CHAPTER 2

Literature survey and study area
ABSTRACT

The content of this chapter as literature survey related to the present study – Chromium Pollution, Physico-Chemical Characteristics of Borewell waters, Environmental Degradation, Briggs Equation, Center of Concentration, Dust Pollution in and around Tumkur city and also details about study area are presented.
In this section, the details of the previous investigations related to the subject embodied in the thesis are presented. This section comprises six subsections.

In the first subsection (2.1.1) we present literature survey related to chromium pollutions in the ground waters of an industrial area in and around Tumkur city, Karnataka, India.

In the second subsection (2.1.2) we present literature survey related to Physico-Chemical characteristics of bore well waters in and around Tumkur city.

In third subsection (2.1.3) Environmental degradation due to urbanization and industrialization in and around Tumkur district.

In fourth subsection (2.1.4) We present literature survey related to Brigg's plume rise equations arise in the study of atmospheric dispersion modeling proposed for bent-over hot buoyant plumes.

In 5th subsection (2.1.5) we present literature survey related to center of concentration. It helps in a better understanding of the concentration of emissions from an assortment of stacks of varying heights and different pollutant emissions.

In 6th subsection (2.1.6) we present literature survey related to effect of traffic on environmental pollution in Tumkur city.

2.1.1 Literature survey on chromium pollution

The phenomenon of environmental pollution has been the subject of intensive scientific investigation over the last five decades and many numbers of investigators have studied the phenomenon under different areas. It has already been mentioned that pollutant is a substance which causes pollution. Pollution is caused by the addition of substances by human activity to the environment. Hence, a large number of experimental investigations have been carried out under varying conditions of one or any of the physical parameters. We summarize in the following pages, the main conclusions of such investigation, which are useful for the present study.
Haniffa [1] studied more elaborately the hydrological studies on the channels of river for the assessment of water quality.

Almost all of the world’s water is located in the oceans, but as might be expected, the high concentration of salts renders the oceans virtually unusable as a source of water for municipal, agricultural or most industrial needs. The sun performs that desalination service for us, when it provides the energy needed to evaporate water, leaving the salts behind. Removing water from wet surfaces by evaporation and from the leaves of plants by transpiration. The combination of processes called evapotranspiration. Water vapour is transported by moving air masses and eventually condenses and returns to the earths surface as precipitation. Over the oceans, there is more evaporation than precipitation and over the land it is the other way around, more precipitation than evapotranspiration. The difference between precipitation and evapotranspiration on land is water that is returned to the oceans, both by stream flow and ground water flow, as run off, groundwater may emerge at the surface contributing to surface water.

Susheel Kumar [2] Investigated the ground water is increasingly dominated by Na and Cl in the down stream region indicating the influence of airborne salts with oceanic affinities. Significant spatial variation was observed in water level of Tumkur city. Water naturally accumulates a variety of dissolved solids or salts, as it passes through soils and rocks on its way to the sea. These salts typically include cations such as Sodium, Calcium, Magnesium and Potassium and anions such as chloride, sulphate and bicarbonate, while a careful analysis of salinity would result in a list of the concentrations of the primary cations and anions, a simpler more commonly used measure of salinity is the concentration of total dissolved solids.


Ground water in the study area forms the mainstay of domestic water supply source for meeting the community needs.
Leather production is a major industry in India, which make significant contribution to the countries. Foreign exchange earning and provides employment opportunities to about 3 million peoples. It is estimated that, 30-35 litres of water is used per kilogram of leather processed, generating about 680 million litres of effluent daily. During the process of leather making several chemicals like chromium sulphate sodium chloride and calcium hydroxide etc are extensively used. Therefore the resultant effluent is enriched with chromium and salts.

Emara [4] investigated, a comparative study on the levels of trace elements particularly chromium contamination in the ground waters.

In the study of ground water contamination, toxic chemicals are the principal pollutants of concern. The 25 most frequently detected contaminants found in ground water at hazardous waste sites. Nine of these contaminants are inorganic: lead (Pb) chromium (Cr), Zinc (Zn), Arsenic (As), Cadmium (Cd), Manganese (Mn), Copper (Cu), Barium (Ba) and Nickel (Ni). Most rocks and soils contain small amounts of chromium. The common one is chromite, chromium in its naturally occurring state is in a highly insoluble form.

Mondal [5] have reported, the process of leather making, several chemicals like chromium sulphate, sodium chloride and calcium hydroxide etc are extensively used. Therefore, the resultant effluent is enriched with chromium and salts.

Ramakrishnaiah [6] have studied the quality of ground water of Tumkur Taluk region Karnataka, India. Hardness in water is due to the presence of Ca++ and Mg++. The presence of Total Dissolved Solids (TDS) is an indication of the degree of contamination of water. It is observed that, all the wells are having good quality of water, calcium in excess in drinking water may lead to formation of kidney stones, chlorides and sulphates contribute for the permanent hardness. The result of analyses has been used to suggest separate models for rural and urban part of Tumkur Taluk for predicting water quality. The observations suggest that, there is need for regular monitoring of ground water quality.

Chromium pollution in the ground water in and around Tumkur city is lacking therefore we are taken up this work.
The present study attempts to capture the environmental impacts of industry effluent irrigation from a tanning industrial cluster.

In the recent years, ground water in the study area forms the mainstay of domestic water supply source for meeting the community needs. But the threat of chromium contamination in the ground waters is looming large over the study area. In view of this, it is of paramount importance to look for and to evaluate the chromium levels in the drinking waters of the area and assess their status of potability in the light of the criteria laid by Bureau of Indian standards. Chromate poisoning causes severe skin disorders such as allergic dermatitis, liver and kidney damage.

2.1.2 Literature survey on physico-chemical analysis of borewell waters

Jayanthi [7] studied that, industrial effluents have to be pre-treated to prevent interference in the clarifying processes. As these streams fulfill 80% of domestic water supply demand of the local community, all specified quality criteria must be met especially before the discharge. It is recommended that apart, from continuous collection of effluents for monitoring purposes, automated measuring and monitoring equipment be installed to check discharge parameters against stipulated standards for drinking water, aquatic life and other uses.

Prakash [8] investigated that, Study of ground water quality around Balavadi Industrial area and sewage farm in Mysore City, the results of investigation clearly indicating that, at Balavadi industrial area hardness of all the ground water samples are moderately high. All the samples show traces of nitrates and phosphate. The total dissolved solids value are too high.

Anand Sharma[9] investigated that, Ground water quality monitoring was carried out during financial year 2007. Water sample were collected from a number of hand pumps and tube wells and analyzed for all relevant parameters as per standard methods APHA 1995, Results were discussed with respect to possible impact on human health.

Ramakrishnaiah [10] investigated that, Ground water quality in Tumkur Taluk has special significance and needs greater attention of all concerned, since it is the
alternate source for domestic, industrial and human consumption, a GIS based ground water quality mapping of the region has been carried out by physico-chemical analysis.

Naveen Kumar Singh [11] studied ground water quality with references to the human health of Pichhore town, Dabra Gwalior. Ground water is most important source of water supply for irrigation, industries and for drinking purposes. The natural quality of ground water tends to be degraded by human activities. The physical and chemical quality of ground water is affected by industrial activities and human activities. The ionic concentrations is expressed in mg/L.

Ayed [12] studied Ecology is a field of study concerned with the relationship between the environment and living organisms. A proper understanding of the true nature of human's interactions with his surroundings would help plan and design a sustainable frame work for resource mobilisation, utilization and protection.

Jayalakshmi Devi [13] studied ground water classification in Mandya (Dt) Karnataka. As ground water moves along flow lines from recharge to discharge areas, its chemistry is altered by the effect of a variety of geochemical processes.


The study area was undertaken in the serial hillocks mining area of Ballary Taluk, located in the Ballary District, Karnataka, India. The assessment of water quality for its suitability for agricultural and domestic purposes was carried out. The result shows that, only 70% of water samples have physio-chemical properties well within the permissible limits. The remaining 30% waste samples falling in C3S3, C4S2, C4S3, & C4S4 were not suitable for irrigation.

Phytoplankton density and diversity indices in relation to water quality parameters like temperature, pH, alkalinity and nutrients of seven lakes situated around Tumkur city were assessed between the period March and Nov of 2008.

The water samples were collected monthly and analysed for their physicochemical characteristics. The seasonal variation of phytoplankton density and diversity were monitored and diversity indices calculated.

In Karnataka there is no significant work on water quality except by Jayanthi (1993) Ayed (2002), Jayalakshmi Devi (2001), T. Suresh (2009) water quality assessment studies in Karnataka, especially on Tumkur District are inadequate. Therefore the present study has been undertaken to assess the water quality in this region.

2.1.3 Literature survey on environmental degradation

Niranjan Kumar[16] studied, assessment of ground water quality for agriculture in Gajwel, Andhra Pradesh, India.

The hydro-chemical study was undertaken to assess the chemical composition of ground water and its suitability for agricultural purpose. The area under investigation is a rural area and main source of occupation is only agriculture with no industries around. In order to evaluate the suitability of ground water for agricultural purpose, the samples were collected and analysed for all major ions and studied using the parameters viz, percent of Sodium, Sodium Adsorption Ratio (SAR), Piper diagram, TDS, Magnesium Ratio, Ayers classification etc. Different graphical methods such as Wilcox, USSL and Gibbs were also used to find-out the suitability of ground water for agricultural purpose.

Sherene [17] investigated the heavy metal status of soils in the industrial belts of Coimbatore District, Tamilnadu.

A study was conducted to investigate the heavy metal contamination of soils in the vicinity of industries in and around Coimbatore city. Categorically the soils were collected from electroplating, textiles, casting, foundry and sewage water irrigated fields. The total metal content was high in soils. In all the industries. Cadmium was found
above the background metal levels. The total Nickel concentration was very high in sewage water irrigated fields followed by electro plating industries. Most of the metals in contaminated soils were in the value of maximum tolerable level in the vicinity of industrial city of Coimbatore city.

Gladis [18] investigated photocatalytic degradation of ortho-cresol over irradiated Zno suspensions in aerated aqueous solution. Complete and relatively fast substrate degradation was achieved after irradiation with UV light, being the reaction rate dependent on the initial pH. The effect of various parameters such as catalyst loading, pH and initial concentration of ortho-cresol on degradation has been determined. The degradation was strongly enhanced in presence of electron acceptors such as $\text{H}_2\text{O}_2$, $\text{K}_2\text{S}_2\text{O}_8$ and $\text{KBrO}_3$.


Assessment of ground water quality in an erstwhile fresh water stream carrying huge quantities of domestic, agricultural and industrial effluents. Samples were collected from channels or river and subjected comprehensive physico-chemical and bacteriological analysis.


Hydro-chemical investigations were carried out in and around Ambattur industrial area (Chennai city), to assess the chemical composition of ground water and its quality for drinking purpose. A total of 54 representative ground water samples were collected from different wells to monitor the water chemistry of various ions. The type of water that predominated in the study area was assessed based on hydro chemical facies. Interpretation of analytical data shows that, Na-Cl, Ca-Cl and mixed are the dominant hydro chemical facies in the study area.

Nature is the valuable asset possessed by the earth that provides all the basic requirements such as food, air, water and shelter for the livelihood of living beings. Nearly 75% of our rural population is primarily dependent on ground water and 25% of people's needs in urban areas of our country are met by ground water. For obvious reasons, surface water is unavailable everywhere and hence ground water becomes the alternate source of good quality water. The ground water exploration and development have gained momentum not only in our country, but also the world over, to cope up with the increase in demand on the quality and quantity of freshwater due to population explosion, industrial expansion and rapid agricultural development.

There is no significant work on environmental degradation due to urbanization and industrialization in and around Tumkur City. Therefore the present study has been undertaken to assess ground water quality in and around Tumkur City.

2.1.4 Literature survey on Brigg's equation

Takeshi Fujino[22] studied numerical analysis of urban thermal environment in a basin climate. Meteorological field observations were conducted at an urban area in a basin in summer. On a calm clear day a mixing layer of about 1500m height was generated by the thermally induced circulation over the basin. Numerical analysis was conducted, to evaluate the day time heating process and urban effects using a three-dimensional K–E model. The results were in good agreement with the observed values of air temperature, mixing ratio, and wind profiles. The large circulations experienced in this region were predicted with the downward wind over the lake bringing a warm and dry air mass to the ground. The air temperature in the urban area rose and maintained its high value until late afternoon, mainly due to the local circulation adding to the urban effects.

Varvayanni [23] investigated, wind flow simulation over greater Athens area with highly resolved topography.

The code system containing the DELTA and the ADREA codes has been developed at the National centre of scientific research (NCSR). The code system follows a particular technique of discretization, according to which the ground can be treated
with a resolution higher than the one used in the atmosphere. This technique called “the high resolution – ground – low – resolution – air” concept, offers to the code system the capability to reliably simulate the thermal air – ground interaction processes, keeping at the same time the computation storage and duration in reasonable levels. Athens area was dominated by the day time thermally driven local systems, generated along the coastlines of the peninsula. The application of the DELTA – ADREA system reproduced the above mesoscale influences and exhibited a favourable agreement with observations.

Gewang [24] studied a numerical study of plume dispersion motivated by a mesoscale atmospheric flow over a complex terrain.

A three dimensional time-dependent mesoscale meteorological model called HOTMAC is applied to study the complex terrain airshed of Elpaso/cindad Juarez starting from November 29 and ending at December 02 1998. The model numerically solves the equations for mass, momentum heat and moisture in terrain following coordinates using the alternative direction implicit finite difference scheme. The model accounts for solar and terrestrial radiation effects, whereby the lower boundary conditions are defined by a surface energy balance and surface layer similarity theory.

Bosanquet [25] studied the spread of smoke and gases from chimneys.

One of the early air pollutant plume dispersion equations was derived by Bosanquet and Pearson. Their equation did not assume Gaussian distribution nor did it include the effect of ground reflection of the pollutant plume.

Briggs G A [26] investigated, a plume rise model compared with observations.

A number of techniques have been proposed in the literature for dealing with plume rise, and they tend to yield very different results. Plume rise depends on momentum and buoyancy, the buoyancy assumed in this analysis is due to the temperature of stack gases being higher than the surrounding ambient, but one could also include differences in molecular weight of exhaust gas versus air.
Brigg’s G A [27] studied, plume rise,

Briggs wrote the section of the publication edited by Slade, dealing with the comparative analysis of plume rise models. That was followed in 1969 by his classical critical review of the entire plume rise literature, in which, he proposed a set of plume rise equations to calculate the rise of bent-over buoyant plumes.

Milton [28] investigated, Logic diagram for using the Briggs equations to calculate the rise of Bent-over buoyant plumes.

Briggs divided air pollution plumes into four general categories

✓ Cold jet plumes in calm ambient air conditions.
✓ Cold jet plumes in windy ambient air conditions.
✓ Hot, buoyant plumes in calm ambient air conditions.
✓ Hot, buoyant plumes in windy ambient air conditions.

A theoretical work undertaken, we are studied, a logic diagram for using the Briggs equations to obtain the plume rise trajectory of bent-over buoyant plumes. Such models are important to governmental agencies tasked with protecting and managing the ambient air quality, the models are typically employed to determine whether existing or proposed new industrial facilities are will be in compliance with national ambient air quality standards.

2.1.5 Literature survey on centre of concentration

Graziani [29] studied, atmospheric dispersion of natural gases at vulcano Island.

Various computational scenarios are analyzed for the evaluation of volcanioc \text{CO}_2 and \text{SO}_2 concentrations in the air over the island of vulcano. Simulations were done using a 3D mesoscale meteorological model for complex terrain. Local wind depends on differences in land heating and cooling and on island topography. Row model outputs were used by a Lagrangian particle model to simulate dispersion of gases emitted from crater fuma roles. Both models were able to reproduce observations. Simulation of the fumarolic gas dispersion at vulcano were performed for selected summer time conditions, when more than 10,000 tourists reside in the area of vulcano Porto.

Simulations of dispersion from an elevated point source in complex terrain and non-stationary flow are presented using the Lagrangian all atmospheric dispersion model. The different algorithms used for release of pollutants into the model domains lead to initial concentrations at the release height.

Francois Des Rosiers [31] studied, Retail concentration and shopping center Rents – A comparison of two cities.

Primarily at testing whether, and to what extent, retail concentration within regional and super regional shopping centers affects rent levels as well as the differential impact, it may exert for various goods categories and sub-categories and in different urban contexts. In this 1499 leases distributed among eleven regional and super regional shopping centers in Montreal and Quebec city Canada and negotiated over the 2000 to 2003 period are being considered. Unit base rents (base rent per. Sq.ft) are regressed on a series of descriptors that include percentage rent rate, retail unit size, lease duration shopping centre age as well as 31 retail categories while the Herfindahl index is used is a measure of intra-category retail concentration. Findings suggest that while, overall intra-category retail concentration affects base rent negatively, the magnitude and eventually direction of the impact varies depending the nature of the activity and the market dynamics that prevail for the category considered.

Sirajuddin M [32] studied level of air contaminants in Tiruchirapalli city in central Tamil Nadu, India.

Contribution of automobiles to air pollution is reported in the range of 40 to 80% of the total air pollution. The challenge facing cities is how to reduce the adverse environmental impacts and other negative effects of transportation without giving up the benefits of mobility. The dilemma becomes most pressing under conditions of rapid urban growth, which is likely to increase travel demand significantly. The growing numbers of automobiles in urban Tiruchirappalli posses a serious threat to its air
environment. Ambient air quality in the city was monitored for concentration of \( \text{SO}_2 \) and \( \text{NO}_x \) at different traffic areas.

Sutton [33] derived an air pollutant plume dispersion equation 1947, which did include the assumption of Gaussian distribution for the vertical and crosswind dispersion of the plume and also included the effect of ground reflection of the plume. It was further developed by Pasquill and Gifford. This solution is commonly known as Gaussian plume model.

A theoretical work undertaken, many esoteric concepts abound exclusive to physics such as center of gravity, wherein the entire weight of a body is supposed to be concentrated at a point. It is also well known that for an exploded projectile under gravity its center of mass still continues to traverse in a parabolic path.

Analogously it is now proposed to introduce a novel concept entitled center of concentration, which helps in a better understanding of the concentration of emissions from an assortment of stacks of varying heights and different pollutants emissions.

Gaussian plume dispersion model is used in the study, comprising of various atmospheric stability classes each of which representing a measure of turbulence in the ambient atmosphere. The effect of wind velocity is also studied. The proposed model helps in protecting and managing ambient.

2.1.6 Literature survey on Dust pollution

Sheetal Agarwal studied [34] Development of Road transport fuel consumption model for Jaipur city.

He developed an empirical mathematical energy consumption equation for the estimation of energy consumption at two highly busy commercial corridors of Jaipur city. This equation incorporates traffic volume, average traffic speed, passenger loading, length of roads and type of fuel used under heterogeneous traffic flow conditions monitoring and modeling were carried out at both of the selected locations. Further, a comparative study was also done by introducing a new theoretical concept of Bus Rapid
Chapter - 2

Transit System (BRTS) in the study. It was found that, 80-90% fuel consumption can be reduced, replacing personalized vehicles by BRTS.

Chow et.al [35] studied soil and other bulk materials resuspended by wind, vehicular traffic; sweeping and handling processes result in considerable contribution to local air quality degradation.

Khare P [36] studied, the source of particulate matter using enrichment factor and principal component analysis.

The emission of dust from the sources is more during the day time than night time. Principal sources of contribution to particulate matter include road dust, emissions from foundries, testing of diesel engines and automobile exhausts.

David [37] studied a critical analysis of emissions, exposure & health effects.

Turner. D B [38] studied, the basic concept of the roadway air dispersion model is to calculate air pollutant levels in the vicinity of a highway or arterial roadway by considering them as line sources.

The model takes into account source characteristics such as traffic volume, vehicle speeds, truck mix and fleet emission controls. In addition, the roadway geometry, surrounding terrain and local meteorology are addressed.

Gupta [39] studied ambient air quality of Shmila town with reference to suspended particulate matter.

Many air quality standards require that certain near worst case meteorological conditions be applied. The calculations are sufficiently complex that a computer model is essential to arrive at authoritative results.

Mazher Sultana [40] investigated study of dust pollution caused by traffic in Thirunmiyur area of Chennai city.
Dust pollution caused by vehicles in Thirunmiyur area of Chennai city four important roads viz. East coast road, Adayar road, Tidal park road and Lattice bridge road of Chennai city were selected. Data revealed that, East coast road was the busiest on which maximum number of vehicles were passed followed by other three roads. Dust fall rate on Tidal park road and east coast road was found to be less, as the condition of the two roads was good and they were used by tourists, software company officers and industrialists etc. The roads were also well maintained by the corporation of Chennai. The dust fall rate at Adayar road and lattice bridge road was found to be highest, because these roads were thickly populated and in very bad condition.

Joel [41] studied Damned Lies and Statistics.

It is a mathematical science pertaining to the collection, analysis, interpretation or explanation, and presentation of data. It also provides tools for prediction and forecasting based on data. It is applicable to a wide variety of academic disciplines from the natural and social sciences to the humanities, government and business.

Desrosieres Alain [42] studied

The politics of large numbers, a history statistical reasoning.

Statistical methods can be used to summarize or describe a collection of data, this is called descriptive statistics. In addition, pattern in the data may be modeled in a way that accounts for randomness and uncertainty in the observations, and are then used to draw inferences about the process or population being studied, this is called inferential statistics. Descriptive and inferential statistics comprise applied statistics.

The effect of dust pollution is not only limited to human beings, animals and plants but it is also harmful to so-phisticated instruments, household things and dietary products. Keeping in view the importance of dust pollution for living organisms, plants and animals and their related articles, an attempt, has been made for the first time to estimate the dust pollution caused by road traffic in Tumkur city and based on traffic data was taken and modeled using regression analysis. It is enables a study of the present situation as well as prediction of population level for a random selection of variables.
Details of the study area:

Tumkur city is located in the South-Eastern corner of Karnataka State in an area characterized by gently-rolling granitic hills and seasonal water sources. It is located between $13^\circ 06'30"$ to $13^\circ 31'00"$ North latitude and $76^\circ 59'00"$ to $77^\circ 19'00"$ East longitude. The city comes under semi-arid region. It is surrounded by Sira taluk in the Northwest, Gubbi Taluk in the West, Koratagere in Northeast, Nelamangala in the Southeast, Magadi in the South-Southeast and Kunigal in the South-Southwest (Map 1). It is well connected with the other taluk head quarters of Tumkur district by good communicable roads. It is the gateway to Bangalore. Tumkur is also connected by rail with Bangalore to Bombay route.

It covers an area of about 1568 sq.kms Tumkur city has a population of 4,81,123. The average annual rainfall of the study area is 510 mm. The average annual maximum temperature is $36^\circ c$ and minimum is $27^\circ c$.

The study area predominantly consists of igneous rocks hillocks. The area comprises of crystalline rocks of Precambrian age in which the major units are gneisses and granites. Weathering hard rock is limited to 3 meters from ground level where as in schists and phyllite it extends up to 14 meters. Secondary porosity weathered zone, joints and fresh hard rock provide room for ground water storage.
Fig. 1 Water Source positions (Samples) in and around Tumkur city.
References:


