International Journal of Engineering, Science and Mathematics
Vol7.Issue 3, Month2018,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com Double-Blind
Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

INTEGRATED TERRAIN AND RESOURCE ANALYSIS FOR ENVIRONMENTAL MANAGEMENT IN KOLLI HILLS, TAMILNADU, INDIA

Sri Ruban D*
Sureshkumar P**
Nagarajan N***
Arunkumar C****

Abstract

In view of the serious environmental problems that have either been experienced by mankind or are likely to happen in future, there has been a growing realization and urgency of the management of land, water, minerals, soil, grasslands, forests, animal life, atmosphere, in other words, the whole environment. Thus the progress of mankind should include a plan to maintain quality of life and as a whole the entire environment. With the increasing awareness on the need to manage the environment effectively, the concept of environmental management has received the attention of the planners and has been accepted as a tool for sustainable development.

Keywords:

Environment
Environmental problems;
Environmental management;
Sustainable development;

Author correspondence:

Sri Ruban D,
Assistant Professor, Department of Civil Engineering
Sri Shakthi Institute of Engineering and technology, Coimbatore, Tamil Nadu, India.

1. Introduction

1.1 Prologue

Among the various developments, which make our time, a remarkable period for the history of mankind is the realization of the symbiotic relationship we have with our environment. This development is due to the increasing knowledge about the functioning of a biotic component of the ecosystem and the realization of their interrelationships. In recent times increasing efforts have been made to deal about the problems relating environmental degradation that has resulted because of human activities. Though a number of international meetings have been held since 1955 to discuss the strategies that helve to be taken to bring down the environmental problems, the United Nations Conference on Human Environment held at Stockholm in 1972 is the one

* Assistant Professor, Department of Civil Engineering, Sri Shakth Institute of Engineering and Technology, Coimbatote-641103, Tamil Nadu, India.
** Assistant Professor, Department of Civil Engineering, Sri Shakth Institute of Engineering and Technology, Coimbatote-641103, Tamil Nadu, India.
*** Assistant Professor, Department of Civil Engineering, Sri Shakth Institute of Engineering and Technology, Coimbatote-641103, Tamil Nadu, India.
**** Assistant Professor, Department of Civil Engineering, Sri Shakth Institute of Engineering and Technology, Coimbatote-641103, Tamil Nadu, India.

which created a strong base for careful planning and rapid action. Since then, a number of international meetings have been held in connection with a variety of environmental problems. These developments have enabled us to understand and deal with the environmental problems at local, regional and global levels.

1.2. Environmental Management

The concepts pertaining to environmental management have been evolving slowly since themselves and since then a number of definitions have been made. Environmental management involves environmental planning, conservation of resources, environmental status evaluation and environmental legislation and administration.

1.3. Remote Sensing and Geographical Information System for Environmental Management

Remarkable achievements in space technology and the wider application range has made remote sensing a powerful tool for obtaining the information needed for taking suitable environmental management plan in a relatively quicker period with lesser cost. The availability of remote sensing data has become a boon in view to the fact that these areas are inaccessible and rugged in nature, which makes conventional ground based studies time consuming and difficult Owing to such advantages, remote sensing has become an indispensable tool for carrying out studies pertaining to environmental management, especially for the hilly areas.

However, it was increasingly recognized that remote sensing by itself could not satisfy all information requirements of application, and that it should be supplemented with data from various other sources. Thus Geographical Information System (GIS) was started as a warehouse of remote-sensing data merging with geo referenced data sets. Numbers of studies have clearly demonstrated the capabilities of the GIS technique, especially for hill areas and these have been described in the „Review of Literature" section.

1.4 The Hill Environment

The hill areas vary widely in terms of elevation, climate, and slope conditions and are also characterized by a multiplicity of human occupancy patterns and economic and social conditions. Population pressure of the plains, on the one hand, and development needs of the other have pushed exploitation of these areas to such an extent in some parts that disastrous consequences have followed. There has been in recent times, many heated and animated discussions on ecology, environment and developmental issues resulting in some understanding on the general characteristic and the environmental problems associated with the hilly areas, which are described in detail in the following section.

1.5. Environmental Problems Associated with the Hill Areas

Perhaps nowhere else in land, the natural resources are more in number of, variety and utility than in the hilly areas. These play very important roles in the distribution and development of water resources; they provide unique habitats for wide-ranging varieties of flora and fauna, and they provide food, fodder, firewood, timber, minerals, etc. for the mankind. Such abundance in resources and utilities has made these areas the target for indiscriminate exploitation resulting in extinction of valuable species, loss of forest cover, increased run off soil loss and sedimentation in the downstream areas, recurrent flooding, landslides, etc. The environmental problems mentioned above are confined to the hilly areas but also affect the foothill and the adjoining plains. Thus, it should be remembered that in the long run, the well-being of the population in the plains and foot hill areas for a major part depends on the well-being of the hill environment.

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1.6 The Study Area

Kolli hills, the area chosen for the present study lies almost wholly in the Namakkal District of Tamil Nadu State (Figure. 1), except a small pocket on the eastern part of the hills, which lies in Tiruchirappalli District. The study area is geographically situated between the north latitudes 11° 11' to 11o 30' and east longitudes 78° 16' to 78° 29' covering an area of about 485 sq.km. On the northern side, it is bounded by Salem District and in the eastern and the south eastern sides, it is bounded by Tillchirappalli District.

The study area forms pan of two taluks viz. Rasipuram Taluk and Namakkal Taluk. While the northern portion of tile hills forms part of the Rasipuram Taluk, the southern portion forms part of the Namakkal Taluk..

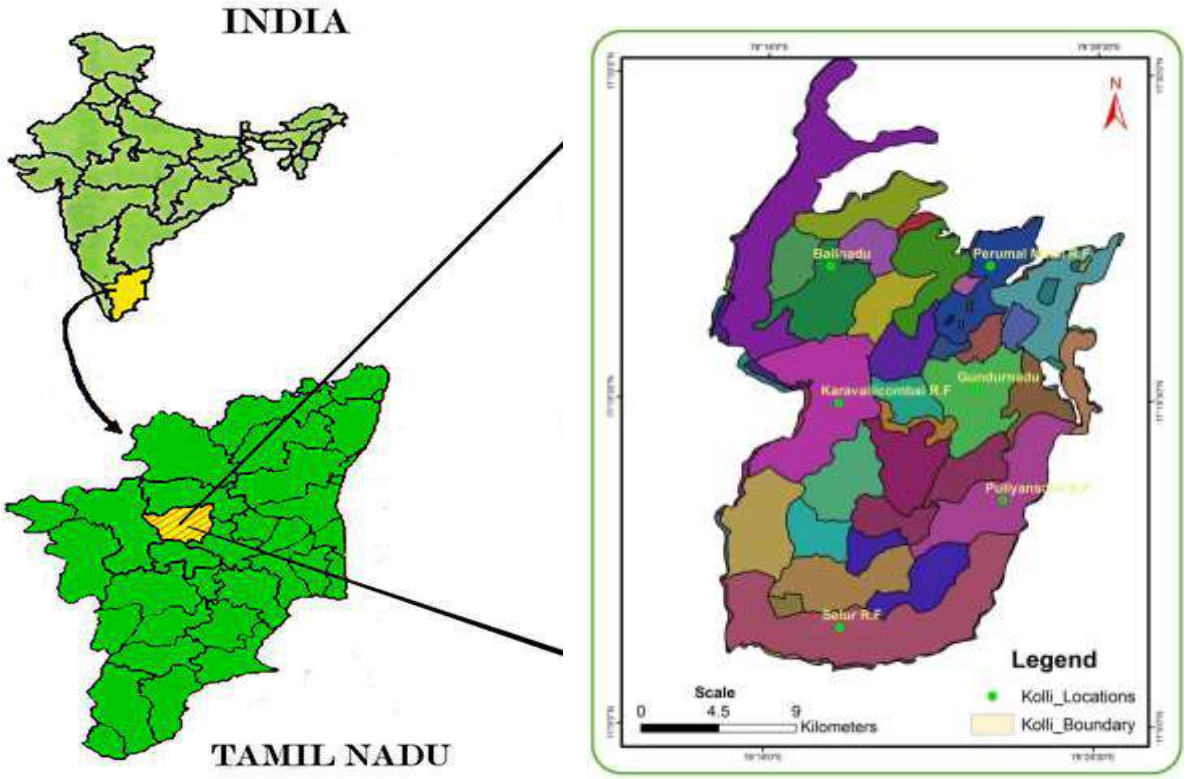

Fig 1. Study Area Map

1.7 Objectives :

- To examine the terrain characteristics of the Kolli hills,
- To assess the natural resource such as drainage pattern, soil, detailed drainage and geology of the area and their role in natural hazards.
- To identify and analyse the impact on human activity on the hilly environment within the study area and the changes that have taken place through time, and.
- To formulate a suitable environmental management plan by integrating the results from the above objectives

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The scope of study includes integration of many thematic maps and demarcation of groundwater quantity and quality domains using integrated geospatial technology

1.8 The Present study and Its need

The Kola Hills, the area chosen for the present study, is bestowed with rich biological resources and further it serves as the catchment area for several important rivers of the region such as the Aiyar, the Thirumanimuthar and the Sweta Nadhi. The adjoining foothills and the plains are intensively irrigated and these areas are mainly dependent upon these rivers for their water supply. These apart, the study area directly supports about 40,000 people who live in these hills.

However, these hills for several decades have been ruthlessly exploited for the abundant resources they possess. This has resulted in the destruction of ecologically sensitive habitate and drastic degradation of overall environment. Such a situation calls for taking up measures to bring down the degradation levels based on scientific studies. The present study has been undertaken with this aim.

1.9 Organization of the thesis

The present study of environmental management of the Kolli hills has been organized into four chapters. In the first chapter, a detailed account of the subject of environmental management along with the general characteristics, environmental problems associated with the hilly areas with objectives of the present study. The Second chapter detailed the review of work done in the hilly area in India. Further the need and the objectives of the present study are elaborated. The third chapter detailed the methodology and the techniques adapted or the present study and the terrain characteristics of the study area, which includes the description of the climate condition, relief, slope, rock types and structure, lineaments, landforms and drainage. Furthermore, a detailed analysis on the drainage network has been made to understand the nature of the various geomorphic processes in the various parts of the study area. In this chapter, an account of the natural resource of the study area, which include surface and ground water, soil, forests, and wild life, has been given further, in this chapter, the GIS technique has been made use to demarcate the ground water zones and the regions vulnerable to erosion. The fourth chapter deals with the human settlement and interpretation in the study area in which the present population distribution, density, occupation and land use / land cover in every single revenue village has been discussed.

2. Materials and Methodology

The methodology adopted for the preset study has been presented as the flow chart (Fig 2). However, the methodology adopted for each of the individual themes has been presented separately in detail at the respective sections.

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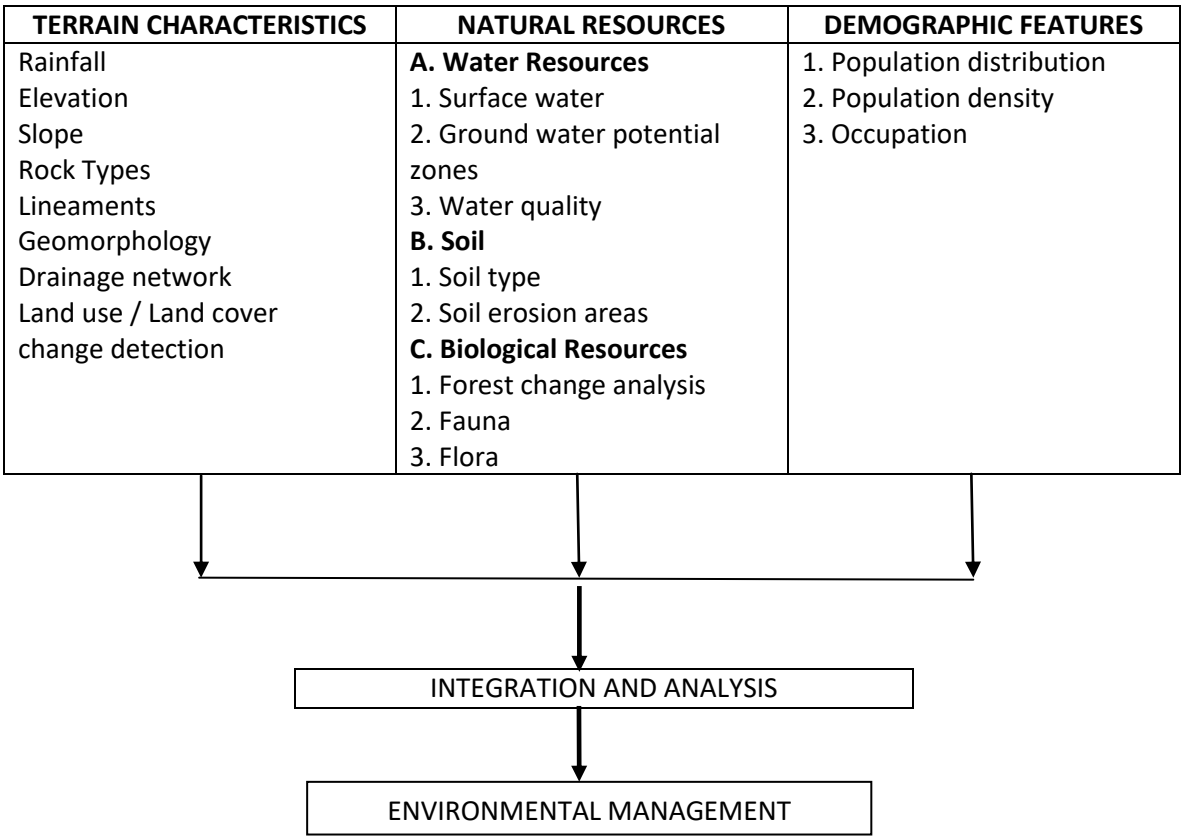

Figure 1.*Overall Methodology* Flow Chart

3 TERRAIN CHARACTERISTICS OF THE STUDY AREA

3.1 Climate

The climate of the study area varies with the altitude. In general, the outer and the lower slope of the hills receive relatively lower rainfall and are characterized by relatively higher temperature ranges. However, in the higher slopes and plateau portion of the hills, rainfall is relatively higher and temperatures are lesser. In the following section, the rainfall and temperature characteristics of the study area are discussed in detail.

3.2 Rainfall

The mean annual rainfall is the sum of twelve month long term monthly average is computed. The mean annual rainfall for the all stations shown in table 1 and (Fig. 3) illustrates the mean annual rainfall of the study area.

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Table 1. Annual mean rainfall

Sl.No	Rainfall Stations	Mean Annual Rainfall
1	Nammakkal	868.43
2	Paramathi	476.20
3	Rasipuram	833.30
4	Pudhuchatram	697.74
5	Tiruchengode	809.70
6	Mohanur	561.90
7	Senthamagalam	742.00

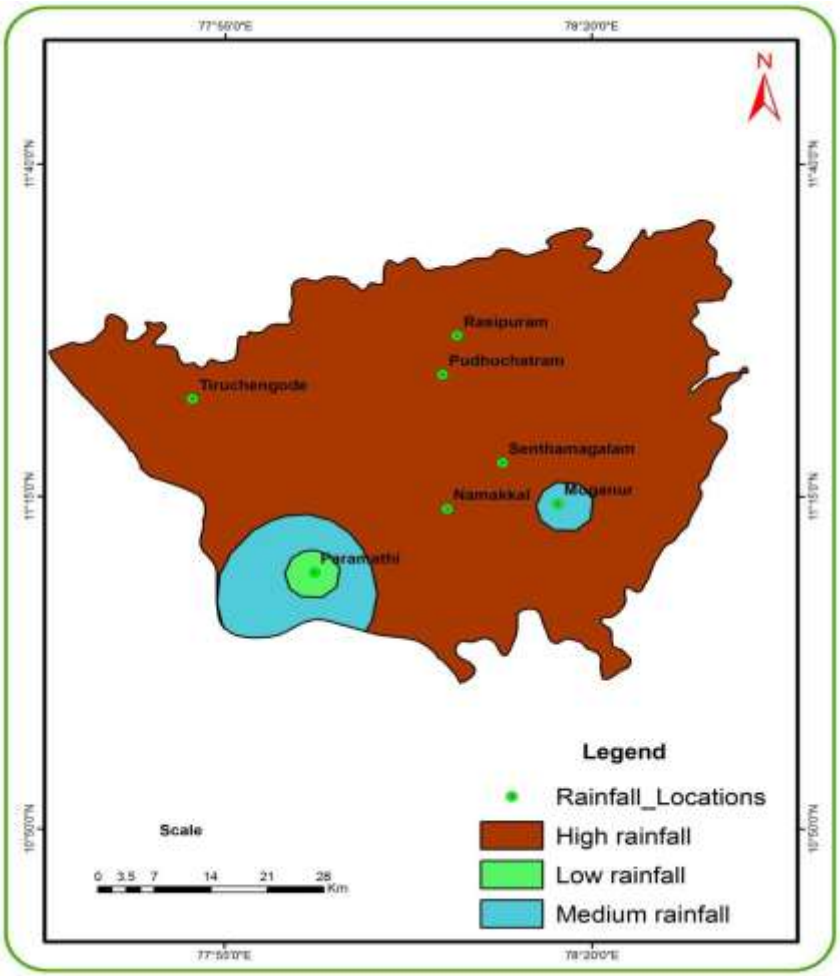

Fig 3. *Annual Rainfall spatial distribution* map

3.4 Geomorphology

The relief, slope, extent of weathering, type of weathered material and overall assemblage of different landforms play an important role in defining the groundwater regime, especially in the hard rocks. Geomorphology was assigned highest weight because it has a dominant role in the movement and storage of groundwater in the study area (Thomas et al. 2009). The geomorphic features were interpreted from IRS LISS III data and visual interpretation

of digitally enhanced images enables identification of the various geomorphic units in the present study. Various landforms identified in the area, as shown in Fig. 4, are structural hills, denudational hills, pediplains, and blood Plaines.

Structural hills: These are formed predominantly by khondalite meta-sediments covering an area. These occupy the NNE, SSE, west and eastern part of the study area. Because of high slope and relief, groundwater prospect in this zone is considered as poor.

Denudational hills: A group of massive hills formed due to differential erosion and weathering. These occupy WNW part of the study area. The groundwater prospect in this zone is also considered as poor.

Pediplains: A pediplain is a gently undulating landscape broken by isolated residual uplands and covered by a varying thickness of overburden material with red soil cover. Pediplain is considered as good prospect zone for groundwater development.

Blood Plaines: Blood plains occupy the very smallest area of the catchment and are characterized by light to medium texture sediments. The porosity and permeability of the blood plains are very high so they are considered as very good zones for groundwater.

3.5 Relative Relief

The various relative relief classes and their distributions in the study area are shown in figure 4. The study area has been divided into various zones based on their relative relief values. Areas with relative relief values (20-100m) represent moderate relative relief zone; areas where the relief values ranging between 100-200m represent moderately high relative relief zone; areas with relative relief values ranging between 200-300m represent high relative relief zone and areas with relative relief values more than 300m represent very high relative relief zone.

From the contour map, it is evident that the areas of very high and relative relief are confined to the higher portions of the outer slopes whereas areas of moderately high relief are confined to the higher portions of the plateau portion of the hill and it was found that this category occupies more area than the other categories. Area of moderate relative relief are found in the plateau portion and also in outer slopes especially in the lower parts, areas with low relative relief are found restricted to some pockets in the Vairichettipalaiyam reserved forest, central portion of the Vazhavandhi Nadu; small pockets in the eastern and the north western parts of Ariyur Nadu and Valappur Nadu respectively and in the some small isolated patches in the Perakarai Nadu and Edapuli Nadu.

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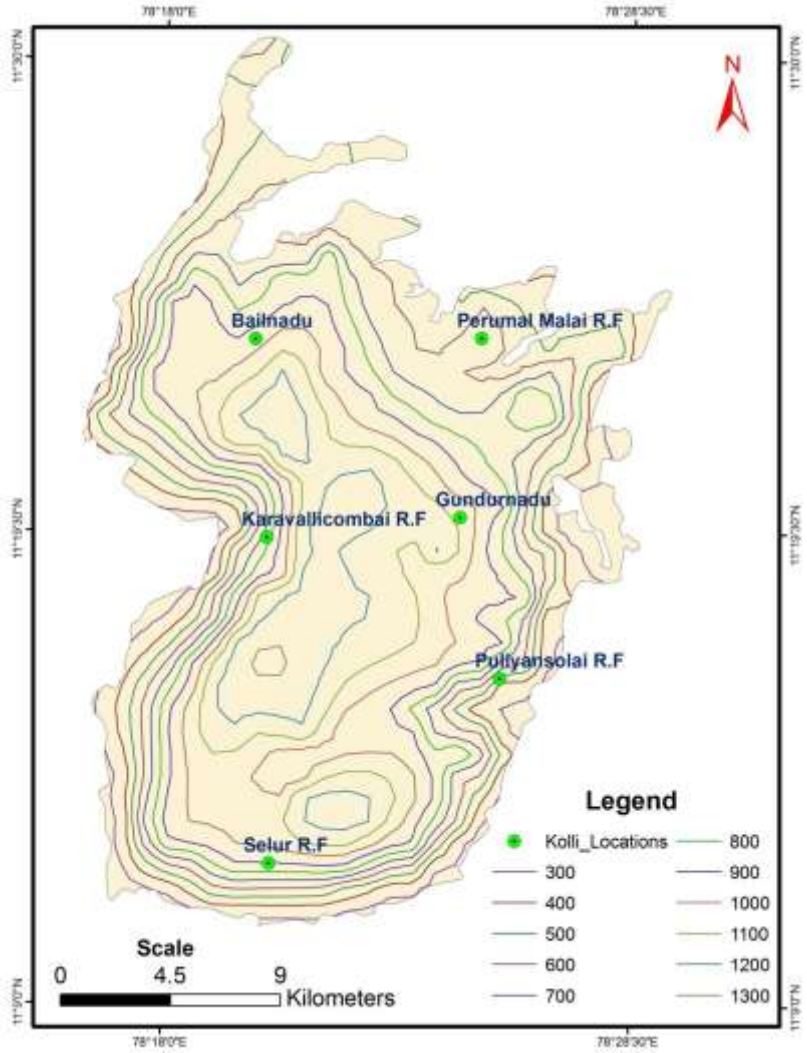

Fig 4. *Relative Relief* map

4.6 Slope

The various slope classes and their spatial distribution map is shown in Fig. 5. In the study area slope varies from 0° to more than 30°. The entire slope map is divided into four categories as follows:

0 – 1° Degree : Nearly level
1 – 5° Gently Sloping
5 – 10 Degree: Moderately Sloping
10 – 15° Degree: Strong Sloping
15 – 35° Degree: Moderately Steep Sloping
>35° Degree: Very Steeply Sloping

4.7 Geology

The kolli hill is almost entirely composed of charnockites except a small patch in the south eastern part of hills (in the Selur reserved forest) which is composed of homblende biotite gneiss.

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A few linear bands of dolerite dykes and magnetite quartzite are found traversing the various parts of the hills.

Charnockites, at some places are found to be garnetiferous.in hand specimens. Charnockite is drak gray in colour, medium to coarse grained showing a greasy lusture with blue quartz, feldspar, hypersthene, garnet and iron ores. Biotite occurs in minor amounts.

The dolerite dykes present in the study area are oriented in the northeast, southern direction. Of these dolerites bands the most prominent one passes right across the kolli hills, extending the whole length of the hills forests area faults. Evidences are not lacking for faulting around the Kolli hills. The board shear zone along their northern foot; the wide distinct shear zone separating the Kolli and Pachamalai hills on the eastern side and a prominent east-west fault south of the Kolli hills and between the Talamalai and the Cauvery river support the above view of blanford on the evolution of the Kolli hills.

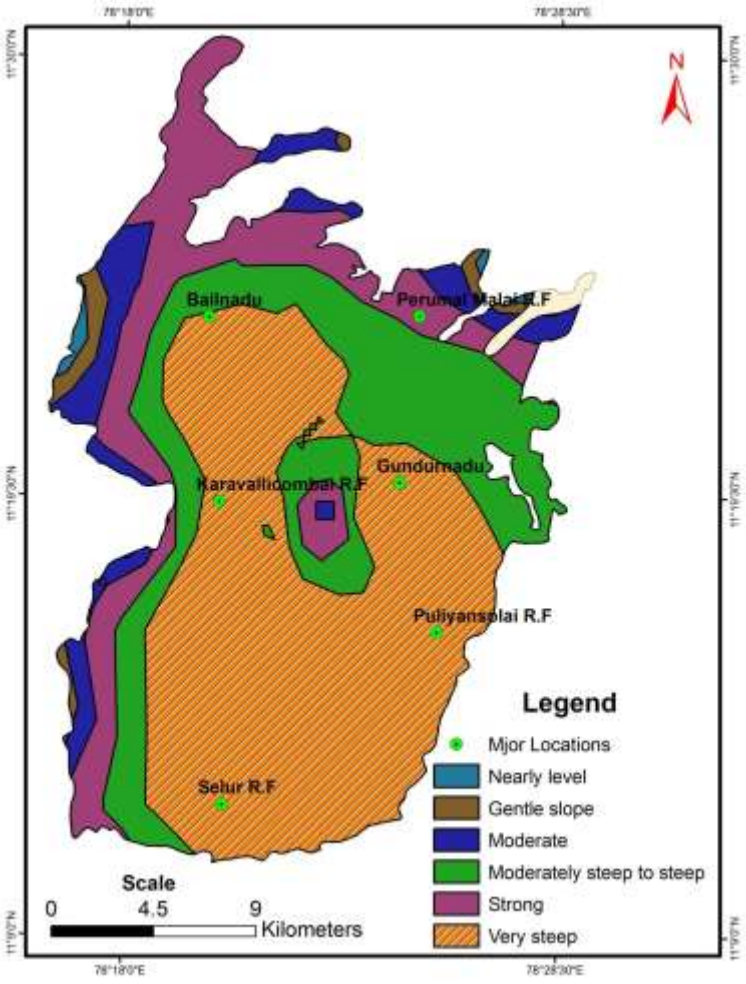

Fig 4. *Spatial distribution* map of Slope

4.8 Lineament

In hard rock terrain the storage and movement of groundwater is controlled by the secondary porosity i.e., presence of lineaments and fractures.Subsurface permeability is a function of fracture density of rocks (Pradeep, 1998). Hence the identification of lineaments in the

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hard rock terrain from the satellite data possesses more importance. Most of the lineaments are identified with the anomalies associated with features like straight drainage course, vegetation pattern, topography etc. The study area is crisscrossed by major and minor lineaments. They vary in length from .few meters to kilometers in dimension. General trend shown by the lineaments present in the study area are NNE - SSE and NE - SW.

4.9 Lineament density

The study of lineament density may help to identify the weathered zones in an area which is very essential in the studies relating to groundwater exploration, soil erosion, landslides etc. the lineament density map for the present study area was prepared using lineament map prepared by interpretation of satellite data.

4.10 Drainage and Drainage density

The Kolli hills from a major catchment area for the important rivers of the region viz.the Aiyar river, the Thirumanimuthar river and the Sweta Nadhi, the tributaries of Aiyar river, the southern plateau region and the eastern slopes of the Kolli hills. In general these tributaries of the Aiyar river in the Kolli hills flow in a west to east direction before joining the main river, the Aiyar, which flows in a north to south direction in the the eastern side of the Kolli hills. Similary, the streams, which drain the western slopes of the Kolli hills, flow in an east west direction before joining the Thirumanimuthar river, which flows in a north to south direction in the adjacent plains, on the western side of the hills. The streams that drain the northern part of the hills flow predominantly in a southwest-northeast direction before joining the Sweta Nadhi, which flows in an east-west direction in the adjacent plains on the northern side of the hills. The drainage map of the study area figure show in Fig 6.

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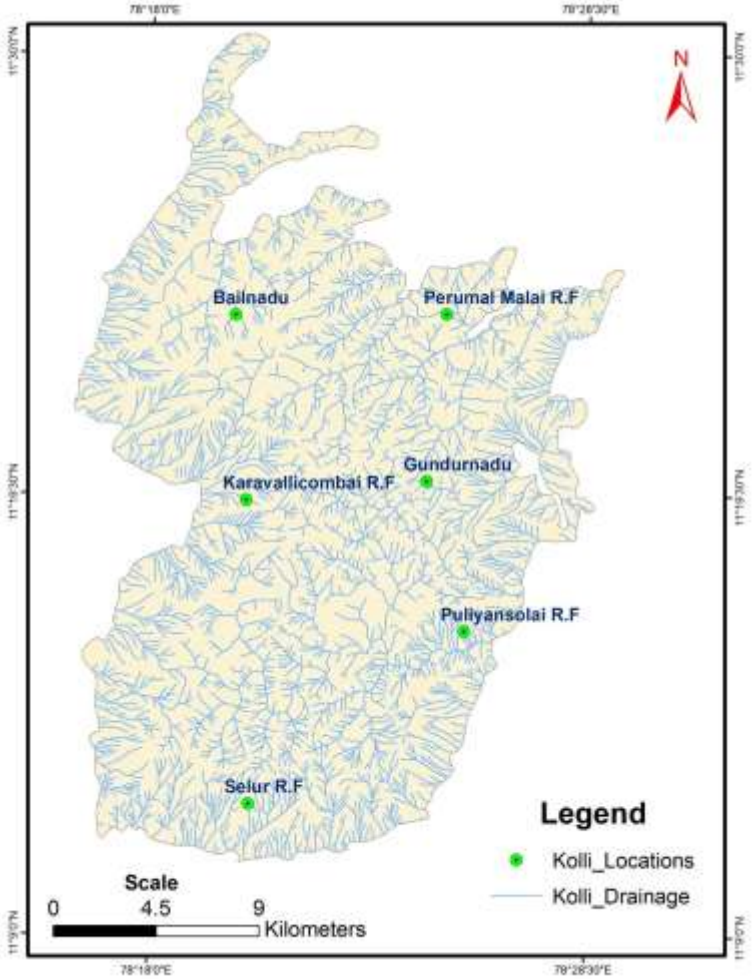

Fig 6. *Drainage* map of the study area

4.11 Water Resource

The primary step in water resources analysis is the assessment of the potentials of surface ground water resource. Owing to the fact the long term hydrological data which could serve as an important source for assessing the water resources of the area is totally absent / not available. Hence been made use of and the sub-basins, which have favourabal characteristics for surface water developments have been identified. Further, groundwater potential zones have been demarcated by using GIS technique. Water quality analysis has also been made to understand the chemical characteristics of water in the study area.

4.12 Surface Water

In the study area, steams are the major surface water bodies. Large surface water storage tanks or lakes are totally absent. The streams are fed by the water from the rains and springs. However, to the natural topographic conditions and the absence of any surface water storage facilities, the income rainfall could not be retained and is lost quickly through surface run off towards the downstream areas resulting in the water shortages during the summer seasons in a number of villages of the study area. Due to the changes in the Environmental conditions, the

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streams, which were perennial in the past, have now turned into ephemeral. For example the Puliyanjolai river which is fed by streams of the southern and central part of the plateau portion and flows through

4.13 Ground Water

In the study area, ground water is not much developed. However, in recent years under the various tribal development schemes, bore wells have been constructed by the government in various parts. But during the field survey undertaken in the villages of the hills most of this government bore wells were found to be in a poor state owing to poor maintenance and low yield. Apart from the government bore wells, a few private landowners have also constructed bore wells. But, it was found that in the hills, the potential of ground water remains largely untapped. For exploiting groundwater, it is essential to have knowledge about the ground potential zones hence in the present study, demarcation of ground water potential zone have been undertaken. Lineament density and drainage density variations in the study area were also analyzed as they would serve as useful inputs along with other commonly used parameters for identifying ground water potential zones.

4.14 GIS Analysis for Identifying Groundwater Potential Zone

Ground potential zones were demarcated with the help of Geo media GIS software developed by Rolta India Pvt.Ltd. the parameters considered for identifying the groundwater potential zones are slope, drainage density, geomorphic units and lineament density. Suitable weightages factors were assigned for each category of the parameters considered. For the various geomorphic units weightages factors were assigned based on their capability to store water. Landforms such as bajada, valley fills were given the highest weightages factors followed by plateau plains. Lower values were assigned for moderately sloping lands and for others geomorphic classes like hogback ridges, cliffs, and cuesta, which hardly have any chances for groundwater storage, are assigned the least values. Of the various drainage density classes higher weightages factor were assigned to very low drainage density category. As this very low drainage density class factors favor more infiltration than surface runoff this category was given higher values. Low drainage density classes were given lower values followed by moderate density classes and least values were assigned for higher drainage density classes. Among the various lineament density classes, very high lineament density category was assigned higher values as this category has chance for groundwater infiltration. Lower values were assigned for higher lineament density classes and still low values were assigned for moderate density class and the least value was assigned for low drainage density class after assigning the weightages values for each of the parameters, groundwater potential were delineated by integrating all the above layers with one another using local sum and local combination operators. Local sum is defined as the process where in the new theme value of each cell indicates the sum of its first theme and the next theme. Similarly, local combination shows the new theme value of each cell, indicating the combination characters associated with that cell on the first theme and any next theme specified. The local sum operators were used to add values between the themes and the derived layers were integrated by using local combination operators to carry out spatial overlay analysis.

The slope units derived from slope map were added with landforms units of geomorphology. The resultant layer was stored as a separate layer and reclassed according to the values of each cell. This procedure was repeated for all the other layers and resultant layers were reclassed. The reclassed layers were then combined to demarcate zones showing very good, good, moderate, low and poor it is found that very good potential zones are confined to the

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south-central parts of the study area. A large patch of this category is found in the eastern part of the Ariyur Nadu and western parts of the Vazhavandhi Nadu. These apart, such smaller patches are observed in the north western part of the Thinnanur

4.15 Soil Erosion Hazard Assessment

Soil erosion hazard zone was demarcated with the help of Geo media-GIS software developed by Rolta India Private limited the parameters considered for demarcating the soil erosion hazard zones are average annual rainfall, slope, soil type and land use / land cover. Suitable weightages factors were assigned for the various categories of these parameters. For the rainfall parameters, higher weightages values were assigned to the areas of very high rainfall and the values were progressively reduced for the lower rainfall categories. As far as slope is concerned the highest weightage value was assigned to the very steep slopes followed by steep slopes category and the weightage values were progressively reduced for the lower steep slope categories. For the soil parameter, the map symbol 114 (gravelly loamy soil), which have greater potential for erosion are given higher weightage factors. For the other soil categories lower values were assigned to agriculture and human habitation category. Lower values were assigned for forest least values were assigned.

After assigning, the parameters overlaid and integrated it one another and the various soil erosion hazard zones were demarcated. It is evident that very high soil erosion hazard zones are found at the inner slopes of the plateau portion and these areas represent the steep slopes in the human habitation where agricultural activities are practical. Also, such high very soil erosion hazard zones are found in the higher outer slopes of Bail Nadu reserved forest. The high soil erosion zones are found mainly distributed in the plateau portion and these areas are mostly used for agricultural purpose. Also the higher slopes of Karavallikombai, Bail Nadu, Selur Nadu, and Puliyanjolai reserved forest. The areas with moderate soil erosions hazards are found confined to the lower outer slopes of the Selur Nadu, Jambuthu reserved forest, Karavallikombai reserved forest, Bail Nadu reserved forest and the entire northern part of slopes comprising the Varagur reserved forest, Perumalmalai resered forest, Adukkampudhukombai reserved forest and Gundur reserved forest. Areas with low soil erosion hazards are found confined to the Ariyur shola reserved forest, Vairichettipalaiyam reserved forest, and southern parts of Perumalmalai reserved forest and south eastern part of Selur reserved forest.

4.16 Forest and Land use / Land cover of the Plateau

The division includes the Ariyur Shola reserved forests and the 14 Panchayat villages. The Ariyur Shola forest, which lies in the central part of the study area, was found to be completely occupied by dense forests. The forests in these reserved forests are popularly known as "Sholas" and such forests are found in large extents in the higher elevation of the Western Ghats. The higher annual rainfall and favourable topographic conditions that prevail in the area have resulted in the formation of these forests.

Thus from the above analysis of the forest and Land use and Land cover of the slopes. It is revealed that the reserved forest such as Varagur reserved forest, Pairichettipalaiyam reserved forest and Gunder reserved forest were fully covered by forest (though the density of forest was lesser in Gundur reserved forests).

On the other land the percentage of forest cover was found to be relatively lesser (<80 percent) in Bail Nadu and Perumalmalai reserved forest. The cause for the lesser forest cover in Bail Nadu reserved forest may be attributed to the human interference from the villages in the adopting places (Venugopal, 1980, Hariharan, 1969; Lakhsminarayan (1990), steep slopes and

poor soil cover. In the rest of the reserved forests, the forest cover was found ranging from 80-90 percent.However, the lesser forest cover in the perumalmalai reserved forest may be attributed to the higher human interference in the area (due to the presence of human habitation in the midst of the forest).

Among the Panchayat villages Bail Nadu was having more area under forests (92.94 sq.km) and Sittur Nadu was having the least area under forest (4.89 sq.km). However, the proportion of forest to the total area of the village was found to be highest Perakarai Nadu where the percentage of the forest found to be 79.2 percent the other villages which were having higher percentages of forests (>65 percent), are Perakarai Nadu, Bail Nadu, Vazhavandhi Nadu, Sittur Nadu, Ariyur Nadu and Valappur Nadu. On other hand the villages where the proportion of forests were relatively low (< 45 percent) are Selur Nadu and Devanur Nadu. In Selur Nadu the percentage of forest was and to be least where only 37.95 percent of the village viz., Edapuli Nadu, Thirupuli Nadu, Alathur Nadu and Kunduni Nadu, Vazhavandhi Nadu, and thinnanur Nadu were found to be having moderated forest cover (45 percent).

It is interested to note that the villages, which were having higher percentages of 1st cover, are the areas where the altitude and annual rainfall are higher. The percentage of the scrubs was found to be higher (> 20 percent) in Thirupuil Nadu, Alathur Nadu, Gundur Nadu, Selur Nadu and Devanur Nadu with the highest being in the Devanur Nadu, (38.19 percent). On the other hand, the percentage of scrubs was found to be lower (15 percent) in Perakarai Nadu, Bail Nadu, Edapuli Nadu, Vazhavandhi Nadu, Valappur Nadu, and Thinnanur Nadu. In other Villages viz. Sittur Nadu, Kunduni Nadu and Ariyur Nadu, the percentage of scrubs was found to be moderate.

The percentage of area under agriculture and human habitation was found to the lower (>30 percent) in the villages of Edapuli Nadu, Kunduni Nadu, Thinnanur Nadu, Selur Nadu. On the other hand, the percentage of area under agriculture and human station was found to be lower (<20 percent) in the village of Perakarai Nadu, Bali Nadu, Thirupuli Nadu, Ariyur Nadu and Gundur Nadu, in the other villages viz. Sittur Nadu, Alathur Nadu, Vazhavanthi Nadu, Valappur Nadu and Devanur Nadu, the percentages of area under agriculture and human habitation was found to be moderate (20-30 percent).

4.17 Population

As per Census 2001, the population of the Kolli Hills is 36852. There are 14 village panchayats and 275 hamlets. The population predominantly consists of scheduled tribes called Hindu Malayali whose spoken language is only Tamil. In two pockets SC population is found which is around 700.

4. Conclusions

The presented integrated study, which involves the analysis of the terrain characteristics, natural resources and anthropogenic environment, has clearly brought out the interrelationships between them. In the plateau portion, the anthropogenic activities, especially the agricultural activity has greatly reduced the forest cover, which were once abundant in this part of the study area. Apart from the destruction of the forests, in the plateau portion, the unscientific agricultural practices that is being followed in the study area has induced severe soil erosion. This, in turn, has affected the agricultural productivity in the region and this can be evidenced from the increase in fallow lands in several villages of the study area. The over dependence on agriculture and poor opportunities for other income generating activities have resulted in the devastation of force sand higher soil erosion hazard.

The present study attempts to understand the realities of hill area management by using conventional data, along with the data obtained from the modern techniques like remote sensing and GIS, still, there exist, wider possibilities for in depth studies on various themes in detail and also micro level studies on community level.

References

[1] Abichandani, C.T. and Ghosh, B. (1968)"Evaluation of Soil Landscape Elements in the Integrated Land Resources Surveys of the Arid Zone of Western Rajasthan" In *P. Roy (Ed.), Aerial Surveys and Integrated Studies, UNESCO Publications*, Paris, pp.387-389.

[2] Babu, S.K. (1992)"Environmental Impact Studies of Patharia Hills" In R.K.Rai, A.C.Mohapatra and N.P.Goel (Eds.), *Environmental Management*, v.I. Rawat Publishers, New Delhi, pp. 73-87.

[3] Chandrasekara, U.M. and Ramakrishnan, P.S. (1994) "Vegetation and Gap Dynamics of a Tropical Wet Evergreen Forest in the Western Ghats of Kerala, India"*Journal Tropical Ecology*, v.10, pp.337-354.

[4] Reddy OGP, Maji, A.K., Gajbhiye, S.K. (2004) "Drainage morphometry and its influence on landform characteristics in a Basaltic terrain, Central India a remote sensing and GIS approach" *International Journal of Applied Earth Observation and Geoinformatics* 6(1):1–16.

[5] Yogesh Dubey and Mathur, V.B (2000)"Development of a Spatial Data Base in Geographical Information system (GIS) Domain for Natural Resources Assessment and Management in Tadobar Reserve, Maharashtra" in *Indian Forester,* October 2000, pp.1105 -1115.