# CHAPTER-1

# INTRODUCTION

## 1.1 Introduction

Water is essential for human beings and the environment. It is abundant on the surface as well as beneath the surface referred as the ground water. All living organism have about 70% of water. It serves as a source of preserving the existence of life on the earth and the physiology of the human body because the average adult human body contains about 60% of water by body weight. The presence of water is essential for the proper functioning of daily life on earth. It supports in maintaining body temperature as well as the movement of oxygen, nutrients, and wastes to the cells and tissues of the body. In general, it can be stated that water plays a remarkable role in the social and economic foundation of life. Apart from it, water is widely used for a variety of applications, including drinking, residential, industrial, and irrigation. Therefore, while planning for development projects, it is essential to have more information about the water quality resources which exist in that region. Water quality is expected to deteriorate caused by different factors, including industrial growth, population growth, urban expansion, and technological advancement.

## 1.2 Global water scenario

Water occupies 71% of the earth's surface, known as "Blue Planet," however water is also available below the surface. The water availability is limited. About 0.5% of the total water on the planet is readily available for human consumption. This 0.5 % of water exists in several forms such as aquifer, river, lake, stream, reservoir, and rainfall etc. The other 97% of the planet's water is saline, that may be accessed by desalination. The remaining 2.5% is freshwater, which is either frozen as ice caps or preserved as underground. Water is allocated unevenly in various regions of the world. Only nine nations Brazil, Canada, China, Columbia, the Democratic Republic of the Congo, India, Indonesia, Russia, and the United States hold more than 60% of the world's freshwater resources. Water is distributed unevenly, even among these nine nations.

Oceans contain 97% of the earth's water, most of which is saline. Freshwater constitutes 3% of the earth's natural water supply and can exist in three different physical states: liquid, gas, or solid. In the polar regions, glaciers, ice caps, and permanent snowpack constitute around 69% of the fresh water of earth. The groundwater constitutes 30% of the earth's freshwater whereas rivers, reservoirs, and lakes only comprise 0.3% of the earth's freshwater (Kibona et al. 2009; Cassardo and Janes 2011; Lui et al. 2011).

Approximately 99% of the water is considered unfit for human consumption, and the remaining 1% of groundwater is challenging and expensive to obtain. About 0.0067% of the total water on the planet is fresh surface water that can be used for human consumption (Cassardo and Jones, 2011). In developed countries, per capita water availability was dropped to 60% in 1950 and would be lowered to 57–58% by 2025, whereas it was 30% in developing countries in 2000 and would be lowered to 23–24% by 2025. The increased demand for water and the continued exploitation of water resources both contribute to the development of broad risks associated with water stress. Water stress occurs when demand exceeds supply due to inadequate safe water availability and poor water quality.

### 1.3 India water Scenario

Water is a highly valuable and limited natural resource that plays an essential role in supporting human existence, livelihoods, ensuring food security, and promoting environmental sustainability. India, although possessing 18% of the global population and 2.4% of the total land area, is only blessed with just 4% of the world's renewable water sources. The availability of water is typically limited due to its uneven spatial and temporal distribution. The availability of water resources is expected to provide a significant challenge in the future, as there is a higher possibility of rising water-related concerns among diverse consumer segments caused by expanding global population, increasing demands of developing nations, and the impact of climate change (National Water Policy, 2012). India has the largest groundwater use globally (Biswas et al., 2013). Groundwater recharge in this nation largely derives from rainwater. The increasing demand for water is expected to continue as a result of the country's expanding economy along with its rapid population, hence increasing the scarcity of this vital resource in the future decades.

India is the biggest user of groundwater in the world because it uses more than a quarter of the world's groundwater every year, which is about 250 billion $m^3$. The groundwater is a valuable source for rural areas as it is estimated that more than 60% of irrigated crops and 85% of the water supply come from underground (Aquastat, 2010; Sishodia et al. 2016). Additionally, it is notable that around 85% of the Indian population resides in rural regions, relying predominantly on groundwater for both agricultural practices and drinking use. In India, a significant proportion of groundwater, approximately 70%, is allocated for irrigation purposes. However, it is significant that a substantial portion of the population, specifically 90% of the rural residents and 50% of urban residents, exclusively depend on groundwater to fulfil their domestic water requirements (Groundwater estimation committee, 2015). The quantity of water that is available in certain countries has been rapidly decreasing over the course of the last two decades (Jasrotia et al., 2016). In India, a significant portion of the population, approximately 0.6 million individuals, faces high levels of stress due to inadequate management practises and limited availability of freshwater resources (NITI Aayog report 2018). As per the findings of CGWB (2006), the total groundwater extraction in the country amounts to 231

BCM. Out of this, around 92% is utilized for agricultural irrigation purposes, while the remaining 8% is allocated for residential and commercial usage.

### 1.4 Chhattisgarh water scenario

The Ganga, Mahanadi, Narmada, and Godawari are among the most significant rivers in Chhattisgarh, India. The Mahanadi and Godawari rivers collectively account for 85% of the total area of the basin. Water has an essential part in promoting global growth, with particular significance in the vicinity of Chhattisgarh, where almost 80% of the population relies on agriculture as their primary source of livelihood. The estimated groundwater volume in Chhattisgarh is approximately 11,960 MCM, while the surface water volume is projected to be around 41,720 MCM. These figures represent 3.20% and 3.17% of India's total water resources, respectively (Water Resource SOE, Chhattisgarh).

Approximately 90% of the total average rainfall of the state are 1400 mm, occurs during the monsoon season (June to September). The temporal and spatial distribution of rainfall exhibits irregular patterns in the state. The groundwater potential of the State is determined to be 13.68 BCM, out of which 10.67 BCM, equivalent to 60% of the total, is considered to be safe and readily available for use. The expansion of water table in the state is primarily undertaken in the public and private sectors. It is regulated to the shallow aquifer zone located within 50 m of the surface. Currently, the present level of groundwater extraction in the state is at 20%, with potential for further expansion in the future (Water Resource SOI, Chhattisgarh).

### 1.5 Coal mining scenario in India

India is currently ranked fourth in terms of coal reserves and holds the third position among nations with the biggest global coal output. India is responsible for providing approximately 6.7% of the global coal reserves, which corresponds to 69% of the total energy use across nations (http://www.worldcoal.org/). The power sector consumed about

75% of total coal productions, while the remaining 25% of coal production are used by other industries like steel, fertilizer, cement, chemical, paper and many more medium and small-scale industry (http://www.indiacore.com/).

Approximately 95% of the coal reserves in India are distributed throughout 44 distinct coal fields situated throughout the peninsular region of the country. Coal India Limited (CIL) is a government-owned enterprise in India, operating as a public sector undertaking (PSU). It assumes responsibility for several essential procedures within coal mines, including coal planning, mining operations, and advancements. Several states in India, such as Chhattisgarh, Jharkhand, Madhya Pradesh, West Bengal, Orissa, Maharashtra, Tamil Nadu, Andhra Pradesh, Assam, and Meghalaya, play a significant role in the coal production industry. Approximately 88% of coal production in India is attributed to nine subsidiary companies of Coal India Limited (CIL), namely Southern Eastern Coalfields (Bilaspur), Eastern Coalfields Limited (West Bengal), Bharat Coking Coal Ltd (Dhanbad), Northern Coalfields Limited (Singrauli), Western Coalfields Limited (Nagpur), Mahanandi Coalfields Limited (Sambalpur), Singerani collieries company (Andhra Pradesh), North Eastern Coalfields Limited (Assam) and Central Coalfield Limited, (Ranchi).

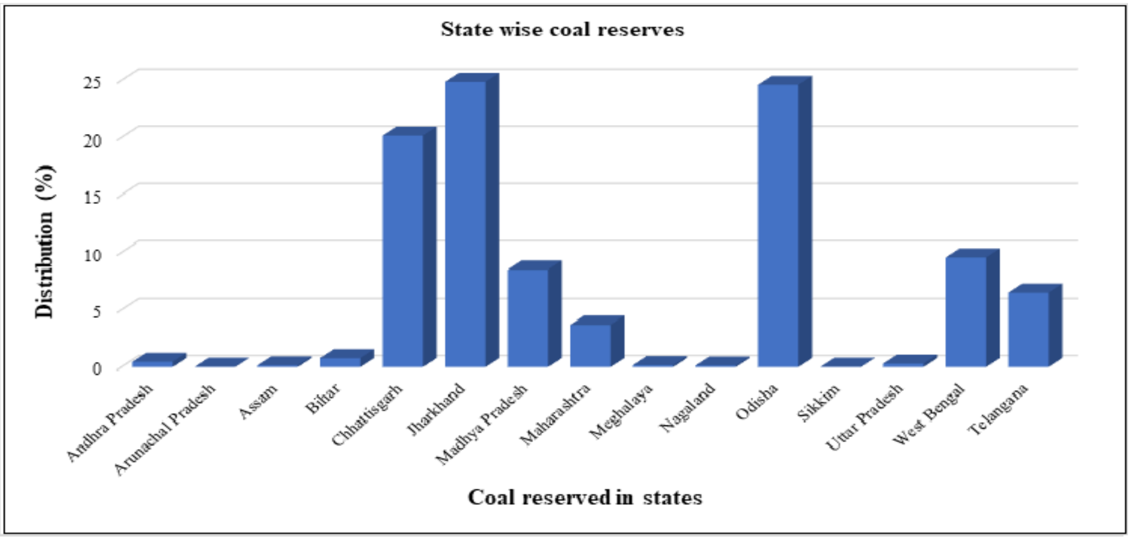


**Fig.1.1** State wise coal distribution in percentage in India (http://mopsi.nic.in/)

The coal deposits found in India can be classified into two main geological periods: Paleozoic (Gondwana) and Tertiary. Gondwana coal comprises around 98% of coal reserves and contributes to approximately 95% of the total coal output. Gondwana coals are found in 14 different basins across India, including central, north-eastern, and north-western sections of Peninsular India. Tertiary brown coal deposits are located in the northeastern and northwestern regions of India. The distribution of coal throughout different states, expressed as a percentage, is illustrated in the following Fig.1.1 (http://mopsi.nic.in/).

### 1.6 Water quality status of KCF Region

The current study is being made in the Korba Coalfield region, operated by South Eastern Coalfield Limited (SECL). The Korba Coalfield is responsible for the production of about 16% of India's coal reserves. Additionally, it serves as a significant electricity hub, having a thermal power output of 6,428 MW. In the vicinity of the Korba Coalfield region, a substantial mining work, in conjunction with many thermal power plants, is producing pollutants that have adverse effects on the surrounding environment and ecology. For example, water pollution is a significant concern in this context.

The primary river courses across the Korba Coalfield region include the Hasdeo, Lilagarh, Ahiran, and Mand rivers. The Hasdeo Bango Dam, which stands as the sole infrastructure built over the Hasdeo River, serves as the primary source of irrigation water for agricultural purposes. There are two additional streams in this area, known as Nalas, which are the Kholar Nala and the Dhengur Nala. The rain serves as the primary source for recharging the aquifer. It is the essential component for the rejuvenation of active groundwater. Environmental parameters such as water quality, metal concentrations, ambient air quality, and noise level are regularly monitored in the Korba coalfield region by monitoring agencies such as the Central Ground Water Board (CGWB) and Central

Mine Planning and Design Institute (CMPDI). Several academics have undertaken studies to assess the quality of surface and groundwater in the Korba Coalfield region (Singh et. al. 2016; Singh et. al. 2017; Singh R et. al. 2017; Chaurasia 2018; Singha and Pasupuleti, 2020).

Singh et al. (2017) stated the effect of coal mining on surface and ground water in the Korba Coalfield of Chhattisgarh. Multiple water samples were collected from various water sources and subjected to analysis for major ions, mine effluent parameters, and trace metals. The pH readings of both groundwater and surface water samples indicated a slightly acidic to mildly alkaline character. According to molar ratios, silicate weathering along with ion exchange is the major solute acquisition process affecting groundwater chemistry in the Korba Coalfield. The hydro-geochemistry of the mine region was primarily characterised by two unique facies, namely Ca-Cl-$SO_4$- and Ca-$HCO_3^-$. According to the Groundwater and River Water Quality Indices (GRWQI), around 82% of the water samples analysed were classified as falling within the "excellent" to "good" range and the remaining 12% of the samples were categorised as being of "poor" quality. Meanwhile, the Effluent Water Quality Indices (EWQI) show that 6 out of 8 samples fall into the "excellent" category. The concentration of Fe, Pb and Mn exceeded the permissible threshold, but the remaining elements remained within acceptable limits. The majority of the samples, as determined by Wilcox and USSL diagrams, fall into "good to permissible" category for irrigational usage. This study led to the conclusion that treating mine effluent water is strictly required.

## 1.7 Major pollutants from coal mining

The opencast and underground mines commonly discharge a substantial amount of wastewater that is heavily contaminated with TDS, TSS, Mn, Fe, hardness, heavy metals, sulphate, nitrate, and oil and grease. Turbidity in water is a good indicator of TSS (Tiwary

2001). TSS degrades the visual appeal of the water bodies. The accumulation of silt can, in severe situations, have an effect on the biological processes that occur in water bodies and can also lead to flooding. Heavy metals are generated by coal itself. The coexistence of pyrite ore with coal indicates a substantial concentration of iron (Fe), and the coal often exhibits the presence of Selenium. Additionally, the water body contains a variety of dissolved cations and anions such as $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $K^{+}$, and $SO_4^{2-}$, $Cl^{-}$, $NO_3^{-}$, $F^{-}$, $HCO_3^{-}$. The nitrates are mostly produced by actions such as rock explosions. The nitrate concentration can be detected in the pit water by leaching processes occurring under wet blast conditions. The lead in the mining sector is primarily caused by transportation. While, washing the equipment in mine workshop oil, and grease are expelled into the water. The reoxygenation of water can be hindered by the formation of a thin layer of oil on the surface of the liquid. The aquatic ecology is impacted by this oil contaminated water.

### 1.8 Heavy metals and their risk on environment and health

Water supplies in proximity to coal mines may exhibit elevated concentrations of heavy metals, a phenomenon commonly associated with low pH levels prevalent in mining regions. The Environment Protection Agency (EPA) states that there are essentially eight different types of heavy metal contaminants in mining region, including As, Cu, Cr, Cd, Pb, Ni, Zn, and Hg. The toxic effects of some important trace metals are significant from a pollution perspective.

Water pollution caused by heavy metals is a matter of great concern globally. However, most of heavy metals being dangerous and non-biodegradable, therefore it is categorized as hazardous toxicants. The persistence of heavy metal toxicity in natural environments has the ability to survive for a longer time (Wang and Chen, 2006). Studies indicate that a number of naturally occurring heavy metals, including As, Ag, Be, Cd, Cu, Co, Cr, Ni, Hg, Pb, Sn, Se, and Zn, are particularly hazardous to human health (Dubey 1985). These metals have many adverse health consequences on individuals, such as vascular damage, central nervous system, renal and hepatic damage, digestive disorders, and double necrotic alterations in the liver and kidney. They also pose a notable threat to both flora and fauna (Prasad et al. 2014). The heavy metals are becoming more hazardous to humans whenever they accumulate in living tissues throughout all levels of the food chain. Since heavy metals are so dangerous, it is frequently necessary to monitor their release into the environment from mines.

### 1.9 Role of Remote sensing & GIS

Remote sensing is an interdisciplinary integrative model often used to examine and monitor the environment. Geographic Information Systems (GIS) offer multiple perspectives for the analysis, assessment, and interpretation of remotely sensed data, enabling the creation of digital map representations (Ozel et al. 1999). The use of GIS and remote sensing data makes it easy to maintain accurate measurements of water quality, which enables continuous monitoring of water quality. Remote sensing and GIS enable the assessment of the environmental impact resulting from various forms of human activity, encompassing both natural and artificial factors. Remote sensing can be utilised to get multitemporal data, which can later be analysed and mapped using GIS.

This approach yields significant and valuable information on the patterns of changes in land use and land cover (LULC), as well as their dynamics (Zhang et al. 2002). The generation of a map of land use and land cover utilizing satellite images is one of the key uses of remote sensing (Bawahidi, 2005). The mapping of mining activities in large mining areas can be facilitated by analysing land use/land cover (LULC) changes and considering associated environmental problems. Continuous monitoring of LULC is crucial for the successful reclamation and management of the surrounding environment.

Therefore, it is crucial to carefully observe and analyze alterations in surface mining activity on a regional scale for a prolonged duration to differentiate between natural variations and those induced by associated human activities (Chitade and Katyar, 2010). It can also be used to analyse environmental degradation with respect to the air, land, water, and vegetation. Additionally, it provides an in-depth analysis of the condition of mining locations as well as the impact that mining has had on the ecosystem of the surrounding area (Lamb, 2000; Joshi et al. 2006).

## 1.10 Coal mining and its environmental impacts

The feasibility of power generation is dependent on an abundant supply of coal, as well as the large production of fly ash associated with coal usage in India. In general, Indian coal has a lower net calorie content of less than 3000 kcal/kg and a relatively high ash level ranging from 30 to 35%. Coal is widely recognized as a vital and essential energy resource on a global scale. Approximately 41% of the global electricity supply is generated from the combustion of coal in outdoor settings. Intensive coal mining operations have contributed to a number of environmental problems, including soil contamination, deforestation, land degradation, air and noise pollution, vibrations, and a decrease in the quality of surface and groundwater (Dutta et al. 2017).

### 1.10.1 Impact on groundwater quality

The waterbodies in and around mining areas are primarily affected by mining activities in terms of both quantity and quality. The groundwater resources are affected by mining activities at distinct intervals during the mine's life cycle or even when it closes. Several major processes that give rise to mine water issues includes the mining process, minerals processing activities, mine dewatering, flooding of mine workings, and the discharge of untreated water (Younger et al. 2002). Mining activities have several effects on the aquatic environment, including changes to hydrological routes, the introduction of hazardous effluent into basins, the release of saline mine water, and the reduction of the water table near the dewatered area. Mining activities pose a severe threat to groundwater reserves, causing the scarcity of drinking water in locations where mining is prevalent.

Mining projects, whether underground or opencast, produce significant quantities of water, and such water are frequently contaminated by mining activities, which can take place either on the surface or underground (Johnson 2003; Singh et al. 2012). While coal mining operations, a substantial volume of mine water and leachate from waste rock is discharged into natural drainage systems without undergoing any form of treatment. Water contamination caused by wastewater discharges is being one of the environmental issues concerned with the Indian coal industry (Choubey 1991; Gupta 1999). The effects of mining on water supplies depend upon several variables, such as mine location, hydrology and climate situation, the characteristics of the coal, the adjacent layers, and the refuse materials (Thompson 1980). Mining operations have the potential to affect aquifer potential, local water levels, and groundwater flow directions.

### 1.10.2 Impact on surface water quality

The surface water contamination issues in the mining area are occurring due to various factors, including the presence of training ponds, elevated sediment levels in streams, mine drainage, disruption of the hydrological cycle, and increased rainfall. The runoff water that collects around the mining area is likely to carry a significant quantity of suspended particles into the surface water bodies that are located in close proximity to the mine area. A long-term dataset on water quality together with water quality parameters are needed to assess the impacts of mining on surface water resources (Singh et al. 2016).

### 1.10.3 Impact on air quality

The extent of air pollution in opencast mines is typically quite high as compared to the extent of pollution seen in underground mining regions. Higher air pollution lowers the quality of the air by contributing gaseous pollutants and suspended dust. This has an impact not only mining operations but also the surrounding residential areas. The coal mining region has experienced significant air pollution due to many activities, including drilling, blasting, overburden and coal transportation, dust emissions from haul and transport roads, stockyards, coal handling plants, the exposed pit face and the mine workshop (CMRI, 1998). Mining sites are characterized by noticeably increased concentrations of suspended particulate matter (SPM), which have the potential to cause respiratory problems such as chronic bronchitis and asthma (http://www.enzenglobal.com/). The emissions in the mining region are only caused by vehicular traffic on the haul road, which accounts for 85% of the dust released by opencast mines. Some of the biggest pollutants in India are nitrogen dioxide, sulphur dioxide, and particle matter (Agrawal and Singh, 2000).

The movement and dispersion of particulate matter (PM) in the environment are influenced by various factors, including size, shape, density, type of particles, and area meteorology. While compared to PM 10 particles, PM 2.5 particles are able to remain suspended in the air for longer periods of time, travel longer distances, and enter the lungs directly, where they have a direct impact on the respiratory system when an individual is breathing. Particles that settle on the surface of the lungs can cause lung inflammation and tissue damage.

Coal is identified as a prominent source of greenhouse gas emissions resulting from human activities within the industrial sector. Coal production has been associated with the release of several greenhouse gases, including $CH_4$, $CO_2$, and $N_2O$. Methane gas is commonly released during underground mining operations, while the combustion of coal results in the production of $CO_2$, and $N_2O$, which are captured for the purpose of generating energy for industrial applications.

### 1.10.4 Impact on underground aquifer system

The topography of the mine, the process of aquifer recharge, and the characteristics of aquifer formations jointly influence the manner in which opencast coal mining impacts the local water regime. The mining operation frequently impacted surrounding features such as aquifer potential, water levels, as well as groundwater movement directions. As a result of blasting operations in coal mines, hydrogeological units adjacent to the working face being interrupted, fractures expand, and joints are becoming more dilated. The opencast coal mining primarily affects the confined aquifer located above the active seam, while the lower aquifer experiences the least amount of damage. The permeable beds behave as distinct hydrogeological units and form a multiple aquifers system due to stratification. As a result, the propagation of drawdown cones is constrained to a short distance from the mine edge.

### 1.10.5 Impact on human health

Air, water, and workplace accidents seem to be the primary causes of health issues in mining areas. The mineral, technology, mining type, and operating scale affected health and safety concerns. The lung problems seem to be more prominent in mining regions due to the high particulate matter concentration within those regions (Saha et al., 2011). The people residing in regions adjacent to underground mines would experience identical health risks associated with pollution resulting from transportation and related operations, similar to those individuals residing in proximity to open-pit mines (Mishra, 2010). The production of finer dust particles is an outcome of advancements in mining technology, posing potential risks to human health. The mining industry is a highly risky occupation, characterized by a significant risk of both immediate injuries and fatalities, as well as enduring health concerns related to asthma and cancer (Stephens and Ahern, 2001).

The study shows that people who live near coal mines are more likely to suffer from cancer, high blood pressure, heart disease, and kidney disease. higher mortality rates (Hendryx and Ahern, 2008). The individuals residing in the vicinity of mining regions may potentially be exposed to water that is contaminated with chemical waste and residual substances resulting from mining activities (Schatlez and Stewart, 2012). High humidity and temperatures can cause heat-related diseases which reduce mineworkers' efficiency (Maurya et al. 2015). Some of the diseases that can be communicated by airborne particles include tuberculosis, respiratory ailments, coughs and colds, stomach problems, eye difficulties, and skin conditions. Whereas, Certain diseases, such as joint pain and skin issues, were identified to be transmitted through water sources.

**1.10.6 Impact on nearby vegetations cover and soil properties**

Mining has a complex impact on vegetation, based on the types and intensity of mining. The transformation of the landscape that occurs during the expansion of coal fields may be responsible for additional damage to the nearby vegetations. The extraction of coal leads to several adverse effects such as surface subsidence, surface fractures, and alterations in surface microtopography, that affect neighbouring vegetation roots (He 2003). The combustion of coal fires results in significant areas of plants experiencing fading or mortality (Zhang et al. 2007; Sun et al. 2008). The farming community is adversely affected by the negative impacts of air pollution resulting from mining operations in multiple ways. It might result in a decrease of crop yield and nutritional value. The plants experience adverse effects, such as reduced yield and considerably lower agricultural output (Spash, 1997). Air pollutants that impact agriculture primarily include gaseous sulphur, nitrogen compounds, photochemical oxidants, ozone, and SPM.

The soil profile is frequently radically changes by coal mining, while nutrient and organic carbon reserves are lost (Indorante et al. 1981). The soil structure would consequently experience significant and enduring damage, resulting in a major effect on both ecosystem functionality and land productivity (Hartmann et al. 2014). Land subsidence is a detrimental consequence associated with mining activities. This phenomenon not only disrupts the integrity of the soil and alters its properties, but also gives rise to additional ecological and environmental issues. These include preventing the vegetation growth, reducing crop yields, degrading the landscape, diminishing agricultural land and topsoil, and various other complications (Bian et al. 2010; Haung et al. 2014; Kuter et al. 2014).

### 1.10.7 Impact on land cover

Land use and land cover (LULC) are having two important terms wherein, land use refers to human activities on the land that are often invisible in photography whereas, land cover refers to vegetation and artificial structures on the land surface (Lo 1986; Burley 1961). The land is a part of nature that mankind is using for material wealth, and exploitation of these resources leads to a change in land uses and land cover (Prakash and Gupta, 1998). Mining operations use advanced machinery and cutting-edge technologies, which have the potential to modify the hydrological land cover patterns of the surrounding region (Turner and Ruscher, 2004; Singh, 2007). Additionally, the associated challenges that negatively affect the regional land use include the clearing and degrading of forests and agricultural lands, large accumulation of solid waste in the form of massive overburden dumps, and many others. The utilization of data obtained through remote sensing would be beneficial in providing information regarding the alterations that occur over time in surface water and land cover in an area where mining is taking place. Remote sensing data seem to be highly useful for assessing environmental impact due to their broad spectral range, low cost, and speedy covering over huge areas.

### 1.10.8 Impact on Land surface temperature

Land surface temperature (LST) is a term that is often used to describe how warm the earth feels at its top (Weng 2001; Kayet et al. 2016). The Land Surface Temperature measured in degrees Celsius, represents the thermal energy emitted by the Earth's surface and is frequently influenced by rising amounts of greenhouse gases in the atmosphere. Coal is a significant source of greenhouse gas emissions from human activities in the industrial sector. Greenhouse gases, such as $CO_2$, $CH_4$, and others, are to cause for regional climate change and surrounding overheating. Acid rain affects groundwater and result in the formation of acid mine drainage (AMD), caused by an increase in $CO_2$ in the atmosphere, mainly due coal burning (Singh et al. 2009). Coal consists primarily of carbon on a chemical scale. Carbon dioxide gas traps the heat that is made when carbon and oxygen interact in the air. When carbon dioxide released into the atmosphere, it behaves as a layer that raises the temperature of the earth above its usual level.

### 1.10.9 Impact on water resource

The long-term coal mining has a considerable impact on the natural environment, as it reduces the quantity of surrounding water bodies from top of the earth surface. So far, the continual extraction of millions of tonnes of coal from the adjacent mining zone has disrupted and polluted nearby water sources such as ponds, canals, and mine sumps. Therefore, the water body around the mining zone changes continuously as a result of the mining operations. The surface water, such as streams, lakes, and even ocean water, can be contaminated by an accidental spill of harmful chemicals, waste material erosion, or mine water discharge (Jhariya et al. 2016). The infiltration of acidic water into groundwater results in the degradation of its acidity and subsequent reduction in its ability to dissolve heavy metals present in rock formations. Consequently, this process leads to a decline in the overall quality of the groundwater (Hudson, 2012).

## 1.11 Problem statement

Coal mines are often close to large water bodies that get polluted by mine waste, especially during the rainy season. Water is extensively used for numerous purposes, including drinking, domestic, commercial, and agricultural irrigation. Therefore, it is crucial to have wider awareness about the water quality resources available within the selected area while planning for development projects. A variety of factors including urbanisation, industrialization, and technological improvement in mine project, are projected to cause a decline in water quality.

A very few studies have been conducted to know about the impact of mining operations on surface and groundwater quality near to the mining region of the Korba coalfield, Chhattisgarh. Some of the researchers have conducted their studies on the quality of the surface and groundwater in the Korba region (Singh et. al. 2016; Singh et. al. 2017; Singh et. al. 2017; Dheeraj et al. 2023).

Hence, this study aims to assess the potential environmental impact of coal mining activities around the mining area on including (i) the quality of surface and groundwater around the mining area, (ii) analyse of heavy metals presence in groundwater, (iii) Land use land cover change analysis along with its accuracy assessment and (iv) Correlation analysis between LST with NDVI and NDWI.

## 1.12 Objective of the present study

Therefore, the primary objective of this thesis is to assess the impact of coal mining on ground and surface water in Korba coalfield region, Chhattisgarh India. The following studies have been done to achieve the goal.

1. Hydrogeochemical characterization and suitability analysis of ground and surface water for drinking and irrigation purposes

2. Heavy metals along with its exploratory data analysis of groundwater samples with special reference to different pollution indices such as HPI, HEI and MI
3. Land use/Land cover change (LULCC) analysis with its accuracy assessment by using remote sensing and GIS techniques for last 20 years satellite data (2001-2021)
4. Correlation studies of land surface temperature (LST) with Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) for last 20 years data

Thus, this chapter explains the background and significance of the study. The next chapter provides Literature survey, Study area, Materials and Methods, Results and Discussion and Conclusion and Future suggestion in details related to the objectives of this thesis.