IJRSG
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International Journal of Remote Sensing & Geoscience (IJRSG)
www.ijrsg.com

ANALYSIS AND SPATIAL DISTRIBUTION OF SURFACE WATER RESOURCES IN THE STUDY AREA OF KALYALNDURG, BRAHMASAMUDRAM AND SETTURU MANDALS OF ANANTAPUR DISTRICT, AP, INDIA: USING REMOTE SENSING AND GIS TECHNIQUES

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Abstract

The present study area consisting three Mandals namely Kalyandurg, Brahmasamudram and Setturu in Anantapur District, A.P. the study area covered in part of two rivers basins which belongs to Krishna, it occupies about 760.66 Sq.km and 69.07 percent of the total study area and Penna, it occupies about 340.58 sq.km and 30.92 percent of the total study area. The average annual water yield in Penna River is nearly 6.31 billion cubic meters. The Bhairavanithippa Irrigation Project was constructed across the Hagiri or Vedavathi River tributary of Penna. This project envisages supply of irrigation water to 12000 acres of Ayacut under 7 villages in 2 mandals namely Gummagutta and Brahmasamudram mandal. Althouth there are few natural open water bodies, there are 43 tanks in three mandals, and some of these have been abandoned. The majority of the tanks are functioning and have been converted to percolation tanks such as irrigation in command areas relies on ground water instead of surface water release from the tanks. From the study, it is observed that only big villages have tanks and providing water for crops and live stock. And the study area is underlined by different litho logical and physiographical units, different types of drainage patterns are find namely a. Dendritic to sub dendritic pattern, b.Trillis, c.Parallel and d.Radial.

Introduction

Water is the most precious gift of the Mother Nature to the mankind. It is not only essential for the survival of the life on the earth but also sustains agricultural crops, other vegetation and manufacturing. The need for proper, planning in development, management and optimal utilization of this vital resource is paramount for the economic development of any region. Particularly so, as the demand for water has become exacting in recent years in view of the myriad water need vis-a-vis looming shortages.

Water is an essential resource for all life on the planet. Of the water resources on Earth only three percent of it is fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. Of the remaining one percent, a fifth is in remote, inaccessible areas and much seasonal rainfall in monsoonal deluges and floods cannot easily be used. At present only about 0.08 percent of all the world’s fresh water is exploited by mankind in ever increasing demand for drinking, sanitation manufacturing, and agriculture. Much effort in water resource management is directed at optimizing the use of water and in minimizing the environmental impact of water use on the natural environment.

Successful management of any resources requires accurate knowledge of the resource available, the uses to which it may be put, the competing demands for the resource, measures to and processes to evaluate the significance and worth of competing demands and mechanisms to translate policy decisions into actions on the ground. For water as a resource this is particularly difficult since sources of water can cross many national boundaries and the uses of water include many that are difficult to assign financial value to and may also be difficult to manage in conventional terms. Examples include rare species or ecosystems or the very long term value of ancient ground water reserves.

Agriculture: water's biggest consumer Agriculture is the largest user of the world's freshwater resources, consuming 70 percent. As the world's population rises and consumes more food (currently exceeding 6%, it is expected to reach 9% by 2050), industries and urban development’s expand,

and the emerging bio fuel crops trade also demands a share of freshwater resources, water scarcity is becoming an important issue. An assessment of water resource management in agriculture was conducted in 2007 by the International Water Management Institute in Sri Lanka to see if the world had sufficient water to provide food for its growing population. It assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. It found that a fifth of the world's people, more than 1.2 billion, live in areas of physical water scarcity, where there is not enough water to meet all demands. A further 1.6 billion people live in areas experiencing economic water scarcity, where the lack of investment in water or insufficient human capacity makes it impossible for authorities to satisfy the demand for water.

The report found that it would be possible to produce the food required in future, but that continuation of today's food production and environmental trends would lead to crises in many parts of the world. Regarding food production, the World Bank targets agricultural food production and water resource management as an increasingly global issue that is fostering an important and growing debate. The authors (Colin Chartres and Samyukta varma) of the book Out of Water: From abundance to Scarcity and How to Solve the World's Water Problems laid down a six-point plan for solving the world's water problems. These are: 1) Improve data related to water; 2) Treasure the environment; 3) Reform water governance; 4) Revitalize agricultural water use; 5) Manage urban and industrial demand; and 6) Empower the poor and women in water resource management. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities find ways to use water more efficiently.

Developing world countries tend to have the lowest levels of wastewater treatment. Often, the water that farmers use for irrigating crops is contaminated with pathogens from sewage. The pathogens of most concern are bacteria, viruses and parasitic worms, which directly affect farmers' health and indirectly affect consumers if they eat the contaminated crops. Common illnesses include diarrhea, which kills 1.1 million people annually and is the second most common cause of infant deaths. Many cholera outbreaks are also related to the reuse of poorly treated wastewater. Actions that reduce or remove contamination, therefore, have the potential to save a large number of lives and improve livelihoods. Scientists have been working to find ways to reduce contamination of food using a method called the 'multiple-barrier approach'.

This involves analyzing the food production process from growing crops to selling them in markets and eating them, then considering where it might be possible to create a barrier against contamination. Barriers include: introducing safer irrigation practices; promoting on-farm wastewater treatment; taking actions that cause pathogens to die off; and effectively washing crops after harvest in markets and restaurants.

India's water resources are finite and greatly diversified in space and time. The utilizable surface water resources of the country on full development of water resources are estimated at 88 million ha. m. However, the present utilization of the surface water is only 22.5 M. ha.m. Of the estimated ground water potential of 42.3 M. ha.m, the utilization of the present is 13.5 M. ha.m. Only.

In our country, the various hydrologic data and water resources are not being collected and maintained at one place or available with one organization. Various central and state government agencies are involved in it. The existing system of water resources information agencies is tedious, time consuming and difficult for remote and in accessible areas. Under these circumstances, remotely sensed data can be gainfully used particularly for the water resources survey.

Study Area

The present Study area of Kalyandurg, consisting of Kalyandurg, Brahmasamudram and Setturu Mandals of Ananthapur district of Andhra Pradesh, India, Lies between 140 17' and 140 40' North Latitude and 760 50' and 770 24' East Longitude. It is located in the middle of the peninsular region and is confined to southwestern part of Andhra Pradesh. It is bounded by Gummagatta, Beluguppa, Atmakur, Kanaganapalli and Kambadur Kundurphi mandals of the same district and western side bounded by Karnataka state. The total geographical area of the study area is 1101.25 Sq Km. According to 2011 census the total population is 1, 76,297 of which urban population is 32,335 (18 %), with literacy rate of 60.92 % and the sex ratio of total population is 964.The Hagiri River flowing in Northern side and Penna River flowing in Eastern side of the study area of Kalyandurg, Bhairavanitippa Reservoir constructed across the Hagiri river in Brahmasamudram Mandal

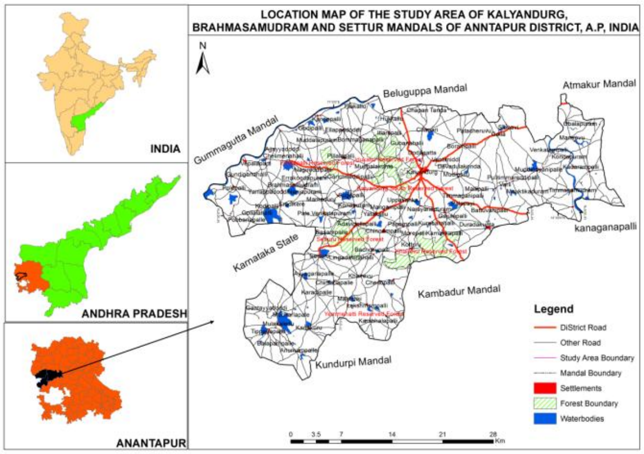

Fig.1. Location Map of the Study Area of Kalyandurg included Base features.

Database and Methodology

In the present study on Application of Geospatial Technologies likes Remote Sensing and GIS techniques is vigorous for evaluation of land resources in the present study Area. ERDAS Imagine 9.6 and Arc GIS 10.1 Software were used for the preparation of all thematic layers and Maps. Survey of India Topographic maps on 1: 50000 scales has been used for preparation of base features such as Settlements, Transportation, Forest boundaries Drainage features and other Resource maps. The drainage, Canal and Water body layers were initially derived from SOI top sheet and subsequently updated using IRS FCC data. The study area falls under Survey of India topo sheet No D43 K14, K15, L2, L3, L6 and L7 of 1: 50,000 scale (latest series).

Results and Discussions

Surface Water Resources

The study area covered in part of two river basins which belong to the Krishna (9.07%) and Penna (30.92 %).

Pennar River Basin

The Penner (also Pennar, Penna or Penneru) is a river of southern India. The Penner rises on the hill of Nandi Hills in Chikballapur District of Karnataka state, and runs north and east through the state of Andhra Pradesh to empty into the Bay of Bengal. It is 597 km long, with a drainage basin 55,213 km2 large. This river basin occupies nearly 55,213 km2 area. Pennar is an interstate river with 6,937 km2 and 48,276 km2 river basin area located in Karnataka and Andhra Pradesh respectively. The river basin receives 500 mm average rain fall annually. The Penner basin lies in the rain shadow of the high Western Ghats ranges, which prevents much moisture from reaching the region. The Penner basin suffered from a prolonged drought in recent years, which caused much misery among the regions farmers and generated political demands to build an aqueduct to bring water from the Krishna River to Rayalaseema.

The study area occupies about 340.58 sq km (30.92% of the total study area) of the total Pennar basin (Fig. 3) the upper basin of the Penner covering the study area is largely made up of ancient Archean principally granite and schist.

The watershed of the Pennar and its tributaries covers part of the southern Deccan plateau, including most of the Rayalaseema region of Andhra Pradesh and part of Karnataka. The Kolar Plateau forms the divide between the Penner watershed and those of the Kaveri, Ponnaiyar and Palar rivers to the south. The Penner drains the northern portion of the plateau, which includes parts of Kolar and Tumkur districts in Karnataka. The Krishna River and its tributaries drain the Deccan plateau to the west and north of the Penner's watershed, and the low Erramala hills forms the northern divide of the Penner basin. The upper watershed of the Penner includes Kadapa District, central and eastern Anantapur District, the southern part of Kurnool District, northwestern Chittoor District. The main tributaries of the Penner are the Jayamangali, Kunderu and Sagileru from the north, and the Chitravati, Papaghni and Cheyyeru from the south. The Penner then flows east through a gap in the Eastern Ghats ranges onto the plain of Coastal Andhra, flowing through Nellore city before it empties into the Bay of Bengal at a place called Uttukuru, 15 km east of Nellore.

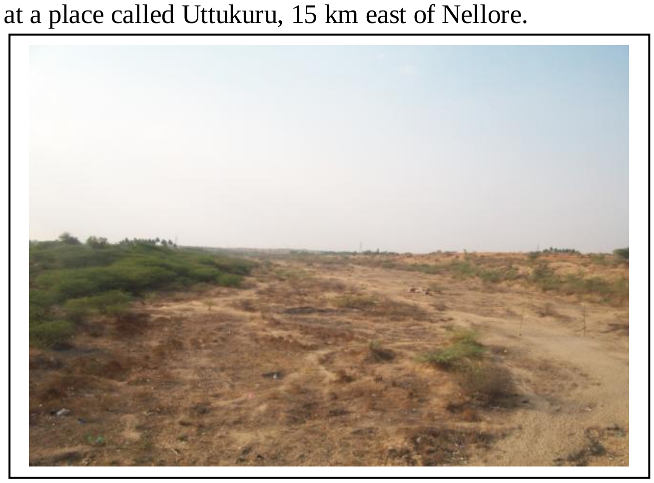

Fig.2 The Pennar River at Timmasamudram vllage, at present showing dry situation.

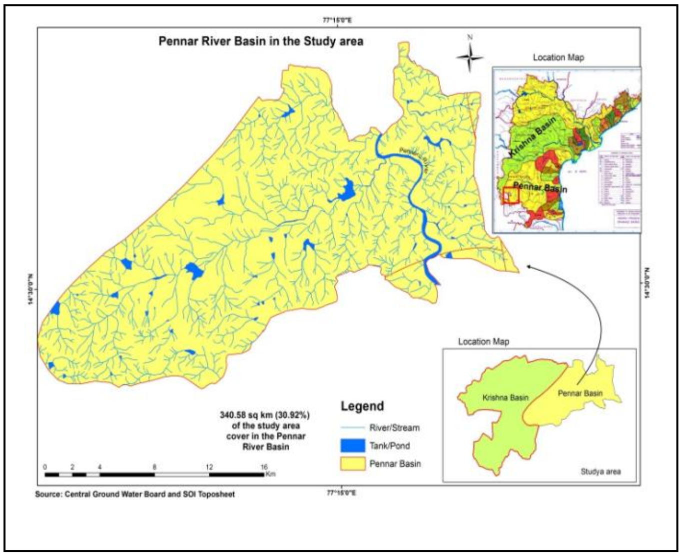

Fig 3 Pennar River Basin in the Study Area.

Water Use Potential

The average annual water yield in river is nearly 6.316 billion cubic meters. All the water sources in the river basin are fully harnessed by constructing nearly 5 billion cubic meters capacity water storage reservoirs. Ground water is also extensively harnessed in the river basin beyond the long term sustainability.

The predominant rain fall is during North East Monsoon season whereas it is in South West monsoon in the adjoining Krishna river basin. This basin is situated geographically at lower elevation compared to the surrounding Krishna river basin. This feature facilitates water transfer from the adjoining Krishna basin. Water can be transferred from the adjoining Krishna basin in to Pennar basin up to 600 m MSL elevation with moderate water pumping (less than 100 m head). The river basin has extensive rain fed agriculture lands and good water storage sites for its all around development provided Krishna river water is imported to the basin. The monsoon flood waters of Krishna River during South West Monsoon months can be transferred for direct use in Pennar basin without the need for water storage.

Krishna Basin

The Krishna Basin extends over Andhra Pradesh, Maharashtra and Karnataka having a total area of 2, 58,948 Sq.km which is nearly 8% of the total geographical area of the country. The basin has a maximum length and width of about 701 km and 672 km and lies between 73°17' to 81°9' east longitudes and 13°10' to 19°22' north latitudes. The Krishna River rises from the Western Ghats near Jor village of Satara district of Maharashtra at an altitude of 1,337 m just north of Mahabaleshwar. The total length of river from origin to its outfall into the Bay of Bengal is 1,400 km. Its principal tributaries joining from right are the Ghatprabha, the Malprabha and the Tungabhadra whereas those joining from left are the Bhima, the Musi and the Munneru are joining the river from left. . Study area occupies about 760.66 sq km (69.07 % of the total study area.) in the Krishna basin (fig 4).

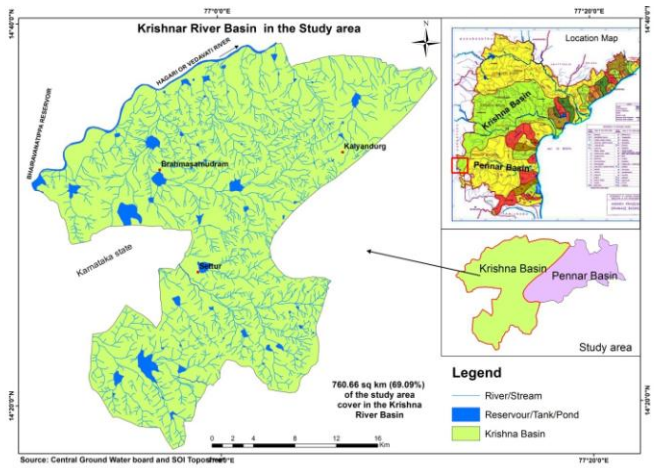

Fig 4 Krishna River Basin in the Study Area

Hagiri or Vedavathi River flows from South west to north east direction in the study area. And it rises from the Western Ghats and flows through the states of Karnataka and Andhra Pradesh. The Vedavathi is a tributary of Tungabhadra Vedavathi is also called the Hagari in parts of Andhra Pradesh. Two rivers, the Veda and Avathi, arise in the eastern part of the Sahyadri Hill range, flow east, and join concert near Pura to form the Vedavathi. The Vedavathi t goes through Gundalaplli and Vepurala and some drylands after it is connected to Tungabhadra a tributary called the Suvarnamukhi confluences with Vedavathi at Koodalahalli, Hiriyur Taluk. It is considered to be a 'Punya Bhumi' or 'Sacred Land' by the locals. The Vedavathi river then flows from Hiriyur towards Narayanapura, Parashurampaura, Vrindavanahalli, where river flows circularly, hence village called Vrindavana Halli and then to Jajur (moodala jajur) Nagagondanahalli, Janamaddi and then enters Andhra Pradesh i.e. Bhairavnapippa Dam. On the banks of Nagagondanahalli there is a famous math by name Chilumeswamy who was an avadhoot and fair is conducted every year and lakhs of people visit. Bhairivani Tippa Reservoir is built across this river, some of the ayacut area of this project covered in Brahmasamudram mandal in the study area.

Bhairavanithippa (BT) Project:

The Bhairavanithippa Project was constructed across the Pedda Hagari River also called Vedavathi river, which is a tributary of Thungabadra River, the entire catchment area lies in Karnataka State. The project is located near Bhairavanithippa (V) in Gummagatta (M), Anantapur district. The nearest town is Rayadurg which is 20 KM from the project. The project is at a distance of 117KM from Anantapur Town. The Project was constructed during 1953 to 1961 with an estimated cost of Rs.1.43 Crores on works and Rs.1.57 Crores including direct and indirect charges (S.S.R.1960-61).

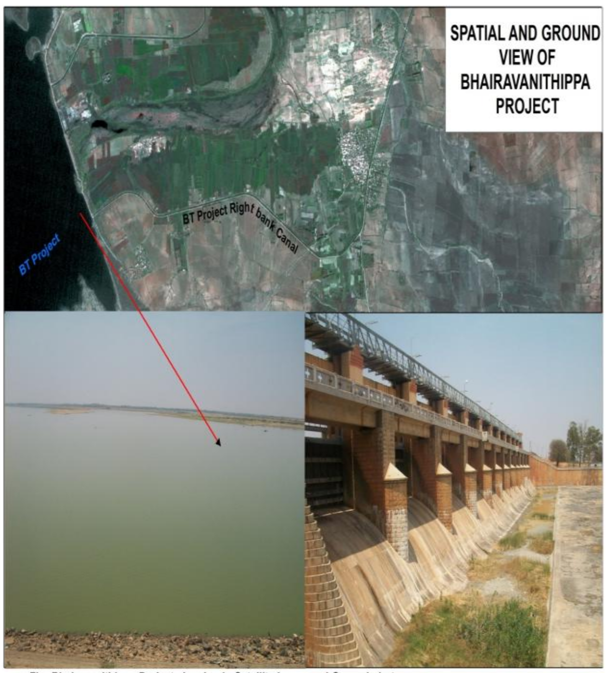

Fig: Bhairavanithippa Project showing in Satellite image and Ground photo

Fig .5 Bhairavanithippa Project from Space

This project envisages supply of Irrigation water to 12,000 acres of ayacut under 7 villages in 2 Mandals namely Gummagatta and Bramhasamudram. The Project utilizes 2.093 TMC of the available water and the Reservoir Storage Capacity is 2.093 TMC (gross) and 2.045 TMC (net). Right Canal length 1380M ayacut: 3768 Acres and its flow in the study area (Table.1).

Table.1 year wise inflow and outflow information about the Project

Year	Inflow (in TMCs)	Outflow (in TMCs)	Surplus (in TMCs)
1995	1.247	0.725	0.0
1996	0.159	0.05	0.0
1997	4.519	1.61	2.23
1998	0.436	0.173	0.0
1999	2.275	1.222	0.41
2000	2.993	1.473	1.194
2001	11.541	1.622	8.919
2002	3.158	1.232	1.563
2003	1.088	0.783	0.0
2004	0.0	0.0	0.0
2005	0.0	0.0	0.0

Source: water resource information system, I& CAD dept., AP.

Tanks and other water bodies in the study area:

Although there are few natural open water bodies, there are 43 tanks in the three mandals some of which date 1987-88. Many of these have been abandoned or are in a state of disrepair with broken bunds and silted beds which are now cropped. The majorities of the tanks (26 tanks at present according to chief planning officer Anantapur) are functioning and have been converted to percolation tanks such that irrigation in command areas relies on groundwater instead of surface water releases from the tank. Fig.5.10 shown Surface water bodies of the Tanks and Drainage system in the study area.

Inflows of many tanks have declined in recent years as a result of increased water harvesting and groundwater extraction in the tank catchment areas. In many cases, this has impacted severely on the utility, biodiversity and cultural value of the tanks. In extreme cases, reduced tank inflows are having had a severe impact on the reliability. Domestic water supplies such severe negative impacts occur when tanks are an important source.

Figure.6 Pulakunta Cheruvu in East Kodipalli Village in Kalyandurg Mandal

From the table 2. it is noticed that at present there are 26 tanks available and distributed in all the three mandals. From the general study, it is observed that only big villages have tanks and providing water for crops and livestock. Many of the small villages and hamlets do not save the storage of rain water in the form of tanks for kuntas. All these tanks are irrigating 3875 acres in one season only.

In these tanks, Eradikara tank and Vurumundara Cheruvu (Mulakaledu Village) are the biggest tanks providing irrigation water more than 500 acres each. There are 12 Tanks which are small in size and providing irrigation less than 100 acres. It is show that tanks irrigation is insignificant and uncertain to supply protective irrigation.

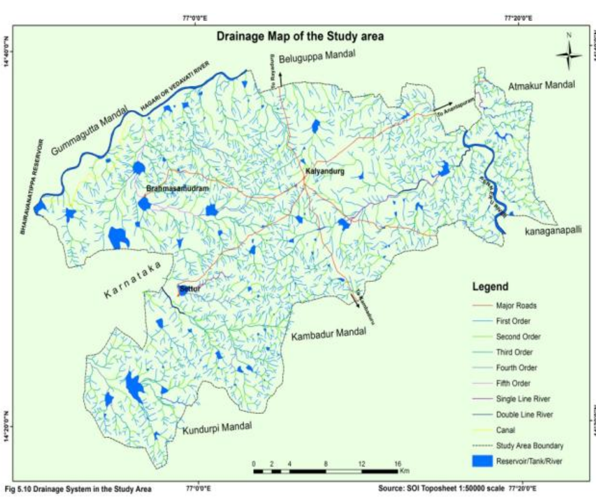

Fig.7 Water bodies of the Reservoir, Tanks and Ponds in the Study Area.

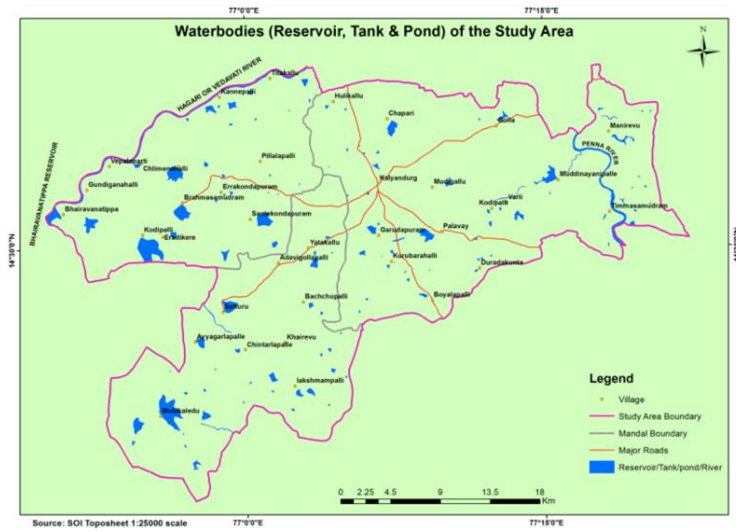

Fig.7 Major Tanks in the Study Area.

Drainage Patterns:

Drainage pattern or arrangement refers to spatial relationship among streams or rivers which may be influenced in their erosion by inequalities of slope, rock resistance, structure and geological history of the region. As the study area is underlined by different litho logical and physiographic units, different types of drainage patterns are noticed as shown in the fig 5.10.

The type, location, underlined morphology and lithoogy of dig gerent drainage patterns existing in the area are as follows.

Dendritic to sub-dendritic pattern:

This is the most common pattern existing in the area. They are characterized by irregular branching of tributary streams in many directions and at less than right angles. These patterns are observed to be developed in the granite gneissic denudational hills and rolling pediplain of the study area, where structural control is negligible. Eg: Penneru or penna and Hagiri or Vedavathi (fig 5.10).

Trellis:

This pattern displays a system of sub-parallel streams, usually aligned along lineaments i.e., faults/fractures or between parallel or nearly parallel topographic features. The major streams frequently make nearly right-angle bends and the primary tributaries are usually at right angles to the main stream and so on. This pattern reflect marked structural control and found on a limited scale over quartzite's (Akkammagarla konda and surrounding hills of Kalyandurg town) and granites in the area (part of Vedavathi and Penneru river) (fig 5.10)

Parallel:

These are usually found in the areas of pronounced slope or structural control which leads to regular spacing of parallel or ne ar-parallel streams. All the streams developed over granite hills of the study area part of this drainage pattern (fig: 5.10).

Radial:

These patterns have streams diverging from a central elevated tract. They develop on domes and various other types of isolated conical and sub- conical hills. In the area these patterns are observed locally over isolated domes and conical hills.

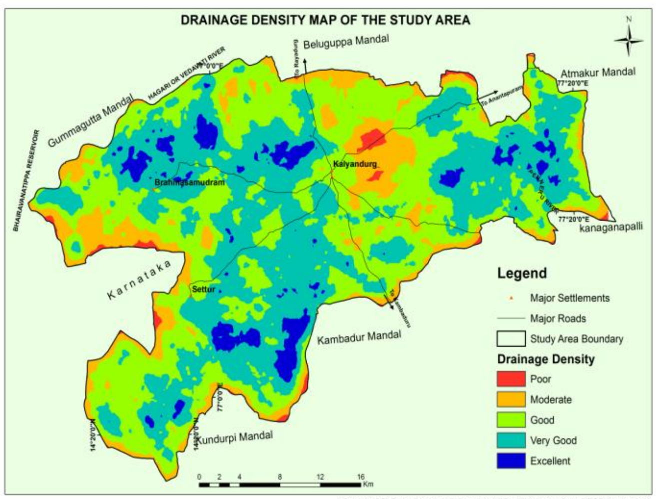

Fig.8 Drainage pattern and Drainage Density Map in the Study

CONCLUSION

The climatic data analysis reveals that Kalyandurg receives more rainfall and Brahmasamudram receives less rainfall in the study area. At the same time number of rainy days are also less 20 days compare to Kalyandurg 25 days and Setturu 23 days.

The study area drained by 2 river basins namely the Pennar and Hagiri or Vedavathi. The pennar and its tributaries accounts for 30.92 % of the study area and Hagiri and its tributaries accounts 69.09 % of the study area.

POLICY RECOMMENDATIONS:

Proper drainage may be provided in the Pennar and Hagiri fluvial plain to minimize the alkalinity/ salinity problem. These lands may be reclaimed with proper treatment.

Apart from these, other rain water harvesting techniques like contour bunding, terrace cultivation, recharge ponds, check dams or wiers wherever feasible are to be constructed to conserve water and arrest flash floods.

ACKNOWLEDGMENTS:

The Author Thanks to Prof.Y.V.Ramanaiah, Prof.Sambashiva Rao and Prof.K.Krishnakumari for inspiring valuable suggestions and encouragement to finalize this work.

BIOGRAPHIES:

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Table.2. Latest Irrigation Tank particulars (Village wise) in the Study Area.

S. No.	Mandal	Village	Tank Name	Present Ayacut Acres
1	Brahmasamudram	Kannepalli	Pedda Cheruvu	239.65
2			Kappala cheruvu	9.46
3		Eradikera	Eradikera M.I.tank	846.67
4			Kuchohaiah kunta	43.10
5	Kalyandurg	Hulukal	Hulikal Tank	130.00
6		Chapari	Muleswamy	109.40
7		Garudapuram	Cholarayanicher	49.05
8		Bydrahalli	Samasthanekulu	39.54
9		Duradakunta	Duradakunta	130.00
10		Palayavoy	Kasaba Talavy	250.69
11		Mudigal	Nagalacheruvu	40.92
12		Golla	Seebai cheruvu	61.13
13		East kodipalli	Pulakunta cheruvu	23.23
14		Varli	Varli	34.30
15		Muddinayanapalli	M.N.halli	107.64
16		Manirevu	Manirevu	43.81
17			Kadarampalli	90.00
18	Settur	Settur	Vurumundara cheruvu	297.26
19		Yatakallu	Chinnampalli tank	133.13
20		Bachehalli	Bachehalli tank	84.90
21		Mulakaledu	Vurumundara Cheruvu	628.05
22		Thippanapalli H/o Mulakaledu	Thippanapalli tank	107.71
23		Kanukuru H/o Mulakaledu	Kanukuru tank	136.30
24		Khyrevu	Makodiki tank	52.97
25		Lashmampalli	Kothacheruvu tank	57.90
26		Ayyagarlapalli	Ayyagarlapalli tank	129.01
TOTAL			3875.82	