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Analysis and Site Suitability Evaluation for Textile Sewage Water Treatment Plant in Salem Corporation, Tamilnadu Using Remote Sensing Techniques

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ABSTRACT
Textile processing units in Erode, Karur, Salem and Tirupur districts of Tamilnadu, India generates chemically toxic waste water there by polluting sub-soil and surface water of water bodies in particular River Cauvery. In Erode district, a model Common effluent treatment plant (CETP) was promoted by State Industrial Promotion Corporation of Tamilnadu Ltd., at Perundurai with 14 textile units as stake holders. Waste water from textile processing units contains a complex mixture of dyes, which are highly resistant to conventional treatment technology. As the characteristics of wash water effluent and dye bath effluent are variable, various physical, chemical and biological treatment methods are adopted for the treatment. Most of the perennial rivers in Tamilnadu have less surface flow water and dried during summer season. The area lies in arid zone of Salem, Tamil Nadu having very scanty rains and very low ground water reserves. Some of the other problems that are faced by the area are disposal of industrial effluent posing threat to its sustainability of water resource. Textiles, dyeing and printing industries, various mechanical process and chemical/synthetic dyes are used and considerable wastewater discharged from these textile units contains about high amount of the dyes into the adjoining drainages. Geographic Information System (GIS) can be used as a decision support tool for planning waste management. The manual methods adopted for the analysis of many factors would be a tedious and lengthy work. Also the possibilities of errors increase when merging the spatial and non-spatial data. But in case of GIS, as the work is carried out in layers, the chances of error will be less and the system is capable to coordinate between spatial and non-spatial data. Remote sensing analysis has been carried out using Resource sat -1 multispectral satellite data along with DEM derived from IRS P5 stereo pair. GIS database generated of various thematic layers viz. base layer - inventorying all water bodies in the vicinity, transport network and village layer, drainage, geomorphology, structure, land use. Analysis of spatial distribution of the features and change detection in land use/cover carried out. GIS maps have been used to help factor in spatial location of source and hydro-geomorphological settings. In our project analyze the chemical content of the water and Site suitability evaluation for waste management is becoming a major criteria for defending the environmental degradation. If proper location for the treatment plant is not selected then it may lead to soil degradation and ground water pollution. The study area is situated in the southern portion of Tamil Nadu, India that is currently experiencing high rates of population growth and economic development. Potential sites for the treatment plant are evaluated using suitability score based on planning and design constraints, including ground slope, land use pattern, and distance to river and roads. Spatial analyst tool of ArcGIS software is used for selection of suitable reclamation plant site. Finally based on weightage value, suitable site for treatment plant have been selected and classified into good, moderate and poorly suitable areas respectively.
KEYWORDS: Analysis, Site Suitability, Textile Sewage Water, Treatment Plant, Salem Corporation, Tamilnadu

I. INTRODUCTION

Textile Sewage is the wastewater from residential and in industrial areas and it generally consists of wastewater from materials, kitchens, toilets and bathrooms. It is necessary to collect, treat and safely dispose of the sewage, because if it is let into the environment without treatment it will be naturally drained by the existing ground slope and will reach the nearby water bodies such as lakes and rivers. The organic waste present in the sewage will undergo decomposition in the water bodies causing depletion of dissolved oxygen in it and causing unhygienic condition leading to the spreading of water borne diseases. Sewage carries pathogenic organisms that transmit diseases to human. It contains organic matter that causes odor and nuisance problems. It carries nutrients that cause eutrophication of receiving water bodies and leads to ecotoxicity. Proper collection and safe disposal of the sewage are legally recognized as a necessity in an urbanized, industrialized society. Globally around 90% of wastewater produced remains untreated causing widespread water pollution especially in low-income countries. Geographic Information System (GIS) can be used as a decision support tool for planning waste management. The manual methods adopted for the analysis of many factors would be a tedious and lengthy work. Also the possibilities of errors increase when merging the spatial and non-spatial data. But in case of GIS, as the work is carried out in layers, the chances of error will be less and the system is capable to coordinate between spatial and non-spatial data.

II. STUDY AREA

Salem is the city and the municipal corporation in Salem district in the Indian state of Tamil Nadu. Salem is located about 160 kilometers (99 mi) northeast of Coimbatore, 186 kilometers (116 mi) southeast of Bangalore and about 340 kilometers (211 mi) southwest of the state capital, Chennai. Salem is the fifth largest city in Tamil Nadu in terms of population, after Chennai, Coimbatore
and Tiruchirappalli respectively, and fourth in terms of urbanization. The area of the city is 100 km^2 (39 sq mi). It is the fifth municipal corporation and urban agglomeration commissioned in Tamil Nadu after Madras (1919), Coimbatore (1981), Madurai (1971) and Tiruchirappalli (1994). As of 2011, the city had a population of 1,272,743.

Salem had a population of 826,267 as of the 2011 census (05740). There were 987 females for every 1,000 males, significantly above the national average of 929. A total of 79,067 were under the age of six, constituting 40,570 males and 38,497 females. Scheduled Castes and Scheduled Tribes accounted for 12.82% and 0.15% of the population, respectively. The average literacy of the city was 76.37%, compared to the national average of 72.99%. The city had a total of 215,747 households. There were a total of 332,147 workers: 1599 cultivators, 3040 main agricultural labours, 32,597 in house hold industries, 278,892 other workers, 16,019 marginal workers, 165 marginal cultivators, 544 marginal agricultural labours, 1937 marginal workers in household industries and 13,373 other marginal workers

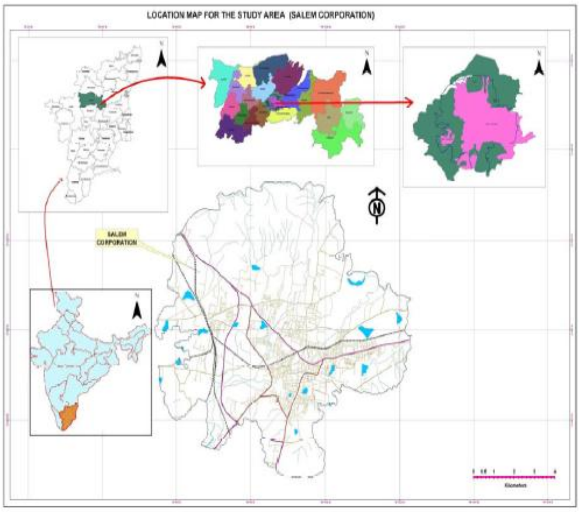

Fig 3.1 Study area map

Textile processing industry is characterized not only by the large volume of water required for various unit operations but also by the variety of chemicals used for various processes. There is a long sequence of wet processing stages requiring inputs of water, chemical and energy and generating wastes at each stage. The other feature of this industry, which is a backbone of fashion garment, is large variation in demand of type, pattern and color combination of fabric resulting into significant fluctuation in waste generation volume and load. Textile processing generates many waste streams, including liquid, gaseous and solid wastes, some of which may be hazardous. The nature of the waste generated depends on the type of textile facility, the processes and technologies being operated, and the types of fibers and chemicals used. The overview on the amounts of waste generated within the textile processes is summarized.

III. TEXTILE INDUSTRIES OVERVIEW

The textile industry is a significant contributor to many national economies, encompassing both small and large-scale operations worldwide. In terms of its output or production and employment, the textile industry is one of the largest industries in the world. The textile manufacturing process is characterized by the high consumption of resources like water, fuel and a variety of chemicals in a long process sequence that generates a significant amount of waste. The common practices of low process efficiency result in substantial wastage of resources and a severe damage to the environment. The main environmental problems associated with textile industry are typically those associated with water body pollution caused by the discharge of untreated effluents. Other environmental issues of equal importance are air emission, notably Volatile Organic Compounds

(VOC)'s and excessive noise or odor as well as workspace safety.

4.1 Textile manufacturing dyes release:

- Aromatic amines (Benzedrine and toluidine)
- Heavy metals
- Ammonia
- Alkali salts
- Toxic solids and large amounts of pigments
- Chlorine, a known carcinogen

Untreated dyes cause chemical and biological changes in our aquatic system, which threaten species of fish and aquatic plants. The presence of these compounds also make practical water use unhealthy or dangerous. The enormous amount of water required by textile production competes with the growing daily water requirements of the half billion people that live in drought-prone regions of the world. By 2025, the number of inhabitants of drought-prone areas is projected to increase to almost one-third of the world's population. If global consumption of fresh water continues to double every 20 years, the polluted waters resulting from textile production will pose a greater threat to human lives.

4.2 Air pollution

Most processes performed in textile mills produce atmospheric emissions. Gaseous emissions have been identified as the second greatest pollution problem (after effluent quality) for the textile industry. Speculation concerning the amounts and types of air pollutants emitted from textile operations has been widespread but, generally, air emission data for textile manufacturing operations are not readily available. Air pollution is the most difficult type of pollution to sample, test, and quantify in an audit.

4.3 Air emissions can be classified according to the nature of their sources

Textile mills usually generate nitrogen and sulphur oxides from boilers. Other significant sources of air emissions in textile operations include resin finishing and drying operations, printing, dyeing, fabric preparation, and wastewater treatment plants. Hydrocarbons are emitted from drying ovens and from mineral oils in high-temperature drying/curing. These processes can emit formaldehyde, acids, softeners, and other volatile compounds.

Table 4.1 summary of the wastes generated during textiles manufacturing

Process	Emission	Wastewater	Solid wastes
Fiber preparation	Little or none	Little or none	Fiber waste and packaging waste.
Yarn spinning	Little or none	Little or none	Packaging wastes; sized yarn; fiber waste; cleaning and processing waste.
Slashing/sizing	VOCs	BOD; COD; metals;	Fiber lint; yarn waste; packaging waste; cleaning waste, size unused starch-based sizes
Weaving	Little or none	Little or none	Packaging waste; yarn and fabric scraps; off-spec fabric; used oil.
Knitting	Little or none	Little or none	Packaging waste yarn and fabric scraps; off-spec fabric.
Tufting	Little or none	Little or none	Packaging waste; yarn, fabric scraps; off-spec fabric
Desizing	VOCs from glycol ethers	BOD from sizes lubricants; biocides; anti-static compounds	Packaging waste; fiber lint; yarn waste; cleaning and maintenance materials
Scouring	VOCs from glycol ethers and scouring solvents	Disinfectants, insecticide residues; NaOH; detergents, oils; knitting lubricants; spin finishes; spent solvents	Little or none
Bleaching	Little or none	H_2O_2, stabilisers; high pH	Little or none, even if little, the impact could be considerable
Singeing	Small amounts of exhaust gases from the burners exhaustic which components.	Little or none	Little or none
Mercerising	Little or none	High pH; NaOH	Little or none
Heat setting	Volatilisation of spin finish agents synthetic fiber manufacture	Little or none	Little or none
Dyeing	VOCs	Metals; salt; surfactants; organic processing assistants; cationic materials; colour; BOD; COD; sulphide; acidity/ alkalinity; spent solvents	Little or none
Printing	Solvents, acetic acid -drying and curing oven emissions combustion; gases	Suspended solids; urea; solvents; colour; metals; heat; BOD; foam	Little or none
Finishing	VOCs; contaminants in purchased chemicals; formaldehyde vapors; combustion gases	COD; suspended solids; toxic materials; spentsolvents	Fabric scraps and trimmings; packaging waste

4.3.1 Point sources:

- Boiler
- Ovens
- Storage
- Tanks

4.3.2 Diffusive

- Solvent – based
- Waste water treatment
- Ware house
- Spills

Residues from fiber preparation sometimes emit pollutants during heat setting processes. Carriers and solvents may be emitted during dyeing operations depending on the types of dyeing processes used and from wastewater treatment plant operations. Carriers used in batch dyeing of disperse dyes may lead to volatilization of aqueous chemical emulsions during heat setting, drying, or curing stages. Acetic acid and formaldehyde are two major emissions of concern in textiles.

Table 4.2 summaries of the wastes generated during textiles manufacturing

Process	Source	Pollutants
Energy production	Emissions from boiler	Particulates, nitrous oxides (Nox) sulphur dioxide (SO_2)
Coating, drying and curing	Emission from high temperature ovens	Volatile organic components (VOCs)
Cotton handling activities	Emissions from preparation, carding, combing, and fabrics manufacturing	Particulates
Sizing	Emission from using sizing compound (gums, PVA)	Nitrogen oxides, sulphur oxide, carbon monoxide.
Bleaching	Emission from using chlorine compound	Chlorine, chlorine dioxide
Dyeing	Disperse dyeing using carriers Sulphur dyeing Aniline dyeing	Carriers H_2S Aniline vapours
Printing	Emission	Hydrocarbons, ammonia
Finishing	Resin finishing heat setting of synthetic fabrics	Formaldehyde carriers - low molecular weight Polymers - lubricating oils
Chemical storage	Emissions from storage tanks for commodity and chemicals	Volatile organic components (VOCs)
Wastewater treatment	Emissions from treatment tanks and vessels	Volatile organic components, toxic emissions

4.4 Water pollution

The textile industry uses high volumes of water throughout its operations, from the washing of fibers to bleaching, dyeing and washing of finished products. On average, approximately 200 liters of water are required to produce l kg of textiles. The large volumes of wastewater generated also contain a wide variety of chemicals, used throughout processing. These can cause damage if not properly treated before being discharged into the environment. Of all the steps involved in textiles processing, wet processing creates the highest volume of wastewater.

Fig 4.2 Textile Wastewater

Table 4.3 sources and types of solid waste in textile manufacturing

Source	Type of Solid waste
Mechanical operations of cotton and synthetics:	
◆ Yarn preparation	Fibers and yarns
◆ Knitting	Fibers and yarns
◆ Weaving	Fibers, yarns and cloth scraps
Dyeing and finishing of woven fabrics:	
◆ Sizing, desizing, mercerising, beaching, washing and chemical finishing	Cloth scraps
◆ Mechanical finishing	Flock
◆ Dyeing and/or printing	Dye containers
◆ Dyeing and/or printing (applied finish)	Chemical containers
Dyeing and finishing of knitted fabrics	Clothe scraps, dye and chemical containers
Dyeing and finishing of carpets:	
◆ Tufting	◆ Yarns and sweepings
◆ Selvage trim	◆ Selvage
◆ Fluff and shear	◆ Flock
◆ Dyeing, printing and finishing	◆ Dye and chemical containers
Dyeing and finishing of yarn and stock	Yarns, dye and chemical containers
Wool fabrication	
◆ Wool scouring	◆ Dirt, wool, vegetable matter, waxes
◆ Wool fabric dyeing and finishing	◆ Flocks, seams, fabric, fibers, dye and chemical containers
Packaging	Paper, cartons, plastic sheets, rope
Workshops	Scrap metal, oily rags
Domestic	Paper, sheets, general domestic wastes
Wastewater treatment	Fiber, wasted sludge and retained sludge

The aquatic toxicity of textile industry wastewater varies considerably among production facilities. The sources of aquatic toxicity can include salt, surfactants, ionic metals and their metal complexes, toxic organic chemicals, biocides and toxic anions. Most textile dyes have low aquatic toxicity. On the other hand, surfactants and related compounds, such as detergents, emulsifiers and dispersants are used in almost each textile process and can be an important contributor to effluent aquatic toxicity, BOD and foaming.

Table 4.4 average water consumption for various types of fabric

Processing subcategory	Water consumption (m^3/ton fibre material)	
	Minimum	Median
Wool	111	285
Woven	5	114
Knit	20	84
Carpet	8.3	47
Stock/yarn	3.3	100
Nonwoven	2.5	40
Felted fabric finishing	33	213

4.5 Solid waste pollution

The primary residual wastes generated from the textile industry are non-hazardous. These include scraps of fabric and yarn, off-specification yarn and fabric and packaging waste. There are also wastes associated with the storage and production of yarns and textiles, such as chemical storage drums, cardboard reels for storing fabric and cones used to hold yarns for dyeing and knitting. Cutting room waste generates a high volume of fabric scraps, which can often be reduced by increasing fabric utilization efficiency in cutting and sewing. Solid wastes associated with various textile manufacturing processes.

Fig 4.3 Solid waste

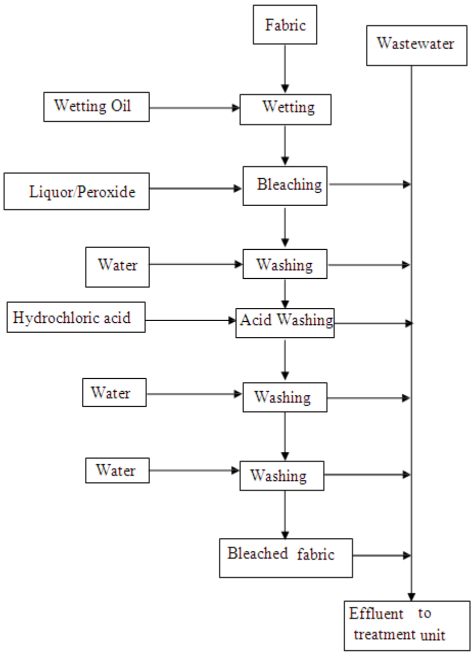

Figure 4.5 General Bleaching Operations

IV. ABOUT REMOTE SENSING & GIS

A geographic information system (GIS) is a computer-based tool for mapping and analyzing feature events on earth. GIS technology integrates common database operations, such as query and statistical analysis, with maps. GIS manages location-based information and provides tools for display and analysis of various statistics, including population characteristics, economic development opportunities, and vegetation types. GIS allows you to link databases and maps to create dynamic displays. Additionally, it provides tools to visualize, query, and overlay those databases in ways not possible with traditional spreadsheets. These abilities distinguish GIS from other information systems, and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies

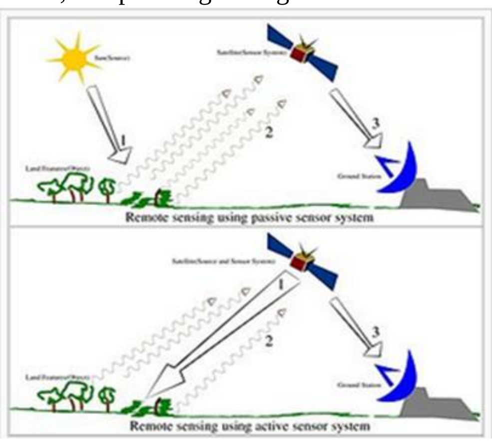

Fig 5.1 Illustration of Remote Sensing

5.1 REMOTE SENSING

Remote sensing is the examination or the gathering of information about a place from a distance. Such examination can occur with devices (e.g. - cameras) based on the ground, and/or sensors or cameras based on ships, aircraft, satellites, or other spacecraft. Today, the data obtained is usually stored and manipulated using computers. The most common software used in remote sensing is ERDAS Imagine, ESRI, MapInfo, and ERMapper.

V. MATERIALS AND METHODS

Thematic maps of the study area can be prepared by integrating topo sheet of 1:50000 scale, existing maps and satellite image IRS P6 by using the software ArcGIS 9.3. ENVI 4.2 is used for sub setting the satellite imagery and for supervised classification. This map was verified in the field through extensive ground truth and necessary corrections were made wherever required. The area under various land use categories was calculated from this map. The thematic maps prepared are integrated by weighted index overlay analysis and weightage is assigned to each theme depends on the importance of influence for locating the plant. The satellite imagery of the study area is shown. It is extracted by mask using ArcGIS software as given in

5.1 METHODOLOGY

The following methodology has been adopted, firstly, from the satellite data various thematic data bases were generated with special reference to groundwater. From the same, all the data set were digitized in GIS environment. Then, ranks and weightages were assigned all the thematic data, based on the groundwater prospects. All the thematic layers were overlaid by using GIS overlay function of ARC GIS. Then, all the individual GIS layers were integrated; the weightages of each parameter added and finally the area has been divided into different groundwater potential zones based on the added weightages using Boolean logic methodology. Finally, the study area has been divided into high groundwater potential, moderate groundwater potential and low ground water potential zones for concluding the site suitability.

Generation of Data Bases for Site Suitability for Study area . The generation of spatial databases from satellite imagery, such as lithology, lineament density, geomorphology,

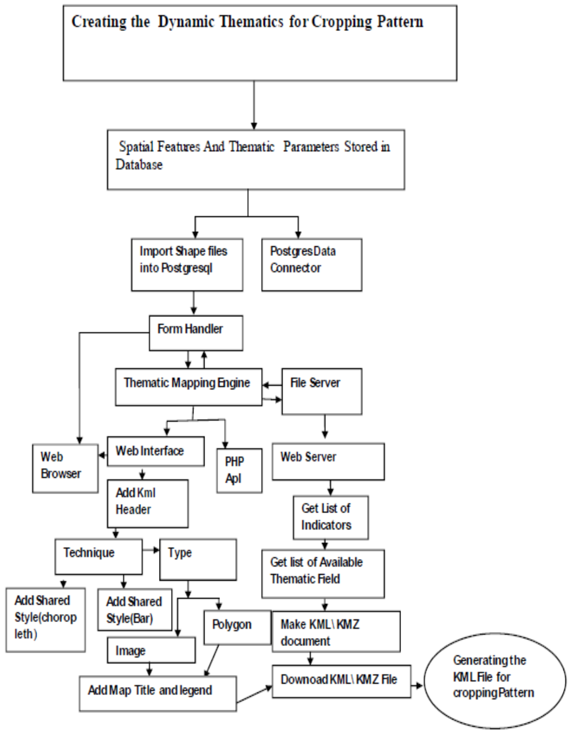

Fig 6.1 Methodology flow chart

drainage density, slope, land use / land cover of the study area was generated with special reference to groundwater point of view, and has been prepared in GIS environment.

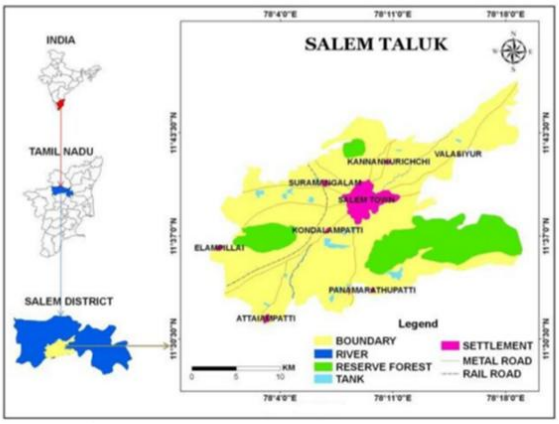

Fig 6.2 Base Map

5.2 GEOMORPHOLOGY

Geomorphologically the study area has special credential owing to the occurrence of multiple landforms. The study area falls under major geomorphic features, such as residual hill, plateau, valley fill, bazada, shallow pediment, moderate pediment, and deep pediment and same has been digitized GIS environment and shown. The geomorphic features were given weightages, based on their groundwater prospects and as shown in Table-1 and accordingly the various geomorphic features were dissolved into five classes using the GIS options. For example, the deep pediment and moderate pediment have most important input to groundwater prospects. Accordingly, these two geomorphic units were dissolved in the geomorphology GIS layer and as- signed 5 & 4 and least weightages was assigned for Rock exposure feature.

5.3 DRAINAGE DENSITY

All the drainages were drawn from topographic data wrapped with spatial data and shown. Similarly, weightages were assigned to drainage density; it is classified into three as high, moderate and low. The drainage density polygons were dissolved into three classes based on the weightages high (2) moderate (3) low (5) were respectively assigned as shown in Table-1 and thus weighted GIS layer was prepared. This was done so, because the zone of high drainage density will have poor groundwater prospects and gradually the zones of lower and lower drainage density zones will have better groundwater prospects.

Slope

For the identification of Groundwater potential zones, the slope angle was considered as an important input as it has considerable influence in the study area. The slope map was derived from a SRTM data of the study area and shown. The slope of the study area was classified into six classes, such as less than 5 degree plain area, slope zone 5- 15º, 15-25º, and 25-35 º and above 45º and weightages of 5, 3, 2 and 1 was respectively assigned to them based on their groundwater prospects. In this case, higher weightage was given to shallow slopes and gradually lesser and lesser weightages were assigned steeper and steeper slopes because runoff is directly proportional to slope.

5.4 LAND COVER

The landuse / land cover map has prepared using spatial data. The following landuse / land cover practices were ob- served, such as built-up land, crop land, fallow land, waste land, scrub forest, barren rock, dense forest, open forest, land with scrub, river and tanks and shown. For the same way, the landuse / land cover features were grouped into

Table 6.1. Assigning rank & weightages of thematic data base

S. No	Thematic data	R	Features	W	TW
1	Geology	9	Fissile hornblende gneiss	5	45
			Basic and ultra basic rock	3	27
			Mafic, ultra basic rock	2	18
2	Lineament density	9	High	5	45
			Moderate	3	27
			Low	2	18
3	Geomorphology	8	Deep pediment	5	40
			River	5	40
			Bajada	5	40
			Valley fill	4	32
			Tank	4	32
			Moderate pediment	4	32
			Shallow pediment	3	24
			Structural hill	2	16
			Pleateau	2	16
			Pediplain	2	16
			Escarpment	1	8
			Residual hill	1	8
			Rocky exposure	1	8
4	Drainage density	7	Low	5	35
			Moderate	3	21
			High	2	14
5	Slope	7	<5	5	35
			5-15	3	21
			15-25	2	14
			25-35	1	7
			35-45	1	7
			>45	1	7
6	Landuse / land cover	5	River	5	25
			Crop land	5	25
			Dense forest	4	20
			Tank	4	20
			Fallow land	3	15
			Open forest	3	15
			Scrub land	2	10
			Land with scrub	2	10
			Waste land	1	5
			Barren rocky	1	5
			Built-up land	1	5

eleven classes and accordingly the corresponding polygons were dissolved and a new GIS layer was created with only five classes as shown and the least weightage was given to the barren rocky, land with scrub, towns and villages. Methodology for Ranking and Weightages For the study, the different ranks and weightages were as- signed to relevant different geo-system parameters viz: lithology, lineament density, geomorphology, slope, drainage density, land use / land cover and their corresponding sub variables for identification of Groundwater potential zones. For assigning the weightage, lithology, lineament density and geomorphology were assigned higher ranks, whereas the slope, drainage density and land use / land cover were assigned lower ranks, thus leading to maximum of 10. After assigning ranks (maximum weightages) to the different geo-system parameters, individual weight ages were given for sub variables of the above main eight geo-system parameters.

Fig 6.3 IRS P6 LISS III Satellite Image

6.5 CRITERIA

For the selection of site for sewage treatment plant, it should satisfy the following criteria should be satisfied.

- Slope of the surface should be less than 15%
- away from the thickly habituated areas
- 200 meters away from the main roads
- 200 meters away from the water bodies

6.6 LAND USE

Land use plays a vital role as it is used for identifying the suitable site. The land use pattern of the study area is classified into various types such as built up lands, agricultural land, and reservoir and river stream based on the level 1 classification by using supervised classification which is shown in fig.

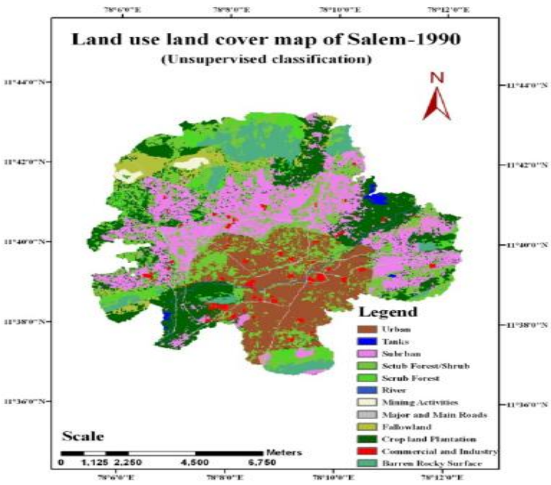

Fig 6.4: Land use land cover-1990.

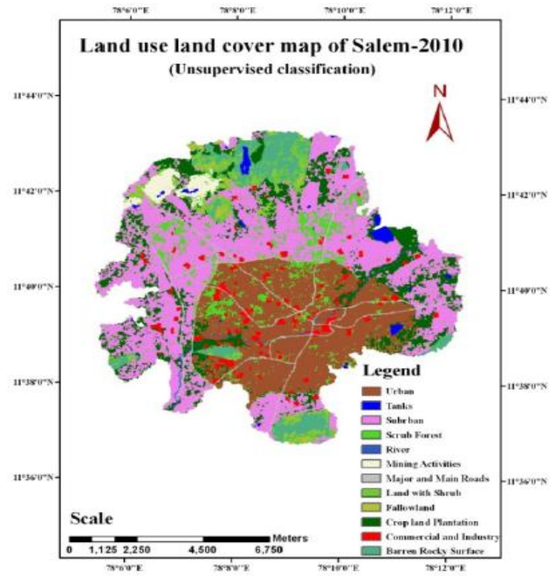

Fig 6.5: Land use land cover-2010.

5.7 ROAD MAP

The map indicates the national highways, district road and village roads. The national highways in the study area from NH 67. Ideally, the sewage treatment plant should be away from major roads. Road map is shown in fig.6.6

Fig 6.6 Road map

5.8 DRAINAGE

All the drainages were drawn from topographic data wrapped with spatial data and shown in Fig. Similarly, weightages were assigned to drainage density; it is classified into three as high, moderate and low. The drainage density polygons were dissolved into three classes based on the

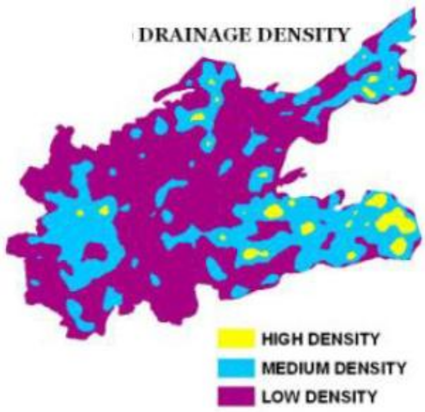

Fig 6.7 : Drainage map

weightages high moderate low were respectively assigned and thus weighted GIS layer was prepared. This was done so, because the zone of high drainage density will have poor groundwater prospects and gradually the zones of lower and lower drainage density zones will have better groundwater prospects.

5.9 SLOPE

For the identification of Groundwater potential zones, the slope angle was considered as an important input as it has considerable influence in the study area. The slope map was derived from a SRTM data of the study area. The slope of the study area was classified into six classes, such as less than 5 degree plain area, slope zone 5-15º, 15-25º, and 25-35º and above 45º and weightages of 5, 3, 2 and 1 was respectively assigned to them based on their groundwater prospects. In this case, higher weightage was given to shallow slopes and gradually lesser and lesser weightages were assigned steeper and steeper slopes because runoff is directly proportional to slope.

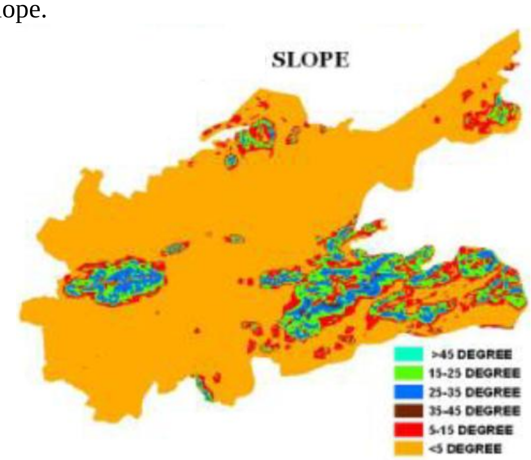

Fig 6.8: slope map

5.10 RESULTS

By integrating different thematic maps such as land use, Slope, drainage and road map in ArcGIS

9.3 software using weightage index overlay analysis, suitable site for sewage treatment plant can be found out and classified as good, moderate and poor as shown . The weights are assigned to various classes in the thematic layers as shown in table. The areas of different categories which are suitable for locating sewage treatment plant are shown in table 6.2.

Table 6.2 Creation table for identify suitable site

CRITERIA	CLASSES	RANK	WEIGHTAGE
Land use	**Crop lad**	**2**	**35**
	Build up	**1**	
	Water bodies	**1**	
	Forest	**2**	
Slope	**0 to 5**	**3**	**25**
	5 to 15	**2**	
	>15	**1**	
Road	**0 to 100m**	**1**	**10**
	100 to 200m	**2**	
	>200m	**3**	
Drainage	**0 to 100m**	**1**	**30**
	100 to 200m	**2**	
	>200	**3**	

Table 6.3 Area of different categories of sewage treatment plant site

S.No	SUITABILITY	AREA (SQ.KM)
1.	**High**	**5.53**
2.	**Moderate**	**18.06**
3.	**Poor**	**0.18**

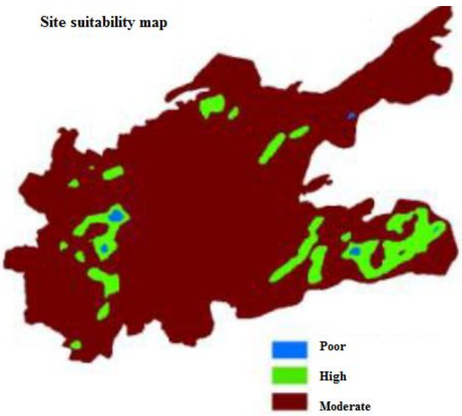

Fig 6.9. Site Suitability Map

VI. TREATMENT PROCESSES IN THAT SITE

The textile dyeing wastewater has a large amount of complex components with high concentrations of organic, high-color and changing greatly characteristics. Owing to their high BOD/COD, their coloration and their salt load, the wastewater resulting from dyeing cotton with reactive dyes are seriously polluted. As aquatic organisms need light in order to develop, any deficit in this respect caused by colored water leads to an imbalance of the ecosystem.

Moreover, the water of rivers that are used for drinking water must not be colored, as otherwise the treatment costs will be increased. Obviously, when legal limits exist (not in all the countries) these should be taken as justification. Studies concerning the feasibility of treating dyeing wastewater are very important (C. All`egre et al.,2006).

In the past several decades, many techniques have been developed to find an economic and efficient way to treat the textile dyeing wastewater, including physicochemical, biochemical, combined treatment processes and other technologies. These technologies are usually highly efficient for the textile dyeing wastewater.

6.1 PHYSICOCHEMICAL WASTEWATER TREATMENT

Wastewater treatment is a mixture of unit processes, some physical, others chemical or biological in their action. A conventional treatment process is comprised of a series of individual unit processes, with the output (or effluent) of one process becoming the input (influent) of the next process.

The first stage will usually be made up of physical processes. Physicochemical wastewater treatment has been widely used in the sewage treatment plant which has a high removal of chroma and suspended substances, while it has a low removal of COD. The common physicochemical methods are shown as followed.

6.1.1 Equalization and homogenization

Because of water quality highly polluted and quantity fluctuations, complex components, textile dyeing wastewater is generally required pretreatment to ensure the treatment effect and stable operation. In general, the regulating tank is set to treat the wastewater. Meantime, to prevent the lint, cotton seed shell, and the slurry Settle to the bottom of the tank, it's usually mixed the wastewater with air or mechanical mixing equipment in the tank. The hydraulic retention time is generally about 8 h.

6.1.2 Floatation

The floatation produces a large number of micro-bubbles in order to form the three-phase substances of water, gas, and solid. Dissolved air under pressure may be added to cause the formation of tiny bubbles which will attach to particles. Under the effect of interfacial tension, buoyancy of bubble rising, hydrostatic pressure and variety of other forces, the microbubble adheres to the tiny fibers. Due to its low density, the mixtures float to the surface so that the oil particles are separated from the water. So, this method can effectively remove the fibers in wastewater.

6.1.3 Coagulation flocculation sedimentation

Coagulation flocculation sedimentation is one of the most used methods, especially in the conventional treatment process. Active on suspended matter, colloidal type of very small size, their electrical charge give repulsion and prevent their aggregation. Adding in water electrolytic products such as aluminum sulphate, ferric sulphate, ferric chloride, giving hydrolysable metallic ions or organic hydrolysable polymers (polyelectrolyte) can eliminate the surface electrical charges of the colloids.

This effect is named coagulation. Normally the colloids bring negative charges, so the coagulants are usually inorganic or organic cationic coagulants (with positive charge in water). The metallic hydroxides and the organic polymers, besides giving the coagulation, can help the particle aggregation into flocks, thereby increasing the sedimentation. The combined action of coagulation, flocculation and settling is named clariflocculation.

Settling needs stillness and flow velocity, so these three processes need different reactions tanks. This processes use mechanical separation among heterogeneous matters, while the dissolved matter is not well removed (clariflocculation can eliminate a part of it by absorption into the flocks). The dissolved matter can be better removed by biological or by other physical chemical processes (Sheng.H et al.,1997) . But additional chemical load on the effluent (which normally increases salt concentration) increases the sludge production and leads to the uncompleted dye removal.

6.1.4 Chemical oxidation

Chemical operations, as the name suggests, are those in which strictly chemical reactions occur, such as precipitation. Chemical treatment relies upon the chemical interactions of the contaminants we wish to remove from water, and the application of chemicals that either aid in the separation of contaminants from water, or assist in the destruction or neutralization of harmful effects associated with contaminants.

Chemical treatment methods are applied both as stand-alone technologies and as an integral part of the treatment process with physical methods (K.Ranganathan et al.,2007).Chemical operations can oxidize the pigment in the printing and dyeing wastewater as well as bleaching the effluent. Currently, Fenton oxidation and ozone oxidation are often used in the wastewater treatment.

Fenton reaction

Oxidative processes represent a widely used chemical method for the treatment of textile effluent, where decolourisation is the main concern. Among the oxidizing agents, the main chemical is hydrogen peroxide (H_2O_2), variously activated to form hydroxyl radicals, which are among the strongest existing oxidizing agents and are able to decolourise a wide range of dyes.

A first method to activate hydroxyl radical formation from H_2O_2 is the so called Fenton reaction, where hydrogen peroxide is added to an acidic solution (pH=2-3) containing Fe_2^+ ions. Fenton reaction is mainly used as a pre-treatment for wastewater resistant to biological treatment or/and toxic to biomass. The reaction is exothermic and should take place at temperature higher than ambient.

In large scale plants, however, the reaction is commonly carried out at ambient temperature using a large excess of iron as well as hydrogen peroxide. In such conditions ions do not act as catalyst and the great amount of total COD removed has to be mainly ascribed to the $Fe(OH)_3$ co-precipitation. The main drawbacks of the method are the significant addition of acid and alkali to reach the required pH, the necessity to abate the residual iron concentration, too high for discharge in final effluent, and the related high sludge production (Sheng.H et al.,1997) .

Ozone oxidation

It is a very effective and fast decolourising treatment, which can easily break the double bonds present in most of the dyes. Ozonation can also inhibit or destroy the foaming properties of residual surfactants and it can oxidize a significant portion of COD. Moreover, it can improve the biodegradability of those effluents which contain a high fraction of nonbiodegradable and toxic components through the conversion (by a limited oxidation) of recalcitrant pollutants into more easily biodegradable intermediates.

As a further advantage, the treatment does increase neither the volume of wastewater nor the sludge mass. Full scale applications are growing in number, mainly as final polishing treatment, generally requiring up-stream treatments such as at least filtration to reduce the suspended solids contents and improve the efficiency of decolourisation. Sodium hypochlorite has been widely used in the past as oxidizing agent. In textile effluent it initiates and accelerates azo bond cleavage. The negative effect is the release of carcinogenic aromatic amines and otherwise toxic molecules and, therefore, it should not be used.

6.1.5 Adsorption

Adsorption is the most used method in physicochemical wastewater treatment, which can mix the wastewater and the porous material powder or granules, such as activated carbon and clay, or let the wastewater through its filter bed composed of granular materials.

Through this method, pollutants in the wastewater are adsorbed and removed on the surface of the porous material or filter. Commonly used adsorbents are activated carbon, silicon polymers and kaolin. Different adsorbents have selective adsorption of dyes. But, so far, activated carbon is still the best adsorbent of dye wastewater.

The chroma can be removed 92.17% and COD can be reduced 91.15% in series adsorption reactors, which meet the wastewater standard in the textile industry and can be reused as the washing water. Because activated carbon has selection to adsorb dyes, it can effectively remove the water-soluble dyes in wastewater, such as reactive dyes, basic dyes and azo dyes, but it can't absorb the suspended solids and insoluble dyes.

Moreover, the activated carbon cannot be directly used in the original textile dyeing wastewater treatment, while generally used in lower concentration of dye wastewater treatment or advanced treatment because of the high cost of regeneration.

6.1.6 Membrane Separation Process

Membrane separation process is the method that uses the membrane's micropores to filter and makes use of membrane's selective permeability to separate certain substances in wastewater. Currently, the membrane separation process is often used for treatment of dyeing wastewater mainly based on membrane pressure, such as reverse osmosis, ultrafiltration, nanofiltration and microfiltration.

Membrane separation process is a new separation technology, with high separation efficiency, low energy consumption, easy operation, no pollution and so on. However, this technology is still not large-scale promoted because it has the limitation of requiring special equipment, and having high investment and the membrane fouling.

Reverse osmosis

Reverse osmosis membranes have a retention rate of 90% or more for most types of ionic compounds and produce a high quality of permeate. Decolorization and elimination of chemical auxiliaries in dye house wastewater can be carried out in a single step by reverse osmosis. Reverse osmosis permits the removal of all mineral salts, hydrolyzed reactive dyes, and chemical auxiliaries. It must be noted that higher the concentration of dissolved salt, the more important the osmotic pressure becomes; therefore, the greater the energy required for the separation process.

Nanofiltration

Nanofiltration has been applied for the treatment of colored effluents from the textile industry. Its aperture is only about several nanometers, the retention molecular weight by which is about 80-1000da, A combination of adsorption and nanofiltration can be adopted for the treatment of textile dye effluents. The adsorption step precedes nanofiltration, because this sequence decreases concentration polarization during the filtration process, which increases the process output.

Nanofiltration membranes retain low molecular weight organic compounds, divalent ions, large monovalent ions, hydrolyzed reactive dyes, and dyeing auxiliaries. Harmful effects of high concentrations of dye and salts in dye house effluents have frequently been reported. In most published studies concerning dye house effluents, the concentration of mineral salts does not exceed 20 g/L, and the concentration of dyestuff does not exceed 1.5 g/L. Generally, the effluents are reconstituted with only one dye, and the volume studied is also low.

The treatment of dyeing wastewater by nanofiltration represents one of the rare applications possible for the treatment of solutions with highly concentrated and complex solutions (B. Ramesh Babu et al.,2007). A major problem is the accumulation of dissolved solids, which makes discharging the treated effluents into water streams impossible. Various research groups have tried to develop economically feasible technologies for effective treatment of dye effluents. Nanofiltration treatment as an alternative has been found to be fairly satisfactory. The technique is also favorable in terms of environmental regulating.

Ultrafiltration

Ultrafiltration whose aperture is only about 1nm-0.05μm, enables elimination of macromolecules and particles, but the elimination of polluting substances, such as dyes, is never complete. Even in the best of cases, the quality of the treated wastewater does not permit its reuse for sensitive processes, such as dyeing of textile. So the retention molecular weight is range from 1000-300000da. Rott and Minke (1999) emphasize that 40% of the water treated by ultrafiltration can be recycled to feed processes termed "minor" in the textile industry (rinsing, washing) in which salinity is not a problem. Ultrafiltration can only be used as a pretreatment for reverse osmosis or in combination with a biological reactor.

Microfiltration

Microfiltration whose aperture is about 0.1-1μm is suitable for treating dye baths containing pigment dyes, as well as for subsequent rinsing baths. The chemicals used in dye bath, which are not filtered by microfiltration, will remain in the bath. Microfiltration can also be used as a pretreatment for nanofiltration or reverse osmosis. Textile wastewater contains large amounts of difficult biodegradable organic matter and inorganic. At present, many factories have adopted physicochemical treatment process.

VII. CONCLUSION

Cleaner production is an attractive approach to tackle environmental problems associated with industrial production and poor material efficiency. Since the cleaner production approach has been successfully implemented in some areas in the textile sector, it shows that significant financial saving and environmental improvements can be made by relatively low-cost and straightforward interventions. This improves the quality of products and minimizes the cost of production, enabling the branch to compete in the global market with help of software. Thus Remote sensing analysis has been carried out using Resource sat -1 multispectral satellite data along with DEM derived from IRS P_5 stereo pair. GIS database generated of various thematic layers viz. base layer - inventorying all water bodies in the vicinity, transport network and village layer, drainage, geomorphology, structure, land use. Analysis of spatial distribution of the features and change detection in land use/cover carried out to find out the site suitability for water treatment plant in Salem Corporation with extra accuracy. The method of applying software in analyzing the site suitability is most advance and detailed which is adopted in future technology with time consuming.

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