Chapter -1

INTRODUCTION

Introduction

A universal truth is that the water is a very important and essential for our life, but the another important & real thing is that, even though having a very simple in molecular composition of water, by nature water is really very complex, it may affect us in so many different ways. Among all the available renewable resources, the most difficult task is getting really usable, fresh and portable water for the mankind. As all we know that is a very hard and complicated to get purified water from the available resources and its transportation is also very costly and even it is next to impossible to make a substitute of fresh water. In our day to day life and for the economic growth of nation, water is required in almost everywhere. There is a rapid and day by day global diplition in freshwater reserves and a significant impact is expected in the areas which are heavely populated like china and even India. [1]

Now a days the water and its resources are the major issue all over the world and is a everyday matter of discussion & clash over water among farmers, residents, ecologist and industrialists and many others like minorities depended on the natural resources and even in between the entrepreneurs who basically uses this resource for profit making commodity.[2]

- As per the Report by United Nations Children's Emergency Fund(UNICEF) on Water :

The water scarcity is a global problem and nearly two billion inhabitants in India are facing the same problem as a routine.[3] And really it's a serious crisis in India as today many Indians are not getting even clean water to drink, and is expecting a poorer circumstance in future, if the same condition will continue. Now the water demand is alarming and we are expecting a surprise growth of approx 1.8 billion Indian populations by 2050 and it may even go beyond the population of china by then as currently India has the second largest population of the world after China. And definitely the increase in people of any country will increase the strain on the available resources of water. The water supply in India is stretched out because of the rapid increase in economy and a large agricultural demand. In India, the over-pumping of available

water resources, mishandling & misuse of the available water & its resources and also the contamination are the major contributors in rapidly dwindling of water. The Climate change and unpredictable weather is also a major reason for reduction in water supply through rainfall and glaciers. In coming years, the demand of fresh & portable water will exceed the supply and definitely, India will have to face many consequences like food shortages and also many conflicts nationwide & even globally.

In India the water crisis is basically a manmade & created problem. Here in India, the climate is not for the most part dry and even there is no lacking of rivers and groundwater. Particularly the basic reason for the water supply crisis is the poor management & undefined laws, dishonesty in government officials & political leaders, large pollution & contamination of available water resources through the waste from the industry and human. A challenging demand balance is must between the requirement of fresh water between the municipal & rural, Rich & underprivileged to manage the resources of water. The general people have the only power to mange & prevent the scarcity of water by changing their action & behavior by managing Indian population, developed way of agriculture and hence the economy, as the people is mainly responsible for this water crisis. Overall, the water scarcity of India is mainly surrounded the available resources & demand, nationwide climate change, contamination of resources, government policies & administration.

❖ Demand and Usage:

In the year 2010, the use of water was approximately 830 billion cubic meter per annum,in the field of farming ,manufacturing as well as for domestic purposes and the use of this much huge quantity of water was approximately the water of size of Eric Lake. And an expectation is that the demand will definitely be doubled by the year 2050 and subsequently it may exceed 1.6trillion cubic meter of supply [4].

The data below represents the water demand by different sectors:

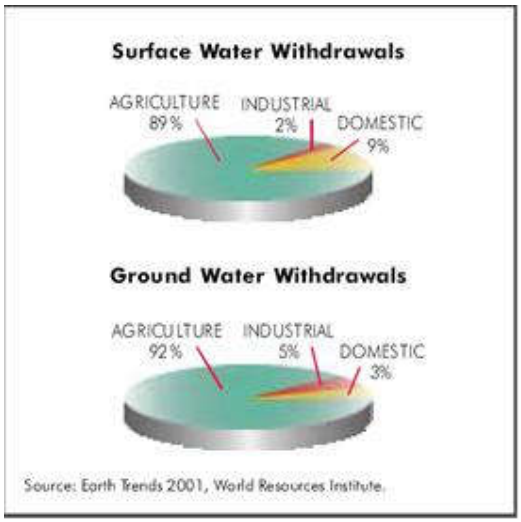

Figure: 1.1 Water Demand by different Sectors

Source: Earth Trends 2001, World Resources Institute

- **Domestic:**

It's approx. 1.2 billion citizens in our nation who needs fresh portable & clean water for drinking purposes. About 4-6% of the total demand of drinking water is separated between the municipal and rural populations [5].The urban peoples are using more water as they are using modernized amenities of metropolitan way of living and facilities like toilet flush, machines for washing clothes etc. The population of cities is increasing day by day and is approximately doubled in past 25 years. And now the urban population has become approx. 30% of the total population of India [6] and is expected to reach nearly 50% of the total population by 2025[7]. The peoples are moving to cities & have become a middle class living status are one of the major reason to accelerate the water scarcity in India. The underground water aquifers are depleting day by day as the urban citizens are now a day's moving towards extraction of ground water, mainly because the rivers are polluted and the present government has no definite policy to deliver clean water to their citizens regularly and even the rural citizens are also facing a similar crisis. Today more than 25% of the rural population lack access to drinking water and

out the total 29 states in India, only 8 have full availability of drinking water for rural residents.[8] The most of the people who lives in rural areas are demanding less water for day-to-day living than people living in municipal areas, and the majority of their water request comes from agricultural needs.

- **Agricultural:**

Agriculture is an integral part of Indian culture and it is the most vital measure of Indian economy even though there is a rapid growth in industries and service sectors. At the time of green revolution during the period 1947 to 1967, the period basically determined on expanding the agriculture, based on double-cropping of existing farmland and using seeds with superior inheritance.[9] The green revolution gives a result of increased crop production and this makes India the biggest exporters of grain all over the world. The water demanding crops, such as sugar cane gave high profit to the farmers because of the availability of ample internal water streams.[10] That was the reason; after the green revolution, India achieved its objective of obtaining food security. Approx two-third of 1.4 billion citizens of Indian population, are depended on the rural financial system.[11] The present water scarcity is accelerated due to huge water requirement for agriculture.

About 90% of total available water resources are currently used for the agricultural sector in India.[12] The fundamental of the economic development is the agriculture and it involves huge quantity of water for the irrigation and sorry to say this may be one of the major reason of ground water reduction. The major rivers in India are mostly polluted and that's the reason approx. 75% of water required for irrigation is mainly drawn from the underground water.[13] As, now a days the water scarcity is the leading problem and the impact of this affecting largely to rural and farming areas. The large agri-business lobby and the politicians are habituated for availing the cheap & discounted electricity and they are again habituated for enormous water pumping from the underground, and these are basically due to the highest priorities to the food

securities and which is somewhat may be the reason, the people are not very concerned about the water conservation. To maintain the food security level, Indian farmers will have to switch over to the crops which require less water and will have to compete with the price of grains global and also the food grain import should be at lower end.

- **Industrial:**

In industries, for cooling the machines, cleaning of finished products and dust control, plenty of water is used and in various manufacturing sectors a huge quantity of water is required. In India, the economic growth is improving by the maximum utilization of underground water, which is available free of cost, and as for example, in steel plants, there are many sections where water is required like in sinter plant, coke oven, furnaces and its byproducts and other chemical process, rolling mills, mechanical pumps, transfer lines for sludge and slurries etc. The different sections of iron & steel industries are using a huge quantity of raw water for cooling purposes and also flushing away the impurities from the final products. It's obvious that with industrial growth, the economy is going up but again the wastes from these industries are polluting the Indian rivers and ground water to a great extent. Maximum establishments are still polluting their input water which is actually in use for many processes in industries. As per the report of ministry of water resources about more than 60 billion cubic meters and nearly 8 percent of total freshwater is generally used in industries.[14] And it is expected that this water is expected to be increased by 11% by 2025.

❖ **Supply:**

In comparison to the other different sources of supply water like desalination, the surface water & Underground water are the cost effective & significant sources of water supply in India.

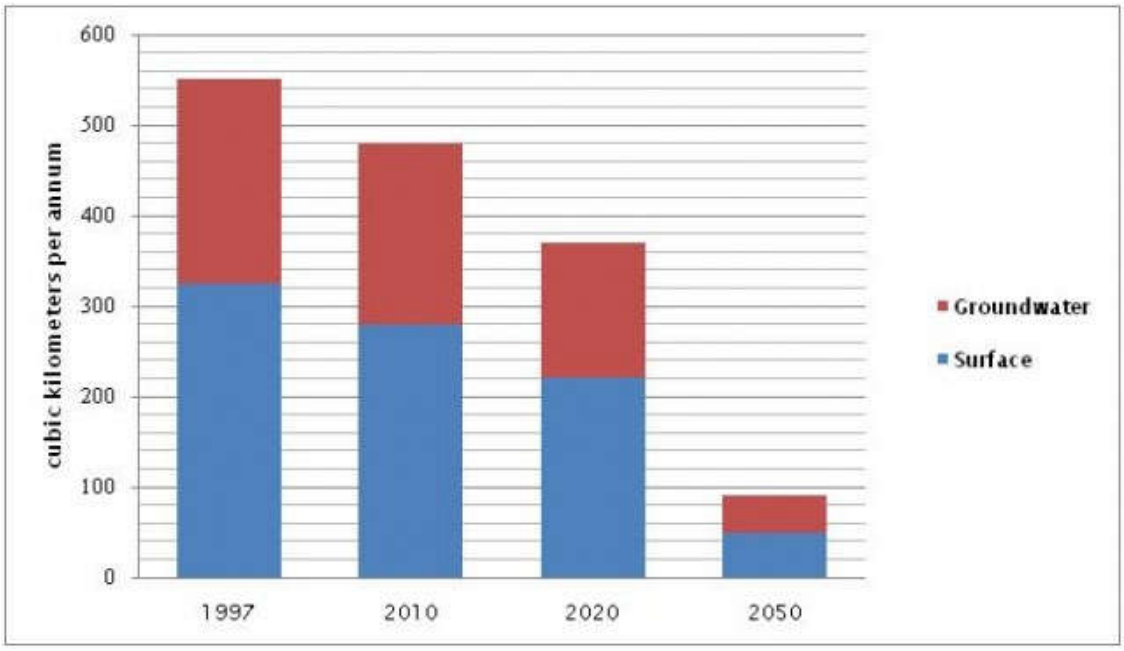

Figure: 1.2: Surface Water, Groundwater Over Time

Source: World Bank Report on Water in Indian Surface Water.

All the major rivers in India like Ganga, Godavari, Kavaei, Krishna, Narmada, Bramhaputa, Mahanandi & Tapti ends its flow in the bay of Bengal & Arabian Sea and are classified into Himalayan, coastal, peninsular, and inland drainage basins. The Himalayan rivers basically Ganga is mainly developed as result of melting of glacier & snow and giving a continuous water flow. The fresh water from the Himalayan polar ice caps is basically the source of fed water for all the seven great Asian rivers.[15] During the period of monsoon in Himalayan region a heavy rainfall occurs and this makes the rivers from Himalaya to swell and causes flood. The rivers on the coastal zone, basically the west coast like the rivers Brahmaputra and the Krishna, are having a short length with small catchment area and the river, mostly the peninsular rivers like Godavari, Mahanadi, Krishna, and Kaveri, are flowing inside and during monsoon their volume increases greatly. Some rivers of the inland drainage basin, basically like Mahanadi and the Godavari are either drain outs towards the muddy lakes like Sambhar, or are

lost in the sands and become completely dry.[16]

In India average rainfall is approx 4500 billion cubic meters per annum, but unfortunately only approx 46% of rainfall is merged with Indian rivers and approx only 20% of rainfall water is properly used for different purposes as in India we are still not very aware about the present scenario of water scarcity and still we have no proper storage and preservation system due to lack of information, crumbled infrastructure and improper policies[17] .In monsoon season during June to September, approx around 70-75% of the total rainfall is annually precipitated and we the citizen of India and the Government is not equipped to store the surplus water for further use after monsoon in the dry days because of no vision & poor infrastructure of India. Another critical problem is the irregular seasonal delivery of rainfall which is not supporting the development & growth of infrastructure for its storing and capturing.

- **Groundwater:**

The major source of drinking water at every part either municipal or the rural in India is the groundwater and it is an important source of providing water for the agricultural purposes and also in the industrial sectors. In India near about 435 billion cubic meter of groundwater is replenished from the rainwater and the drainage of the rivers yearly, but only 390 billion cubic meters are actually utilizable. Out of that 390 billion cubic meter, approx. 80% of water is utilized for the irrigation & agricultural uses, and only the rest 20% is distributed for the domestic and industrial purposes.[18] And total availability of static groundwater is approx. 10,815 billion cubic meters.[19]

The water from rainfall is not enough to refill the level of underground water which is being rapidly pumped out the lower levels of ground. In India the recharge rate of river basins is 265m3/day.[20] As per the estimation of Delhi Jal Board, responsible for providing clean water, the underground water tables are going down very rapidly with an average fall of 0.6 meters yearly.[21] The ground water is continuously contaminating through the addition of wastages from human, agriculture waste & the industrial waste to the Indian rivers which pollutes the ground water through seep into the ground. The natural factors, like human action due to unawareness and negligence, are the basic reasons for the crisis of underground water. And further to this the basic reason of rapid fall of water level in the various parts of India during last decades are the increase in the extraction of water from the ground. In past two decades the number of wells and deep bore wells has been increased, especially for the use of domestic and agriculture purposes.[22]

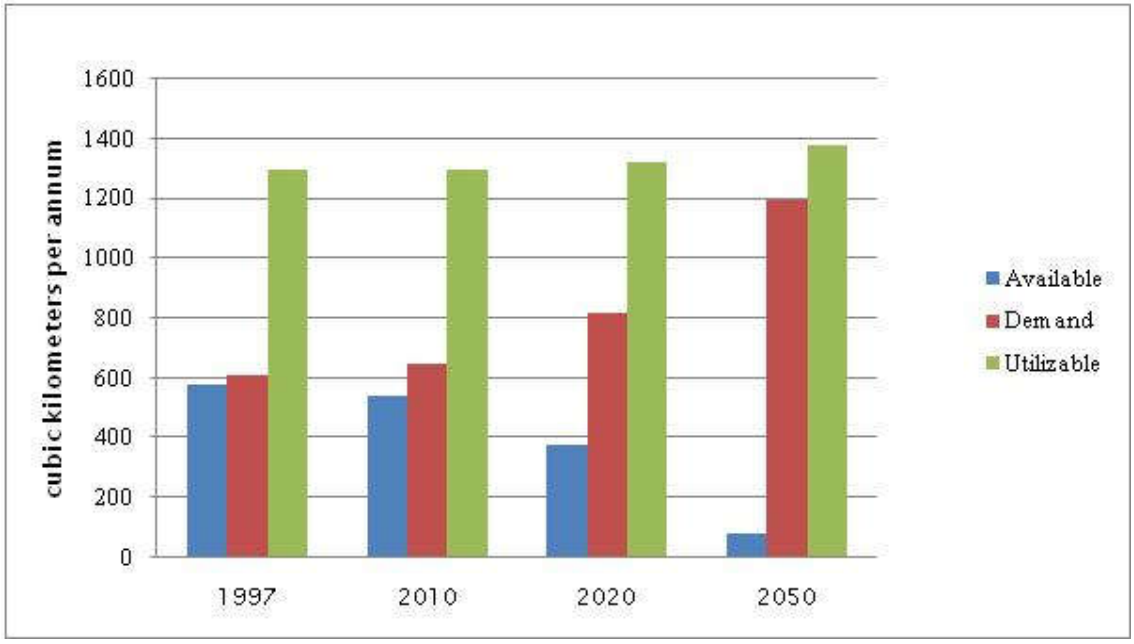

Figure: 1.3: Water for use(utilizable), demand and availability

Source: A report by World Bank on Indian Water.

- **Climate Change:**

The major reason of depletion of water supply in India is the change of climate. As the climate is getting warmer day by day, the Himalayan glaciers & the Tibetan Plateau glaciers are melting. As per the intergovernmental panel on climate change (IPCC) survey, the global temperatures have warmed by 0.80 Celsius over the last 10 decades.[23] An intense flooding situation is created during almost every monsoon season due to a heavy rainfall, and we are less equipped to accumulate and reuse the same. Indian rivers are continuously fed by the water through the melting of glaciers, near about 75% of discharge to the Ganges river comes through the rivers of Nepal, i.e through the snow feeding of Himalayan glaciers. [24] The various branch rivers of Ganges river supplies water to all over the nation for survival of millions of

citizens across India and a great number of populations of Indian citizen will be severely affected, if the river Ganges dried up even partly. **The glaciers are very much supporting and responsible for regulating the supply of water of the rivers like Ganga, Indu & Brahmaputra, it is believed that the glaciers are mainly retreating the level of all these rivers at a rate nearly 35-55ft each year.**[25]

It is very much uncertain that how much the rainfall is affected by the climate change, but it very true that the pattern of rainfall is greatly affected by the change in climate. And it has been now accepted by the scientists also that the irregular climate is the main reason of unpredictable rainfall and this certainly causes an erratic weather. During the summer season, it is a belief that due to increase in the standard water temperate in the oceans; there is a probability of increasing the monsoons during the summer season.[26] India is one of the world's largest emitters of greenhouse gases and is responsible for significant contributor of global warming, however as India is a developing country, it is not requisite under the "Kyoto Protocol" to decrease its emission.[27] And this is definitely a very unfortunate instance of how India is overlooking its environmental values and its natural resources only for the growth of its economy.

- **Water Management:**

The biggest misfortune regarding water scarcity in India is to avoid the best available practices of water management techniques. The lack of infrastructure, lack in effectiveness of water recycling & its uses and also the lack of attention in the directives & regulations of use & conservation of water. It's a known fact that initially the water has been assumed & treated as an unlimited & unrestricted resource and was assumed that it's not required to manage Basically the history of water has been viewed as an unlimited resource that did not need to be managed as a insufficient commodity, and since very long back it has been treated and provided as an basic human right. Now as per the increase in demand & decreasing level of resources, the attitudes are shifting in India and now a days its demand for managing the system by decentralizing the processes, and the local municipalities will have make a regulating system of distribution as per the need of the particular area.

The economic growth & food security is the prime goal of our nation after the independence but there was no policy & focus on the water, its conservation which results a very and there was no focus on water conservation and a very severe consequences in present days. In fact there is no proper legislation regarding the underground water in our nation, unlike the other growing & emerging countries like china & other developing countries with acute water shortage issue. Anyone ether farmer, industrialist or any other citizens can extract waters from the underground of their plot as per their wish as long as they want.[28] The depletion in aquifers is because of rapid pumping of groundwater, and this is mainly supported by the easily availability and distribution of pumps & electricity to the farmers and agriculturists. Approximately about 22 million wells in India are one of the major reasons depletion of underground water in India.[29] And these wells are free of cost, the owners of these wells is not required to pay for extracting water from it, and that's why the people never bothered to preserve, save or recycle water and the real fact is that these people are habituated of overdrawing the available resources and are also misusing the same. The Indian citizens have a tendency to unnecessarily extract more water

from the ground and misusing more water uselessly; even the industries are not reusing or recycling the water which has been using for the different process of cooling the machines & final products and these wastewater is fed into the canals & rivers and polluting it rather than reusing it. Mr. Manmohan Singh, the ex-prime minister has already warned against the over-pumping from the underground water, but the authorities have not taken any action and it's still continuing in a very rapid way.[30] We have to boost our agriculture production to feed the population of India, which is growing rapidly, without putting endanger the available resources of water and also now it is the demand of present days that the Indian farmers should switch to crops which require less water for their production.

The government of India is lacking behind to supply the available portable water effectively to its citizen. The water storing capacity of china is approx six (06) times more water per person than the capacity of India.[31], then this is very obvious that India has very poor water management. As per the Indian government approx 8 to 9 out of 10 people is getting water for their daily uses and the actual fact is that the water people are using is really very contaminated.[32] The citizens of India are getting only few hours per day of water supply in all the 35 cities having population of approx one million and more.[33] In New Delhi, the capital itself the water condition is very distinctive in comparison of the other cities in India, the actual truth is that, the capital of our nation i.e. new Delhi is not really lacking of water, but the reality is something different that in fact there is no quality infrastructure.

Because of various different infrastructures problems & unequal policies, the population of Delhi is receiving only 18 million cubic meters of water in a day instead of the actual demand of approx 38 million cubic meters per day, and as per the record the Delhi jal board is supplying 30 million cubic meters of water per day, but unfortunately due to bad infrastructure like leakage in supply lines more than 50% of water is wasted in between only. [34] Due to the negligence of the responsible authorities for the maintenance of water supply system & the pipelines, a huge quantity of water is being wasted and this is causing a major difficulty in the

proper utilize of water. Approx 45% of the supply pipelines are leaks out and as per the record the Delhi Jal board is supplying water through approx 5600 miles of pipelines throughout the Delhi and due the major leakage in pipes near about 45-50% water leaks out.[35] The people of New Delhi are waiting in crowded lines for the tankers of water send by the Jal board and even though what quantity & quality are they receiving are a big question. Around 28% of homes in New Delhi are receiving water through taps only for 3 hours a day and the rest people are bounded to receive their daily use water through the tankers delivered by the Municipal board as the government is expending more in supplying water through tanker rather than creating more pipelines for supplying the water.[36] As the government is not able to make available satisfactory water to the citizens, the private players are emerging rapidly and they are working at their term & conditions and supplying water at a very high rates, and that's why people have started digging their own wells and doing deep bore wells & further the groundwater is depleting rapidly.

- **Pollution:**

There is no proper rules & regulation in India on usage of water and also there is very few regulations on water pollution and the implementation of these existing regulations are very less. Despite of huge expenses on the processes of cleaning & minimization of population, no significant change has been ever seen in actual. The audit of Indian Government in 2005 gives a data that the Jal board of itself spent more than $200 million to make a pollution free environment but there is no significant result.[37] The rivers in India are contaminated & can't be used for drinking and even not for the industrial & agriculture purposes as many pollutants like arsenic, fluoride from the chemical industries, agricultural overflow wastages, water waste from sewage disposal are the main pollutants responsible for polluting the rivers.[38]

In New Delhi alone approx 3.8 million cubic meters of wastages from the sewage is produced in a single day and even not more than half is actually treated effectively, as the management system is not efficient. As approx 42% of the total population of New Delhi is not linked with

the municipal sewage system and all these untreated waste is directly fed to the river Yamuna.[39] The quantity of dumping the sewage wastages in the river Yamuna is increasing day by day with the exponential growth in population as the population who are not directly connected to the sewage lines and the wastages are directly to the rivers and polluting it. The treatment of city sewage waste requires intensive treatment, which is an expensive affair and these are fed to the rivers directly without any treatment and making them polluted. And that is why in India almost each & every river is polluted up to some level.

The water quality of underground wells is violated as they are contaminated with the toxic metals, fluoride, nitrates and other dissolved oxygen & chloroform etc.[40] In India the rivers are highly contaminated with fluoride content of more than the permissible limit of 1.6 ppm and are affecting approx 70 million people. The agricultural products are also getting contaminated and highly affected with this waste & polluted water which seeps inside the ground and used for the irrigation purposes. Almost approx. more than 25% of infectious diseases are linked with the use of to insecure water.[41] Many avoidable diseases are affecting millions of poor citizens with the infections due to insufficient water supply and unacceptable sanitation systems. An effective legislation should be implemented as an immediate solution of water emergency to change the practices of the management system of regulating water. However, it is already mentioned herewith and known fact that there is a major disagreement with the raise in the tariff of electricity, and most likely its obvious fact that there would be even a more conflict in enacting the tariff on water also. [42]

Privatization of the supply & the distribution system of water may be a solution to water crisis and it is predictable that a private player may be able to stop the wastages of water and will definitely improve the efficiency and this will also encourage the new innovations. A policy of privatization of Indian water distribution system in support of World Bank has been developed to supply the water to all the inhabitants of India, but these private players are charging very huge amount against their services. [42] Indian citizens are in oppose of this privatization of

water distribution as they are saying that the privatization of these basic need enhance the existing poverty exponentially and even the track record doing privatization is not good through the world. Indian government has started extensive engineering projects of South-to-North water diversion project. Being the largest democratic country, India is facing lots of difficulties to pass and start these types of extensive projects because of the controversial debate and much more resistances will be created by people. The interlinking river project of approx $115 billion is the most prestigious project of India. This project of Inter linking the rivers has been already approved by the president of that time in the year 2002 itself and it has been assumed that the project will be completed by the end of year 2016. This Interlinking river project is assumed to link approximately all the rivers by more than thousands of miles of canal and dozens of large dams.[43] This project is planned to boost the amount of water accessible for irrigation and this may add 36,000mw of hydropower to the nationwide pool.[44]

The Indian government has already given instructions to state government for the rainwater harvesting in order to more efficiently tapping of heavy monsoon rain. The collection of rain water recharge the water tables and allows easier accessibility to the resources of water and this increases the availability of water for irrigation throughout the year, which leads to enhanced living standards of village.[45] Approx. more than 1.6 billion Indians and even the entire globe is facing a aggressive water disaster that has implication for more than 1.3 billion citizen of India and even may be intended for the whole globe. The supply of water is stretching day by day in India but the demand for clean & useable water is growing at rapid growth. The government is facing difficulties in providing proper water supply due collapsed infrastructure of water supply line & even the poor management. The pollution is also uncontrolled because of very bad & unplanned waste management policies, law and its practices and unregulated financial growth. It is an obvious expectation & and thinking of various different analysts that the demand water will exceed the actual supply of the same by the year 2022[46], and even there is still some hope in India, if we become able to manage it

properly. In India, the imminent crisis of water may be ward off or at least it can be mollified, if we make a significant changes in the way of thinking of managing the water and its resources as basically in our country the scarcity of water nothing but this is mostly a manmade crisis. In India there is a significant & progressive success in developing the water infrastructure & facilities, which allow taking benefit of its water resources at first place and to achieve the food security. The expansion of industrial sectors & urban society and the increased availability of safe drinking water can be enabled by these projects of improving infrastructure & facilities. As in past India has made the food security & economic growth as a priority, in the same fashion it also needs to make the water supply as a national priority. Due to the rapid depletion of water supply, the problems related to the environment and the rapid growth in population, India needs a complete management program to overcome these severe problems. The water crisis has a big effect on Indian industrial sector and many other industries in addition of agricultural sector. As many rivers which originates from India and supply the water too many other countries, India is finally becomes a place for water war internationally. In India, by conserving water, harvesting rainwater, by treating the wastages from human, industries & agriculture properly and by regulating the withdrawal of ground water, we can avoid the expected dark future of India.

As, we all know the fact that water is the most necessary and inadequate resource in our nation. And at the moment the quality & accessibility of the clean & the fresh water resources is the most crucial among all the other ecological challenges on the nationwide perspective. The actual forms of impact of stress on water reserves are much diversified. With the geometric growth in population and at the same time the rapid development of urban, industrial and agricultural growth, has a deep impact on the quality & quantity of the water in India. This situation requires an immediate comeback through drastically enhancement of resource for water and also the management strategies for water quality. The present research work highlights the steps involved in preparation of a water quality management plan in a rational manner.

The government organizations such as **Central Pollution Control Board (CPCB)** and the **Ministry of Environment and Forests (MOEFs)** have made some guiding principle [47] under the chairmanship **of Mr. J.M. MAUSKAR,** for quality management of water and these are :-

The "Step – IX" is regarding industrial Pollution Sources:

If the undertakings and the administrative Ministry/State Government failed to respond, action A time bond programme should be implemented for the installation of effluent treatment plants (ETPs) for each and every industry responsible for water pollution but have not installed an effective effluent treatment plants. This industry should be asked to deliver a time bound agenda to the Ministry of Environment and Forests for successful management of their effluents. And for those industries already committed under Corporate Responsibility on Environment Protection (CREP) will have to hold fast to it. The existing & proposed arrangements and their detailed scheduling with proper time should be clearly indicated by these programs of CREP. The concerned ministry of administration or the respective state government, which may be applicable, should provide the necessary funds & also should ensure the compliance of the project by the concerned industries.

The State pollution control board monitors the progress and also makes a report on the result & outcome of the project. The established provision in charging the supply of water for industry should be examined by the state pollution control boards and should also put together proposal in discussion with the concerned department on how the scheme can be restructured to preserve, recycle and reuse of the water. The secondary treatment technology should be adopted for the organic wastes from different industries and the other promising technology like aerobic composting, ferti-irrigation, vermiculture and many others. The energy saving alternative to treat the wastewater from industries is root-zone technique, which has been developed very recent.

There should be a very attractive incentive policy for the industries to make it pollution free and for the control measures of pollution. This is also very important for assessing the effectiveness of the control measures and also to work out for other measures which may serve effectively

Reuse, Recycling of Treated Industrial Waste and Resource Recovery:

The reuse and recycling of wastes for agricultural purpose would not only help to reduce the pollution and requirement of fresh water for such use but also would supplement the much needed nutrients and organic manure to the plants.

The majority of waste streams may be recycled and reused by the segregation of waste water streams and it may also help in reducing waste water volume and waste strength.

Waste Minimization and Clean Technologies:

By the recycling technology the concentration of waste may increase but the actual total load may remain same as earlier. The concentration of waste strength is affected positively by the economic conversion of the spent wash into bio-fertilizer. To achieve reduced waste strength; some in plant control parameters like wastes leakage reduction, removal of procedure failure, handling of equipments and the improved techniques of dry clean processes should be implemented properly. These are the clean & green technology and is directly related to the industrial gains and is generally doesn't added to the production cost. The innovations for the pollution control & minimization of waste should be severely promoted. In India the efforts for the waste minimization & for the prevention of pollution are usually prepared only for the improvement of the quality of the product, or may be for the energy saving & any other trade and industry reasons but the pollution control is the subsidiary.

- **Waste Water Discharge Standards and Charges on Residual Pollution:**

There should be a pre-defined parameter & a fixed limit on the use of water and the generation of wastewater, per unit production for all industries. An efficient guiding principle must be

there to achieve the goal and all the industries should be mandatory to take on recycling and reuse the water and wastewater through a proper legislation and effective monitoring.

To encourage the recycle & reuse of the effluents some new policies & rules should be introduced, like imposing charge on residual pollution, if the set restrictions are complied in view of the zero-discharge perception.

- **Mixing Sewage with Industrial Waste:**

If there is no toxicity in mixing of industrial waste with the domestic waste for the treatment, it should be treated as a combined process, wherever it is possible. There are some advantages of jointly treatment of domestic & industrial wastages like better treatment quality of industrial effluents, good arrangement of treated disposal and financial system scale.

For industrial areas nearby the residential areas and for the cities & towns the joint treatment schemes are always attractive. The cities like Baroda and Ahmadabad are already having joint treatment schemes under a formula of notified charges. The joint collection & treatment scheme is a very effective and a win-win option for the industries located near the cities. For medium and large industries wherever possible such joint collection and treatment would improve, besides other technical advantages, financial feasibility of the city sewerage and treatment system.

The next step suggested in the report of Central Pollution Control Board & Ministry of Environment & Forest [47] is -

Step X - Non-point sources pollution:

There should be an attentive focus on the problem of non point pollution from unreserved sanitation, abandoned wastes dumped randomly in urban & commercial areas and chemical uses like the use of pesticides, insecticides other chemical fertilizers in agriculture. With the maximum application of the commodities like pesticides & fertilizers the pollutants in the

underground water & runoff water is expected to increase at very high level. An integrated pest managing strategy should be evolved and some standards should be made there to regulate the uses of toxic pesticides and to build up substitute which are eco logically more suitable. The global environment is adversely impacted with rapid growth of urbanization & the industrialization. [48] With the rapid growth in small scale industries in India and the inappropriate waste water management practices, the resulting pollution is the major ecological problem in our country.

The present study is on the steel industrial sectors in the country, the steel industry is one of the most significant and very important Industries of present and even of the future. This industry is an asset of any nation. The steel plant uses a very large quantity of water for the transfer of waste generated from the industry and also for cooling purposes & the dust control. There are various processes in any steel plants like sintering system, coke oven, blast furnaces and the byproducts of chemical processes, water cooled rolls, pumps, extrusion experiment, transfer lines for and slurries and sludge and water is used to cool the products and flush the impurities away from the finished stock. And a very large quantity of water is required to do all these processes and again a large quantity of wastewater is generated as a result.

The wastewater generated from the steel industries is very huge in quantity and many dissolved & undisclosed particles & chemicals are contained with these wastewater; during the different processes of the steel industries. In India, basically in total, there are seven integrated iron and steel plants. And among all these five industries comes under "Steel Authority of India Limited (SAIL)", and out of rest two one is a private sector company and the last one is the "Visakhapatnam Steel Project" at Visakhapatnam. Globally, the total annual production of steel is 716 million ton and the contribution of India is approx. 15 million tones [49]. The industrial growth anywhere produces pollutants up to some extent and the steel industry is also not an exception. Here the tables -1.1 below describe the discharge from an integrated steel plant.

Table: 1.1 the discharge from Steel Plants are:

Process	Water Usages	Emission of Stack	Deserter of secondary	Solids
• Transportation	• Suspended solids, • run-off water		• Dusts: Iron oxide, • coal limestone	• Spillage, • Muds.
• Blending & bedding	• Suspended solids, • run-off water		• Iron oxides, • coals, • recycled dust	• Dust from bag house, • cyclones etc.
• Coke ovens	• Phenols, • Cyanides, • Tars, • Ammonia, • sulphides, • chlorides.	• Smoke, • So2, • No2, • steam gas flare	• Coal or coke dusts, sulphurous emissions, • smoke, • benzene, Steam	• Bag house, dust with alkalies filler cake.
• Blast furnaces	• Suspended solids, • phenols, • cyanides, • lead and zinc compounds • chlorides, • Fluorides, • Heat	• H2si, • so2 steam from slag cooling beds	• Iron oxides, • H2S, • cast house fumes, • co,coke dust,noise	• Carbonaceous solids from bag houses, pitch, tar refractories.
• Hot Metal Treatment	• Alkalies, • suspended solids	• Particulates alkalies, • fluorides	• Na2o, • K2O, • Lime dust, • Iron oxide fumes	• Baghouse Dusts with high lime corrosive slags.
• Steel Making	• Scrubber waters, • suspended solids, • Zinc compounds	• Co flare, • co2 • SiF4, • Fluorides. • Iron oxides	• Fine Iron oxides alloy fume	• Skimmer, • ladle Slags, • refractories Bag house dust

The manufacturing of steel involves number of different process and all these process consumes a minimum of 35 to 70 cubic meters of raw water for each ton of steel production. [50] And the consumption of water in countries other than India varies from 4 to 7 cubic meters as compared to 35 to 70 in our nation.

- The use of water, plant wise is as shown in the table below. Table 1.2.

Table: 1.2 Water Consumed (cubic meter) Per Ton of Steel Produced [51]**:**

Steel Plant	Consumption of water (m^3) per Ton production of steel
Steel Authority of India Limited (Rourkela)	69
Steel Authority of India Limited (Bhilai)	34
Steel Authority of India Limited (Bokaro)	59
Steel Authority of India Limited (Durgapur)	49
Steel Authority of India Limited, IISCO, Burnpur.	43
TATA Steel, Jamshedpur (TISCO)	27
Rastriya Plant Ispat Nigam Vizag Steel.	29

Source:–CPCB, COINDS/27/1998; New Delhi.

The water required for producing one Ton of steel in finished shape is nearly 250-500 cubic meters, if considering the whole processes of the production. And nearly two third of the total water used is mainly required for indirect cooling, where heat is the main contaminant. The used is then segregated and recycled after cooling. And the rest of the water, which carries the suspended solid part are allowed to settle down and is again recycled in the system having a closed loop. After that, the balanced water is generally contaminated with the different pollutants & chemicals and the effluents from coke-oven, cold rolling mill and the other by

products, acid pickling etc. The waste water management needs extra attention and more concern as this wastewater requires a special and precise treatment.

The waste water from the byproduct of coke oven (COBP) is the most polluted watercourse, which comes from an IISI (integrated iron & steel industry). This water are very harmful, if it discharged as untreated, as it contains toxic chemical such as phenol, ammonia & cyanide. The authorities of pollution control board have realized the adverse impact on the environment and have given notice the discharge norm exclusively to the Coke oven byproducts industries and the guidelines are as shown in the Table 1.3 below:

Table: 1.3 The standard set for the discharge of Wastewater from an Integrated Iron & Steel plant:

Sl. No.	Parameter for the coke oven by product plant (mg/l)	Acceptable Concentration in mg/l pH (Not to exceeded)
1.	• pH	**6.0 - 8.0**
2.	• Suspended Solids	**100.0**
3.	• Phenol	**1.0**
4.	• Cyanide	**0.20**
5.	• B.O.D	**30.0**
6.	• COD	**250.0**
7.	• Ammonia Nitrogen	**50.0**
8.	• O&G	**10.0**

Source: COINDS/27/1998 – CPCB, New Delhi.

The chemical, physical, biological & mathematical approaches are the four different technologies used for treating the industrial wastewater. The Floatation, Sedimentation, Stripping, Filtering, Ionexchange, Adsorption & few other processes that achieve removal of dissolved and undisclosed substance, without changing the chemical structure; are the physical treatment process. The most useful & realistic approach for the development of a well operating cost effective treatment system for treating the wastewater is the mathematical approach.

There are various strategies to remove the all the different impurities from the waste water of steel industries are as below:-

1. Removal of suspended solids.

2. Grease & oil removal.

3. Biodegradable organic removal.

4. Process of activated sludge system.

5. Process by trickling filtering.

6. Toxic materials treatment.

7. Acid & alkali treatment.

8. And the treatment of additional organics.

The different technologies of steel industries are basically the processes of Cooling Tower unit, Process of demineralization Plant, River & sewage water treatment plant. The conventional methods of primary, secondary and tertiary treatment processes followed by the ozonation method is generally applied by the sewage treatment plants (STP) & the wastewater treatment plants (WWTP). Lastly, the Preozonation, Chlorination, Flocculation, Filtration or aeration, pH correction and Adsorption processes are mainly used for the treatment of river water.

To address the pollution coming out from the industries the technologies for clean production & waste minimization initiatives should be encouraged.

The treatment processes by conventional methods of treating the wastewater is expensive and also this require composite operation and maintenance. The total estimated cost for the establishment of a system for treating the industrial wastewater is approx Rs. 8,500 crores as per the estimation of central pollution control board, and this is about 08 to10 times the amount estimated by the government of India to spend. The economics of different level of treatments through conventional measures is already illustrated in the Table 1. In India, the removal,

treatment and handling of sludge is the most neglected part in the sewage treatment plant (STP). As per the report of central pollution control board (2007b), the facilities constructed to treat the wastewater is never functioned properly & mostly remains closed because of inappropriate design, improper maintenance schedule, electric power supply breakdown on regular basis and the most important part is the shortage of technical workforce. In most of the cases the use of biogas generated by the reactor of UASB and or the digesters of sludge is not adequate. In many cases the gas generated is not properly utilized and is being flared in the open environment. One of the major problems with waste water treatment technique is that none of the existing technology has any direct financial return. As, there is no financial return the local establishment are usually not interested in any project of waste water treatment. As per the survey done by the central pollution control board (CPCB) carried for the performance evaluation of sewage treatment plant in the major selected cities indicates that out of 94 sewage treatment plants, 27 plants for treating the sewage, had not met the agreed standard set for the biological oxygen demand and these waters were inappropriate for the domestic purpose. The waste water treatment facility in our country has improved by near about 3.5 times since 1977-78, even though hardly 12% of the sewage coming out is effectively treated and the rest sewage water is dispensed its own mode into the natural ecosystem and is mainly accountable for the large scale contamination of the river and the ground waters [Nakate & Trivedy 200].

An alarming concern for all of us is the innovative technologies development for the treatment of wastewater from the steel industries. Many research papers have been reported & published regarding the studies of waste water pollution control, but the research work carried out for the treatment of the wastewater from the steel industries are very few, particularly with reference to the development of design of the industrial effluent treatment system. The most beneficial aspect of this research work is the reuse of water and sludge from steel industry and also the effective recycling of the same. This Paper discusses the evolution of **Common Effluent Treatment Plants (CETPs)** in Indian context and their performance evaluation. This report

also presents the implementation of Membrane technology, Ion-exchange, de-chlorination and reverse osmosis for the better results towards getting clean water from the steel wastewater. For an effective wastewater treatment of small to medium enterprises the Common Effluent Treatment Plants (CETPs) are considered as one of the most viable solution. However, many common effluents treatment plants, which are in operation are not performing optimally due to different technological and administrative reason. As per the guidelines suggested by Central pollution control board, Delhi, for the quality management of water, it is considered that this type of joint collection & treatment policies for the small scale industry in & around the cities is always a win-win choice. For medium and large industries wherever possible such joint collection and treatment technologies should be improved, in addition of other technological advantages, economic viability of the city and the industrial sewerage and waste treatment systems. In this study we have tried to understand the issues related to the operating Common Effluents Treatment Plants (CETPs) and also tried to discuss information related to the Best Available Techniques (BAT), along with economic possibilities.