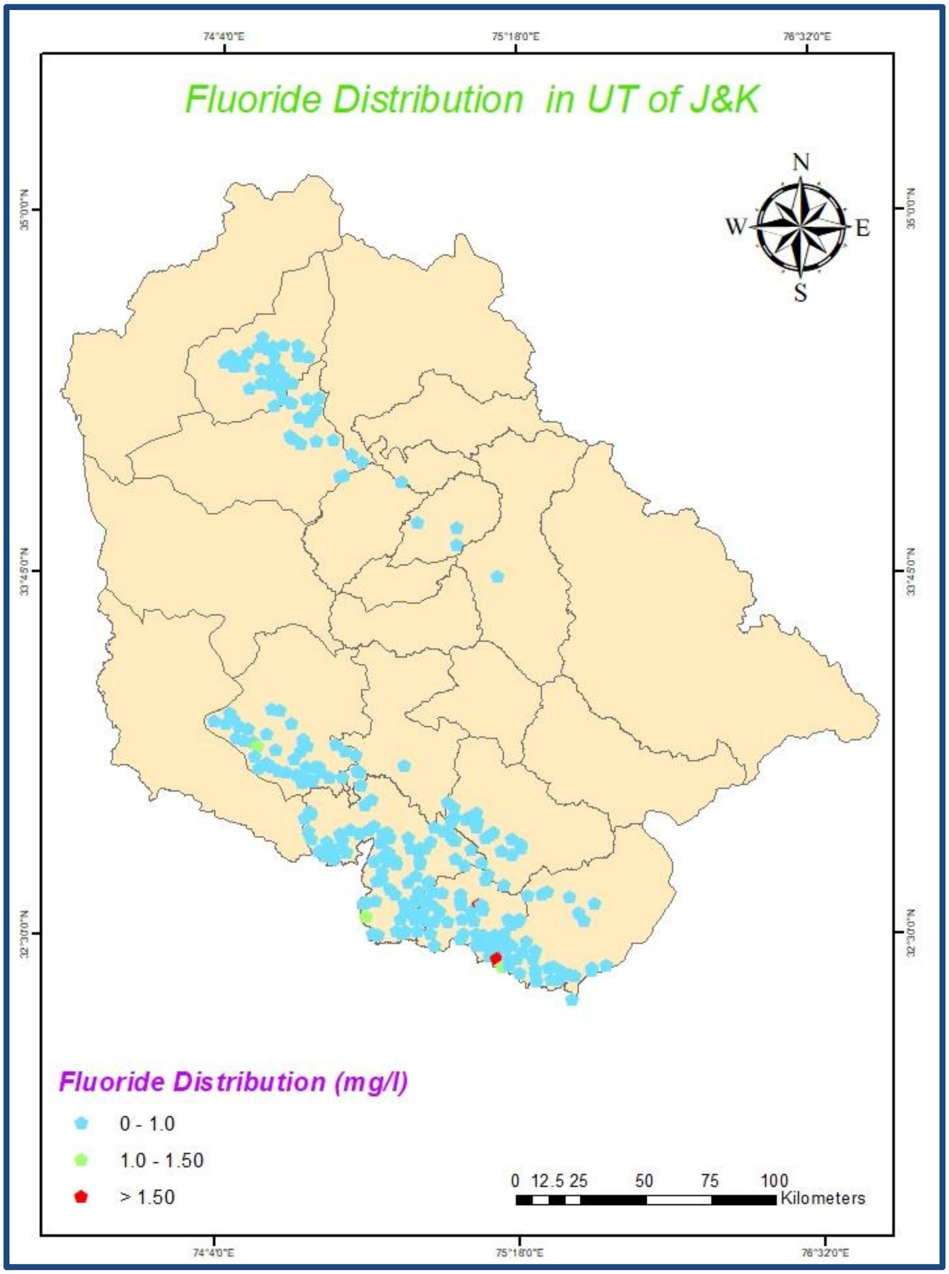

Fig.4.7.1: Fluoride Distribution in UT of J&K

Table-4.7.3: Comparative Change in number of Districts having F > 1.5 mg/L in UT

S. No.	State	Nos. of districts having F> 1.5 mg/L.		
		2015	**2022**	**Increase/Decrease**
1.	Jammu & Kashmir	03	02	-1
	Total	**03**	**02**	**01**

TREND ON FLUORIDE

The occurrence of fluoride in groundwater is mainly due to weathering and leaching of fluoride bearing minerals from rocks and sediments. To assess the trend of ground water pollution due to geogenic activity, the percentage of well exceeds the permissible limit of 1.5mg/L for the period of 2015 to 2022 were compared and presented in the Table 4.7.4 and Fig 4.7.2 and observed that the percentage of samples exceed the permissible limit of fluoride 1.5 mg/L were

Table 4.7.4: Percentage of wells Exceed fluoride >1.5 mg/L during the period of 2015-2022

Year	Total Number of samples analysed	No. of districts affected by Fluoride	No. of locations affected by Fluoride	% of locations affected by Fluoride (F >1.5mg/L)
2015	205	02	03	**1.5**

2016	247	0	0	**0**
2017	208	0	0	**0**
2020	215	02	02	**0.93**
2021	250	05	05	**2**
2022	273	02	02	**0.73**

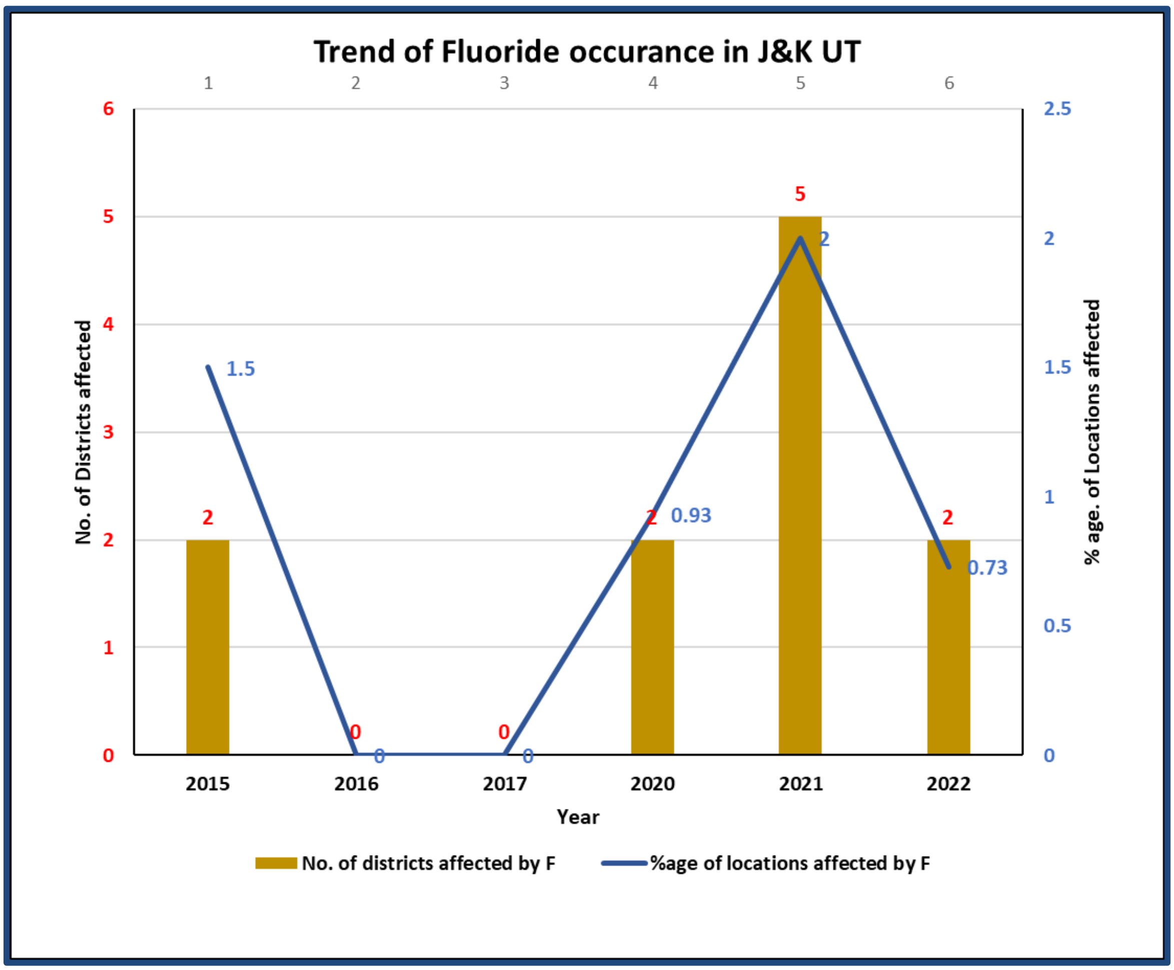

Fig. 4.7.2 Trend of Fluoride occurrence in UT of J&K

Remedial Measures for Fluoride

The fluoride remedial measures broadly adopted are ex-situ techniques. They can be classified into three major categories.

(a) Adsorption and ion exchange

This technique functions on the adsorption of fluoride ions onto the surface of an active agent such as activated alumina, red mud, bone char, brick pieces column, mud pot and natural adsorbents where fluoride is removed by ion exchange or surface chemical reaction with the solid bed matrix.

Activated alumina: Activated alumina is a highly porous aluminum oxide exhibiting high surface area. Alumina has a high preference for fluoride compared to other anionic species, and hence is an attractive adsorbent. The crystal structure of alumina contains cation lattice discontinuities giving rise to localized areas of positive charge which makes it attract various anionic species. It also does not shrink, swell, soften nor disintegrate when immersed in water. The maximum absorption capacity of activated alumina for fluoride is found to be 3.6 mg F/g of alumina.

Ion-Exchange resins: Synthetic chemicals, namely, anion and cation exchange resins have been used for fluoride removal. Some of these are Polyanion (NCL), Tul-sion A - 27, Deacedite FF (IP), Amberllte IRA 400, LewatitMIH - 59, and AmberliteXE - 75. These resins have been used in chloride and hydroxy form. The fluoride exchange capacity of these resins depends upon the ratio of fluoride to total anions in water.

(b) Coagulation-precipitation

Precipitation methods are based on the addition of chemicals (coagulants and coagulant aids) and the subsequent precipitation of a sparingly soluble fluoride salt as insoluble. Fluoride removal is accomplished with separation of solids from liquid. Aluminium salts (eg. Alum), lime, Poly Aluminium Chloride, Poly Aluminium Hydroxy sulphate and

Brushite are some of the frequently used materials in defluoridation by precipitation technique. The best example for this technique is the famous Nalgonda technique.

Nalgonda Technique

Nalgonda technique involves addition of Aluminium salts, lime and bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection. It is opined that this technique is preferable at all levels because of the low price and ease of handling, is highly versatile and can be used in various scales from household level to community scale water supply.

The Nalgonda technique can be used for raw water having fluoride concentration between 1.5 and 20 mg/L and the total dissolved solids should be <1500 mg/L, and total hardness < 600 mg/L. The alkalinity of the water to be treated must be sufficient to ensure complete hydrolysis of alum added to it and to retain a minimum residual alkalinity of 1 - 2 meq/L in the treated water to achieve a pH of 6.5 - 8.5 in treated water. Several researchers have attempted to improve the technique by increasing the removal efficiency of fluoride using Poly Aluminium Chloride (PAC) and Poly Aluminium Hydroxy Sulphate (PAHS).

(c) Membrane techniques

Reverse osmosis, nanofiltration, dialysis and electro dialysis are physical methods that have been tested for defluorination of water. Though they are effective in removing fluoride salts from water, however, there are certain procedural disadvantages that limit their usage on a large scale.

Nitrate

Nitrate is a naturally occurring compound that is formed in the soil when nitrogen and oxygen combine. The primary source of all nitrates is atmospheric nitrogen gas. This is converted into organic nitrogen by some plants by a process called nitrogen fixation. Dissolved Nitrogen in the form of Nitrate is the most common contaminant of ground water. Nitrate in groundwater generally originates from non-point sources such as leaching of chemical fertilizers & animal manure, groundwater pollution from septic and sewage discharges etc. It is difficult to identify the natural and man-made sources of nitrogen contamination of ground water. Some chemical and micro-biological processes such as nitrification and denitrification also influence the nitrate concentration in ground water.

As per the BIS Standard for drinking water the maximum desirable limit of Nitrate concentration in ground water is 45 mg/L with no relaxation. Though, Nitrate is considered relatively non-toxic, a high nitrate concentration in drinking water is an environmental health concern arising from increased risks of methemoglobinemia particularly to infants. Adults can tolerate little higher concentrations. The specified limits are not to be exceeded in public water supply. If the limit is exceeded, water is considered to be unfit for human consumption.

The occurrences of Nitrate in ground water beyond permissible limit (45 mg /L) have been shown on the map as a point source Fig 4.7.3. Table-4.7.6 shows the districts where nitrate has been found in excess of 45 mg/L in groundwater.

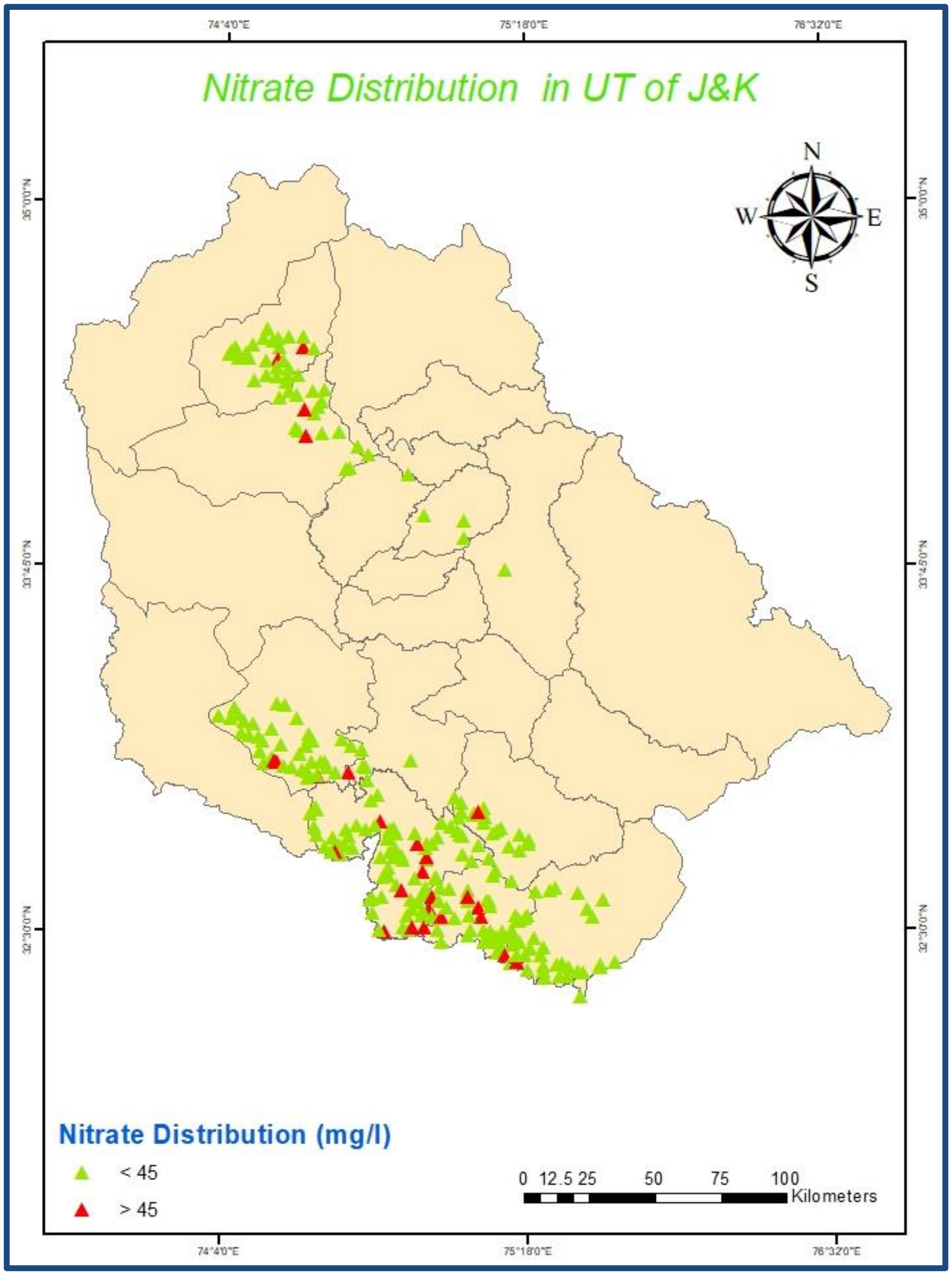

Fig 4.7.3: Locations having Nitrate concentration in UT of J&K, during 2022-23

Table 4.7.5: Percentage of wells having Nitrate > 45 mg/L

S. No	UT	No. of Samples collected (NHS 2022-23)	No. of Samples (NO3 > 45 mg/L)	(%) Samples (NO3 > 45mg/L)
14	Jammu & Kashmir	273	26	9.50
	Total (India)	**273**	**26**	**9.50**

Table 4.7.6: List of Districts Showing Localized Occurrence of Nitrate (>45 mg/L) in Ground Water in UT of J&K

Sl. No.	UT	Parts of Districts having Nitrate > 45 mg/L
1.	**Jammu & Kashmir**	Baramulla, Jammu, Rajouri, Reasi, Samba, Kupwara, Udhampur, Kathua

Table-4.7.7: Comparative Change in number of Districts having Nitrate > 45 mg/L in UT of J&K

S. No.	UT	Nos. of districts having NO_3> 45 mg/L.		
		2015	2022	Increase/ Decrease
1.	Jammu & Kashmir	05	08	3
	Total	**05**	**08**	**3**

TREND ON NITRATE

Trend analysis determines whether the measured values of the water quality variables increase or decrease during a time period. Nitrate is one of the major indicators of anthropogenic sources of pollution. Nitrate is the ultimate oxidized product of all nitrogen containing matter and its occurrence in groundwater can be fairly attributed to infiltration of water through soil containing domestic waste, animal waste, fertilizer and industrial pollution. As the lithogenic sources of nitrogen are very rare, its presence in ground water is almost due to anthropogenic activity. Hence, nitrate was taken to assess the trend of ground water quality in India due to anthropogenic activity.

The percentage of well exceeds the permissible limit of 45mg/L for the period of 2015 to 2022 were compared and presented in the Table 4.7.8 and Fig 4.7.7 and observed that the percentage of samples exceed the permissible limit of nitrate (> 45 mg/L) were ranging between 10 - 13 % and no significant trend was noticed. It is also observed that the type of waste generated is important in causing the nitrate pollution and also indicates that domestic waste leads to more nitrate problem. This could be due to the leaching of nitrate from the open sewerage lines.

District wise trend for three districts in UT of J&K was also analysed for the period 2017 to 2022.There is declining trend in the Jammu District as depicted in figure 4.7.4. Whereas rising trend can be seen in Samba and Kathua District (fig.4.7.5 & 4.7.6) which may be due to improper waste management.

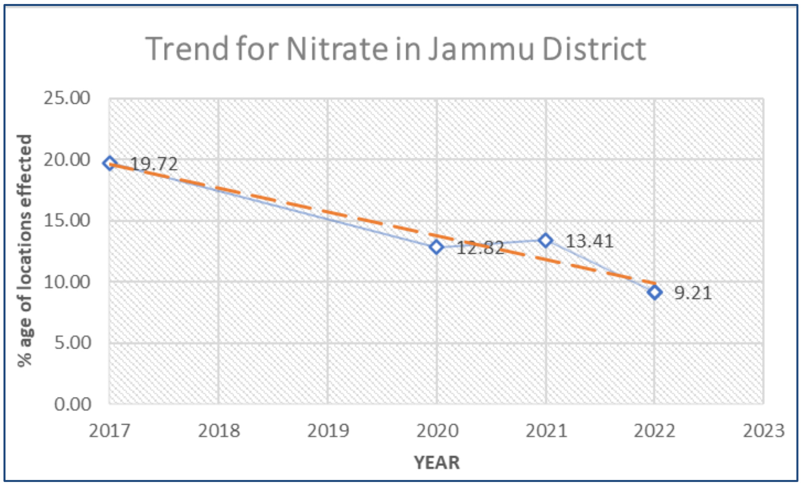

Fig. 4.7.4: Trend of Nitrate occurrence in Jammu District, J&K

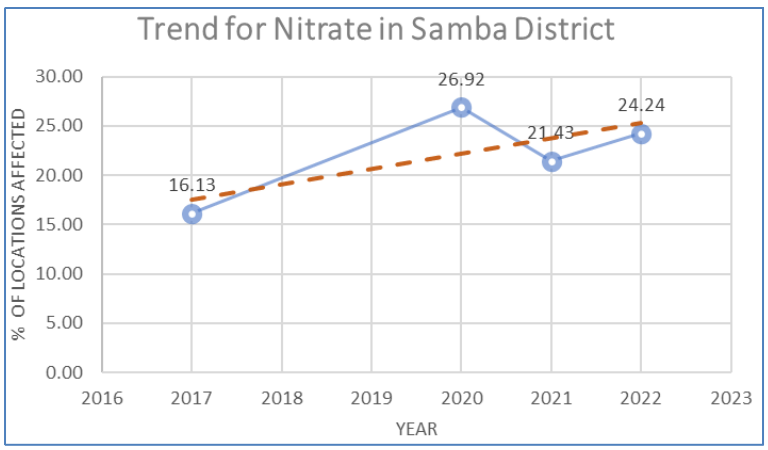

Fig. 4.7.5: Trend of Nitrate occurrence in Samba District, J&K

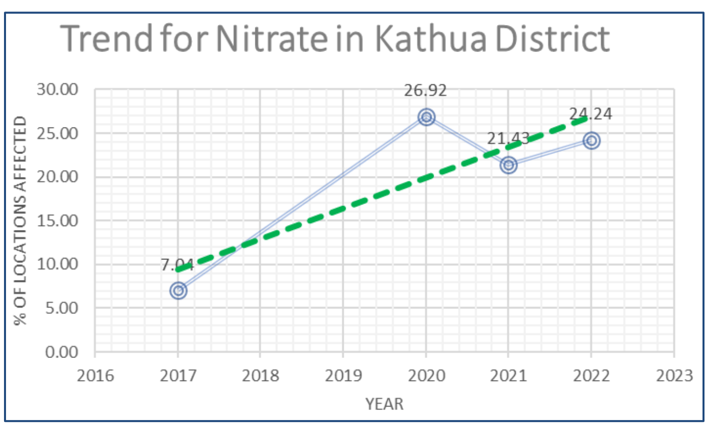

Fig. 4.7.6: Trend of Nitrate occurrence in Kathua District, J&K

Table 4.7.8: Percentage of wells Exceed Nitrate >1.5 mg/L during the period of 2015-2022

Year	Total Number of samples analysed	No. of districts affected by Nitrate	No. of locations affected by Nitrate	% age of samples affected by Nitrate (NO_3 >45 mg/L)
2015	205	05	25	**10.1**
2016	247	05	25	**10.1**
2017	208	06	26	**12.5**
2020	215	05	28	**13.0**
2021	250	08	27	**10.8**
2022	273	08	26	**9.50**

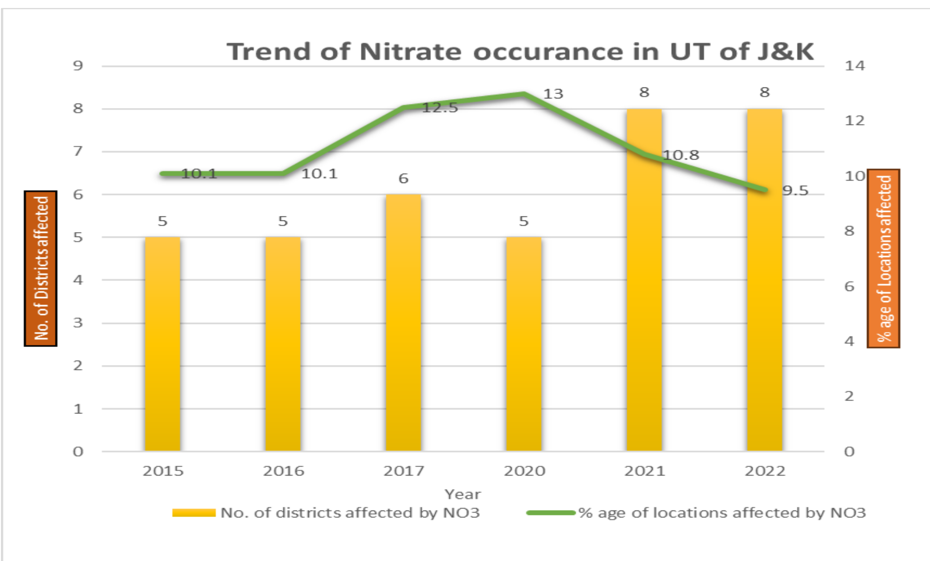

Fig. 4.7.7: Trend of Nitrate occurrence in J&K

Remedial Measures for Nitrate

For removal of nitrate both non-treatment techniques like blending and treatment processes such as ion-exchange, reverse osmosis, biological denitrification and chemical reduction are useful. The most important thing is that neither of these methods is completely effective in removing all the nitrogen from the water.

a) Methods involving no treatment: In order to use any of these options the nitrate problem must be local-scale. Common methods are –

- Raw water source substitution
- Blending with low nitrate waters

This greatly reduces expenses and helps to provide safer drinking water to larger numbers of people.

b) Methods involving Treatment:

They are as follows

- Adsorption/Ion Exchange
- Reverse Osmosis
- Electrodialysis
- Bio-chemical Denitrification **(**By using denitrifying bacteria and microbes)
- Catalytic Reduction/Denitrification (using hydrogen gas)

The mechanism of nitrate pollution in subsurface porous unconfined/confined aquifer is governed by complex biogeochemical processes. Apart from recharge conditions, groundwater chemistry may be impacted by the mineral kinetics of water-rock interactions. Consequently, suitable nitrate removal technologies should be selected. Nitrate is a very soluble ion with limited potential for co-precipitation or adsorption. This makes it difficult such as chemical coagulation, lime softening and filtration which are commonly used for removing most of the chemical pollutants such as fluoride, arsenic and heavy metals. According to King et al., 2012 nitrate treatment technologies can be classified in two categories in two categories, i.e. nitrate reduction and nitrate removal options. Nitrate removal technologies involve physical processes that does not necessarily involve any alteration of the chemical state of nitrate ions. Bio-chemical reduction options aim to reduce nitrate ions to other states of nitrogen, e.g. ammonia, or a more innocuous form as nitrogen gas. In-situ bioremediation is also effectively used in used in nitrate treatment of contaminated groundwater. Reverse Osmosis, catalytic reduction and blending are effective methods for nitrate removal from groundwater. For nitrate removal, operating trans-membrane pressure of RO unit generally ranges from 20 to 100 bar.

4.8 Spatial Distribution of various parameters in J&K UT

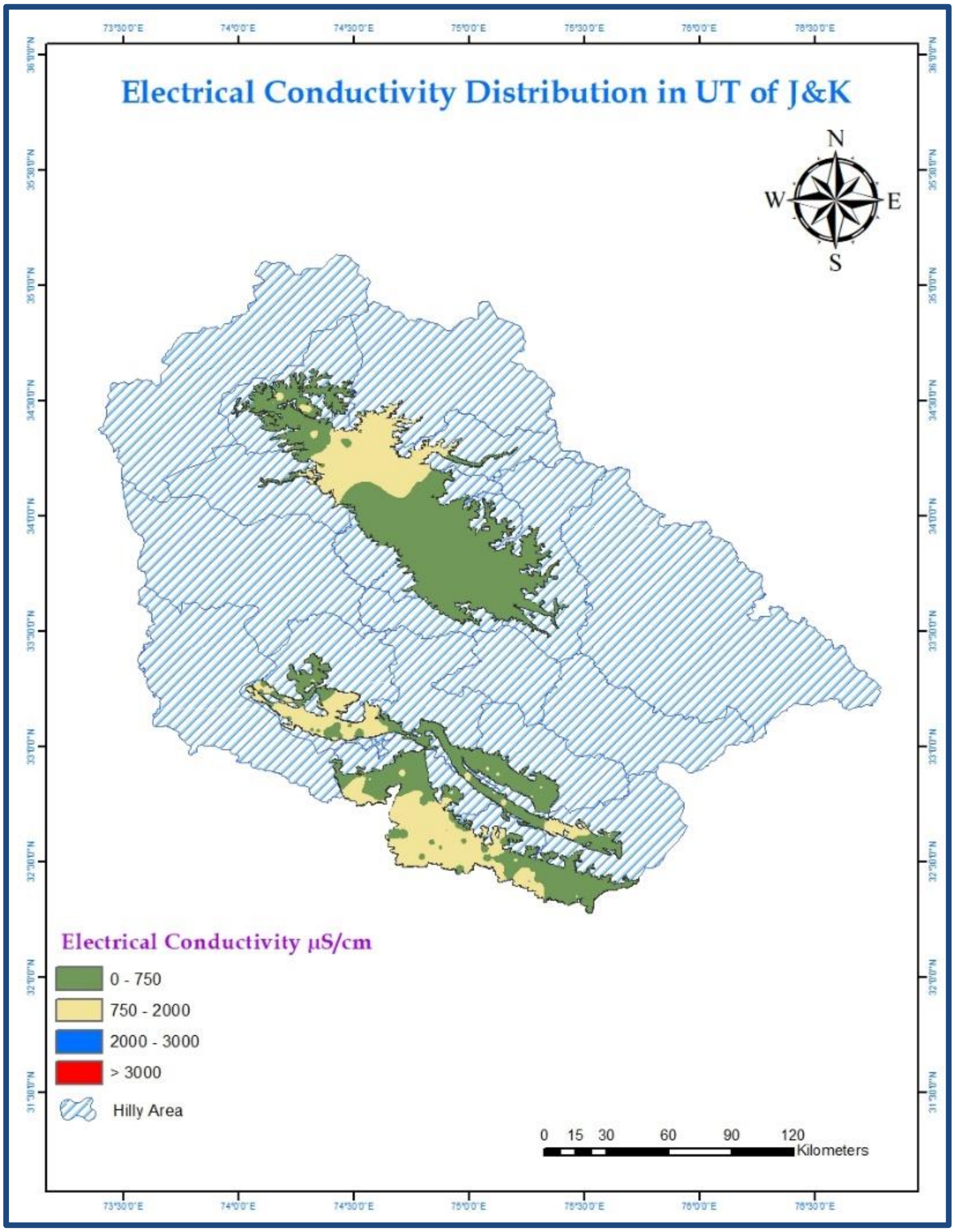

Fig. 4.8.1 Electrical conductivity Distribution in UT of J&K

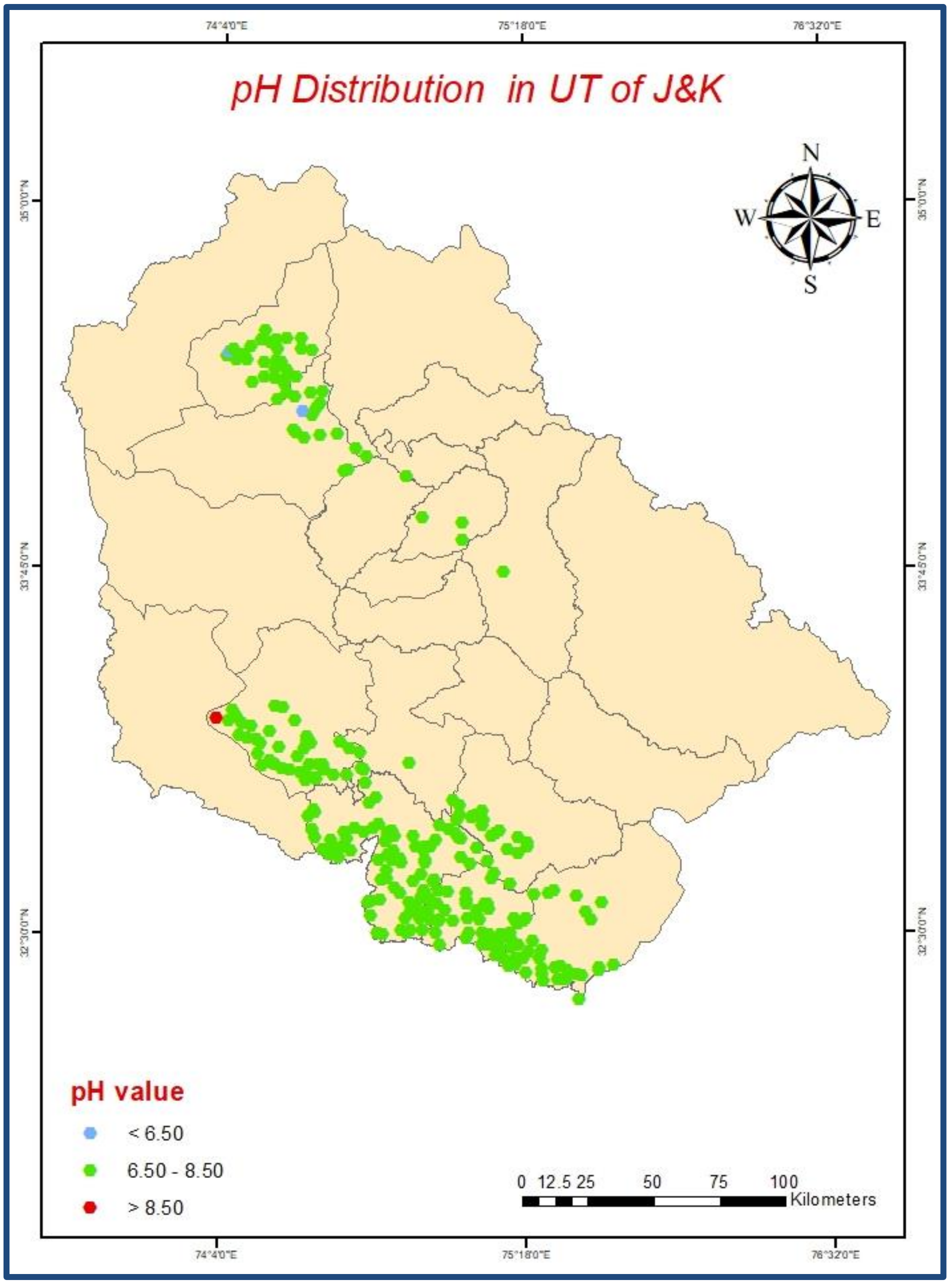

Fig. 4.8.2 pH Distribution in UT of J&K

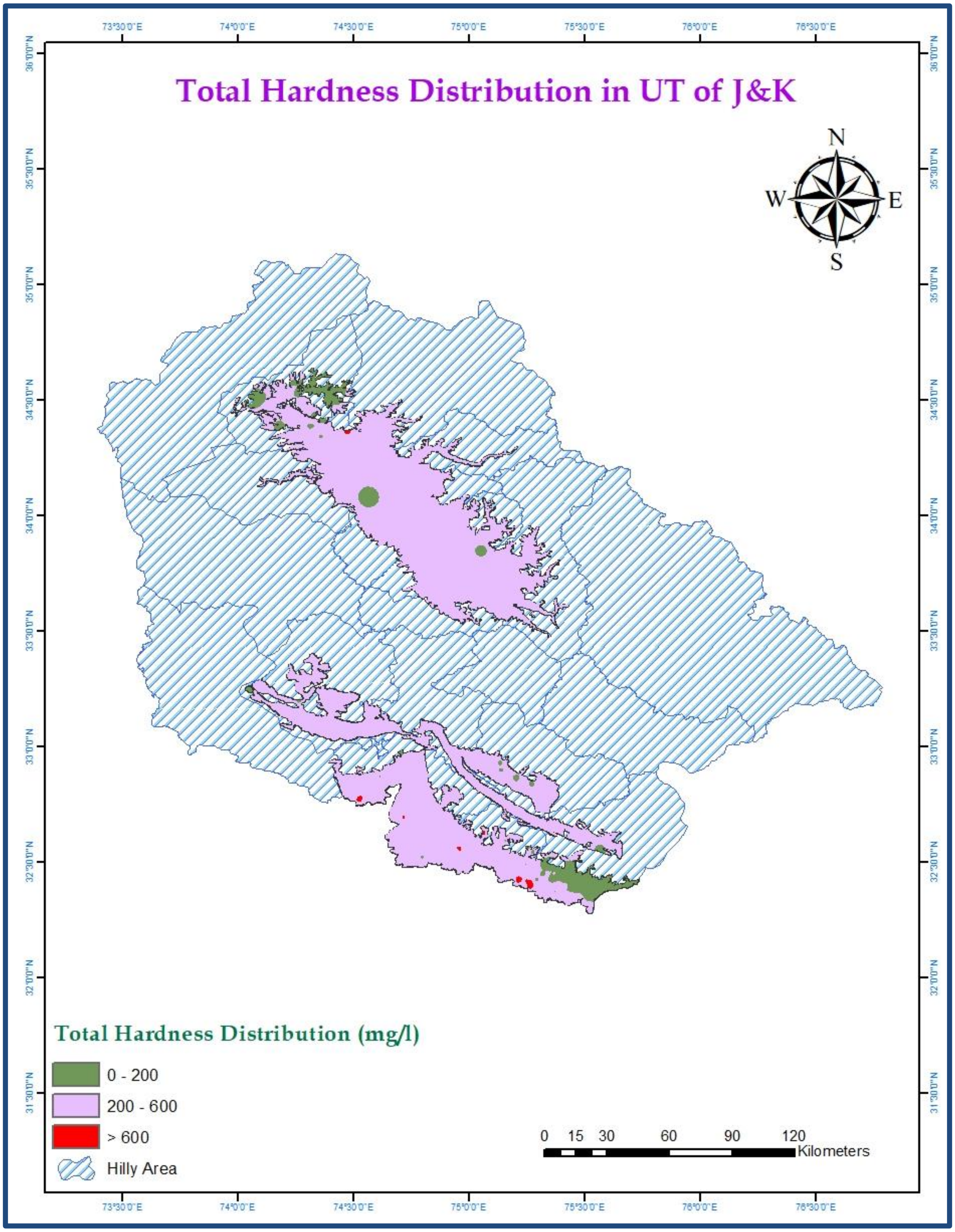

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Fig. 4.8.3 Hardness Distribution in UT of J&K

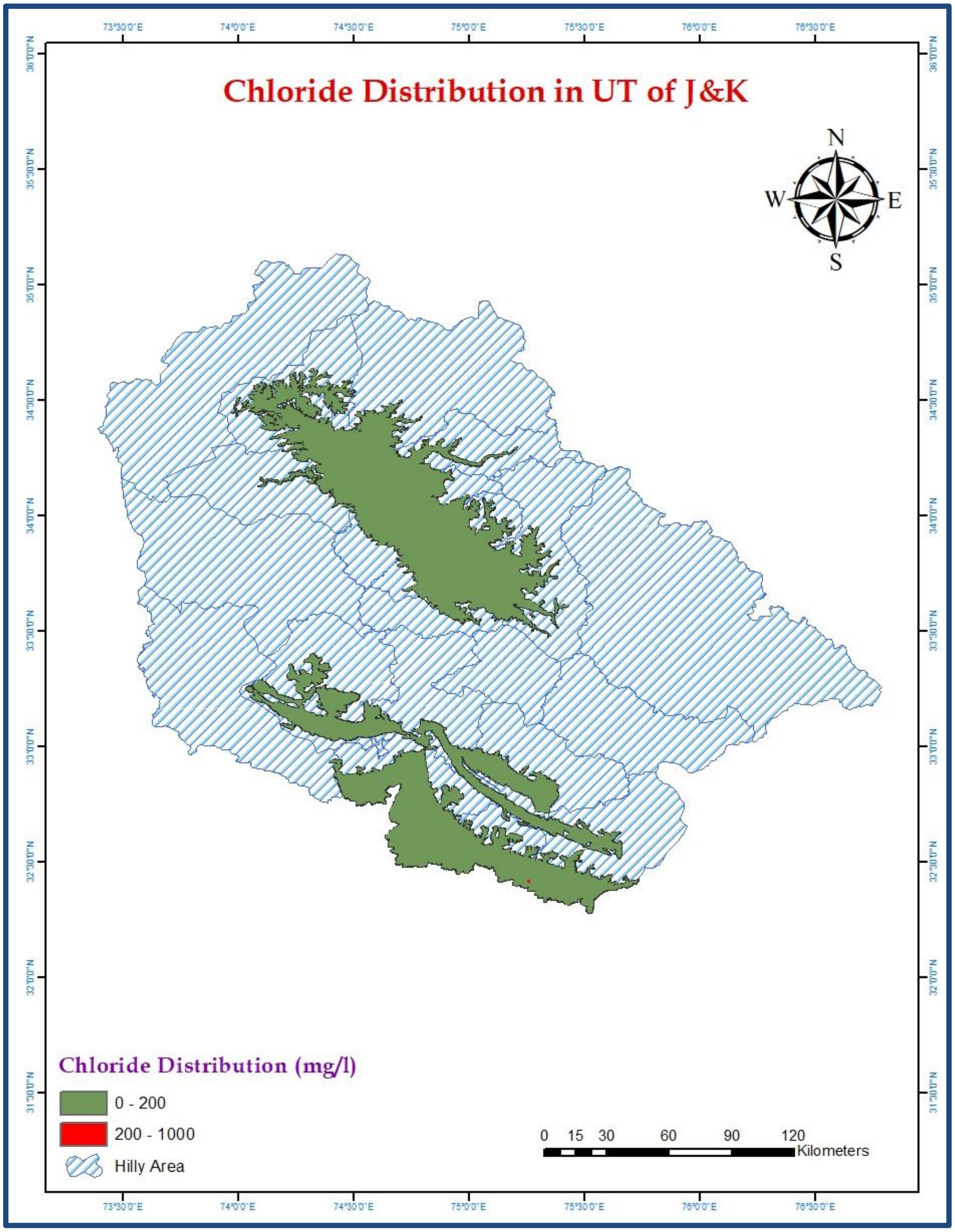

Fig. 4.8.4 Chloride Distribution in UT of J&K

4.9 Graphical Representation of Pollution Parameter:

The graphical representation of average value of pollution parameters viz. Electrical Conductivity, Nitrate and Fluoride is depicted below for Jammu & Kashmir UT

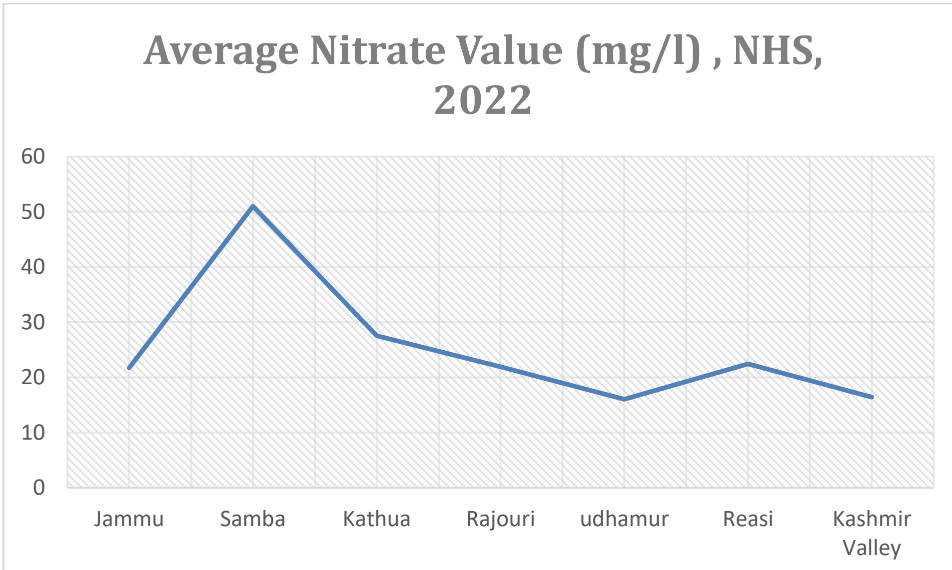

Fig 4.9.1- Average Nitrate distribution

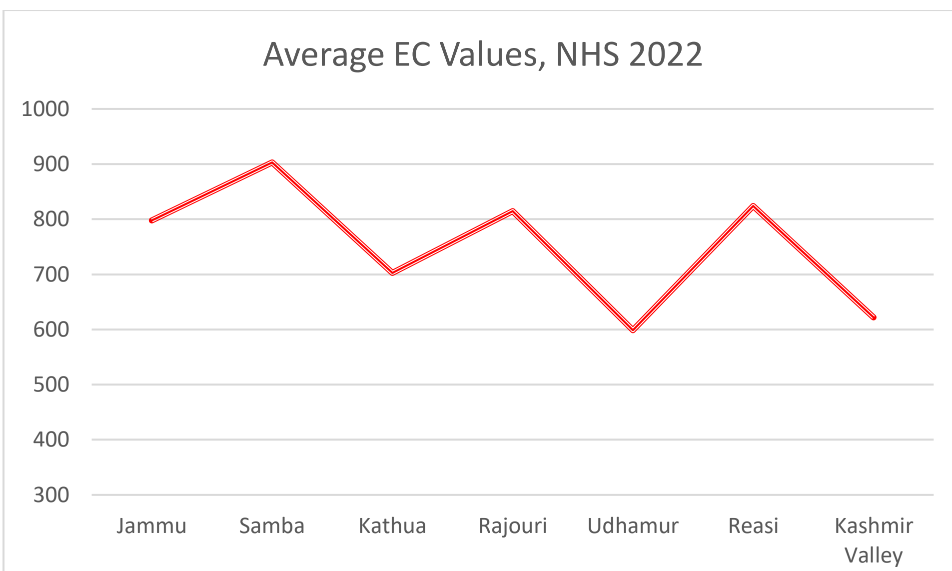

Fig 4.9.2 Average EC distribution

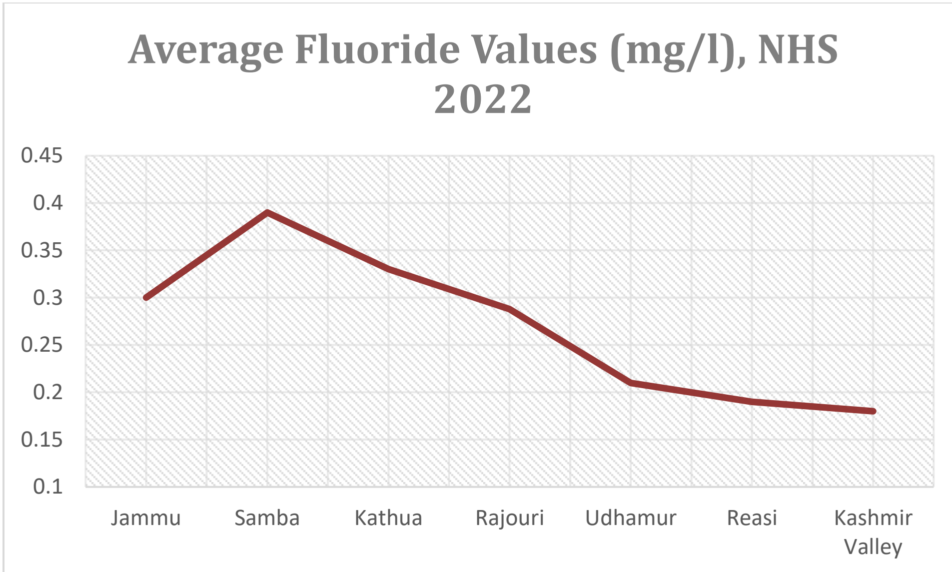

Fig 4.9.3- Average Fluoride distribution

5.0 Result and Discussion

The Ground water quality in Jammu and Kashmir is found to be fresh. The hydrochemical facie of groundwater is Ca-Mg-HCO_3 Ca-HCO3, Ca-Mg-Na-HCO3. In terms of pH values, the measure of nature of water, the groundwater is found to be neutral to alkaline. The values of electrical conductivity (EC) in majority of the samples are well below the 750 µS/cm at 25^{o}C suggesting that the salinity is not a concern in the UT of J&K. No Sample is found having EC value greater than 3000 µS/cm.

The major anions such as Bicarbonates, Chloride, Nitrate, Sulphate and Fluoride are analyzed to assess the groundwater quality. Bicarbonate is the dominating anion present in the groundwater. The values of chloride are well within the range prescribed by BIS suggesting that salinity is not an issue in J&K UT. However, the values of Nitrate are found to be higher in 28 samples than 45 mg/L as prescribed by the BIS suggesting the anthropogenic pollution could be behind the increase. The high values of nitrate may be due to the Human and animal excreta adding nitrate to water by bacterial decomposition and usage of nitrogen pesticides/ fertilizers in agriculture and horticulture. The mixing from septic tank and sewage discharges etc in groundwater can also leads to increase in nitrate concentration in groundwater which is a matter of concern.

The fluoride ion is required by human body in some quantity. However, high concentration of the fluoride can cause fluorosis and other issues. In J&K, most of the water samples have fluoride concentration well within the range prescribed by the BIS. Two samples show greater than 1.50 mg/l fluoride concentration. Those samples, which are having high fluoride concentration, may be due to Geogenic sources. Rest other anions such as Sulphate, phosphate is found well within the range.

The major cations analysed in the ground water are Calcium, Magnesium, Sodium and Potassium. The values of calcium and magnesium ion are found well within the range prescribed by the BIS.

The salts of Calcium and Magnesium cations present in the groundwater represent the hardness. As per the classification of hardness, 09 samples fall under very hard category i.e. greater than 600 mg/ land 221 samples fall in hard category (200-600 mg/l). 43 samples are found in soft category i.e., less than 200 mg/l of hardness.The high values of hardness can cause scaling in the pipes and can cause skin, hair and gastro problems etc.

The radioactive element Uranium was also analysed in the groundwater samples. All the samples are found having uranium concentration of less than 30 ppb.

6. RECOMMENDATIONS & REMEDIAL MEASURES

- As the water supply in UT of Jammu and Kashmir are ground water based, proper well head protection measures need to be taken to avoid bacteriological contamination like coliform bacteria and E-coli. These water supply pipes should be thoroughly checked for ant mixing with sewer pipelines.
- Nitrate contamination in ground water is a cause of concern as pollution.The mixing from septic tank and sewage discharges etc. in groundwater can leads to increase in nitrate concentration in groundwater. Thus, proper sewage system may be developed, and their disposal should be far away from water sources thus rendering less chances of the contamination.
- Most of the ground water is hard to very hard category causing gastro-intestinal problems. This type of water may be treated properly before supplying the water for drinking. RO, Ion exchange processes etc. may be used to treat the water and then supply it for drinking purpose. These same processes can be used to treat fluoride problem also.
- Deeper aquifers in both Jammu Division and Kashmir valley can be developed for mitigating the water supply requirements. Micro-level planning is required to develop these aquifers based on the available data of aquifer geometry, parameters and water resources. Tube wells shall be constructed by tapping good quality aquifers free from any contamination.
- Fast developing urban & industrial areas need special attention/quality surveillance by the State government authorities. Proper monitoring for pollutants in industrial clusters shall be taken up. Monitoring network stations shall be established all along the nalas and drains carrying industrial effluents.
- There is lack of proper sewage and sanitation in all over the UT resulting into ground water and surface water contaminations. This issue needs to be addressed immediately by the authorities. Village sewages shall be disposed off properly after proper treatment. In water logging areas, where ground water is being contaminated by polluted surface water, proper drainage shall be created for avoiding the water logging conditions.
- The existing data base on quality with different organizations like CGWB, PHED, State pollution control board, academic institutions like Jammu university and

Kashmir university need to integrate and a comprehensive data base need to be established so that better management of groundwater system is prepared.

- Proper management strategies need to be drawn up to combat the problems of geo-genic contamination. Cost effective community level treatment plants need to be established to provide better drinking water facility in the rural areas. The treatment plants as recommended in this report shall be constructed with trained manpower as in charges so that these treatment plants may work efficiently for longer periods.

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Chemicals Results 2022-23

Annexure-I

Sr. No.	Location	District	Block	Lat. in decimal	Long. in decimal	pH	EC (µs/cm) at 25^0 C	CO3 (mg/l)	HCO_3 (mg/l)	Cl (mg/l)	NO3 (mg/l)	F (mg/l)	SO4 mg/l	PO4 (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Total Hardness as CaCO3 (mg/l)	U (µg/l)	SAR	RSC
1	Rangoora	Samba	Samba	32.75056	74.89639	7.02	720	0	384.3	17.5	40.1	0.14	28.4	0	116.4	25.2	9.9	0	394.96	0.88	0.217	-1.601
2	Sidhra	Samba	Samba	32.75972	74.89472	7.05	990	0	463.6	33.4	61.3	0.16	50.45	0	143.9	37.1	18.1	0	512.80	2.2	0.348	-2.659
3	Nagrota	Jammu	Jammu	32.80403	74.92070	7.11	830	0	414.8	30.3	39.5	0.21	38.4	0	135.9	17.6	27.4	0.5	412.36	4.64	0.587	-1.449
4	Khanpur (Nagrota)	Jammu	Jammu	32.79061	74.89222	7.29	670	0	451.4	8.2	2.99	0.09	5.1	0	90.6	24.2	36.4	0	326.33	3.7	0.876	0.871
5	Jagati	Jammu	Jammu	32.80556	74.89583	7.08	550	0	268.4	8.1	4.5	0.15	15.5	0	79.5	12.2	4.8	0	249.08	8.4	0.132	-0.583
6	Upper Ban	Jammu	Jammu	32.82917	74.93833	6.74	210	0	122.0	5.5	1.9	0.17	9.2	0	41.5	3.6	1.3	0	118.60	0.014	0.052	-0.373
7	Sugetar	Jammu	Jammu	32.87917	74.95833	7.17	740	0	427.0	18.6	4.7	0.33	21.8	0	94.1	12.6	52	0	287.23	5.12	1.334	1.253
8	Talwara	Reasi	Reasi	33.09167	74.83333	6.92	730	0	463.6	8.8	2.5	0.17	16.9	0	100.2	39.8	6.5	0	414.69	0.745	0.139	-0.696
9	Dhanu Kannal	Reasi	Reasi	32.96278	75.00722	6.93	640	0	420.9	4.9	2.1	0.12	7.3	0	113.8	18.2	5.1	0	359.58	1.03	0.117	-0.294
10	Badola	Udhampur	Udhampur	32.94444	75.03472	7	630	0	305.0	24	32.8	0.12	18.1	0.14	113.6	9.8	7.3	0	324.43	2.1	0.176	-1.490
11	Jhakkar	Udhampur	Udhampur	32.92645	75.13024	6.51	300	0	170.8	7.7	3.8	0.17	9.8	0	50.9	7	4.9	0	156.13	0	0.171	-0.323
12	Birmah	Udhampur	Udhampur	32.91500	75.10889	7.21	610	0	341.6	17.3	3.6	0.12	18.4	0	106.6	9.1	13.5	0.06	304.04	0.6	0.337	-0.483
13	Kotli Pain	Udhampur	Udhampur	32.90889	75.09139	6.89	560	0	323.3	10.7	5.8	0.24	21.2	0	96.2	15.9	6.7	0	306.09	3	0.167	-0.824
14	Garhi (Udh)	Udhampur	Udhampur	32.90500	75.08250	7.1	860	0	451.4	31.3	25.1	0.19	35.2	0	145.4	20.4	19.1	0	447.66	2.6	0.392	-1.556
15	Seen Thakaran	Udhampur	Udhampur	32.91306	75.03833	7.02	690	0	378.2	18.2	14.9	0.17	23.9	0	120.2	12.8	14.9	0	353.31	2.1	0.345	-0.868

16	Eastern Mand	Udhampur	Udhampur	32.89667	75.02389	7.14	640	0	366.0	19.3	2.34	0.14	21.02	0	97.54	18.35	14	0	319.55	1.48	0.341	-0.393
17	Katcha Pind (Dansal)	Jammu	Jammu	32.86556	74.99528	7.09	920	0	512.4	38.5	4.7	0.28	36.9	0	139.4	31.2	27.3	0	477.21	3.6	0.543	-1.147
18	Badsoo	Jammu	Jammu	32.85250	75.01861	7.03	560	0	323.3	12.5	6.2	0.26	20.6	0	97.5	12	9.9	0.1	293.25	4.3	0.251	-0.567
19	Kah Pahuta	Jammu	Jammu	32.83444	75.04167	7.04	580	0	323.3	18.4	7.9	0.2	22.8	0	85.3	15.3	18.2	0.2	276.37	2.4	0.476	-0.229
20	Kunihala	Jammu	Jammu	32.83722	75.03333	7.13	570	0	341.6	12.9	6.9	0.25	14.3	0	100.4	10.3	12.2	0	293.49	1.75	0.310	-0.272
21	Kot Kaswal	Jammu	Jammu	32.79889	75.10833	7.07	760	0	457.5	15.7	10.2	0.25	23.7	0	133.9	17.7	13.8	0.3	407.77	4.47	0.297	-0.658
22	Phangyal	Udhampur	Udhampur	32.89556	75.13528	6.52	330	0	122.0	28.9	21.6	0.1	14.4	0	36.8	14.5	8.4	0	151.82	0	0.296	-1.037
23	Battal Ballian	Udhampur	Udhampur	32.87972	75.12556	6.99	840	0	262.3	63.9	35.7	0.25	82.8	0	97.6	21.1	44.1	0.5	331.05	2.11	1.054	-2.322
24	Rakh Badali	Udhampur	Udhampur	32.91528	75.10889	6.68	570	0	201.3	37.7	67.2	0.15	19.3	0	81.8	15.7	12.9	0.1	269.27	0	0.342	-2.086
25	Talpad	Udhampur	Udhampur	32.85946	75.19880	6.77	390	0	207.4	17.6	2.67	0.19	11.9	0	46.5	11.8	18.3	0	164.93	0	0.620	0.100
26	Nagrota Panjgrain	Udhampur	Udhampur	32.83583	75.27083	6.89	380	0	207.4	9.9	7.9	0.23	10.5	0	48.1	14.4	10.7	0.2	179.66	0	0.347	-0.194
27	Dalsar	Udhampur	Ramnagar	32.81917	75.31250	7.33	810	0	488.0	15.9	3	0.29	20.8	0	98.1	18.9	51.3	0.5	323.22	2.96	1.241	1.533
28	Ramnagar	Udhampur	Ramnagar	32.80639	75.31000	6.9	440	0	237.9	15.5	14.3	0.09	13.8	0.23	65.7	10.5	14	0.2	207.57	0	0.422	-0.253
29	Dehari	Udhampur	Ramnagar	32.78139	75.27278	7.49	760	0	433.1	16.6	5.1	0.69	15.4	0	72.7	17.2	71.8	0.53	252.71	5.9	1.964	2.044
30	Jallow	Udhampur	Ramnagar	32.79583	75.23167	7.55	740	0	420.9	24.1	3	0.21	30.6	0	117.5	16.6	19.9	5.2	362.23	3.55	0.455	-0.347
31	Ritti	Udhampur	Udhampur	32.84167	75.16333	7.64	530	0	317.2	12.84	3.44	0.24	8.5	0	70	10.9	34	0.1	219.97	0.68	0.997	0.799
32	Kuperlah	Udhampur	Udhampur	32.85028	75.18194	7.4	520	0	286.7	21.3	4.88	0.16	21.6	0	77.8	13.8	14.7	0.2	251.43	0.88	0.403	-0.330
33	Manwall	Udhampur	Ramnagar	32.75556	75.15000	7.28	790	0	390.4	39.2	36.8	0.16	21	0	134.7	14.3	16.5	0.5	395.74	3.46	0.361	-1.517

34	Salabra	Udhampur	Ramnagar	32.71667	75.17500	7.12	560	0	353.8	9.59	8.66	0.17	13.2	0	96.7	17.3	9.7	0.3	313.12	2.86	0.238	-0.464
35	Sunal	Udhampur	Ramnagar	32.67944	75.24250	7.35	600	0	372.1	14.3	8.5	0.19	17.2	0	104.4	19.1	6.64	0.2	339.80	2.59	0.157	-0.698
36	Ramkot	Kathua	Billawar	32.64167	75.33611	7.26	760	0	451.4	21.6	11.5	0.2	18.6	0.18	117.4	22.6	21.6	5.8	386.73	2.87	0.478	-0.337
37	Nagrota˚Gujroo	Kathua	Billawar	32.64639	75.39389	7.19	1190	0	555.1	100.3	12.3	0.2	56.9	0	134.1	28.04	97.44	5.8	450.93	1.19	1.995	0.078
38	Lakri	Kathua	Billawar	32.65611	75.41528	6.99	830	0	457.5	41.8	2.5	0.16	6.58	0.47	121.3	18	28	4.5	377.51	1.09	0.627	-0.053
39	Mandli	Kathua	Billawar	32.63556	75.50833	6.97	840	0	481.9	32.88	2.3	0.26	28.8	0	116.5	22.6	38.5	4.2	384.48	2.84	0.854	0.208
40	Phinter	Kathua	Billawar	32.58278	75.54444	6.76	470	0	201.3	31.5	22.6	0.11	20.8	0	57.7	14	16	2.95	202.01	0	0.489	-0.741
41	Billawar	Kathua	Billawar	32.61306	75.60833	7.06	760	0	433.1	31.3	3.8	0.33	13.7	0	111.5	14.1	35.9	1.97	336.92	2.57	0.850	0.359
42	Pallan	Kathua	Billawar	32.55639	75.56583	6.72	350	0	201.3	14.9	3.1	0.13	16.38	0	52.76	10.14	10.7	0.3	173.73	0	0.353	-0.176
43	Chhani Mansar	Udhampur	Ramnagar	32.69722	75.16444	7.22	660	0	408.7	8.55	4.18	0.21	10.4	0	109.8	14.35	17.1	0.6	333.70	2.57	0.407	0.024
44	Sagoon	Samba	Samba	32.74722	75.07722	7.39	530	0	305.0	11.01	4.89	0.19	21.92	0	65	23.7	18.2	0.78	260.27	8.13	0.490	-0.207
45	Surinsar	Jammu	Jammu	32.76722	75.04306	7.2	730	0	427.0	7.5	4.9	0.34	10.6	0	112.2	11.2	27.1	0.5	326.70	6.45	0.652	0.464
46	Muthi	Jammu	Bhalwal	32.75050	74.79965	7.19	740	0	335.5	29.3	19.4	0.24	44.6	0	86	32.2	15.9	0.5	347.84	1.63	0.371	-1.459
47	Patyale Chak	Jammu	Marh	32.76248	74.77597	7.32	940	0	518.5	22.6	4.8	0.93	56.1	0	69.6	53.8	57.1	0.8	395.95	3.8	1.248	0.578
48	Nagbani	Jammu	Marh	32.76201	74.76282	7.27	840	0	488.0	12.7	2.3	0.68	40.2	0	86.6	31.7	56.5	0.23	347.28	2.74	1.318	1.052
49	Gho Manhasan (Talab Tillo)	Jammu	Marh	32.72289	74.73957	7.21	1000	0	585.6	31.3	4.9	0.34	58.8	0	126.4	53.3	31.3	0	535.88	13.06	0.588	-1.121
50	Gajansoo	Jammu	Marh	32.76100	74.71065	7.2	750	0	427.0	25.2	4.2	0.25	27.8	0	104.8	27.9	18.1	2.5	377.10	2.31	0.405	-0.544
51	Marh	Jammu	Marh	32.77640	74.74572	6.96	890	0	500.2	33.8	5.7	0.28	71.5	0	129.1	41.7	19.8	0.2	494.78	3.04	0.387	-1.698
52	Lower Barnai	Jammu	Bhalwal	32.76264	74.79208	7.05	540	0	305.0	9.9	2.9	0	22.5	1.98	73.8	18.9	4.4	20.3	262.47	0	0.118	-0.251

53	Garhi (Jammu)	Jammu	Bhalwal	32.79067	74.76555	7.17	1040	0	549.0	43.5	22	0.32	47.8	0	147.5	38.9	24.9	1	529.23	3.1	0.471	-1.588
54	Jhiri	Jammu	Marh	32.82553	74.73298	7.11	530	0	298.9	8.3	2.7	0.17	26.6	0	75.5	23.6	3.7	1.3	286.11	0.83	0.095	-0.824
55	Sajwal	Jammu	Pargwal	32.79233	74.59297	7.29	660	0	378.2	4.9	2.5	0.41	44.6	0.35	95.4	28.1	3.9	4.6	354.42	2.8	0.090	-0.891
56	Hamirpur Kohna	Jammu	Pargwal	32.76672	74.54968	7.16	980	0	469.7	18.3	42.1	0.26	62	0	122.9	31.8	8.1	43.2	438.44	17.4	0.168	-1.071
57	Akhnoor	Jammu	Bhalwal	32.85585	74.74669	7.04	470	0	256.2	6.7	7.6	0.16	26.4	0	74.3	16.7	1.7	1.4	254.64	1.5	0.046	-0.894
58	Batera	Jammu	Bhalwal	32.84848	74.74640	7.47	550	0	286.7	8.1	12.4	0.14	28.5	0	75.1	24.9	1.9	0	290.47	0	0.048	-1.111
59	Khairi (Raipur)	Jammu	Bhalwal	32.80763	74.85752	6.85	670	0	317.2	19.5	45.4	0.41	27.8	0	98.5	22.4	9.7	0.2	338.66	0	0.229	-1.575
60	Kangar	Jammu	Bhalwal	32.84007	74.84597	7.09	630	0	384.3	7.7	10.4	0.22	9.3	0	105.6	20.2	4	0	347.33	2.7	0.093	-0.649
61	Pata Khu	Jammu	Bhalwal	32.83999	74.77155	7.61	510	0	292.8	6.2	11.6	0.22	17.6	0	77.95	20.2	3.26	0.2	278.21	0.9	0.085	-0.766
62	Dharam Khu	Jammu	Bhalwal	32.85995	74.76329	7.43	530	0	298.9	7.3	10.3	0.16	23.3	0	83.9	18.44	2.8	0.1	285.82	1.35	0.072	-0.818
63	Sumah	Jammu	Bhalwal	32.95725	74.67018	7.22	500	0	311.1	7.5	2.6	0.14	9.1	0	73.5	21.2	3.7	0.3	271.21	1.2	0.098	-0.326
64	Shama Chak	Jammu	Bhalwal	32.82817	74.74192	7.31	570	0	305.0	10.1	17.5	0.21	28.4	0	77.7	24.7	6.2	3.3	296.15	0.93	0.157	-0.925
65	Gura (Akhnoor)	Jammu	Akhnoor	32.88127	74.70799	7.27	930	0	518.5	30.7	57.7	0.32	35.4	0	135.7	45	20.5	0	524.89	0.78	0.389	-2.001
66	Leherian	Jammu	Akhnoor	32.86925	74.68850	7.11	620	0	359.9	7.9	11.8	0.21	19.9	0	90.7	27.3	4.5	0.2	339.37	1.12	0.106	-0.889
67	Devipura	Jammu	Bhalwal Brahmana	32.85562	74.65060	7.55	490	0	298.9	5.1	7.5	0.15	21	0	73.5	24.2	0.13	0.5	283.58	1.05	0.003	-0.773
68	Jourian	Jammu	Akhnoor	32.83314	74.57702	7.12	680	0	329.4	15.4	43.8	0.1	32.3	0	112.6	16.6	9.6	0.4	349.98	2.4	0.223	-1.601
69	Bakora	Jammu	Khour	32.80618	74.56198	7.12	470	0	268.4	8.3	3.9	0.25	23.3	0	83.6	11.9	3.9	0	258.09	0	0.106	-0.763
70	Dhanpur	Jammu	Khour	32.80257	74.54016	7.3	640	0	341.6	7.8	34.5	0.08	32	0	117.7	11.3	9.6	0.2	340.87	10.95	0.226	-1.219
71	Pangli Colony	Jammu	Khour	32.78895	74.52130	7.24	900	0	567.3	13	2.7	0.19	34.9	0	172.7	17.6	12.2	3.6	504.36	5.03	0.236	-0.790

72	Hamirpur Sidhar	Jammu	Khour	32.77652	74.52564	7.09	1730	0	652.7	94.7	168	0.19	194.4	0	249.7	56.3	77.9	15	856.51	26.1	1.157	-6.434
73	Senth	Jammu	Khour	32.77649	74.50986	7.17	1100	0	628.3	36.2	11.9	0.24	62.9	0.75	175.4	31.9	32.8	0.5	570.10	6.02	0.597	-1.105
74	Khour	Jammu	Khour	32.82944	74.51729	7.09	750	0	433.1	9.2	21.8	0.09	35.4	0	150.8	11.8	5.02	0	425.68	7.07	0.106	-1.416
75	Gigrial	Jammu	Khour	32.79614	74.48177	7.23	960	0	475.8	35.5	11.6	0.25	63.9	0	141	23.1	25.3	20.1	447.80	1.32	0.520	-1.158
76	Palatan	Jammu	Khour	32.83703	74.44860	7.32	620	0	341.6	10.6	8.2	0.16	34.8	0.33	108.6	12.7	9.2	0.3	323.89	2.64	0.222	-0.880
77	Kachrial	Jammu	Khour	32.86570	74.43846	7.15	380	0	207.4	4.9	3.5	0.21	21.7	0	70.9	7.3	0.86	0.2	207.37	0.5	0.026	-0.748
78	Bhagwana Chak	Jammu	Bhalwal Brahmana	32.85605	74.56949	7.29	760	0	396.5	18	40.3	0.31	27.7	0	110.6	23.7	21.3	0.2	374.27	2.45	0.479	-0.988
79	Taryai	Jammu	Bhalwal Brahmana	32.86955	74.61340	6.85	410	0	213.5	10.1	27.1	0.16	6.7	0	58	11.8	11.9	0	193.68	0.52	0.372	-0.375
80	Kalah	Jammu	Samwan	32.92074	74.44842	7.17	450	0	244.0	9.8	7.8	0.17	16.4	0	71	10.6	7.7	1.4	221.23	3.44	0.225	-0.426
81	Jogwan	Jammu	Samwan	32.93246	74.44182	7.33	760	0	384.3	12.4	29.1	0.22	17.8	0	127.3	13.3	7	0.5	373.12	1.67	0.158	-1.164
82	Baradow	Jammu	Samwan	32.90927	74.42506	7.02	490	0	305.0	6.5	6.9	0.16	8.9	0	86.9	9.1	7.4	0.1	254.79	1	0.202	-0.097
83	Tanda Sheeda	Jammu	Akhnoor	32.97218	74.69882	6.63	310	0	170.8	8.3	6.5	0.13	8.1	0	44.5	10.4	2.8	0.67	154.15	0	0.098	-0.284
84	Chowki Chora	Jammu	Akhnoor	33.02236	74.65152	7.27	610	0	305.0	35.2	12.3	0.25	23.9	0	77.2	16.4	16.8	21	260.66	3.65	0.452	-0.215
85	Bhamlba	Reasi	Reasi	33.05186	74.57709	7.01	1230	0	579.5	73.8	80.9	0.19	47.5	0	194.5	17.9	71.9	1	560.09	13.8	1.321	-1.705
86	Dadua	Reasi	Reasi	33.07164	74.63972	7.05	770	0	445.3	27.4	12.9	0.19	17	0	139.7	17.2	10.2	0.2	420.21	2.4	0.216	-1.107
87	Garan Jagir	Reasi	Reasi	33.07087	74.64886	7.43	740	0	481.9	8.4	4.5	0.26	13.9	0	119	22.6	14.5	0	390.73	6.16	0.319	0.083
88	Nanora	Reasi	Reasi	33.12806	74.63107	7.26	660	0	390.4	16.4	5.5	0.22	19.2	0	91.4	26.7	8.4	0.2	338.65	2.1	0.198	-0.375
89	Thangrot	Rajouri	Sunderbani	33.14179	74.58825	7.19	760	0	402.6	29	15.6	0.23	24.6	0	116.3	25.3	12.9	0.3	395.12	3.92	0.282	-1.305
90	Aliyah	Reasi	Reasi	33.16501	74.55299	7.06	780	0	512.4	10.6	10.4	0.21	13.7	0.65	153.5	17.3	1.9	0.5	455.12	1.66	0.039	-0.705
91	Thanda Pani	Rajouri	Sunderbani	33.06726	74.48680	7.14	840	0	445.3	34.76	17.2	0.2	41.5	0.66	149.9	15.4	19.76	0.2	438.28	7.14	0.410	-1.468

92	Marchola	Rajouri	Sunderbani	33.08843	74.47842	7.26	670	0	420.9	10.03	8.5	0.18	13.3	0	126.1	12.02	7.1	0.3	364.84	1.55	0.162	-0.399
93	Channi Parat	Rajouri	Sunderbani	33.08734	74.46401	7.26	970	0	488.0	31.1	21.5	0.36	26.3	0	106.1	13.6	68	0.5	321.36	10.9	1.649	1.570
94	Siot	Rajouri	Nausheera	33.11282	74.37883	7.11	940	0	451.4	34.1	24.4	0.25	26.1	0	108.15	20.05	45.32	0.73	353.09	17.4	1.049	0.336
95	Dharamshal	Rajouri	Kalakote	33.13846	74.40566	7.07	1030	0	634.4	22.2	23.3	0.19	18.64	0	127.8	44.5	33.05	0.1	503.08	3.4	0.641	0.335
96	Lower Kharak	Rajouri	Kalakote	33.16623	74.41646	6.97	790	0	494.1	13.7	12.8	0.22	14.5	0	136.4	24.6	10.8	0.3	442.49	5.6	0.223	-0.752
97	Solki	Rajouri	Kalakote	33.16056	74.43281	7.49	920	0	585.6	12.6	5.8	0.29	9.2	0	69.7	30.2	90.2	0.3	298.84	2.17	2.269	3.620
98	Panja	Rajouri	Kalakote	33.18007	74.41573	7.06	860	0	494.1	20.1	26.9	0.3	20.8	0	139.2	24.3	21.1	0.2	448.25	5.07	0.433	-0.868
99	Dayala	Rajouri	Kalakote	33.23638	74.36884	7.08	520	0	311.1	7.8	4.4	0.15	10.8	0	90.3	10.6	8.9	0.3	269.48	1.36	0.236	-0.291
100	Potha	Rajouri	Nausheera	33.28119	74.31813	7.21	770	0	445.3	12.98	16.4	0.21	17.92	0	131.9	16.6	13.94	1.12	398.23	3.35	0.304	-0.667
101	Chittiar	Rajouri	Rajouri	33.28666	74.28340	7.16	420	0	250.1	5.8	2.56	0.18	6.56	0	65.6	10.4	7.06	0.2	206.90	0.51	0.213	-0.039
102	Nariyan	Rajouri	Nausheera	33.19673	74.26153	7.26	340	0	195.2	7.4	2.4	0.14	7.4	0	58.9	6.45	3.97	0.2	173.86	0.43	0.131	-0.278
103	Naunihal	Rajouri	Nausheera	33.17182	74.21290	7.16	860	0	433.1	33.5	28.6	0.23	26.5	0	123.2	23.9	18.5	0.3	406.60	7.07	0.399	-1.034
104	Bhatta Morch	Rajouri	Nausheera	33.21475	74.18760	7.54	730	0	439.2	14.77	9	0.3	21.7	0	72.9	7.5	84	0.3	213.19	3.2	2.501	2.934
105	Darhal Quilla	Rajouri	Nausheera	33.22426	74.15048	7.12	690	0	451.4	10.6	5.1	0.2	15.99	0	130.9	11.2	8.74	0.5	373.45	5.98	0.197	-0.072
106	Pokharni	Rajouri	Nausheera	33.27138	74.11382	7.22	680	0	469.7	12.75	7.1	0.21	12.7	0	96.4	23.1	33.9	0.1	336.30	3.76	0.804	0.972
107	Lam	Rajouri	Nausheera	33.24969	74.12700	7	870	0	439.2	29.84	31.7	0.14	24.4	0	145.9	15.9	14.6	0.3	430.34	6.18	0.306	-1.409
108	Laroka	Rajouri	Nausheera	33.23559	74.09685	7.12	710	0	366.0	26.4	18.8	0.17	25.5	0	124.4	13.7	11.7	0.2	367.52	5.34	0.265	-1.352
109	Jhangar	Rajouri	Nausheera	33.24038	74.04722	8.98	1250	27.9	378.2	101.1	7.8	1	61.6	0	19.8	3.75	233	0.6	64.97	0	#####	5.829
110	Kalsian	Rajouri	Nausheera	33.18439	74.13907	7.08	670	0	396.5	14.9	7.12	0.28	15.3	0	107.2	17.5	13.1	0.3	340.19	3.04	0.309	-0.306
111	Chowki Handa	Rajouri	Nausheera	33.17314	74.16993	7.34	880	0	433.1	54.3	2.6	0.2	31.7	0	120.1	24.3	38.1	0.2	400.50	3.77	0.828	-0.912
112	Bagnoti	Rajouri	Nausheera	33.14259	74.30329	7.21	900	0	433.1	50.3	23.2	0.25	31.6	0	137.3	18.1	35.1	0.3	417.92	7.96	0.747	-1.261
113	Bakhar	Rajouri	Sunderbani	33.08796	74.42747	7.15	630	0	384.3	11.2	3.69	0.19	16.5	0	116.8	12.3	8.2	0.4	342.74	3.28	0.193	-0.557

114	Salote	Rajouri	Sunderbani	33.05008	74.52439	7.13	570	0	256.2	34.2	9.7	0.22	29.3	0	81.9	18.5	11.6	0.2	281.07	1.59	0.301	-1.423
115	Banpari	Rajouri	Sunderbani	33.03672	74.45662	7.27	1000	0	475.8	38.9	50.9	0.16	54.4	0	152.1	23.9	36.3	0.6	478.85	5.1	0.721	-1.780
116	Ainpur	Rajouri	Sunderbani	33.04224	74.44648	7.36	650	0	402.6	9.7	9.7	0.26	13.4	0	95.1	19	18.1	0.3	316.13	3.59	0.443	0.275
117	Dhok Baniyar	Rajouri	Sunderbani	33.03217	74.41236	7.2	780	0	475.8	24.2	18.5	0.18	20.5	0	137	22.9	17.4	0.2	436.97	3.9	0.362	-0.942
118	Baja Bain	Rajouri	Sunderbani	33.05442	74.41358	7.07	690	0	390.4	15.4	14	0.17	18.5	0	106.4	18.3	15.35	7.6	341.50	0.57	0.361	-0.432
119	Kangri (Grid Station)	Rajouri	Sunderbani	33.06050	74.39161	7.3	660	0	378.2	14.1	8.9	0.25	22.5	0	110.6	16.6	13.5	0.3	344.98	4.05	0.316	-0.702
120	Jabah	Rajouri	Naushera	33.06832	74.34353	7.17	730	0	353.8	24.3	15.8	0.22	20.8	0	100.2	17.12	13.1	0.3	321.13	2.14	0.318	-0.624
121	Gahgrot	Rajouri	Naushera	33.09740	74.26500	7.21	770	0	420.9	21.1	21.3	0.22	33.6	0	99.5	27.7	22.8	0.2	363.02	3.92	0.520	-0.363
122	Bareri	Rajouri	Naushera	33.15537	74.22511	7.38	1440	0	512.4	154.2	42.2	1.18	58.17	0	86.1	28.6	172.5	0.9	333.24	18.73	4.109	1.733
123	Rumli Dara	Rajouri	Naushera	33.12257	74.21787	7.08	620	0	311.1	14.4	11.3	0.27	15.2	0	71.7	17.9	19.7	0.2	253.09	0.898	0.538	0.036
124	Kalal	Rajouri	Naushera	33.08024	74.23302	7.08	760	0	414.8	17.5	32.4	0.2	21.8	0	107	23	17.7	0.5	362.38	2.15	0.404	-0.450
125	Ding	Rajouri	Naushera	33.08785	74.27630	7.23	1110	0	488.0	55.1	52.7	0.35	66.8	0	137.5	51.2	26.8	0.3	554.97	6.5	0.495	-3.102
126	Seri	Rajouri	Naushera	33.08330	74.28732	7.28	1540	0	512.4	126.5	126	0.19	103.2	0	125.47	71.1	95.1	0.2	606.99	2.93	1.678	-3.743
127	Sial	Rajouri	Naushera	33.07292	74.31577	7.33	680	0	347.7	18.5	8.3	0.28	22.9	0	75.8	21.5	25.2	0.3	278.20	2.94	0.657	0.134
128	Cherkut	Kupwara	Sogam	34.54444	74.32639	7.12	290	0	146.4	9.2	9.2	0.21	10.1	0.44	36.05	8.9	11.36	3.14	126.84	0.03	0.439	-0.138
129	Lassipora	Kupwara	Sogam	34.50806	74.38306	6.71	480	0	164.7	43.4	51.9	0.13	12.6	0.58	53.3	14.55	29.06	0.2	193.27	0.019	0.909	-1.166
130	Lalpora (Shalgund)	Kupwara	Sogam	34.50194	74.42778	7	420	0	183.0	31.2	3.1	0.13	9.55	0	56.3	10.7	13.3	0.5	184.89	0	0.425	-0.699
131	Mir Mohalla (Katyan Wali)	Kupwara	Kalarooch	34.54444	74.38472	7.14	150	0	73.2	6.45	4.26	0.13	9.87	0	23.05	4.6	2.05	0.8	76.60	0	0.102	-0.332
132	Guse	Kupwara	Kupwara	34.53861	74.27972	6.91	470	0	140.3	39.4	30.9	0.15	29	0	48.3	13.7	24.1	0.2	177.27	0.004	0.787	-1.246

133	Drugmulla	Kupwara	Drugmulla	34.50556	74.28694	7.19	460	0	237.9	19.13	10.4	0.11	11.4	0	75.02	9.75	10.04	0.3	227.77	0.93	0.289	-0.657
134	Bramri	Srinagar	Nutnoosa	34.46611	74.27833	6.97	980	0	298.9	99.5	47.8	0.15	44.4	0	86.2	29.4	68.3	0.1	336.79	0.226	1.618	-1.837
135	Badran	Baramulla	Wagoora	34.09306	74.57639	6.75	230	0	115.9	9.55	9.55	0.09	8.04	0	35.9	5.98	4.2	0.3	114.42	0	0.171	-0.389
136	Waripora	Baramulla	Wagoora	34.09056	74.56111	6.68	190	0	85.4	7.9	8.4	0.09	8.24	0	30.2	4.1	3.1	0.1	92.41	0	0.140	-0.449
137	Wadipora	Kupwara	Rajwar	34.40972	74.23333	6.67	490	0	219.6	27.6	19.3	0.13	14.8	0	67.5	15.5	11.6	0.3	232.69	0	0.331	-1.055
138	Chanjmul	Kupwara	Rajwar	34.39167	74.18222	6.87	320	0	158.6	10.6	11.2	0.13	7.1	0	50.1	8.7	1.72	0	161.14	0	0.059	-0.624
139	Handwara al Mustafa Colony	Kupwara	Handwara	34.40444	74.27833	6.99	610	0	225.7	46.2	26.1	0.15	30.1	0	77.5	15.5	24.4	0.1	257.69	0.2	0.661	-1.455
140	Radbug	Kupwara	Nutnoosa	34.46056	74.30250	6.95	920	0	347.7	107.6	9.37	0.19	36.7	0	117.2	28.4	40.66	0.2	410.16	0.58	0.873	-2.505
141	Tarich	Kupwara	Nutnoosa	34.43556	74.32556	6.77	320	0	170.8	13.3	5.8	0.14	7.54	0	46.5	9.66	7.7	0.1	156.10	0	0.268	-0.323
142	Chowgal	Kupwara	Handwara	34.40583	74.32056	7.17	570	0	329.4	9.12	10.8	0.15	15.7	0	93.18	17.9	4.15	0.2	306.79	1.74	0.103	-0.738
143	Panipora (Sagipora)	Kupwara	Handwara	34.41222	74.36444	7.03	320	0	176.9	7.24	11.9	0.15	7.03	0	49.95	9	4.83	0	162.00	0	0.165	-0.341
144	Gulooora	Kupwara	Langate	34.38750	74.31583	7	200	0	97.6	4.6	2.7	0.21	3.36	0	26.43	4.76	2.63	0.1	85.71	0	0.124	-0.115
145	Khanpora	Kupwara	Magam	34.43861	74.27306	6.98	510	0	256.2	30.7	11.1	0.18	14	0	73.76	15.8	10.6	0.2	249.58	0	0.292	-0.793
146	Magam	Kupwara	Magam	34.46083	74.23278	7.1	680	0	347.7	36.7	13	0.19	14.33	0	94.37	24.21	18.86	0.3	335.80	0.714	0.447	-1.018
147	Dolipora	Kupwara	Taratpora	34.46920	74.16206	7.16	590	0	213.5	61.84	3.35	0.18	15.35	2.7	61.96	20.7	21.9	2.29	240.30	0.182	0.614	-1.307
148	Dohama	Kupwara	Taratpora	34.48806	74.14750	7.3	760	0	298.9	52.9	40.4	0.18	35.24	0	95.66	33.7	12.3	0.2	378.18	0	0.275	-2.665
149	Taratpora	Kupwara	Taratpora	34.46972	74.11694	7.28	650	0	317.2	39.66	9.4	0.24	13.1	0	82.5	24.4	17.7	0.1	306.91	1.14	0.439	-0.940
150	Panzgam - II	Kupwara	Kralpora	34.48338	74.07706	7.04	430	0	219.4	21.4	3.5	0.22	13.3	0	55.5	16	12	1.8	204.76	0.083	0.365	-0.500
151	Batpora Bala	Kupwara	Kralpora	34.49444	74.08889	6.33	160	0	67.1	10.5	3.35	0.13	11.1	0	19.2	4.97	8.6	0	68.50	0	0.452	-0.270
152	Wasar Khoto	Kupwara	Kralpora	34.50639	74.10611	6.56	290	0	146.4	14.84	4.34	0.1	8.1	0	45.4	7.2	6.2	0.1	143.20	0	0.225	-0.465

153	Trehgam	Kupwara	Trehgam	34.51667	74.17528	6.95	880	0	439.2	30.5	8.9	0.18	28.4	0	114.7	26.9	21.66	0.5	397.72	3.11	0.472	-0.757
154	Gulgam	Kupwara	Trehgam	34.53694	74.21944	7.21	740	0	323.3	41.8	22.2	0.25	25.8	0	79.4	20.8	40.4	7.8	284.31	0.285	1.042	-0.388
155	Halmathpora (Chota Mohalla)	Kupwara	Ramhal	34.57083	74.23639	6.98	400	0	189.1	21.67	11.1	0.24	9	0	55.97	10.7	13	0.2	184.07	0	0.417	-0.582
156	Kupwara Main chowk	Kupwara	Kupwara	34.52778	74.25917	7.14	310	0	134.2	21.9	3.85	0.25	9.7	0	37.44	8.8	11.9	0.1	129.90	0.038	0.454	-0.399
157	Bomai	Baramulla	Tujjer Sharief	34.35639	74.42139	7.52	930	0	451.4	62.4	5.9	0.21	29.3	0	122.36	30.33	37	0.5	431.02	3.6	0.775	-1.223
158	Sopore Model Town D	Baramulla	Sopore	34.30497	74.44354	7.21	870	0	359.9	59.9	20.8	0.21	23.2	2.3	98.43	15.8	50	11.2	311.26	0.514	1.232	-0.327
159	Regal Chowk	Srinagar	Srinagar	34.07278	74.81694	7.48	690	0	353.8	39.4	2.98	0.12	16.3	0	92.5	28.7	13.5	0.2	349.65	1.4	0.314	-1.195
160	Urwan (Warwan)	Pulwama	Kakpora	33.93083	74.88500	7.85	430	0	304.8	4.33	2.48	0.32	4.55	0	47.1	28.1	9.33	0.1	233.67	0	0.265	0.322
161	Mirgund	Baramulla	Singhpora	34.14083	74.65333	7.58	890	0	553.8	23	4.1	0.25	25.17	0	100.4	32.1	60.3	0.767	383.43	2.29	1.339	1.406
162	Dusilpora	Baramulla	Singhpora	34.16944	74.61278	6.81	1220	0	578.6	66.98	8.6	0.2	59.6	0	147.3	36.9	43.5	0.2	520.48	4.8	0.829	-0.927
163	Lolipora	Baramulla	Pattan	34.21639	74.53639	6.69	1520	0	528.9	167.8	6.5	0.16	72	0	172.99	33.2	49.3	39	569.44	6.558	0.898	-2.721
164	Authoora	Baramulla	Pattan	34.21389	74.46583	6.89	810	0	479.1	34.74	2.5	0.15	12.9	0	142.6	15.2	24.46	0.3	419.21	1.488	0.519	-0.533
165	Jambazpora	Baramulla	Baramulla	34.21917	74.36333	6.9	680	0	410.7	24.8	3	0.2	11.7	0	89.5	21	31.97	0.2	310.38	0.083	0.789	0.522
166	Uplna	Baramulla	Baramulla	34.20083	74.39750	6.8	1140	0	522.6	54.78	120	0.22	48.32	0	190	24.4	43.9	4.87	575.66	4.38	0.796	-2.949
167	Binner	Baramulla	Baramulla	34.23194	74.35528	7.2	850	0	504.0	31.22	4.7	0.27	16.4	0	132.22	27.11	18	0.3	442.39	1.25	0.372	-0.589
168	Kunel	Kupwara	Langate	34.33222	74.28528	6.83	450	0	273.8	7.3	4.7	0.21	7.2	0	65.8	14.5	8.8	0.2	224.32	0.723	0.255	0.000
169	Hampora	Handwara	Qaziabad	34.35639	74.32722	6.75	1130	0	547.5	98.7	8.9	0.22	26.5	0	166.7	24.3	38.9	0.7	517.00	2.1	0.744	-1.367
170	Tral	Pulwama	Tral	33.91335	75.04662	7.54	570	0	304.8	17.7	22.8	0.16	6.1	0	93.5	15.1	4	0.2	296.04	1.404	0.101	-0.926
171	Ranbirpora	Anantnag	Koviripora	33.74681	75.21501	7.38	370	0	230.2	5.3	6.3	0.46	7.2	0	67.8	8.15	0.965	0.3	203.12	0.007	0.029	-0.290

172	G H Bhat	Anantnag	Anantnag	33.85342	75.04994	7.08	420	0	267.5	5.4	2.5	0.09	3.2	0	48.9	14.7	20.05	0.1	182.89	0	0.645	0.726
173	Said pora	Baramulla	Bandipora	34.32111	74.46306	6.65	410	0	217.7	20.7	3.7	0.13	17.5	0	60.5	14.1	7.64	0.2	209.42	0	0.230	-0.621
174	Palpora	Kupwara	Qaziabad	34.34111	74.35778	6.72	390	0	199.1	18.3	9.05	0.19	11.66	0	55.5	9.03	12.3	0.7	176.00	0.194	0.403	-0.257
175	Mazbugh	Baramulla	Sopore	34.27806	74.42944	6.85	810	0	448.0	30.6	3.77	0.18	28.03	0	117	23	27.74	2.11	387.38	3.64	0.613	-0.406
176	Hadipora	Baramulla	Rafiabad	34.29139	74.39083	6.27	760	0	180.4	78.5	67.2	0.16	45.13	0	81	19.72	40.1	0.98	283.85	0	1.035	-2.721
177	Mandji	Baramulla	Sopore	34.36000	74.47194	7.8	1500	0	578.6	179.44	14	0.13	45.05	0	193	48	37.9	0.3	680.52	8.644	0.632	-4.128
178	Lalyal	Jammu	Jammu	32.66444	74.77389	7.9	1310	0	622.0	78.4	6.3	0.18	126.1	0	155.5	48.7	74	28	589.66	3.47	1.325	-1.600
179	Sohanjana	Jammu	Satwari	32.69722	74.74306	6.92	1130	0	578.0	34.1	14.5	0.16	75.5	0	154.1	38.4	0	51.5	543.67	4.82	0.000	-1.401
180	Makwal	Jammu	Jammu	32.69333	74.71694	7.26	1610	0	690.6	54.25	6	0.27	169	0	140	64	61.8	34.75	614.03	3.42	1.084	-0.963
181	Trikuta Nagar	Jammu	Jammu	32.71160	74.88000	6.83	880	0	379.5	27.8	52.4	0.32	55.3	0	100.6	30.4	32.5	9.1	376.91	3.12	0.728	-1.319
182	Chatta	Jammu	Satwari	32.69300	74.93440	6.7	500	0	278.0	4.12	9.46	0.29	15.6	0	85.7	8.2	8.4	1.1	248.08	0.566	0.232	-0.406
183	Birpur	Samba	Samba	32.65556	74.95167	6.78	660	0	348.4	9.05	16.6	0.24	20.2	0	112.2	6.91	12.5	0.45	309.01	1.62	0.309	-0.471
184	Maheen Charkan	Samba	Vijaypur	32.64972	74.98667	6.6	510	0	304.8	0.32	3.33	0.31	8.3	3.8	67.8	18.5	2.46	13.45	245.82	0.62	0.068	0.079
185	Kaluchak	Jammu	Jammu	32.65700	74.89200	7.1	990	0	609.7	8.58	6.26	0.56	29.55	0	66.3	46.7	92.11	4.8	358.41	0.81	2.115	2.824
186	Greater Kailash	Jammu	Jammu	32.68610	74.93050	6.92	740	0	392.0	9.4	29.5	0.22	20.9	0	123.6	12.73	12.71	1	361.52	0.46	0.291	-0.806
187	Satwari	Jammu	Jammu	32.68890	74.84580	6.95	820	0	416.8	17.96	42.9	0.14	34	0	95.75	35.21	24.93	0.775	384.63	1.24	0.553	-0.862
188	Miran Sahib	Jammu	R.S.Pora	32.64580	74.79470	6.98	1240	0	504.0	49.7	110	0.26	64.4	0	142.8	41.7	52.3	0.5	529.03	0.51	0.989	-2.321
189	Agre Chak	Jammu	R.S.Pora	32.62250	74.71583	7.18	540	0	267.5	4.7	13.7	0.37	31.6	0	75.8	18.8	5.75	0.1	267.06	0.877	0.153	-0.957
190	Bera	Jammu	R.S.Pora	32.61900	74.67700	7.2	550	0	311.1	0	10.7	0.51	27.57	0	84	17.3	6.02	0.2	281.37	0.69	0.156	-0.529
191	Bega	Jammu	R.S.Pora	32.61472	74.66806	7.22	620	0	367.1	0	6.7	0.57	29.8	0	73.98	30.35	18.22	1.35	310.16	2.99	0.450	-0.187
192	Suchet garh II	Jammu	R.S.Pora	32.56750	74.67556	7.28	1310	0	703.0	45.4	5.6	1.16	67.2	0	63	81.7	115.1	1.9	494.55	7.44	2.250	1.630
193	Sei Khurd	Jammu	R.S.Pora	32.50750	74.72472	7.01	1330	0	572.4	41.62	89.6	0.4	67.94	0	124.9	32.5	75.2	45.24	446.33	5.88	1.548	0.454

194	Nikowal	Jammu	R.S.Pora	32.50830	74.70560	7.21	1040	0	640.8	21.44	6.46	0.53	30.8	0	78.2	57.3	78.8	2.74	431.89	17.95	1.649	1.864
195	Salehar II	Jammu	Bishna	32.56028	74.81806	7.16	1090	0	572.4	22.02	5.7	0.25	54.6	2.13	66.97	39.1	33.6	109.1	328.73	1.07	0.806	2.806
196	Laswara	Jammu	Bishna	32.58500	74.83694	6.91	510	0	248.9	9.3	4.1	0.25	34.81	0	78.2	10.5	10.8	2.9	238.82	0.8	0.304	-0.697
197	Bishnah	Jammu	Bishna	32.60800	74.85700	7.2	1000	0	398.2	61.4	26.2	0.37	55.6	0	130.97	28.3	26.3	1.1	444.17	1.22	0.543	-2.358
198	Khairi (Bishnah)	Jammu	Bishna	32.58528	74.90639	7.21	1470	0	703.0	56.7	45.1	0.56	54.7	0	78.9	49.6	93.6	91.9	401.87	3.42	2.030	3.483
199	Palli	Jammu	Bishna	32.62694	74.88861	7.02	900	0	466.6	22.4	19.9	0.78	41.9	0	73.5	42.3	45.5	7.8	358.25	0	1.045	0.482
200	Uprala kanhal	Samba	Samba	32.63330	74.88330	7.26	1070	0	591.0	39.5	5.7	0.29	42.5	0	103.9	47.9	57.6	1.8	457.36	4.11	1.171	0.538
201	Bassi Kalan	Samba	Samba	32.63722	74.90139	7.09	710	0	367.1	32.9	15.6	0.21	19.7	0	97.7	27.6	15.6	1.29	358.11	3.84	0.358	-1.146
202	Kotli Charkan	Jammu	Bishna	32.61556	74.83417	7	1020	0	497.8	38.9	7.2	0.48	55.8	0	108.8	47.9	24.1	12.3	469.61	0.766	0.484	-1.234
203	Kothey Saini	Jammu	Bishna	32.57722	74.88167	6.82	830	0	398.2	21.4	42.5	0.41	53.2	0	94.4	34.5	36.9	2.8	378.33	1.28	0.825	-1.041
204	Rehal	Jammu	Bishna	32.56140	74.87610	7.05	630	0	385.8	1.59	2.8	0.46	20.35	0	56.9	32.4	31.7	2.25	275.91	4.9	0.830	0.804
205	Poal II	Jammu	Bishna	32.51000	74.82000	7.21	1220	0	572.4	34.9	39.9	0.5	85.3	0	126.6	37.3	71.2	13.2	470.38	4.9	1.427	-0.027
206	Arnia II	Jammu	R.S.Pora	32.52028	74.79861	7.69	460	0	298.6	0.12	2.8	0.63	7.9	0	28.2	22.1	42.5	0.8	161.67	6.8	1.453	1.660
207	Allah	Jammu	Bishna	32.51750	74.83667	7.27	1890	0	815.0	60.4	79	0.28	116	0	112.9	51.2	87.6	186.2	493.47	4.6	1.715	3.487
208	Nandpur	Samba	Samba	32.51810	74.88860	7.15	950	0	435.0	22	68.8	0.22	44.8	0	91.1	31.4	46.8	37.6	357.29	1.523	1.076	-0.017
209	Majua Laxmi	Samba	Samba	32.55520	74.91800	7.11	1100	0	560.0	24.2	18	0.37	56.4	0	79.4	55.7	27.4	47.2	428.29	3.98	0.576	0.612
210	Gho Rakawalan	Samba	Samba	32.55167	74.94889	7.07	1020	0	510.2	45.33	16.1	0.44	35.4	0	94.54	34.97	60.6	0.2	380.62	6.35	1.351	0.749
211	Gho Brahmna	Samba	Samba	32.55600	74.95410	7.27	2100	0	790.2	176.9	109	0.64	153.6	0	141.2	113.1	165.2	5.8	819.58	15.6	2.509	-3.442
212	Mahalshah Kalandrian	Samba	Samba	32.51028	74.94250	6.99	1100	0	647.0	21.3	6.54	0.79	34.2	0	95.77	37.5	86.9	0.18	394.13	10.7	1.903	2.721
213	Didyal	Samba	Samba	32.47030	74.95830	6.92	570	0	323.5	7.5	24.6	0.3	13.1	0	76	11.6	35.1	0.5	237.85	3.03	0.990	0.544

214	Gudwal	Samba	Samba	32.55000	75.00970	6.76	900	0	429.3	54.3	20.3	0.26	18.8	0	116.8	18.7	40.4	13.3	369.15	0.2	0.914	-0.348
215	Kainthpur	Samba	Samba	32.58750	74.97500	6.94	530	0	311.1	1.74	11	0.28	12.73	0	89.8	10.6	8.97	0.3	268.23	1.16	0.238	-0.266
216	Channi	Samba	Samba	32.62600	74.91900	7.21	1210	0	391.9	61.14	163	0.26	59.6	0	182.6	27.6	23.1	0.98	570.36	2.94	0.421	-4.985
217	Patli	Samba	Samba	32.60830	74.94580	7.35	1040	0	547.5	23	18	0.62	36.2	0	58	20.3	133.8	0.07	228.75	2.7	3.846	4.398
218	Kamila	Samba	Samba	32.60917	75.06528	6.74	340	0	186.6	1.54	3.02	0.2	18.11	0	58.4	5.47	5.26	1.06	168.57	0.96	0.176	-0.313
219	Nagrota Uttarbani	Samba	Samba	32.62389	75.06500	6.97	1040	0	435.5	40.7	82.2	0.32	47.4	0	146.44	23	29.34	17.9	460.98	4.27	0.594	-2.083
220	Uttarbani	Samba	Purmandal	32.64778	75.06361	7.13	740	0	448.0	10.2	2.8	0.18	24.4	0	88.24	38.6	16.3	7.5	379.84	1.82	0.364	-0.255
221	Mothian kalan	Samba	Samba	32.62300	75.06300	6.99	2200	0	578.4	213.2	398	0.44	96.7	0	235	99.63	82.1	45.23	998.51	12.18	1.130	#####
222	Dhora	Samba	Samba	32.61000	75.14000	7.15	840	0	416.8	33.25	9.34	1.6	39.1	0	124.65	16.1	25.8	14.6	378.04	3.86	0.577	-0.730
223	Nud	Samba	Samba	32.61250	75.14780	7.01	820	0	342.2	42.24	11.1	0.42	55.27	0	122.1	12.16	29.4	3	355.42	15.05	0.678	-1.500
224	Daboh	Samba	Samba	32.58580	75.10500	7.04	830	0	342.2	25.73	69.4	0.2	36.8	0	127.2	12.4	24.16	0.76	369.16	3.35	0.547	-1.775
225	Painthi	Samba	Samba	32.59303	75.15558	6.73	360	0	199.1	2.2	3.74	0.18	16.2	0	62.2	4.74	5.9	0.7	175.05	0	0.194	-0.238
226	Samba	Samba	Samba	32.55750	75.11920	6.81	1000	0	348.4	45.5	92.1	0.17	44.9	0	128.7	11.1	48.2	3.9	367.54	0.7	1.093	-1.641
227	Supwal	Samba	Samba	32.55830	75.06670	6.64	610	0	323.5	19.9	3	0.25	10.1	0	75.1	22.2	17	1	279.33	0.19	0.442	-0.285
228	Pangdour	Samba	Samba	32.50861	75.07222	6.96	550	0	435.5	1.5	2.8	0.64	6.8	0	95.1	21.6	15.1	2.7	326.86	1.08	0.363	0.600
229	Bengular	Samba	Samba	32.49440	75.06250	7.26	1210	0	597.3	38.9	42.2	0.34	49	1.56	142.1	24.7	54.9	54.7	457.15	2.72	1.116	0.646
230	Sadoh	Samba	Samba	32.47080	75.12500	7.11	820	0	410.0	15.7	37.4	0.38	34.4	0	99.9	30.1	29.4	2.5	373.92	1.71	0.661	-0.759
231	Raiyan	Samba	Samba	32.50830	75.12500	7.09	700	0	416.0	6.9	15.1	0.25	13.9	0	122.4	10.9	17.7	0.7	350.97	0.47	0.411	-0.202
232	Phalora	Kathua	Hira Nagar	32.47778	75.13417	7.16	880	0	454.0	25.9	15.1	0.52	31.9	0	62.4	21.1	92.5	0.3	243.05	3.13	2.580	2.579
233	Madun	Kathua	Hira Nagar	32.47100	75.16100	7.35	740	0	404.0	11.7	21.9	0.42	20	0	75.8	30.3	32.6	1.1	314.50	12.03	0.799	0.331
234	Naran	Kathua	Hira Nagar	32.50420	75.15420	7.39	680	0	404.0	4.8	21.2	0.3	12.4	0	91.9	24.3	22.9	1.5	330.00	2.18	0.548	0.021
235	Kootah	Kathua	Hira Nagar	32.51140	75.24170	6.76	650	0	280.0	34.4	30.6	0.23	22.4	0	80.8	15.2	29.6	7.8	264.71	0	0.791	-0.705

236	Nilcha	Kathua	Hira Nagar	32.55970	75.25420	7.13	320	0	199.0	1.1	8	0.29	7.6	0	52.2	8.2	7.5	1.5	164.33	0.32	0.254	-0.025
237	Patyari II	Kathua	Hira Nagar	32.54700	75.26500	7.24	660	0	404.4	9.4	4.3	0.24	13	0	95	16.6	19.5	1.6	305.98	1.36	0.485	0.508
238	Saida	Samba	Ghagwal	32.55100	75.29300	7.11	480	0	273.7	1.7	8.6	0.19	15.6	0	67	10.6	13.7	3.4	211.23	0.7	0.410	0.261
239	Nauni	Kathua	Hira Nagar	32.55806	75.30194	7.04	680	0	379.5	4.7	12.5	0.27	33.1	0	104	15.5	11.9	0.7	323.94	4.42	0.287	-0.260
240	Lokli	Kathua	Hira Nagar	32.54417	75.27333	6.71	260	0	149.3	0.45	7.7	0.15	12.6	0	48	3.7	3.8	0.6	135.26	0	0.142	-0.259
241	Raghu Chak	Kathua	Hira Nagar	32.48611	75.20417	7.02	550	0	304.8	9.2	3.7	0.25	17.5	0	77.6	12.9	15.8	1.7	247.22	1.12	0.437	0.051
242	Jasath	Samba	Samba	32.50400	75.20200	7.13	830	0	466.6	14.9	9.3	0.48	23.5	0	114.4	24.5	15.4	2.2	387.07	0.5	0.340	-0.095
243	Sanoora	Kathua	Hira Nagar	32.48778	75.17778	6.81	410	0	255.1	0.6	3.6	0.22	12.8	0	66.1	10.9	9.5	1.4	210.22	1.27	0.285	-0.024
244	Chan Khatrian	Kathua	Hira Nagar	32.48750	75.24580	6.86	380	0	230.2	0.04	4.6	0.38	11.8	0	64.4	6.7	8.3	0.8	188.64	0.49	0.263	0.000
245	Jandi (New)	Kathua	Hira Nagar	32.46250	75.24580	7.34	1020	0	542.0	25.7	8.4	0.36	34.8	0	126	25.4	22.6	29.2	419.79	1.49	0.480	0.487
246	Feruchak	Kathua	Hira Nagar	32.46800	75.27400	7.05	580	0	342.2	5.03	11.3	0.28	15.8	0	90.2	14.3	15.1	1.3	284.49	1.84	0.389	-0.082
247	Lale Chak	Kathua	Hira Nagar	32.45420	75.19780	6.92	620	0	336.0	20.8	4.5	0.27	20.2	0	86.8	14.23	25.4	1	275.70	4.15	0.665	-0.008
248	Dulme Chak	Kathua	Hira Nagar	32.43330	75.18330	7.1	510	0	330.0	0.43	5.5	0.21	7.98	0	69.95	17.4	17.1	1.07	246.66	2.39	0.473	0.475
249	Londi	Kathua	Hira Nagar	32.42500	75.21250	7.51	1870	0	827.5	74.7		1.71	152	0	94	138.6	135	10.3	806.78	10.92	2.066	-2.575
250	Karol Krishna	Kathua	Hira Nagar	32.39580	75.23610	7.61	1930	0	970.6	81.1	20.7	1.16	103.5	0	23.1	72.7	159.3	227.6	357.67	3.91	3.662	8.753
251	Gangu Chak	Kathua	Hira Nagar	32.40139	75.26278	7.4	1930	0	771.5	179.1	74.3	0.65	165	0	180	89.7	149.6	14.9	820.05	4.35	2.271	-3.758
252	Chakara	Kathua	Hira Nagar	32.41800	75.25900	6.95	2400	0	541.3	326.3	314	0.53	197.1	0	240	83.12	212.44	4.2	942.90	11.1	3.008	-9.987
253	Konthal	Kathua	Hira Nagar	32.42360	75.26030	7.02	770	0	379.5	25.6	19.2	0.47	41.2	0	99.33	24.8	31.8	1.32	350.64	2.19	0.738	-0.793
254	Chanranga	Kathua	Hira Nagar	32.48330	75.33060	6.68	280	0	168.0	0.22	5.7	0.18	11.7	0	41.22	6.2	9.8	0.73	128.63	0	0.376	0.181
255	Chapki Kalan	Kathua	Hira Nagar	32.44722	75.31472	6.68	330	0	193.0	0.3	4.2	0.19	12.12	0	45.2	10.4	9.73	2.4	155.90	0	0.339	0.045
256	Hore	Kathua	Kathua	32.42300	75.29100	7.13	280	0	168.0	0	8.3	0.16	9	0	44.8	4.7	8.33	1	131.39	0.13	0.316	0.125
257	Pansar	Kathua	Hira Nagar	32.37220	75.30640	7.59	810	0	566.2	0.37	10.5	0.37	19.1	0	81	44	43.5	2.6	384.02	0.41	0.965	1.599

258	Khanpur	Kathua	Hira Nagar	32.42500	75.35610	7.34	370	0	199.0	0.77	9.6	0.24	12.8	0	52.11	9.84	9.92	0.91	170.87	0.48	0.330	-0.156
259	Chakhariya	Kathua	Hira Nagar	32.38890	75.36670	7.21	510	0	292.4	2.63	12.6	0.19	15.14	0	82.2	8.1	11.2	4.4	238.92	1.77	0.315	0.014
260	Mukandpur	Kathua	Kathua	32.36940	75.36890	7.43	420	0	255.1	0.1	8.83	0.13	11	0	69.44	5.8	9.8	1.8	197.53	0.7	0.303	0.230
261	Kotepanu	Kathua	Kathua	32.34580	75.37580	7.18	470	0	278.0	1.66	3.6	0.22	16.4	0	75.6	8	13.1	1.7	222.00	0.91	0.382	0.116
262	Nagri	Kathua	Kathua	32.35000	75.43330	7.41	480	0	261.3	5.96	3.5	0.21	26.9	0	70.17	12.2	14.3	1.6	225.76	0	0.414	-0.233
263	Patiari	Kathua	Kathua	32.39580	75.44170	7.21	340	0	174.2	0.97	9.6	0.17	20.1	0	55.93	6.23	5.94	1.27	165.53	0	0.201	-0.456
264	Sumwan	Kathua	Kathua	32.39400	75.42000	7.1	430	0	242.6	0.11	8.5	0.18	16.36	0	71.1	7.36	8.96	1.28	208.11	1.34	0.270	-0.187
265	Bhagwal	Kathua	Hira Nagar	32.45000	75.36670	7	410	0	242.6	3.2	17.8	0.19	13.9	0	64	10.3	10.8	1.2	202.49	0	0.330	-0.074
266	Jindor	Kathua	Kathua	32.39200	75.59700	7	400	0	192.9	4.13	15.3	0.28	19.3	0	52.4	9.1	15.7	1.93	168.54	0	0.526	-0.210
267	Barni	Kathua	Kathua	32.40200	75.65600	7.25	360	0	211.5	1.02	8.01	0.26	10.3	0	47.4	13.03	9.51	0.43	172.25	0	0.315	0.021
268	Lakhanpur Fort	Kathua	Kathua	32.38100	75.60000	6.65	280	0	130.4	5.55	10.2	0.22	23.33	0	37.68	7.14	10.25	3.73	123.66	0	0.401	-0.336
269	Kerian Ramnagar	Kathua	Kathua	32.28083	75.51944	7.04	720	0	373.3	1	8.2	0.33	79.6	0	118.2	20.1	9.07	3.6	378.42	12.13	0.203	-1.451
270	Kathua	Kathua	Kathua	32.36390	75.52920	6.73	420	0	174.0	17.97	10.8	0.16	29.7	0	36.7	8.95	35.8	4.4	128.67	0	1.372	0.278
271	Kothian	Kathua	Kathua	32.36670	75.50830	6.56	390	0	118.0	12	33.4	0.17	38	0	46.2	10.2	13.1	1.31	157.58	0	0.454	-1.218
272	Khukhial	Kathua	Kathua	32.35000	75.46670	7.15	790	0	379.4	20.8	18	0.17	39.5	0	90.4	19.4	23.9	35.5	306.03	1.05	0.594	0.097
273	Nanke Chak (Sherpur)	Kathua	Kathua	32.38100	75.46800	6.53	250	0	112.0	3	9.66	0.12	22.4	0	30.14	6.33	8.08	4.12	101.46	0	0.349	-0.194