RS AND GIS TOOLS TO SUPPORT CONSERVATION AND SUSTAINABLE MANAGEMENT OF SACRED GROVES IN KODAGU DISTRICT

Thesis

Submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

by

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D E C L A R A T I O N

by the Ph.D. Research Scholar

I hereby *declare* that the Research Thesis entitled **"Remote Sensing And Geographic Information System Tools To Support Conservation And Sustainable Management Of Sacred Groves In Kodagu District",** which is being submitted to the National Institute of Technology Karnataka, Surathkal, in partial fulfillment of the requirements for the award of the Degree of Doctor of Philosophy in **Civil Engineering** is a *bonafide report of the research work carried out by me*. The material contained in this Research Thesis has not been submitted to any University or Institution for the award of any degree.

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C E R T I F I C A T E

This is to *certify* that the Research Thesis entitled **"Remote Sensing And Geographic Information System Tools To Support Conservation And Sustainable Management Of Sacred Groves In Kodagu District"** submitted by Mrs. **Shushma shashi.B.** (Register Number: **81034AM08P03**) as the record of the research work carried out by her, is *accepted as the Research Thesis Submission* in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy.

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Dedicated to

my beloved family

and teachers

ABSTRACT

India has got worldwide recognition in terms of biodiversity, as it is a mega-diverse country having four biodiversity hotspots. The biodiversity of the country mainly preserved on the religious beliefs and even today traditional conservation practices are followed in all most all parts of the country. One among such tradition is the tradition of Sacred Grove (SG) which can be defined as "patches of forestland, preserved in their virgin condition on religious grounds, satisfying the aesthetic, scientific, cultural and recreational needs of mankind". They are extremely useful and essential for the maintenance of biodiversity, ecosystem and to bring harmony in social life. But increased population and its growing demands assimilated with few other facts are acting behind the degradation of these SGs. This calls for the need to prudent conservation and sustainable management of these delicate resources. Remote Sensing (RS) and Geographic Information System (GIS) techniques can be applied as an effective measure to generate data and information needed for conservation and sustainable management of the SGs. The research is carried out to make use of the recent technology to get the support required for preservation of SG. Aiming towards conservation and sustainable management, the objectives of the research work has been set in such a way that, the outcome of the research work must support effectively for the conservation process. The study area considered for the research is Kodagu district of Karnataka, as it is the 'HOTSPOT' for SGs. The objectives of research are viz., (i) development of a complete geodatabase, (ii) prioritization of SGs, (iii) estimation of biodiversity based on ecological indices, Land Use Land Cover (LULC) classification and Normalized Differential Vegetative Index (NDVI) (iv) development of web based Sacred Grove Information System (SGIS), and (v) estimation of ground water recharge and discharge in the study area. Data for attaining the objectives have been collected from field visits and state and central government departments. Geodatabase was developed with the schema that holds all the necessary attributes of SG. The biodiversity was estimated by using ecological indices and LULC, NDVI classification for the year 2006 and 2012 by following the supervised classification technique. For the dissemination of SGs data in the internet, the web based SGIS was developed through open source OpenGeo suite application of GIS. The groundwater recharge and discharge rates were estimated based on hydraulic conductivity, water table, and

bed rock elevation data with help of PRO GRADE plug-in package. Based on these findings of above objectives Sacred Grove Management plan was prepared.

The geodatabase was developed for 85 SGs of study area holds complete information about 2831 individual species along with the conservation status of flora and fauna. The biodiversity estimation was done for all the four types of species such as 'Trees', 'Medicinal Plants', 'Animals', 'Birds', by using five ecological indices. Among them Shannon's and Simpson's index and Margalef's index have shown highest and higher values for all types of species present in Virajapet, and Mercara taluk respectively. LULC classification suggests that increase in built up and agricultural land is due to urban expansion and the economic returns of coffee plantations. The reduction in water resource, forest resource and sandy area as is due to the increase in demand for raw materials and land resource. The NDVI analysis shows the decrease of vegetation by 177 sq km area. The reduction in surface water resource might have caused more exploitation of ground water resource and decrease of vegetation reduces water retention capacity of soils which affect the ground water recharge .In this way these factors may also be attributable for, the increase in ground water discharge rate and decreased recharge rate. This has been well represented by the zonation maps obtained by PRO GRADE GIS. The prioritization of SG represents the threat status, which is alarming and calls for the conservation plans and action. The details in the geodatabase were made, accessible in internet through OpenGeo suite software, which helps in dissemination of data that also supports to bring awareness about the tradition and its value. From the present work it was found that, these SGs are very essential for the well being of human beings as well as ecosystem and their dwindling nature calls for the urgent need for protection of SG. The essential and basic supporting parameters needed for conservation can be prepared /developed by using RS and GIS and it can be used as an effective tool for planning and management of SGs. This in turn helps policy makers for the implementation of new policies by the government towards the conservation of SGs.

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LIST OF ABBREVIATION

RS – Remote Sensing

GIS - Geographic Information System

IUCN - International Union for Conservation of Nature

FRLHT- Foundation for Revitalization of Local Health Tradition

ENVIS - Environmental Information System

LISS - Linear imaging self scanning Sensor

LULC – Land Use Land Cover

NDVI-Normalized Differential vegetation Index

KBA- Key Bio diversity area

OB well - Observatory well

PRO GIS -Pattern recognition Organizer

GRADE GIS -Ground water recharge and discharge estimator

SGIS - Sacred Grove Information System

SGMP - Sacred Grove Management Plan

CHAPTER 1

INTRODUCTION

1.1 GENERAL

India is identified as one of the 17 mega-diverse countries and has four biodiversity hotspots. Biodiversity encompasses not only species diversity and populations, but also the ecosystem services upon which human beings are dependent for their subsistence and livelihood purposes. India is also known for its vast repository of Traditional Knowledge (TK) associated with biological resources (MoEF 2009). In many parts of India, even now, local folk follow several such traditional conservation practices. Among them the most well known and followed in India is the tradition of Sacred Groves (SGs). SG is an age-old tradition where "a patch of forest or water body is dedicated to local deities and none is allowed to cut plants or to kill animals or any form of life (due to faith or fear associated with the local deity)". SGs can also be defined as "patches of forestland, preserved in their virgin condition on religious grounds, satisfying the aesthetic, scientific, cultural and recreational needs of mankind" or "Sacred groves are(Devara Kadu), sacred forests housing a particular deity or temple". These SGs are considered as very important as they play a significant role not only in conservation of biodiversity but also render all sorts of ecosystem services. (Chandrakanth et al. 1990). Although they are extremely useful and essential to different forms of life, increased population and its growing demands assimilated with few other facts are supporting the degradation of these SGs. This calls for the need to prudent conservation and sustainable management of these delicate resources.

Remote Sensing (RS) and Geographic Information System (GIS) techniques can be applied as an effective measure to generate data and information needed for conservation and sustainable management of the SGs. Remotely sensed data provides an unparalleled view or panoramic view of the Earth for tasks that require synoptic or periodic observations and space-derived information. Its analysis and its visualization, offers substantial input into decision-making processes. GIS provides valuable tools for analysis, automated mapping and data integration of spatial features. The tools of GIS software are user friendly which provide a platform for direct as well as easy collection, storage, manipulation and management of

large volumes of data. GIS also supports their interactive analysis and to display and interpret results.

In addition to this GIS supports various data types, data formats and is effective not only in spatial data management but also is very useful in decision making processes.

1.2 SACRED GROVE AND ITS DISTRIBUTION

The concept of sacredness is concerned with the insight of the existence of something, or which is not fully understood. Human being is only a small fraction of entire nature but the whole is awe, inspiring, not fully understood. So it needs to be treated with care and respect. The word 'sacred' should not be restricted to the narrow sense of spiritual belief alone, but the right interpretation of 'sacred' is that which is held in great esteem and admiration and hence sacred to the people. Our ancestors followed 'nature worship' through many traditional practices, as they were aware of the importance and sacredness of nature, which is very crucial for the well being of the ecosystem and life.

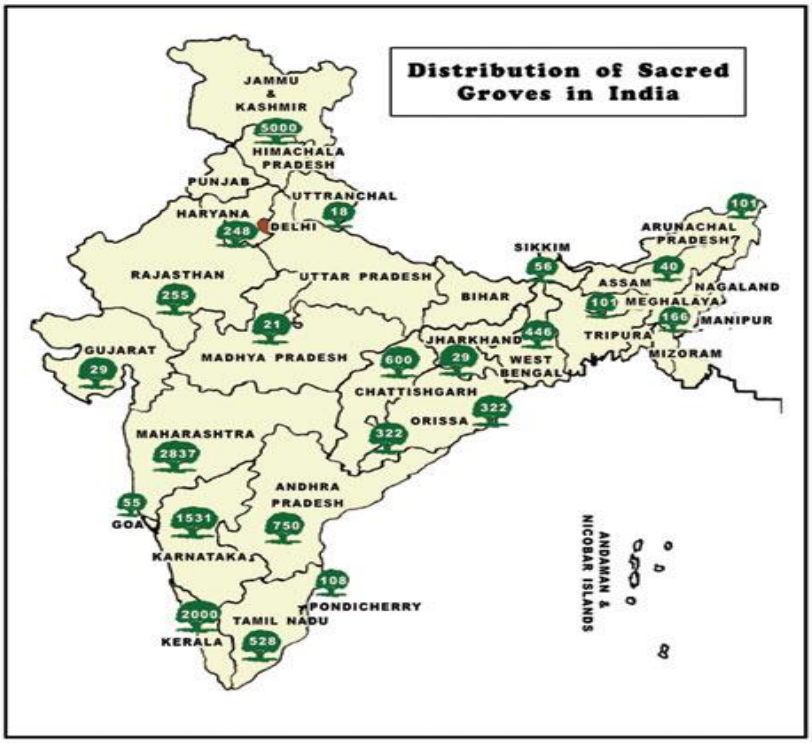

Figure 1.1. Statistics of the documented SGs in various states of India.
Source: http://ecoheritage.cpreec.org/

M.S. Swaminathan Research Foundation in Chennai observes that, these "SGs are a biological heritage and a system that aids to preserve the representative genetic resources existing in the surrounding regions for generations. By conserving the flora and fauna, these communities have conserved valuable genetic resources, which can be used in further afforestation programme and also certain endemic and rare plants are being conserved in the sacred groves. A study to identify such existing SGs and the threats faced by these SGs has to be undertaken on a priority basis" (Anup S. 2006).

1.2.1 SGs distribution in the world

SGs, sacred areas, natural sites may be observed in almost all parts of the world. The different continents of the world indicates the presence of SGs viz, Africa, Asia, Europe, Austro- pacific region and America (Hughes and chandran 1998, Malhotra et al, 2007). In Africa it is found in countries like Ghana, Kenya, Ivory Coast, Zimbabwe, Nigeria, and old calabar, Sierra Leone, South Africa and Egypt. In Asia the SGs have been reported from various countries such as India, Korea, Japan, China, Thailand and Indonesia. In earlier days nations such as Germany, Britain, Italy and Finland in Europe had thousands of SGs but most of them, have disappeared now. The SGs are widely known in the Austro-Pacific Region, New Zealand and Polynesia. In America, native people considered that, although the whole earth is sacred, only in few places the spirit power manifests itself more clearly and readily. Many of these places were groves of trees or totally covered by gaint trees. Americans of European descent also had hallowed groves of trees. Some of SGs have been rededicated or renamed for early settlers or to the war heads or to the noted leaders (Ampili bharat kumar 2014).The history of SGs most likely dates back to an ancient pre-agrarian hunter-gathering era, and their presence has been reported since before 1800s. (Bisht, T. et al. 2011) Considering trees to be the house of Gods and ancestral spirits, many communities set aside sanctified or holy areas of forest and established rules, customs to safeguard them as our trees were often not only essential providers of resources, but also became the powerful symbols of fecundity, generosity, strength, birth and growth, refuge, therapeutic, power, magnificence, and inspiration. The customary rules and traditions to safeguard trees varied from one SG to another SG, but in all the SGs the rule of cutting or killing of any form of life was banned.

it was strongly believed that the presiding deities direct or orders punishment, often either to death, or punishment to individuals who violated the rules, or sometimes to the whole community in the form of disease or crop failure. (Alison Ormsby and Shonil A. B., 2010) As a result of strong religious beliefs, these SGs were preserved over countless years. The sacred conservation practices followed by folks have come into focus lately, due to their importance for protecting several fragile ecosystems and endangered species and because of the explicit connections they show between cultural and biological diversity (Dudley et al. 2010).

1.2.2 Distribution and size of SGs in India

In India, the SGs are found all over the country and they are abundant along the Western Ghats in the states of Kerala and Karnataka. The SGs of the country have not been expansively studied, nearly 13,270 SGs have been documented so far, but the actual number could be in the range of 100,000 – 150,000 (Malhotra et al, 2007). The actual locations of SGs in different states of country and their details are given in Figure 1.1 and table 1.1 respectively.

It has been found from various literatures that SGs are found in almost all parts of the country but no records have been found on existence of SGs, in central part of India, except in some parts of Madhya Pradesh. Further, these SGs vary in size, from a few trees to dense forests covering huge area.

In Karnataka, SGs have been reported from the districts of Uttara Kannada, Shimoga and Kodagu districts. A total of 1214, 1000, and 314 SGs have been documented from Kodagu, Uttara Kannda and Shimoga districts, respectively. These SGs are called by different local names in various parts of Karnataka such as – Devarabana, Devarakadu, Hulidevarakadu, Nagabana, Bhutappanbana, Jataka-ppanbana, Chowdibana, etc. (Malhotra et al. 2001).

Table 1.1 Distribution of SGs in India and their local Name
(Source: Malhotra et al, 2007)

State	Local term for SG	No. of SGs
Himachal Pradesh	Deo Bhumi	5,000
Kerala	Kavus	2000
Maharashtra	Devrais	1,600
Karnataka	Devara Kadu	1,424
Andhra Pradesh	-	750
West Bengal	Garamthan, Harithan, Jahera,Sabitrithan,	670
Chhattisgsarh	Sarna, Devlas, Mandar, Budhadev	600
Tamilnadu	Kovil Kadu	448
Manipur	Gamkhap, Mauhak (sacred bamboo reserves)	365
Orissa	Jahera, Thakuramma	322
Haryana	-	248
Meghalaya	Law Lyngdhoh	79
Arunachal	Gumpa Forests (Sacred Groves attached to Buddhist	58
Sikkim	Gumpa Forests	56
Assam	-	40
Gujrath	-	29
Jharkhand	Sarana	21
Uttaranchal	Deo Bhumi, Bugyal (sacred alpine meadows)	1
Rajasthan	Orans, Kenkris, Jogmaya	9
Total		**13 ,720**

1.3 ECOLOGICAL SIGNIFICANCE

Several ecological functions, which can influence directly or indirectly, the maintenance of ecosystem health of all interacting landscape units, are carried out through SGs. These SGs can influence the flora and fauna of the region as well as the microclimate of that locality with their obscure array of interaction. The soils of SGs show comparatively high porosity and low bulk density compared to the soils of the neighborhood area. (Ray et al. 2015) The substantial litter cover and channels created by soil macro fauna collectively enhance the

water retention capacity, development of root system, gaseous exchange rate, and heat conductance capacity. Along with this the transpiration from the SGs vegetation increases atmospheric humidity and reduces temperature in the immediate vicinity and produces a more favorable microclimate for many organisms (Khiewtam and Ramakrishnan, 1989). Apart from this, another main function of SG is to diminish the incidence and intensity of forest fire, at least in some climates. The ecosystem services of SGs through watershed functions in Tamil Nadu have been studied in detail (Swamy et al. 1998). The fragility of the humid sub tropical forests of Chirapunji in Meghalaya of northeast India is compounded by the limestone formations beneath which shows extensive Karst topography. In spite of the the presence of limestone formation, the soil is highly acidic (pH 3.9-5.2) and with poor nutrient contents , with very high annual litter fall and rapid litter decomposition rate comparable to lower montane rain forests, the nutrient release rate in the SGs which is adjacent to the forest is very high (Khiewtam and Ramakrishnan, 1993). Most of the SGs are associated with freshwater ecosystem and they gave rise to water resources in the form of springs, ponds, lakes, streams or rivers. The vegetation of the grove itself retains water, soaking it up like a sponge during wet periods and releasing it slowly during drought period. It is evident that one of the important ecological roles of these groves is, it acts as water source and helps to sustain the life adjacent to groves (Puspangadan et al. 1998).

1.4 BIODIVERSITY VALUE

"Biological diversity – or biodiversity – is the term given to the variety of life on Earth. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact". Our ancestors followed different methods to conserve biodiversity. The tradition of SGs is one among such methods, which is very ancient and they are protected by means of customary rules and taboos. Due to the consequence of such restriction only, the SGs have evolved as reservoirs of biodiversity and considered as 'Gene bank'. Many SGs constitute untouched vegetation, and are particularly rich with different forms of life. Several researchers have highlighted that many SGs are climax forests, and probably constitute the only representative of near-natural vegetation in many parts of India (Khurnbongmayum et al.2005).

SGs of the hilly states of north eastern India are noted for rare species of orchids. (Pushpangadan et al. 1998) and the study highlights that SGs of Kerala closely resemble the typical biological spectrum of tropical forest biodiversity. SGs which occupy only 1.4 km^2 contained 722 species of angiosperms, compared with 960 species occurring in 90 km2 of the Silent Valley forest. With the nonstop deterioration of forest all around them, the SGs have become fragmented habitats housing gene pools and became the last refuge for many threatened, endangered and endemic plant and animal species. Tree species like *Phoebahainsiana* (vulnerable), *Rhus hookeri* (endangered) and *Flacourtia cataphracta* (endangered)have been found to be well represented in two SGs in Manipur valley. The SGs also preserve genotypes which may be useful in tree-breeding programmes and they are also of great interest in forestry as indicators of natural productivity of the region. SGs of Manipur containecologically valuable species like *Albizia lebbeck* and *Ficus glomerata* which have been reported to conserve high amount of nitrogen, phosphorous, magnesium and calcium in their leaves. (Ashalata et al. 2006) SGs also act as a store house of many plants used in ayurveda, tribal and folk medicines. The valuable species of plants which may not have immediate risk at the present day are preserved in SGs that may have great potential for diverse uses in future.

1.5 THREATS

The ever increasing population and ever increasing demands both for land and natural resources are leading to the deterioration of both the cultural and biological integrity of SGs. Though the nature and extent of threats and pressures on SGs are quite often regional, the magnitude of these threats varies from region to region and from one SG to other SG. The major threats to SGs can be grouped under the following 7 heads:

(i) Sanskritization

In modern era nature worship has been converted to idol worship, Transformation of the primitive forms of nature worship into formal temple worship is taking place without understanding the sacredness of nature.

(ii) Removal of biomass and cattle grazing

In many SGs, removal of biomass and cattle grazing was permitted and continuation of these practices over generations and increase in livestock and fuel wood collection has resulted in the dwindling of the SGs

(iii) Small holder plantations and encroachment

SGs have been encroached by local communities as well as by immigrants for setting plantations, settlements and agriculture.

(iv) Deforestation for development Projects

Many unplanned developmental works such as construction of railroads and highways have also taken their toll of many SGs leading to the fragmentation and some of them have been inundated by big dam projects.

(v) Pilgrimage and Tourism

SGs are suffering deterioration due to the influx of large number of pilgrims and tourists.

(vi) Urbanization and lack of value system or lack of awareness

Due to the process of modernization, impact of westernized urban culture and also due to inability of the present education system to instill respect towards local age old traditions cultural belief and value system is weakening in the younger generations. The spread of market economy as well as the lure of short-term commercial gains has also prompted the destruction of SGs

(vii) Invasion by exotic weeds

One among the serious threats to SGis invasion of exotic weed species such as Eupatorium odoratum, Lantana camara and Prosopis juliflora.

1.6 STUDY AREA

Kodagu is located in the Western ghats extending about 100 km from the Bramhagiri (average elevation 1360 m) forming the southern boundary with the Wayanad plateau of Kerala, up to Subramanya in the north west. It is a land of fascinating geographical diversity with forests and hills, rivers and streams that cascade through the valleys, pasture land and plantations, wildlife sanctuaries and historical monuments.

The name “Kodagu” is derived from “Kodimalainad” meaning ‘Dense forest on steep hills’. The other view is that Kodagu means the country of millions of hills as a mountainous

configuration Kodagu is one of the smallest districts in Karnataka. It lies in between North latitude 11^{O} 56' and 11^{O} 52' and East longitude 75^{O} 22' and 76^{O} 12', and the district has an area of 4102 sq.km (Figure 1.2).

(i) Divisions: For administrative purposes the district has been divided into three taluks viz., Madikeri, Virajpet and Somvarpet. Among them Virajpet is the biggest taluk having 1,646 sq.km. area followed by Madikeri having 1,449 sq.km and smallest being Somavarpet having 999 sq.km. The district has 16 Hoblis, 3 Taluk Panchayat Samithis, 65 Mandal Panchayats and 10 Towns.

(ii) Geography: The district has an undulating mountainous configuration which presents a grand panorama of verdant valleys, ravines, streams, lofty peaks and awe inspiring spurs. Tadiandamol, Brahmagiri and Pushpagiri Hills are the major peaks. The largest river in Kodagu district is the Cauvery with its principal tributaries Hemavathi, Lakshmanathirtha, Kakkabbe and Harangi or Survanavati which flows in easterly directions and the river Barapole flows towards the West.

(iii) Temperature and rainfall: The mean daily minimum temperature, in the month of January at about 14.2º C, and during December to February the minimum temperature may go down to 6º C. Temperature begins to increase from mid February and reaches maximum during April and May with mean daily maximum temperature at 28.6º C. The amount of rainfall varies from 6350 mm in the west of the district to a mere 1016 mm in the East.

(iv) Forest cover in Kodagu: It is fifth in the state with respect to the forest area with 20% of the total forest area of the state. The total area under forests in the district is 1259.52 sq. km which is 30% of the total area. The forest cover in Kodagu district ranges from dry to moist deciduous and evergreen forests. The western border of the district towards Dakshina Kannada district and Kerala state has dense forest dominated by the moist deciduous and evergreen forest at the high altitudes. The north eastern side towards Hassan district is highly degraded. The total forest area of Kodagu has been divided into two divisions i.e. Madikeri and Virajpet for easy administration of the forest resources and these two divisions are further divided into 14 ranges, 43 sections and 79 beats. The richness of the forest cover has led to the formation of three wild life sanctuaries viz., Talacauvery, Brahmagiri Pushpagiri Wildlife Sanctuary and Nagarhole National Park.

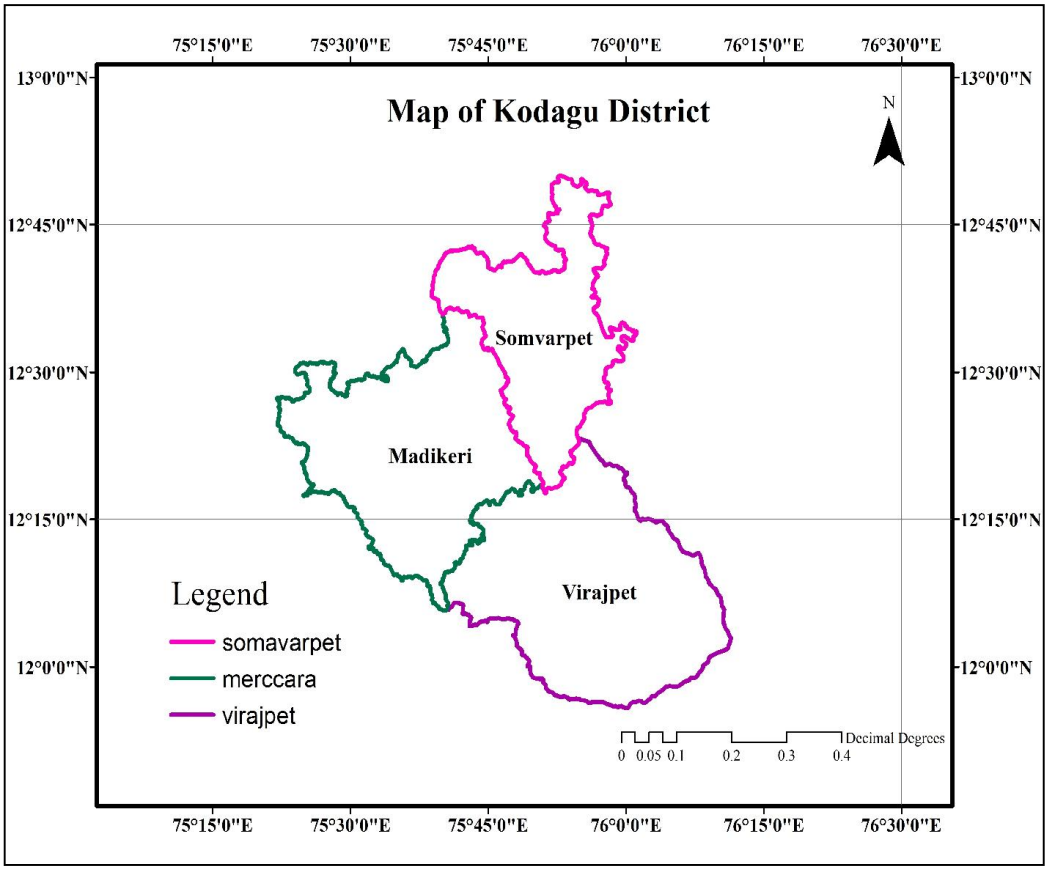

Figure 1.2 Location Map of Kodagu District

(v) SGs in Kodagu:

Kodagu district is famous as the 'hotspot of SGs tradition' not only in the state but also in the national and International level since this district has the largest number of SGs in proportion to the area of the district in the world and all the eighteen native communities are stake holders in this unique tradition.

There are 1214 listed SGs in Kodagu covering an area of 2520 hectares. The SGs in Kodagu are small islands surrounded by other landscapes like coffee estates, paddy fields, reserve forests and habitations. These SGs/Devara kadus are owned by forest department and managed by the community with the help of local Devara Kadu committees. Apart from that, SGs are also associated with the Matta (monasteries) and few are in private ownership with the families. Every village has at least one and there are 39 villages which have more than 7 SGs. These SGs have been protected in the names of 65 deities of which Ayyappa, Bhagavathi, Bhadrakali and Mahadeva are common names. Hence, the SGs in Kodagu are small islands surrounded by other landscapes like coffee estates, paddy fields, reserve forests

and habitations. The privileges and rights such as extraction of firewood for temple worship, materials for the erection of pandals and timber for temple construction vests with the temple committee (Bhagwat et al 2005). Devara Kadu exists in all villages of Kodagu district and each Devara Kadu is named after a specific Deity. (chandrakanth et al. 2014) reported that there are about 1214 Devara Kadu in Kodagu district, of which 557 (46%) are of less than one acre in size and 9% of the Devaru Kadu area is around 5 to 10 acres. About 4% of the Devara kadu are more than 25 acres in size and the details about the area of different SGs of Kodagu district are given in Table1. 2.

Table 1.3 shows the variation in number and size of SGs with resepect to time and Devara Kadu area has drastically reduced by 62% during the period 1905 to 1985. Hence, in the last eighty years 62% of the SGs were lost and the groves got fragmented resulting in an increase in their number. This decrease in area under SGs was due to many reasons like (i) confusion in the regulatory and legal status of the sacred groves in Kodagu (ii) revenue department allowing landless people from outside the district to build houses in the SGs (iii) illegal tree cutting, firewood removal, grazing (Bhagwat et al. 2005).

Table1.2 Area wise distribution of Devara Kadu in Kodagu District, 2000
(*Source: Joint Forest Planning and Management – Devara Kadu Report 2001*)

Extent (Acres)	***Virajpet Taluk***	***Percent (%)***	***Madikeri Taluk***	***Percent (%)***	***Somwarpet Taluk***	***Percent (%)***	***Total***	***Percent (%)***
0-1	210	41.34	109	38.38	238	56.40	557	45.88
1.01-2	89	17.52	45	15.85	70	16.59	204	16.80
2.01-3	46	9.06	19	6.69	29	6.87	94	7.74
3.01-4	38	7.48	16	5.63	18	4.27	72	5.93
4.01-5	25	4.92	14	4.93	13	3.08	52	4.28
5.01-10	50	9.84	34	11.97	28	6.64	112	9.23
10.01-15	7	1.38	15	5.28	7	1.66	29	2.39
15.01-20	16	3.15	9	3.17	7	1.66	32	2.64
20.01-25	9	1.77	5	1.76	1	0.24	15	1.24
>25	18	3.54	18	6.34	11	2.61	47	3.87
Total	**508**	**100.00**	**284**	**100.00**	**422**	**100.00**	**1214**	**100.00**

Table 1.3 Status of Devara Kadu in Kodagu District *(Source: Kalam1996)*

Devara Kadu	***1873***	***1905***	***Variation***	***1985***	***Variation***
Number	873	-	-	1214	39%
Area (acres)	10865	15506	+43%	5947	-62%
Status	Protected forests	-	-	Protected forests	-
Ownership	Karnataka Forest Dept.	-	-	Karnataka Forest Dept.	-

1.7 OBJECTIVES OF THE STUDY

The following objectives have been framed for the present study:

- To develop SGs Geodatabase
- To estimate the biodiversity
- To assess Geographic settings and disturbance regimes
- To develop Web based Sacred Grove Information System (SGIS)
- To estimate Role of SGs in aquifer Recharge
- To prepare Sacred Grove Management Plan (SGMP)

1.8 SCOPE OF THE PRESENT WORK

The present work is aimed at identification and development of basic and essential parameters that uphold the process of effective conservation and sustainable management of SGs through the advanced technology of RS and GIS tools. The present work is also carried out to demonstrate the applicability and efficiency of the technology and tools in attaining the conservation. The present scenario of SGs, demands implementation of immediate and effective conservation measures, aiming the same the research has been conducted to fill the gap identified through literature survey. The major tasks performed as part of research are (i) compilation of Geographical data of SGs as well as data related to the cultural, biological, sociological and ecological attributes (ii) development of the comprehensive Geodatabase about the floral and faunal species of SGs (iii) identification and measurement of the biodiversity value of the floral and faunal species (iv) analysis of disturbances regimes and categorization of SGs based on kind and severity of the disturbance (v) compilation of soil textural, hydraulic conductance and topographical data to evaluate the

ground water recharge of site and to analyse the SGs impact on the same (vi) analysis of change detection with respect to LULC and NDVI pattern (vii) application of web interface to SGs database (viii) drawing out the management plans to protect SGs.

1.9 OUTLINE OF THE THESIS

The present thesis is devided into five chapters.

Chapter 1. Introduces the tradition of SGs, its distribution, importance and describes the present status as well as problems, advantages, and introduces the RS and GIS technology and describes the study area considered for the present research and scope and objectives of the present study.

Chapter 2. The review of literature regarding the tradition of SGs, its distribution, importance and describes the present status as well as problems, advantages and applicability of RS and GIS technology to study the different aspects of SGs and reviewers point.

Chapter 3. Describes the various data products used and systematic methodology adopted to achieve framed objectives.

Chapter 4. Present the various results obtained and prioritization of SGs and development of SGMP.

Chapter 5. Provide the conclusions of the present work and scope for the future work.

CHAPTER 2

LITERATURE SURVEY

2.1. GENERAL

Recent technological innovations are leading to the development of new tools and technology that can be adopted to make the tedious task of conservation as simple and as cost effective as possible. The advances in technology aids conservationist to take decisions to formulate the effective conservation and management plans and helps to implement the required actions accordingly. With these background literatures have been surveyed. In order to carry out the research work in a proper way, basics about the Sacred Groves (SG) and its different aspects were studied first through the various literatures. This chapter reviews research on (i) the inception of this traditional culture, to explore the existence of practice of nature worship, throughout the country and state (ii) to describe the ecological value, cultural value and role of SG to promote, preserve, protect, and sustainability of SGs (iii) the significance of rich biodiversity which is preserved by these SGs (iv) the adverse impacts of the population pressure, change in value systems and beliefs which are leading towards the deterioration of Sacred Tradition. (v) To identify the parameters required for the process of conservation of SG and application of technology and its tools in order to explore different aspects of SG.

2.2. SACRED GROVE AND ITS DISTRIBUTION

Nadkarni (2013) recapitulated the various definitions given for SG by different scholars as (i) “SGs are the place where the old lady of the groves live and the village population propitiates her at the time of SarhuI festival in the month of March-April. (2) "SG as nature worship, where all forms of vegetation including shrubs and climbers are under the protection of the reigning deity of the grove and the removal of any material, even dead wood of twig is a taboo”. (3) “SG is a small patch of vegetation,

which has traditionally been protected by local communities". (4) "SG as an area of "natural" vegetation preserved through local taboos and sanctions that entail or involve the spiritual and ecological values". (5) "SG as segments of landscape, containing trees and other form of life and geographical features that are delineated and protected by human societies because it is believed that, to keep them in a relatively undisturbed state is an expression of important relationship to the divine or to nature" (6) "SGs are made up of inorganic matter, stone or rock formations prominent in a landscape horizon" (7) "SG is recognized as culturally a living place of the deities and spirits of the village, which protect them from calamities and bring prosperity and a patch of pristine forest having well conserved biodiversity.

Kumar and Khan (2008) have done a extensive study on the literatures as well as on previous workings about SG and quoted the following findings about the origin of SGs (i) Origin of SG forests dates back to thousands of years when human society was still in the primitive stage. (ii) History of SGs links to the pre- agricultural, hunting and gathering stage of societies and opined that SGs were believed to be pre-Vedic in origin, i.e, about 3000 to 5000 years and SGs might have also originated as a result of their utilitarian nature or due sociological causes (iii) and argued that the SG or sanctuaries were the first temples of God. In Greek groves and forests were enclosed usually by stone walls. This enclosure was called "Temenos" in Greek, meaning a cut-off place or a demarcated place.

Bhakat (1990) opined that In India, SGs were found mainly in tribal dominated areas and were known by different names in ethnic terms such as "Sarna" or "Dev" in Madhya Pradesh, "Devrai" or "Deovani" in Maharashtra, "Sarnas" in Bihar, "Orans" in Rajasthan, "Devaravana" or "Devarakadu" in Karnataka, "Sarpakavu" and "Kavu" in Tamil Nadu and Kerala, "Dev van" in Himachal Pradesh, "Law Lyngdoh" or "Law Kyntang" etc. in Meghalaya, "Sarana" or "Jaherthan" in Jharkhand and "Lai umang" in Manipur.

Malhotra (2001) argued that based on the finding of various researchers, the distribution of SGs in various states of India can be summarized as follows: In Kodagu

district of Karnataka 1214 SGs with an area of 5947ha., in Kerala 2000 SGs occupying 500ha., in Maharashtra 483 SGs covering 3570ha., in Meghalaya 79 SGs extending about 26326 ha, in Orissa 322 SGs covering an area of 50ha., in Rajasthan one SG covering an area of 83ha., 8 SGs covering an area of 158ha., in Tamil Nadu 10SGs occupying an area of 127ha, in Uttaranchal only one SG occupying 5500ha., Totally 4415 SGs covering an area of 42278ha are found to be reported in different literatures. It was also found that the SGs are referred to by different names in various parts of Karnataka such as Devarabana, Devarakadu, Hulidevarakadu, Nagabana, Bhutappanbana, Jatakappanbana, Chowdibana, etc.

Vartak and Gadgil (1973) based on the studies conducted on different SGs of Maharashtra and Uttara Kannada opined that the area occupied by these SGs ranges from few square meters to several hectare and these SGs can be seen in all type of topographies. All forms of vegetation in SGs were supposed to be under the protection of reigning deity of that grove, and the removal of even a small twig was considered as taboo and these SGs were protected by means of tradition of nature worship, cultural and religious practices along with the associated taboos

Kushalappa and Bhagwat (2001) studied the status of the number and extent of the Devarakadus of Kodagu district and compared with SGs of earlier days. The research revealed that in Kodagu, the first inventory of SGs was done in 1873 where 873 SGs extending to an area of 4398 ha., were identified, then the extent was increased to 6277 ha., during the year 1905 followed by another. Perhaps the last inventory was undertaken during 1985 and at that time the number of SGs increased to 1214 but the extent was reduced to 2550 ha. From this finding it is opined that in the last eighty years fragmentation of SGs has taken place and about 42% of the area under SG was lost.

Gokhale et.al (2010) analyzed the traditional conservation practices followed in Karnataka and found Devarakadu as important features of Kodagu dsitrict which lies in Western Ghats and the district could be called “hotspot” of sacred grove tradition, as the district has the largest number of SG in proportion to the area of the district.

2.3 ECOLOGICAL IMPORTANCE OF SG

Anthwal et al. (2006) opined that SGs are considered to serve a variety of functions and as essential component of the mountain forest ecosystem. SGs help to enhance the soil fertility through efficient nutrient cycling, for retention of soil moisture through humus build up in the soil and partly through a deeply placed root system which has root biomass uniformly distributed throughout the soil profile. SGs have immense value from economic point of view also as they are good sources of a variety of non-wood products, fatty oils, species like pepper, cinnamon and nutmeg, medicinal plants, etc.

Bhagwat (2009) identified 5 categories of ecosystem services such as (1) preserving services: which means maintenance of genetic and species diversity (2) supporting services: which includes purification of air and water, pollination of crops and dispersal of seeds. (3) Provisioning services: which means provision of foods, herbal medicines and sources of energy such as hydropower or fuel wood. (4) regulating services: which includes carbon sequestration or climate regulation, waste decomposition or nutrient dispersal and (5) cultural services: which means recreational experience or intellectual inspiration. Based on the results documented in various literatures it is opined that, sacred natural sites provide a wide range of 'ecosystem services', as ecologists define it, but the truth behind the protection of these sites is, SGs are not driven by material benefits, but by cultural traditions of local people that have been followed through generations.

Chandrasekhara (2010) found that out of 28 SGs of Kerala in ten SGs 10 fresh water ponds were found, in 3 SGs wells were seen , 8 SGs were connected with streams, 2 SGs paved a way to rivulets and watersheds, 1 SG gave rise to perennial stream that commences from the forested area of SG, a perennial spring was found to be originated from another sacred kavu, 2SGs were situated at the river bank and 1 SG was surrounded by river. The study proved that these SGs acted as a major water

source and played an important role in recharging ground water as well as the rivulets and rivers.

Kulkarni et al. (2013) estimated the amount of carbon sequestered from the floral species biomass of Kalamvihira SG in Kalamvihri village of Jawhar Tehsil, Thane District. During the study it was observed that in Kalamvihira SG, totally 22 floral species including 54 individuals exist. The study summarizes the mean of above ground organic carbon (AGC) per tree (t/tree), mean of below ground organic carbon (BGC) per tree (t/tree), the total organic carbon of each species in tones and the total organic carbon sequestrated from 54 floral species. The study revealed the fact that *Terminalia tomentosa* species sequestrated 293.12 tons of carbon in its standing biomass, followed by *Ixora brachiata* (96.2 tons), *Gaurga pinnata* (48.75 tons), *Terminalia bellierica* (37.96 tons), *Madhuca indica*(36.42), *Schleichera oleosa (*36.4 tons), *Stereospermum chelenoides (*23.68 tons), *Lagerstoemia microcarpa* (28.5tons), *Carallia brachiata (*11.52 tons), *Miliusa tomentosa (*17.62 tons),*Heterophragma roxburghii(*15.22 tons) ,*Ficus racemosa((*15.22 tons). The remaining tree species were having organic carbon content below 10tons/species. The *Lannea coromandilina* has the lowest carbon sequestration potential 2.41 tons and the second lowest carbon sequestrating species was *Syzygium cumini* having carbon content 2.3 tons. This study demonstrated that SGs are a prominent source of carbon emitted in the atmosphere in large quantities.

Rawat (2014) investigated how SGs help in rejuvenating the microclimate which is very much essential for the well being of the ecosystem. The study compared the temple forest of Nagdev area, Pauri Garhwal in Uttarakhand Himalaya with the neighboring forest (Control Site) area by taking microclimatic characters, vegetation attributes and soil texture and chemical nutrients into consideration. Statistical analyses of weather parameters and structural analysis of the floral species were carried out and along with that Mechanical and chemical analysis soil was conducted in order to measure the soil nutrients such as Carbon(C), Nitrogen (N), phosphorus (P), potassium (K) and calcium (Ca) and it was found that (i) the Soil texture of SG varied from sandy

to loam and in control site it ranged from sandy to sandy loam (ii) 7 tree species, 13 Shrub species,18 herb species were recorded from control site, whereas 10,15, 24 were recorded from temple forest site (iii) minimum temperature recorded was higher in temple forest when compared to the control site. Similarly more wind speed and sunshine hours at the control site, resulted in more evaporation and less soil moisture. The study points out the high species richness and presence of essential microclimatic parameters in the SG than to the neighboring forest land.

2.4 BIODIVERSITY AND CONSERVATION SG

Bianchi et al. (2004) Ecologists, conservation practitioners, managers and policy makers highlight the need to develop cost-effective sampling methods to provide comparative measures of biodiversity and to create a platform of ‘‘biodiversity baselines’’. There is currently no single sampling method that has been demonstrated to be sufficiently representing adequate community assessment and monitoring in coralligenous outcrops

Sunil et al. (2012) and Ray et al. (2010) analyzed the Riparian vegetation Dynamics across the two different landscapes such as agro ecosystem and sacred landscapes in Kodagu district and SGs of Uttara Kannada districts respectively by using Shannon Wiener Diversity index, Marglef's index and Simpson's index. It was found that sacred landscapes in Kodagu harbored the highest number of species (83), from 38 families, while the agro ecosystem landscape supported 74 species from 35 families. The sacred landscapes had 65.06 % of unique species within the riparian zone, slightly more than the agro ecosystem landscape (60.8%). Also, 29 species constituting 22.4% of the total were common to both zones and a rarefaction plot confirmed higher species richness for the sacred compared to the agro ecosystem landscapes, and diversity indices with more evenness in distribution were evident in sacred landscapes. It was also found that the SGs of Uttara Kannada district also harbor good diversity as Shannon index is always ≥3 and Simpson's value is also 0.9.

Boraiah et al. (2003) investigated 5 SGs of Kodagu District. Based on the extent of canopy cover these SGs were categorized as "Conserved" and "Disturbed" and from each category all the 5 SGs were taken into consideration for the study and comparison was made for regeneration of the species with that of species of adjoining reserve forest of the respective locality. It was analyzed that out of 241 floral species 136 were identified as regenerating plant species with medicinal value i.e, SGs holds about 60% of the regenerating medicinal plant while only 50% can be seen in reserve forests and it was noticed that, the density of regenerating medicinal plants in reserved forest is only half as that of SG (25,008 vs 58,280 per ha) and important medicinal plants were found regenerating only among SGs but not among reserve forests. It was also found that SGs act as important repositories of medicinal flora and possess a higher success of regeneration compared to reserve forests, and opined that these SGs can be considered as places of tremendous conservation value.

Jayarajan (2004) highlighted the rich floral and faunal biodiversity of SG based on the study conducted in five different selected localities SGs of North Kerala and it was found that 246 species belonging to 83 families of flowering plants were seen and among the 246 species of flowering plants, 24 species were endemic to peninsular India and only two were very common species of Gymnosperms of north Kerala which found to grow abundantly in these groves .It was also observed that fern flora is also abundant in these groves. 26 species of ferns are listed from 5 sacred groves. The study also highlighted the faunal biodiversity in SGS of Kannur and southern part of Kasargod district with 117 species of butterflies, 8 species of spiders, 11 species of amphibians, 23 species of reptiles, 178 species of birds, and 24 species of mammals.

Bhagwat et al. (2005) examined the floral and faunal diversity and the role of SGs in maintaining the biodiversity at 58 sites in three types landscape viz., SGs coffee plantations and reserve forests of Kodagu district in the Western Ghats of India and the study revealed following findings such as the (i) distribution of macrofungal species was observed across all the three land-use types and it was realized that SGs witnessed high number of micro fungal assemblages, possibly because of a greater

microhabitat heterogeneity that SGs provide in the landscape.(ii) There was no major difference in the distribution of endemic birds, between the selected landscape and only 16% of the birds species were endemic, which is very less when compared to 63% speices of trees were endemic (iii) many evergreen tree species are endemic to the Western Ghats and were restricted to the forest reserve, where as threatened trees, birds were restricted to SG and regeneration of the threatened and endemic species is possible only in SG. These findings showed that the SGs are the key to maintain biodiversity.

Manikandan et al. (2011) studied 32 SGs of Theni district of Tamil nadu and observed that out of 32 SGs, eleven has sthalavirksha, all the sthalavirkshas were considered as very rare species. Study showed that these SGs holds totally 98 species belonging to 38 family with 76 genera , out of total 112 floral species 50 are medicinal, 14 were having timber value others were economically important minor forest products. This study highlighted the concept that though the SGs are small in size, they acts as important repositories of endemic flora and have a high biodiversity value.

Irizarry et al. (2012) identified the Key Biodiversity Areas (KBAs) for the Caribbean Islands. During the study vulnerability criterion was applied and a total of 284 KBA were defined and mapped as holding 409 (54%) of the region's threatened species, of these, 144 (or 51%) overlapped partially or completely with protected areas. This study proves that KBA provides not only a valuable framework for the assessment of the adequacy of existing national protected area systems, but also shows how to prioritize which species and sites which require the most urgent conservation attention.

Natori et al. (2012) identified Priority sites within Japan Hotspot using Key Biodiversity Area (KBA) criteria, based on vulnerability and irreplaceability. The identification process considered 217 trigger species from mammals, birds, reptiles, amphibians, freshwater and brackish water fishes and odonates, and focused on identifying gaps in Japan's protected-area system. The study demarcated 228 sites as KBAs and 50 rivers as candidate KBAs and revealed that 20% of Japanese terrestrial area is already protected, although to varying degrees, but additional 8% also needs

protection or proper management to strengthen the conservation of biodiversity in Japan.

2.5 THREATS TO SACRED GROVES

Chandran et al. (1997) have studied the SGs of South India and investigated those cultural factors responsible for dwindling of SGs and elaborately narrated the facts behind declining SG. It was observed that in many cases the local deities to whom the SGs are dedicated have been identified with, or absorbed into the great Gods of pantheon, due to the influence of literary tradition dominated by great epic priestly rituals and the desire of the local community to assert its importance by construction impressive temples which resulted in the diminution of SGs and relaxation of taboos which protects the SGs

Saxena (1998) conducted a study, on the status of some SGs of Himalayan region which indicated that the economic forces are influencing the traditional communities to discard the community-oriented protection to these groves and they are now being exploited and it was also observed SGs (Orans) located in Shekhala village of Rajasthan getting degraded also because of the introduction of exotic species, due to the concern for more income generation

Chandrakanth et al. (2004). investigated the threats encountered by the SG of Kodagu district and opined that SGs are facing threats (i) as there is an increase in demand for the valuable timber and other natural resources which SGs stores , (ii) due to the encroachment by the coffee plantations (iii) as there is uncertainty in the legal ownership though many SG are owned by the forest department but they are managed by local village temple committees which hinders protection and study depicted that the mixed property risks regime has created a rift between the state and the communities in the proper management and use of SGs.

Ormsby (2013) applied social science research methods for the SGs of Meghalaya and Karnataka to determine local attitudes toward the SGs, elements of SG management including restrictions on resource use, as well as ceremonies associated with it and

found along with the other factors, urbanization and clearance of SGs by the immigrant so as to get permanent settlement are posing problems for the existence of SGs

Sudha et al. (1998) studied 3 SGs in Sagara taluk of Shimoga, district in the Western Ghat region of Karnataka, South India, and opined that the active participation of Forest department is lacking and rarely the department has been granting seedlings or cash to the villagers towards the conservation of the three SGs. The villagers are scared that the Forest Department could take away the sacred forest from them and that they would lose control over their common property resources. It is opined that the department should not only take active participation in conserving the SG but also help promote sustainable extraction of resources on a large scale as well as in its processing and marketing at the village level to help generate more employment.

Totey and Verma (1996) based on the studies opined that one unfortunate matter that hinders the conservation of sacred grove is that the village people living nearby the SG are poor and so they depend on the grove to meet their vital domestic necessities, such as fuel wood, vegetables, medicinal plants etc. It is also commented that rural poor depend upon biological resources for meeting 90% of their day-to-day needs. So, until and unless viable option is provided to these people for sustaining their economic condition, any step for the conservation of the SG will not be successful.

Sinha and Maikhuri (1998) opined that Increasing threats to biodiversity demand new conservation approaches emphasizing on the hidden values of conservation to the local communities and positive local attitude towards national and global conservation goals

2.6 APPLICATION REMOTE SENSING AND GIS FOR SACRED GROVES

Munsi et al. (2009) opined that "Land-use and land cover changes" (LUL/LC) are continuous processes taking place due to various natural and anthropogenic factors and the studies help in assessing and monitoring the status of the natural resources, detecting the changes on spatial and temporal scale and predict them for future. During the study Land Use Land Cover (LU/LC) classification of Pithoragarh district of

Uttarakhand, India, using multi temporal data of Landsat MSS, Landsat 5 ETM, Landsat 7 ETM, IRS P6 LISS III was conducted where the scene was classified into 9 classes. It was found the area of evergreen dense forest had decreased over the time, whereas the area of evergreen open forest had increased which is probably due to the conversion of evergreen dense forest into open forest as a result of deforestation. Similarly, scrub area had increased from 1999 to 2006 due to cutting down of dense and open forests. Area under cultivation had increased which is probably due to the increasing human population. Built-up/settlement area had also increased drastically over the time.

Yiran et al. (2012) carried out satellite image classification and change detection analysis of multi temporal data, and images were classified into 7 classes. Change detection performed showed that the environment is deteriorating. Land covers such as close savannah woodland, open savannah woodland and exposed soil diminished over the period whereas settlement and water bodies increased. The grassland/unharvested farmland showed high increases because the images were captured at the time when farms were still crops or crop residue. Urbanization, land clearing for farming, over grazing, firewood fetching and bush burning were identified as some of the underlying forces of vegetal cover degradation. Based on the result it is opined that the socio-cultural beliefs and practices of the people also influenced land cover change such as SGs, and medicinal plants were preserved, but it is not properly integrated with scientific knowledge for effective planning for sustainable land management. This is due to lack of expertise in remote sensing and geographic information systems (GIS) in the area.

Bawa et al. (2002) depicted the potential use of satellite imagery to characterize areas of high and low species richness of trees in tropical forests of Biligiri Rangaswamy hills in the Western Ghats, India, by using the multi temporal IRS 1C LISS III images, with a spatial resolution of 23.5 m. The study area comprised of scrub, dry deciduous, moist deciduous and evergreen forests. Many cells had more than one vegetation type. Thus, they were categorized according to whichever vegetation type occupied more

than 60% area of the cell. Species diversity was determined for 134 cells in 80 x 5-m plots laid in the center of each cell. The study showed there was a positive correlation between mean NDVI and tree species diversity for all cells, without considering the vegetation types. From the results of the study it is evident that the NDVI may be used not only to detect spatial patterns of biodiversity but also the distribution of biophysical parameters.

Gould (2000) used Remote sensing satellite imagery of single Landsat TM scene (path 46 row 13) of 12 July 1987 for Hood River region of the Central Canadian Arctic to prepare a vegetation map, to estimate and map the regional variation in plant species richness, and to compare the species richness estimation techniques. Estimates of the three vascular species richness were derived from measures of variation in normalized difference of vegetation index (NDVI), abundance of mapped vegetation types weighted by relative potential species richness, and a multiple regression of both these variables for 17 sampling sites of 500 pixels each. The results of study indicated that the value of NDVI variability is an indicator of landscape heterogeneity and biological diversity. Vegetation maps was prepared based on the NDVI information, which aids in integrating vegetation data required to indicate landscape patterns of biological diversity. NDVI variability alone explained a greater portion of the variation in species richness than analyzing the vegetation map (65% vs. 34%), and the multiple regression analysis combining the two data sets significantly improves the explanatory power of the data (79%).

Superchi et al. (2010) argued that geodatabase is a database designed to store, query, and manipulate different types of geographic information and spatial data. In order to re-evaluate the currently existing information on the slide, an electronic bibliographic database and an ESRI-geodatabase have been developed for Vaiont dam reservoir area and found that it was e-bibliography and the geodatabase represent a powerful tool to extract and select experimental data and scientific contents from the extensive documentation on the Vaiont landslide.

Gaikwad et al. (2004) developed web interfaced multimedia database on SGs of India, so as to build the complete information resource, documenting status of biodiversity present in sacred groves. The SGIS was developed by using Oracle 8i at back-end for the database and Java Server Pages (JSP) at front end for the web application to collate and disseminate the information. The developed SGIS holds cursory information about 3000 SG from the state of Andhra Pradesh, Maharashtra, and Tamil Nadu. It is opined that use of GIS would handle and analyze spatially referenced data and offers tremendous potential in storing voluminous spatial and non-spatial data. During the development of SGIS, GIS and remote sensing technologies were employed as the technology results in better and informed decisions and action plan for effective management of abiotic and biotic resources of the SG ecosystems.

Mathiyalagan et al. (2005) developed an interactive WebGIS and geodatabase for Florida's wetlands which provided map and data services. In the development process ArcIMS was used and which was extended using a MSAccess database, Java, Visual Basic and Active Server Pages to customize the application. The so developed Web-based tool facilitates to share data globally, provide end-users a cost-saving solution to access up-to-date spatial datasets customized for a specific topic to users with limited GIS knowledge.

Anderson et al. (2005) analyzed the vegetation of SGs in the Menri region where ArcView Version 3.2a (ESRI 2000) was used for the spatial analysis of three layers such as vegetation layer, elevation layer, features layer so as to get a single map for each of the two study areas (high- and low-elevation). Detrended correspondence analysis (DCA) ordination was also performed which revealed the significant difference in composition of both useful species and endemic species. It was also found that in the landscape of higher elevation significantly more endemic species were found than that of the landscapes of lower elevation.

Campbell (2005) used Geographical Information Systems (GIS) analysis of time series images (1960-98), comprehensive social surveys and ecological field methods to evaluate four SG and eight unprotected tree stands in the coastal savanna of Ghana The

justification for the use of GIS was that based on feature identification and supporting fieldwork, it allows quantification of the social impacts on the landscape. In this study the black and white aerial photographs of 1960 and 1986, were used to digitize the feature map of the study area and Changes between 1960, 1986 and 1996 and for vegetation assessment was carried out.

Neelakandan et al. (2006), have developed Bio Geographical information system for Kollam and Pathanamthitta districts, as well as the adjacent Periyar Tiger Reserve (PTR) in Idukki district in Kerala. A BGIS has been developed and successfully implemented on Windows NT workstation which holds the organized spatial as well as non spatial and information related to the biological resources and their conservation status, estimates of their abundance and habitat status. From the study it is evident that GIS can be used as a tool to manage as well as to monitor the spatial relationships of species distribution pattern, plant associations, bio-geo-climatic variables, and forest and soil types. The so developed BGIS was proved to be very useful for implementing the National Biodiversity Action Plans currently underway in the country.

Saikia (2006) delineated the 30 SGs of the East Khasi Hills Meghalaya district, with the help of remote sensing and GIS Technology. During the study supervised classification of the satellite imagery was performed following field checks aided by a hand held global positioning system (GPS) and the same was made use of, to track the path of SG in order to delineate the boundary. This delineation of the spatial extent of SGs was carried out aiming to fill an information gap which could assist future conservation strategies.

Rabindra et al. (2010) analyzed the change detection analysis of forest cover over the hill chain of Western Ghats which has been recognized as one of the world's 18 biodiversity hotspots. In this study an attempt has been made to quantify change in forest area of the Western Ghats of Maharashtra over a span of 20-year (1985–87 to 2005) using visual interpretation technique at scale of 1:250K. For study the Forest Survey of India vegetation maps were used which had been prepared using Landsat TM data and IRS LISS III imagery of 2005. The results showed loss of dense forest at

an annual rate of 0.72% and that of open forest at 0.49%. It also reported an increase in mangrove vegetation and water bodies in the study area. The scale at which study the has been carried out is very well suitable for regional level interpretation, therefore the findings recommend to carry out detailed as well as targeted studies at finer resolutions to get accurate findings and prioritize conservation of forest resource at the local level.

Nziku et al. (2009) analyzed the ground water pattern and estimated the ground water recharge rates in Ma keng iron mining area, Fu jian Province, China by using PRO-GRADE, an ARC GIS 9.2 plug in and research resulted in distribution of recharge areas as 5.30, 11.03, 67.51, 6.38 & 9.78% for very high, High , Medium, Low and very low recharge rates respectively and found that PROGRADE is an effective tool for the analysis and estimation of ground water recharge and discharge.

2.6 REVIEWER'S POINTS

Considering the above findings the following facts/ issues can be summarized.

1. In earlier studies importance has been given to understand the facts about sociological, cultural and Geographical and anthropological issues which were discussed elaborately, which formed the foundation for exploring the remaining parameters associated with SGs.
2. Later researches started, exploring and documenting the cultural value, biodiversity value, social issues and concern for the conservation has gained importance.
3. At present with the growing population demands for the natural resources has increased. The consequences of environmental as well as ecological problems is paving a way to the research on conservation and scientific study of ecosystems services.
4. SGs provide regeneration of the threatened species in order to bring back the glory of SGs and for the sustainable use of SGs.

5. In India these SGs are mainly managed by local community but in order to take stringent action towards the protection of SGs policies have not been found effectively implemented by the government.
6. Till today in India many researches and investigations were carried out to understand the conservation process, policies and parameter needed for effective management but very little initiative has taken to make use of the existing scientific technology and its tools to understand and plan conservation and management of SG.
7. It was noted that use of RS and GIS tools was limited only to the mapping and identification of SGs and was found to be used very rarely to achieve the goal of conservation in India.
8. Though many studies have been carried out on the various aspects of SGs data/information sharing, updating the facts and status, dissemination of data and initiatives such as spreading awareness was, found to be very limited which plays very essential role in conservation and management of SGs.

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1. GENERAL

For conservation of any resource, knowledge about the status, statistics, and significance as well understanding the reasons for its deterioration is very important, and without this knowledge the goal of conservation may not be achieved. The present work aims to identify and formulate the parameters needed to support the conservation and sustainable management of the SGs with the help of RS and GIS. Chapter 2 explains the biodiversity value, ecological and cultural value of SGs and the significance behind SGs conservation. Like all conservation plans, conservation of SG is also a tedious task, as data about the SGs is diverse in nature and it has been scattered at various levels of people from folks to scientists and also present in various formats such as verbal stories to books and CDs. Some of the data about SG is with senior folks, some are with the forest department, some are with the researchers, some are with the technical experts and some of the data are in books and literatures. Apart from this, even now the scientific community is unaware of the conservation priority of SGs, which is very crucial in conservation, and management of SG. Keeping all these points in mind the objectives of the study have been set to bring all the data together into one platform, to assess diversity in species of SGs, to analyze the temporal variation of LULC pattern, vegetation and SGs, to identify the factors that are affecting the existence of SGs, to identify the SGs which needs immediate attention in order to protect them , to disseminate all these findings among the public so as to spread awareness about its value and also to plan for conservation and proper management of the SGs. To achieve all these above mentioned objectives, the data requirement is charted and collected from field visits, from various departments, centers and also by internet searches Engines. In this chapter methodology adopted to achieve various objectives have been described.

Table 3.1 Different data products used for the research work

Sl. No.	Type of Data	Source	Year	Map/ Satellite Image	Scale/ Resolution	Purpose
1	SOI Toposheets	Department of SOI	1974	(Tiff image)	1:50,000	To prepare the base map
2	Satellite data	KSRSAC	2006 & 2008	IRS-1C LISS -III (img.)	23.5m	To prepare LULC and NDVI maps
3	DEM Data	http://asterweb jpl.nasa.gov/gdem. asp.		(Tiff image)	90m	To bed rock elevation map, slope map.
4	Soil Data	KSRSAC	-	Soil Map (Jpeg.) & (Excel)	1:50,000	To prepare the soil profile map
5	Hydraulic conductivit y data	KSRSAC	-	Hydraulic conductivity data (Jpeg.) & (Excel)	1:50,000	To measure the ground water recharge
6	Water Level Data	Central ground water board and Department of Mines and Geology	2000-14	Excel	-	To measure the ground water recharge
7	Bore well location & depth data	-,,-	-	Excel	-	To measure the ground water recharge
8	GPS Data	Collected from Field Visit	2009, 2011, 2014	Excel	-	To prepare the Geo database
9	Non spatial data about SG	From forest department, localities, literatures and from Internet search engine	-	Excel	-	To prepare the Geo database

3.2 Data Sets used

The present work uses both Spatial and Non spatial data are as follows

3.2.1 Spatial Data used

The base map was prepared using Survey of India (SOI) toposheets. From the satellite data, the study area has been extracted as shown in figures 3.1 and 3.2 for the year 2006 and 2012 respectively.

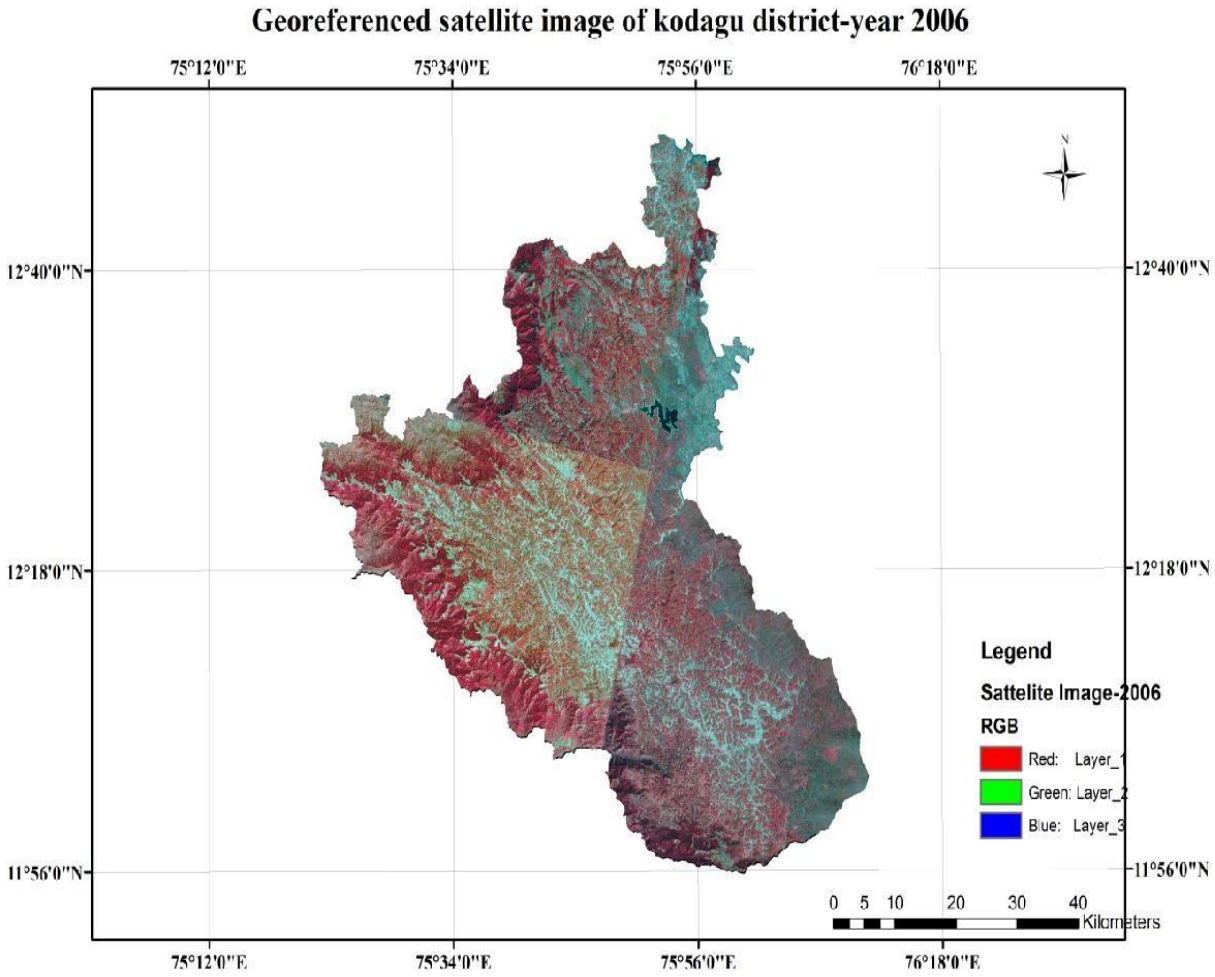

Figure.3.1 Georeferenced satellite data of study area for the year 2006

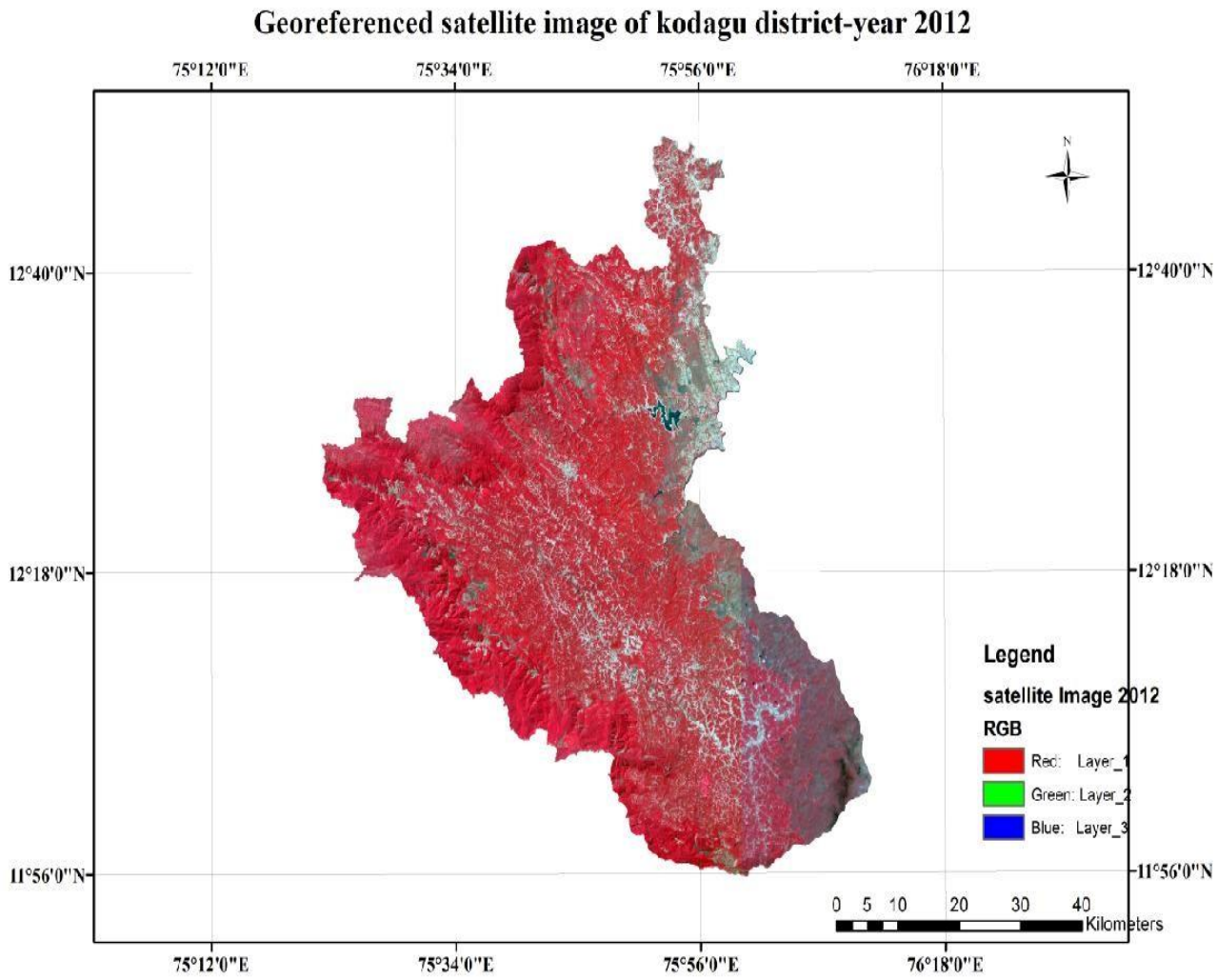

Figure. 3.2 Georeferenced satellite data of study area for the year 2012

(i) Digital Elevation Model DEM) data

A digital elevation model (DEM) is a digital model used for representation of three dimensional terrain surface and it can be generated by using stereo-pair of images acquired with nadir and backward angles over the same area. On October 17, 2011, the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space administration (NASA) jointly released Advanced

Space-borne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model Version 2 (GDEM V2). This DEM data can be freely downloaded from http://asterwebjpl.nasa.gov/gdem.asp. This DEM can be freely downloaded from http://asterwebjpl.nasa.gov/gdem.asp.The Posting interval of DEM is 30m, DEM accuracy (stdev.) 7-14m, DEM coverage is 83 degrees north ~ 83 degrees south.The extracted DEM is shown in Figure 3.3.

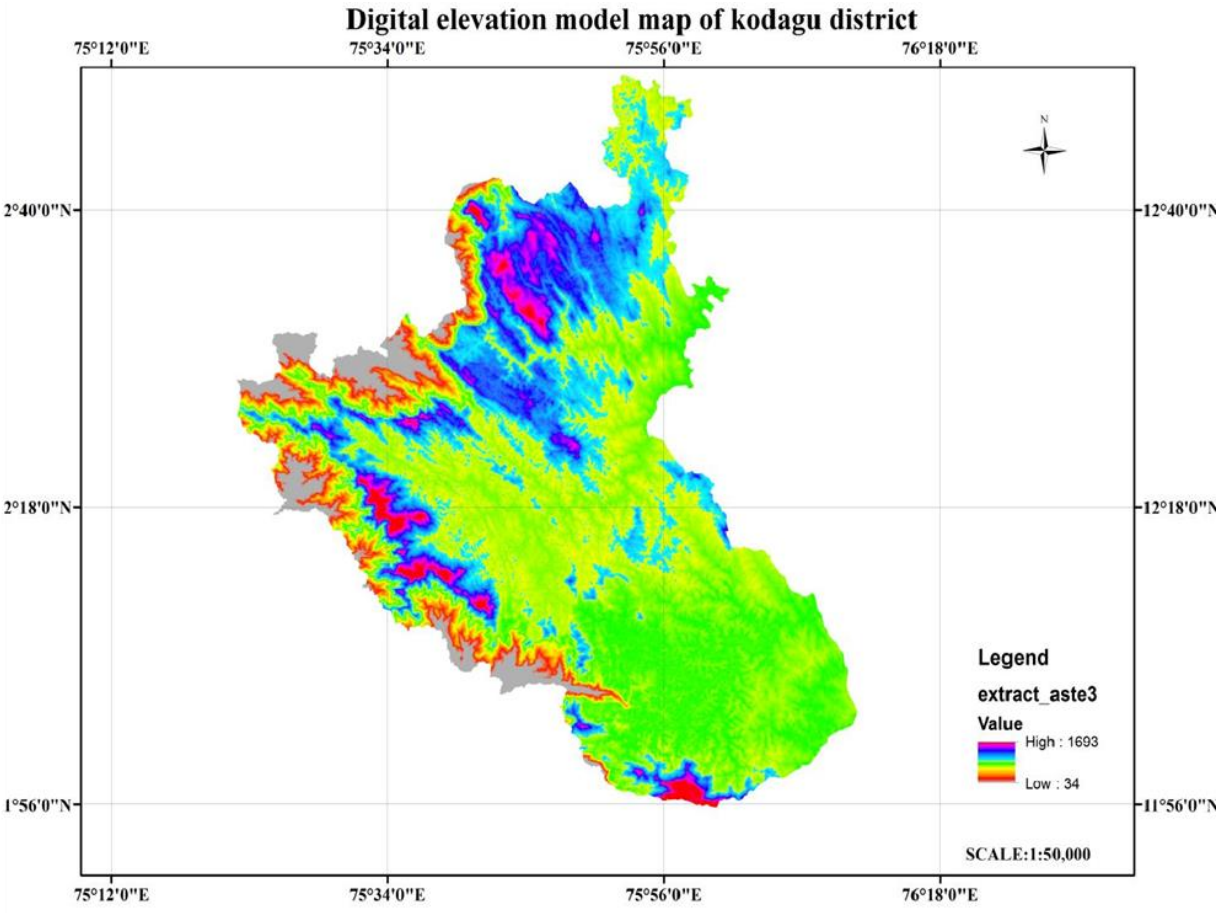

Figure.3.3 Map representing Digital Elevation Model of Kodagu District for the year 2011

(ii) Soil data

Soil Profile Map and database for the Kodagu district was obtained from Karnataka StateRemote Sensing Application Center (KSRSAC). The soil of the district was grouped into13 groups and among those groups 6 types of textures were identified as shown in Figure3.4

(iii)Hydraulic Conductivity data

The hydraulic Conductivity data as well as the hydraulic conductivity map was obtained from KSRSAC (Figure 3.5) where hydraulic conductivity values were determined by taking the standard values assigned to different texture of soil from USDA website http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey. The Hydraulic conductivity is measured in micro meter/sec.

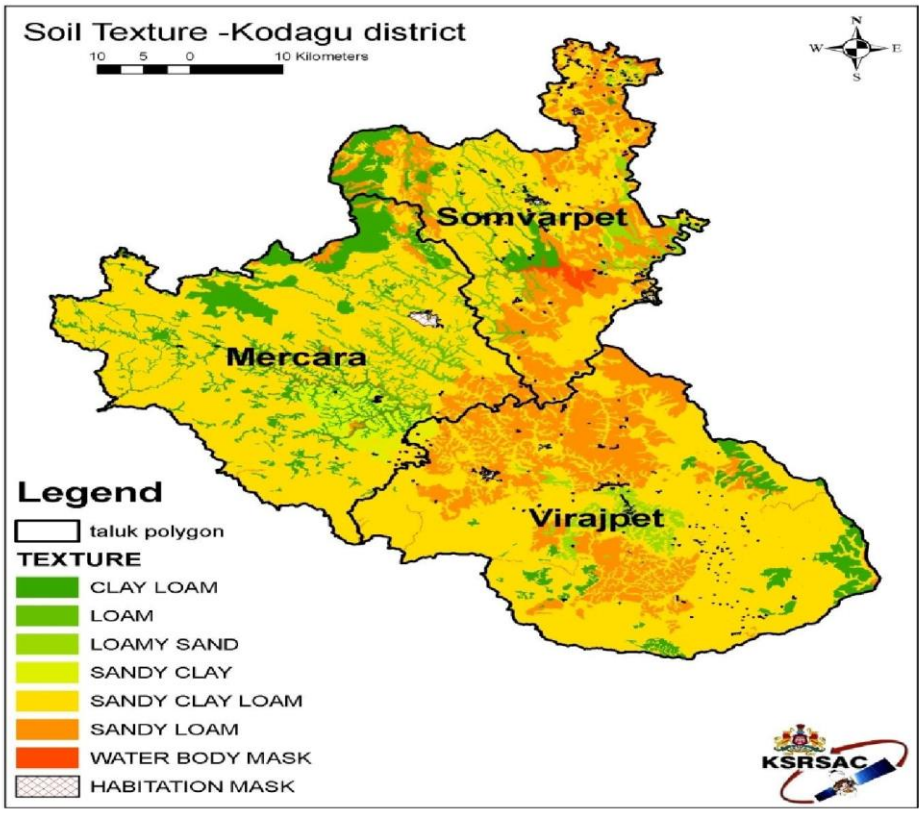

Figure 3.4 Classified Soil Texture Map of Kodagu District

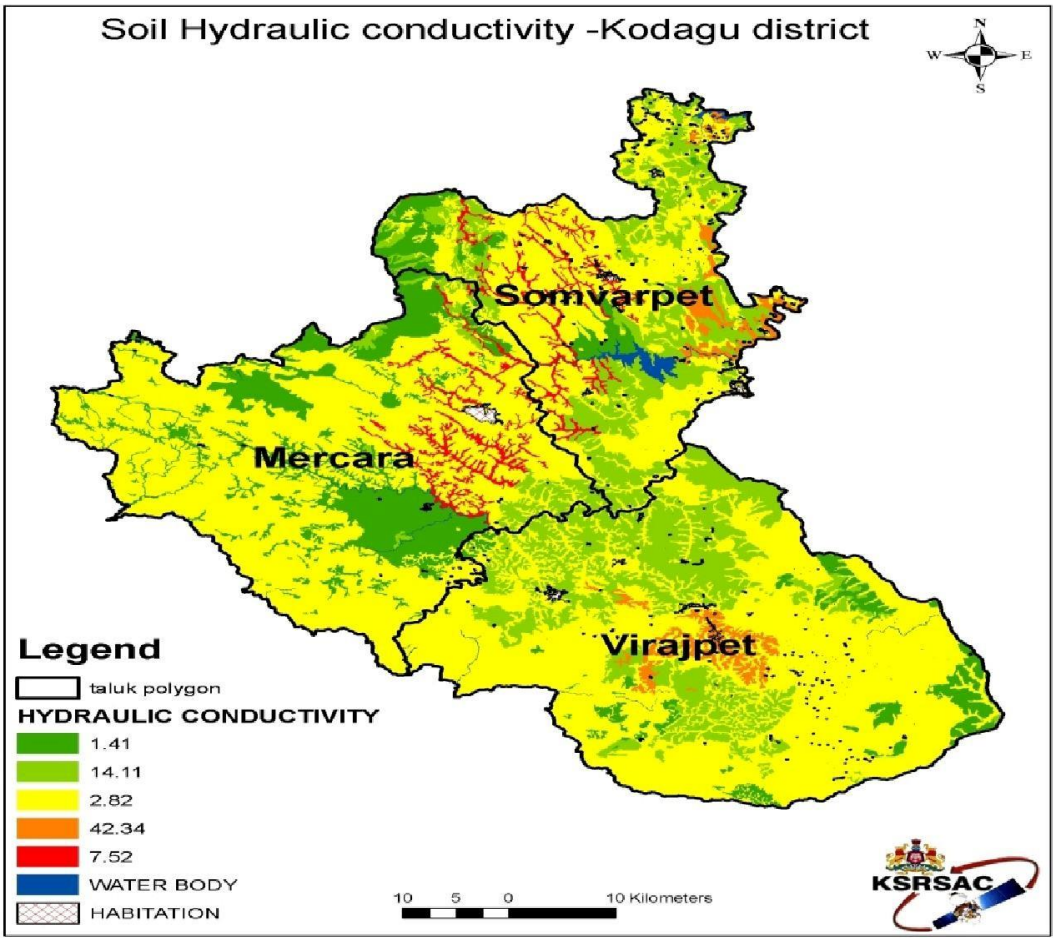

Figure 3.5: Hydraulic Conductivity Map for different soils of Kodagu District

(iv) Ground water data and Bore well depth data

The water table data and depth of the observatory (OB) well data required for the ground water recharge and discharge estimation has been obtained by Central Ground Water Board (CGWB) and Department of Mines and Geology (DMG). The study has been conducted by taking 24 OB well data from CGWB for the year 2011 and 30 OB well data from DMG for the year 2014. With this data bed rock elevation and water table elevation has been derived by keeping the surface elevation data of DEM as reference. The data prepared for estimation of ground water recharge and discharge is given in Table 3.2 and 3

Table 3.2 Soil Texure, water elvation, bed rock elevation, and Saturated Hydraulic Conductivity data of Kodagu District

Sl. No.	Location	Lat (Deg. and Min.)	Long (Deg. and Min.)	Type of Well	Soil_Texture	Wt. Elev.(Bed Elevation+ Wt. Depth)	Bed Eleva. (Surface Elevation- OB well Depth)	Sat_ HC (µ/sec)
1	Ammatti (karmad)	12.24	75.87	Dug/Borewell	Sandy clay Loam	919.2	753.4	2.82
2	Bhagamandala	12.38	75.53	Dug/Borewell	Sandy clay Loam	829.03	688.27	2.82
3	Cheerambane	12.37	75.64	Dug/Borewell	Sandy clay Loam	906.765	778.285	2.82
4	Cheyyandane	12.23	75.69	Dug/Borewell	Clay Loam	844.835	711.055	1.41
5	Devarakolli	12.45	75.64	Dug/Borewell	Clay Loam	302.13	158.48	1.41
6	Gonikoppal	12.22	75.94	Dug/Borewell	Sandy Loam	828.31	657.78	14.11
7	Goudahalli	12.66	75.88	Dug/Borewell	Sandy clay Loam	940.82	838.82	2.82
8	Heravanad	12.38	75.71	Dug/Borewell	Loam	886.88	750.86	7.52
9	Hudukeri	12.08	75.95	Dug/Borewell	Sandy Loam	834.965	666.625	14.11
10	Igoor	12.53	75.85	Dug/Borewell	Clay Loam	915.88	808.2	1.41
11	Kakkabe	12.25	75.64	Dug/Borewell	Clay Loam	877.432	737.432	1.41
12	Kodlipet	12.8	75.88	Dug/Borewell	Sandy clay Loam	924.985	824.585	2.82
13	Madalapura	12.53	75.89	Dug/Borewell	Sandy Loam	831.781	724.501	14.11
14	Madikeri	12.42	75.75	Dug/Borewell	Sandy clay Loam	1109.283	971.043	2.82
15	Murnad	12.32	75.76	Dug/Borewell	Sandy clay Loam	874.792	741.792	2.82
16	Nanjarajpatna	12.38	75.89	Dug/Borewell	Sandy clay Loam	845.983	737.183	2.82
17	Napoklu	12.3	75.69	Dug/Borewell	Clay Loam	881.185	744.825	1.41
18	Ponnampet	12.15	75.94	Dug/Borewell	Sandy clay Loam	856.365	689.365	2.82
19	Shanivarasante	12.73	75.85	Dug/Borewell	Sandy Loam	877.85	778.72	14.11
20	Siddapura	12.25	75.85	Dug/Borewell	Sandy clay Loam	893.455	718.035	2.82
21	Somvarpet	12.6	75.83	Dug/Borewell	Sandy clay Loam	943.895	847.865	2.82
22	Srimangala	12.5	76	Dug/Borewell	Sandy clay Loam	819.01	653.23	2.82
23	Suntikoppa	12.45	75.83	Dug/Borewell	Sandy clay Loam	953.405	814.865	2.82
24	Virajendrapet	12.2	75.8	Dug/Borewell	Sandy clay Loam	896.65	732.13	2.82

(Source: Central Ground Water Board and Karnataka state Remote Sensing Center)

Table 3.3: Soil Texure, water elvation, bed rock elevation, and Saturated Hydraulic Conductivity data of Kodagu District

Sl No	Location	Lat (Dd)	Long (Dd)	Type of Well	Soil_Texure	Wt. Elev.(Bed Elevation+ Wt. Depth)	Bed Eleva. (Elevation-OB well Depth)	Sat_ HC (µ/sec)
1	Madikeri	12.41	75.73	Dug_well	SandyclayLoam	1224.89	1218.37	2.82
2	Devarkolli	12.45	75.57	Dug_well	Clayloam	598.42	596.7	1.41
3	Sampaje	12.47	75.55	Dug_well	Clayloam	495.62	450	1.41
4	Appangala	12.38	75.7	Dug_well	Clayloam	894.061	893.8	1.41
5	Cherambane	12.37	75.62	Dug_well	SandyclayLoam	901.13	860	2.82
6	Bhagamandala	12.37	75.62	Dug_well	SandyclayLoam	967.39	963.1	2.82
7	Napoklu	12.39	75.52	Dug_well	Clayloam	898.60	894.7	1.41
8	Kunjila	12.3	75.68	Dug_well	Sandyclay	939.14	900	1.41
9	Chayyanadane	12.26	75.66	Dug_well	Sandyclay	908.55	906.25	1.41
10	Sampaje	12.22	75.69	Bore_well	Clayloam	386.8	350	1.41
11	Kunjila	12.47	75.57	Bore_well	Sandyclay	936.8	900	1.41
12	Cherambane	12.26	75.66	Bore_well	SandyclayLoam	891.53	855	2.82
13	Somwarpet keb well	12.6	75.85	Dug_well	Loam	1128.7	1114.75	7.52
14	Shanivarsanthe	12.73	75.89	Dug_well	SandyLoam	951.845	907	14.11
15	Kodlipet	12.8	75.88	Dug_well	Sandy clayLoam	945.83	943.65	2.82
16	Belur	12.56	75.86	Dug_well	Sandy clayLoam	1077.95	1035	2.82
17	Hebbale	12.53	75.98	Dug_well	SandyLoam	818.44	811.1	14.11
18	Kushalnagar	12.46	75.96	Bore_well	Sandy clayLoam	856.405	810	2.82
19	Shanivarasanthe	12.56	75.09	Bore_well	SandyLoam	950.01	903	14.11
20	Belur.	12.02	75.8	Bore_well	SandyLoam	1031.68	990	14.11
21	Virajpet	12.24	75.87	Dug Well	Sandy clayLoam	914.98	911.95	2.82
22	Ammathi	12.19	75.92	Dug Well	Sandy clayLoam	992.64	932	2.82
23	Gonikoppa	12.14	75.93	Dug Well	SandyLoam	865.33	861.25	14.11
24	Ponnampet	12.05	76.11	Dug Well	Sandy clayLoam	810.02	807.05	2.82
25	Srimangala	12.98	76.05	Dug Well	Sandy clayLoam	830.54	825.3	2.82

26	Kutta	12.29	75.79	Dug Well	Sandy clayLoam	856.45	853.25	2.82
27	Kondangeri	11.99	76.08	Dug Well	SandyLoam	891.88	883.63	14.11
28	Nagarahole	12.33	75.95	Dug Well	Sandy clayLoam	870.22	865	2.82
29	Maldare	12.15	76.05	Bore Well	Sandy clayLoam	906.26	880	2.82
30	Balele	12.15	76.05	Bore Well	Sandy clayLoam	819.29	780	2.82

(Source: Department of Mines and geology and Karnataka state Remote Sensing Center)

(v) GPS data from field visits and attribute data from state Department

Spatial data has been collected from randomly selected 26 SGs of Madikeri taluk .30 SGs of Somvarapete taluk and 29 SGs of Virajapete taluk. The details about area and extent of each SG have been obtained from Forest department .The Geographic location information and its extent and land details collected during field visit and from the forest department, respectively, are shown in the table 3.4 to 3.6, and Figure 3.6 shows the 85 Locations of SG in the study area.

Table 3.4 Details about SGs of Madikeri Taulk

Sl. No.	SG ID	Lat (Deg. Min)	Long (Deg. Min)	Location of SG	Name of SG	Sy. No	Area (Acres)
1	SG-1	12.32	75.73	Hoddur	Shashta eshwarappa Devarakadu	40/1	20.88
2	SG-2	12.3	75.74	Kodambur	Bhadrakali Devarakadu	128	10.46
3	SG-3	12.32	75.75	Murnadu	Aiyyappa Devarakadu	46	11.25
4	SG-4	12.33	75.75	Mutharmudi	Bhadrakali Devarakadu	125/6	36.94
5	SG-5	12.34	75.75	Mutharmudi	Ayyappa Devarakadu	38/1	20.2
6	SG-6	12.31	75.8	Kattemadu	Bhadrakali Devarakadu	83	47.37
7	SG-7	12.43	75.7	Katakeri	Appandriyappa Devarakadu	3/2	319.61
8	SG-8	12.42	75.68	Madenadu	Sri Mademadurappa Devarakadu	155	51.4
9	SG-9	12.38	75.68	Heravanadu	Ayyappa Devarakadu	166/3	51.13
10	SG-10	12.41	75.72	Katakeri	Uduvathu Ayyappa Devarakadu	123	15.99
11	SG-11	12.49	75.72	Eduvattu	Bhadrakali Devarakadu	49	3.19
12	SG-12	12.4	75.69	Madenadu	SriAyyappa Devarakadu	456	15.28
13	SG-15	12.51	75.59	Arekal	Arekal Ayyappa Devarakadu	1/1	1100
14	SG-16	12.45	75.69	Monageri	Bhadrakali Devarakadu	19	22.37
15	SG-17	12.47	75.69	Galeebeedu	Kundumale Ayyappa Devarakadu	70	5.2
16	SG-18	12.47	75.69	Galeebeedu	Sri pooda Devarakadu	84	6.88
17	SG-19	12.39	75.74	Mekere	Uru parambu sri Ayyappa Devarakadu	191	5.12
18	SG-20	12.39	75.76	Kaggodlu	Bellichettimani Aiyyappa	11	8.24
19	SG-21	12.36	75.66	Kargonda	Ayyappa Devarakadu	116	13.13
20	SG-22	12.37	75.67	Kargonda	Ambala Bhagavati Devarakadu	109	0.36
21	SG-23	12.35	75.66	Aivatoklu	Ayyappa Devarakadu	22	14.1
22	SG-24	12.34	75.65	Aivatoklu	Medara Ayyappa Devarakadu	132/1	2.26
23	SG-25	12.34	75.61	B Badaga	Bhagavati Devarakadu	288	3.62
24	SG-26	12.37	75.61	B Badaga	Bhagavati Devarabana	25	7.17
25	SG-25	12.38	75.53	Bagha mandala	Sangama Devarakadu	55/4	93
26	SG-26	12.37	75.57	Padakal	Padakal Devarakadu	80	2.18

Table 3.5 Details about SGs of Somvarapete Taulk

Sl. No.	SG ID	Lat (Deg. Min)	Long (Deg. Min)	Location of SG	Name of SG	Sy. No	Area (Acres)
1	SG-1	12.4	75.91	Rangasamudra	Choundi bana	25/1	1.2
2	SG-2	12.38	75.89	Nanjarayapatna	Patlamanti Devarakadu	30/1	10.62
3	SG-3	12.34	75.86	Abhythamangala	Aiyyappa Devara kadu	10	18.36
4	SG-4	12.33	75.88	Nellihudikeri	Baradi sri Aiyyappa Devarakadu	91/1	35.05
5	SG-5	12.34	75.85	Abhythamangala	Aiyyappa devara kadu	98	8.34
6	SG-6	12.39	75.81	Iralavalamudi	Vara Devarakadu	144	6.41
7	SG-7	12.44	75.79	Kedakal	Kedakal sri Bhadrakaleshwari Devarakadu	86	1.72
8	SG-8	12.52	75.79	Muvathoklu	Sri Bhadrakali devarakadu	94	40.37
9	SG-9	12.52	75.8	Muvathoklu	Brahma devarakadu	60	8.48
10	SG-10	12.57	75.79	Garvale	Nadamma devarabana (Povvedi / mahadeva Devarakadu)	35	78.67
11	SG-11	12.58	75.79	Thakeri	Aiyyappa Devara kadu	64/1	4.75
12	SG-12	12.57	75.75	Garvale	Kumara Devarakadu (Subramanya Devarakadu)	120	21.26
13	SG-13	12.54	75.8	Kirudale	Gowdamma Devarakadu	15	37.38
14	SG-14	12.52	75.82	Kumbur	Bhootha Devarakadu	103/1	16.83
15	SG-15	12.44	75.93	Basavanahalli	Doddammana bana	10	2.6
16	SG-16	12.31	75.87	Nelli hudukeri	Vishnumurthy and Bhagavathi Devarakadu	145/10	1.04
17	SG-17	12.31	75.87	Nelli hudukeri	Vishnumurthy Devarakadu(Aiyyappa devarige serida bana)	145/2	2.16
18	SG-18	12.3	75.86	Nelli hudukeri	Mariyamma Devaragudi	108/4	9.29
19	SG-19	12.3	75.86	Kudlu chettihalli	Mariyamma Devarakadu	145/11	0.88
20	SG-20	12.36	75.86	Kudlu chettihalli	Aiyyappa Devara kadu	28	6.52
21	SG-21	12.66	75.84	Chikka tolur vg	Suggi Devara kadu	NA	55.48
22	SG-22	12.68	75.79	Koothi	Suggi Devarabana	NA	14.91
23	SG-23	12.66	75.78	nagarahalli/nagaroor	Sabamma Devarabana	81	2.51
24	SG-24	12.63	75.8	Thalthere shethalli	Suggi Devara kadu	2/1.	99.33

25	SG-25	12.65	75.77	Bettadahalli	Beeradevara bana	142	2.17
26	SG-26	12.65	75.73	Kothanahalli	Brahmadevarakadu	1/5	6.93
27	SG-27	12.65	75.73	Kothanahalli	Byra Devara kadu	1/6	1.92
28	SG-28	12.64	75.73	Kunigana halli	No name for devarakadu	125/8	8.27
29	SG-29	12.61	75.76	Haraga	Chappeshwara devalaya	34/78	9.6
30	SG-30	12.59	75.81	Thalthere shethalli	Bairaveshwara /beera Devara kadu	104	17.29

Table 3.6 Details about SGs of Virajapete Taulk

Sl. No.	SGID	Lat (Deg. Min)	Long (Deg. Min)	Location of SG	Name of SG	Sy. No	Area (Acres)
1	SG-1	12.2	75.96	Hebbale	Aiyyappa,Bhdadrakali Devarakadu	8/1	78.24
2	SG-2	12.19	75.95	Balaji	Aiyyappa Devarakadu	1/11	61.76
3	SG-3	12.19	75.97	Mayanmudi	Maha devarakadu	1/19	15.6
4	SG-4	12.18	76	Dhanugala	Murudeshwara Devarakadu	1/7	9.06
5	SG-5	12.22	75.78	Kadanur	Aiyyappa Devarakadu	51	22.24
6	SG-6	12.26	75.81	Devanagiri	Aiyyappa Devarakadu	48	20.25
7	SG-7	12.26	75.79	Mythadi	Tomadu Devarakadu	56/4	9.80
8	SG-8	12.28	75.78	Halagunda	Bolu Aiyyappa Devarakadu	264	19.76
9	SG-9	12.27	75.84	Kannagala	Aiyyappa Devarakadu	1/9	36.31
10	SG-10	12.27	75.84	Kannagala	Mahalakshmi Devarakadu	81/1	12.31
11	SG-11	12.26	75.84	Kannagala	Chamundi Mahalakshmi Devarakadu	2/14	11.25
12	SG-12	12.24	75.86	Karmadu	Jeethadadu Devarakadu	10/11	4.46
13	SG-13	12.17	75.86	K.Baigodu	Aiyyappa Devarakadu		
14	SG-14	12.12	75.95	Mugutageri	Sri.Tonakeri Baghavati Devarakadu	122/1	45.97
15	SG-15	12.03	76.04	Nalkeri	Madakappa Malinga Devarakadu	95/3	37.28
16	SG-16	12.01	76.04	K.Badaga	Aiyyappa Devarakadu	192	1.2
17	SG-17	11.96	76.04	Kutta	Aiyyappa Devarakadu	66/3	1.45
18	SG-18	11.96	76.04	Kutta	Karingali Devarakadu	59/5	19.46
19	SG-19	11.98	76.04	Thaila	Swami saranam Devarakadu	23/10A	16.2

20	SG-20	12.06	75.95	Konnageri	Tuppananai Devarabana	102	1.2
21	SG-21	12.08	75.95	Konnageri	Konnageri Aiyyappa Devarakadu	90/1	45.46
22	SG-22	12.08	75.94	Hudikeri	Aiyyappa Devarakadu	206/1	23.3
23	SG-23	12.15	75.96	Kirugur	Betegara Savira Billu, Kuttichatta Aiyyappa Devarakadu	35	16.25
24	SG-24	12.03	75.93	Aravathoklu	Gurikeri Aiyyappa Devarakadu	103	16.74
25	SG-25	12.17	75.92	Aravathoklu	Kadala Aiyyapa Mahadevara Devarakadu	135	14.05
26	SG-26	12.17	75.87	Hatur	VanaBhadarkali Devarakadu	61/3	16.37
27	SG-27	12.16	75.86	Rudraguppe	Aiyyappa Devarakadu	54	27.76
28	SG-28	12.21	75.89	Husur	Mahadevaragudi	92	2.45
29	SG-29	12.21	75.95	Hebbale	Beete kurubara Devarakadu	8/2	36.33

3.2.1. Non Spatial data collection

(vi) Field data Collection.

Non spatial data has been collected for all the selected 85 SGs of the district. These data were collected from localities and sacred temple committee members, forest gaurds during the field visit in the form of questionnaire format prepared for the study. During this 11 different types of non spatial data regarding the sociological, cultural, biological and ecological features were collected and recorded as shown in table 3.7

(vii) Data from Internet Search Engines.

Data regarding the SG species, their conservation status, medicinal value and growth height has been obtained by various literatures and mainly from websites of International Union for Conservation of Nature (IUCN), environmental information system (ENVIS) and India biodiversity portal (IBP)

(i) IUCN is considered as the world's oldest and largest global environmental organization, which was founded in 1948. As the world's first global environmental organization it focuses mainly on conservation of biodiversity. The IUCN Red List of 'Threatened Species' provides information about taxonomic characters, conservation status and distribution information on various organisms that have been globally evaluated using

the IUCN Red List Categories and Criteria. All these information can be accessed through the website of www.iucnredlist.org/.

(ii) ENVIS was established by the Ministry of Environment and Forests (MoEF), Government of India in December 1982 to provide information about traded and conservation concerned medicinal plants to decision- makers, policy-planners, scientist research community, students, etc. This Centre aims to create awareness about the different aspects related to conservation of Indian Medicinal Plants through the "ENVIS Centre on Medicinal Plants", which is also called Foundation for Revitalisation of Local Health Traditions (FRLHT). The status of the plant species with respect to medicinal value can be accessed through the website of http://envis.frlht.org/.

India Biodiversity Portal (IBP) is a repository of information designed to harness and disseminates collective intelligence on the biodiversity of the Indian subcontinent. This portal aims to provide information on biodiversity in India which can be accessed through the website http://indiabiodiversity.org/theportal

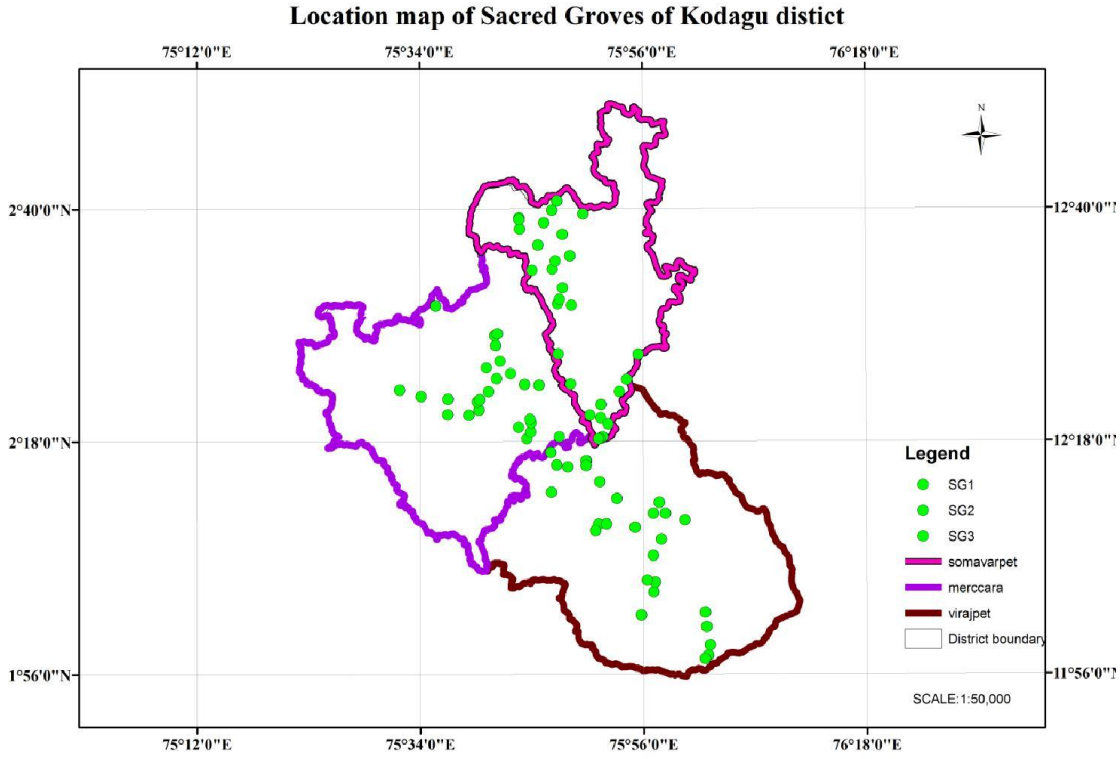

Figure 3.6 Map of SG location in Kodagu District

3.3 SOFTWARE USED

3.3.1 Remote Sensing Software

For performing different functionalities such as Georeferencing, analysis of Land use Land Cover pattern, Normalised Differentaiaton Vegetation Index analysis the remote sensing software viz. Erdas Imagine, which is designed mainly for for geospatial applications, is used widely because of its capability to handle the satellite images. For the Present research, Erdas Imagine 9.2 is used to get the accurate results.

3.3.2 GIS Software and its interfaces

ArcGIS is a geographic information system (GIS) software developed by ESRI .It is a user friendly software which is mainly used to work with spatial and non spatial information. It is used for not only mapping and compiling geographic data but also for analyzing, managing and dissemination of mapped information as it provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the Web. The present work has been carried out with Arc GIS 9.2 version.

3.3.2.1 GIS Interfaces

(i) A Geographic Information System (GIS) plug-in tool package designed for recognizing patterns from raster data, such as groundwater recharge and discharge patterns is PRO-GRADE and it works in ArcGIS 9.2- SP2 or 9.3X. The package mainly consists of two different programs: (a) the Pattern Recognition Organizer for GIS (PRO-GIS), and (b) the Groundwater Recharge and Discharge Estimator for GIS (GRADE-GIS).

(ii) OpenGeo Suite is a geospatial platform, which is well developed for managing data and creates maps and applications across web browsers such as desktops, and mobile devices. OpenGeo suite is built on leading open source geospatial software, and it is a robust and flexible design that enables organizations to consistently manage and publish geospatial data. In the present work OpenGeo suite version 3.0.2 and 4.6.1 has been made use of.

3.3.3 GPS SOFTWARE

Garmin Map source is a GPS software developed by Garmin for transferring waypoints from a Garmin GPS device and for viewing maps, routes and tracks. It is included with some Garmin GPS devices, and with some Garmin Map products. The present study is carried out by using 6.1.2 version of Garmin Mapsource.

3.4 DEVELOPMENT OF SG GEODATABASE

A geodatabase is a database designed to store, query, and manipulate geographic information and spatial data. Different types of spatial data, such as vector and raster datasets, and their attributes and location information can be stored in Geodatabase. (Superchi 2010) .File based Geodatabase is planned to develop for SG as it is capable of holding datasets scaling up to 1 TB in size. The methodology adopted for development of SG Geodatabase is shown in Figure3.7. The schema (Figure 3.8) of the SG Geodatabase designed aims to store and manage both spatial and non-spatial data in the form of different 'Feature datasets', raster images and digital elevation model (DEM).Each Feature data set consists of several 'Feature class' which share a common co ordinate system. In SG Geodatabase feature data set of SG Kodagu was created so as to hold feature class such as Sacred Grove locations, species data. Apart from these, the layers of the base map were exported and stored in the form feature class. Feature class of Kodagu area will have 'Sub types' viz, Madikeri, Virajpet, Somavarapet and 'Domains' viz, Area and Deity which has been incorporated so as to make the 'database content' search in an easier way. Data for Individual SGs stored in such a Geodatabase will have spatial and attribute data such as name of the Sacred Grove, name of the deity associated with it, and geographic location of the Grove, jurisdiction details with respect to the taluk, local and scientific names of the flora and fauna species, growth height of the flora species, information regarding biodiversity and conservation status with respect to IUCN RED LIST and ENVIS-India. To follow the methodology 85 SG Locations have been visited and all the data is captured in digital format i.e., as excel files and later fed into the Arc GIS software by converting it into the shape files. After this, the shape files have been exported to the feature data sets in the form of different feature classes. The data stored in the SG Geodatabase has been used

to generate and summarize various kinds of reports which can be used for biodiversity estimation, prioritization and can also be used to generate Web based maps through web GIS.

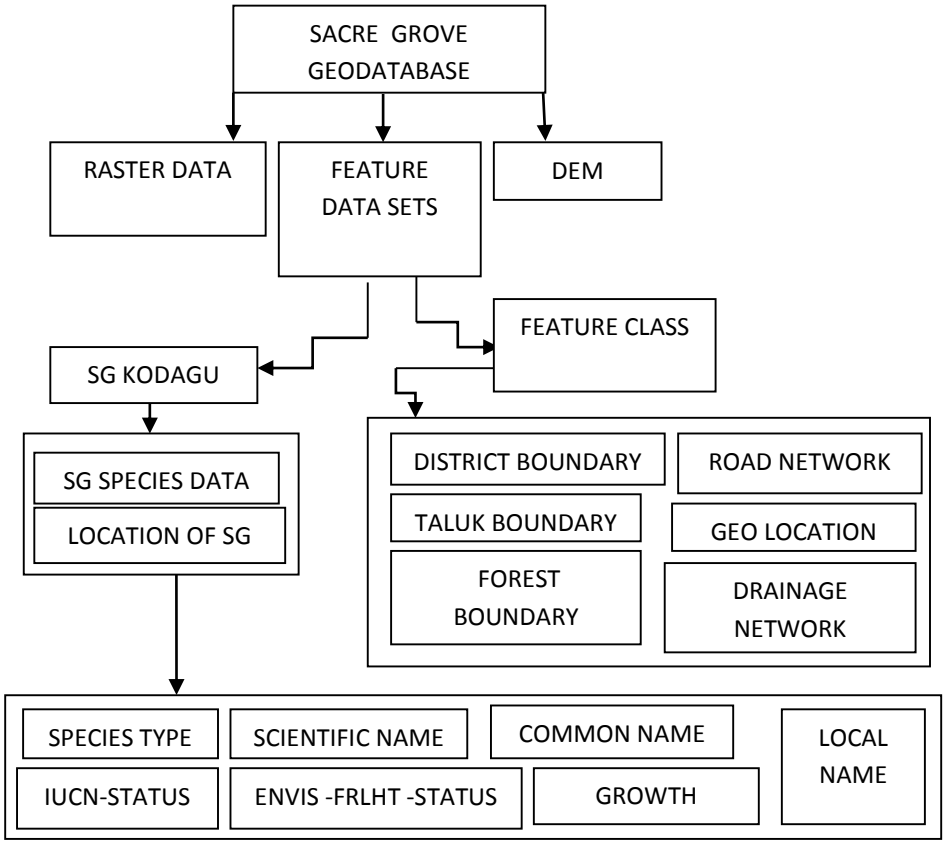

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Figure 3.7 Work Flow diagrams for Development of SG Geodatabase

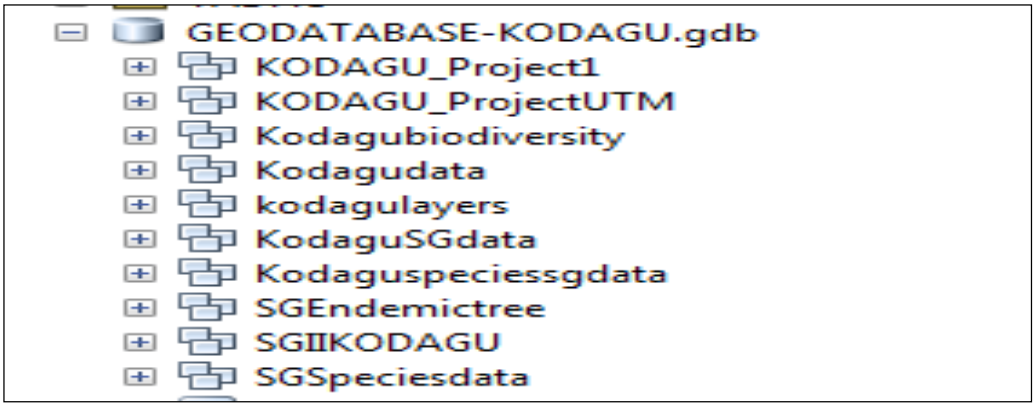

Figure 3.8 Schema of Geodatabase

3.5. ASSESSMENT OF BIODIVERSITY IN SGs

Biodiversity is a contraction of 'biological diversity' and is used to describe the variety of life. It refers to the number and variety of organisms within a particular area and has three components: species diversity; ecosystem (or habitat) diversity; and genetic diversity. Biodiversity is often used as a measure of the health of biological systems. The details of Biodiversity brought into the Geodatabase as explained in the section 3.4 and the data in SG Geodatabase have been used for further analysis of the data. Various ecological indices such as, (i) dominance, (ii) Shannon's index, (iii) Simpson's index, iv). Marglef's index and (v) Pielou's evenness have been used to estimate the biodiversity and the methodology adopted for this estimation as shown in Figure 3.9

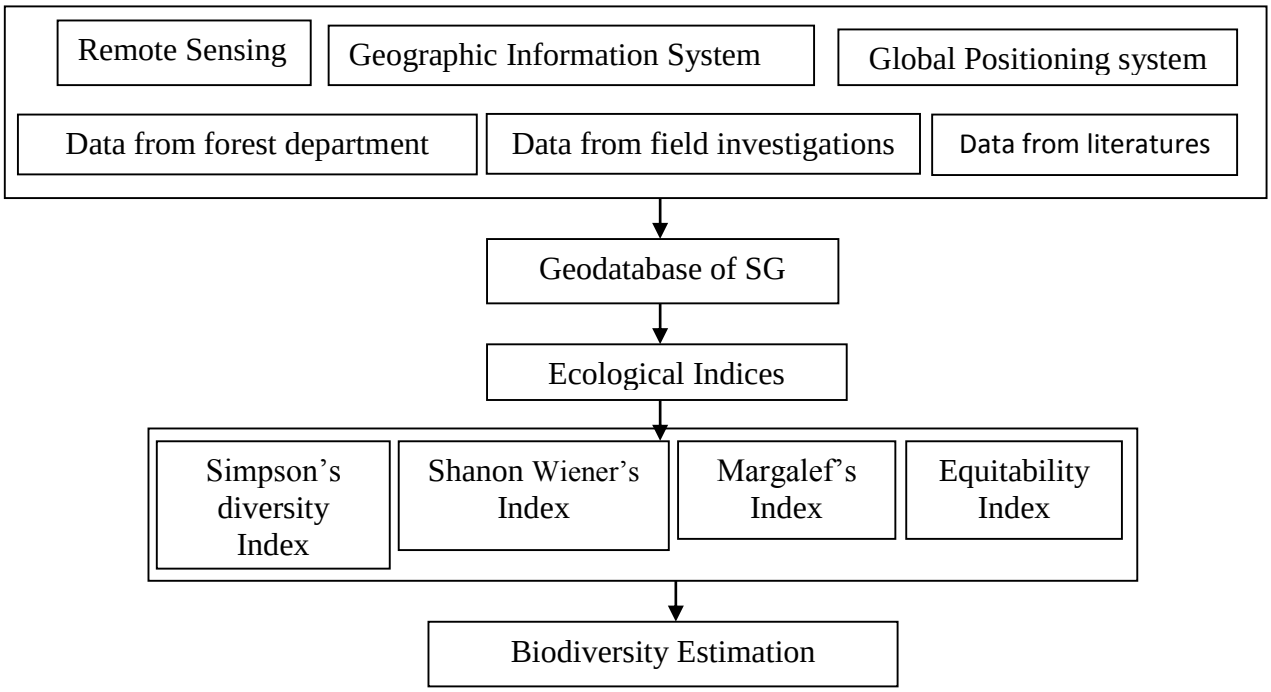

Figure 3.9 Mehodology for estimating biodiversity

Biodiversity estimation of SGs is restricted only to understand the Species diversity as well as Species richness.

Species Diversity

Species diversity relates to the number of the different species and the number of individuals of each species within any one community. A number of objective measures have been created in order to measure species diversity.

Species richness

Species richness is the number of different species present in an area. The more species present in a sample the 'richer' the area.

(a) Ecological indices used for biodiversity estimation

Species diversity is a measure of the structural complexity of communities and it is also termed as measures of the variation in the number of species that make up communities.There are several ways to measure the diversity. Among those 5 widely used methods, viz., i) Dominance ii) Shannon-Wiener's diversity index (H) iii) Simpson's diversity index (D) iv) Margalef's Species richness index v) Equitability or evenness, has been followed for estimation of biodiversity in SGs.

(i) Dominance

This method is used to assess the dominancy of the species in a particular area.

Density "D" is a measure of the numerical number by total number of samples.

$$\textbf{Density (D)} = \frac{\text{Total no. of individuals}}{\text{Total no. of sample area}}$$

(ii). Shannon-Wiener's diversity index (H)

In this index, importance is given to species diversity rather than species abundance.

Shannon-Wiener's diversity index (H) is calculated by

Shannon-Weiner Diversity Index $\mathbf{H = \sum pi \ln pi}$

Where, 'ith' species = one of all the enumerated species

pi = the proportion of the 'i'th species = (ni /N)

ni = number of individuals of the 'i'th species

N = total number of individuals.

(iii). Simpson's diversity index (D)

In this index the species abundance has more importance than species richness. Simpson's diversity index (D) has been calculated using the following formula

Simpson's Diversity Index $\mathbf{D = \sum \frac{((ni\ (ni-1))}{((N(N-1))}}$

Where, ni = number of individuals of the 'i'th species

N = total number of individuals.

The value of this index can theoretically range from zero to infinity. However, values normally range from 0 to 4.

(iv) Margalef's Species richness index

The simplest measure of species diversity is through the use of a species richness index, which is the number of species in community regardless of dominance, Margalef's species richness index was used to assess the species richness in the present study

Margalef's Species richness index D = (S-1)/ ln N

Where, S= number of species

N= total number of individuals

This index commonly varies between 1 and 5, and larger the index means a more healthy Ecosystem. When it tends towards 1, it indicates, sort of disturbance and damage should be suspected.

(v). Equitability or evenness

Pielou's Equitability index was calculated for knowing the evenness.

Pielou's Equitability Index $E = H^1 / \ln S$

Where , S= number of species

H^1= Shannon-Wiener Diversity index

This index measures the evenness in the species composition in the sample and the value of ranges between 0 and 1. Value 0 indicates complete dissimilarity, whereas value 1 denotes maximum evenness between samples (or communities).

3.5.1 Interpretation of LULC features Change and Change Detection

Analysis Multi temporal satellite Data has been used to classify and analyze the land use land cover (LULC) features of the study area. The Classification proce ss started with Image to Map registration with a root mean square error of 0.45 and the images has been projected to Geographic - Lat/Lon (WGS84). Later these images subset with the boundary of Kodagu district and re-projected to UTM - WGS 84 North projection to get the area of individual class in meters. Then supervised classification has been carried out by applying Maximum likelihood algorithm, and preliminary maps were prepared.These maps were corrected and modified based on the ground truth data. , and then the final maps were prepared with all the base map details derived from Toposheets of SOI. Accuracy of the performed classification has been tested. The study area has been classified into 7 categories of LULC class such as built up land, crop Land, dense forest, sandy area, scrub land and water body and SG. Finally area for each and every class has been calculated and the change pattern is assessed.

The methodology adopted has been represented in Fig 3.10

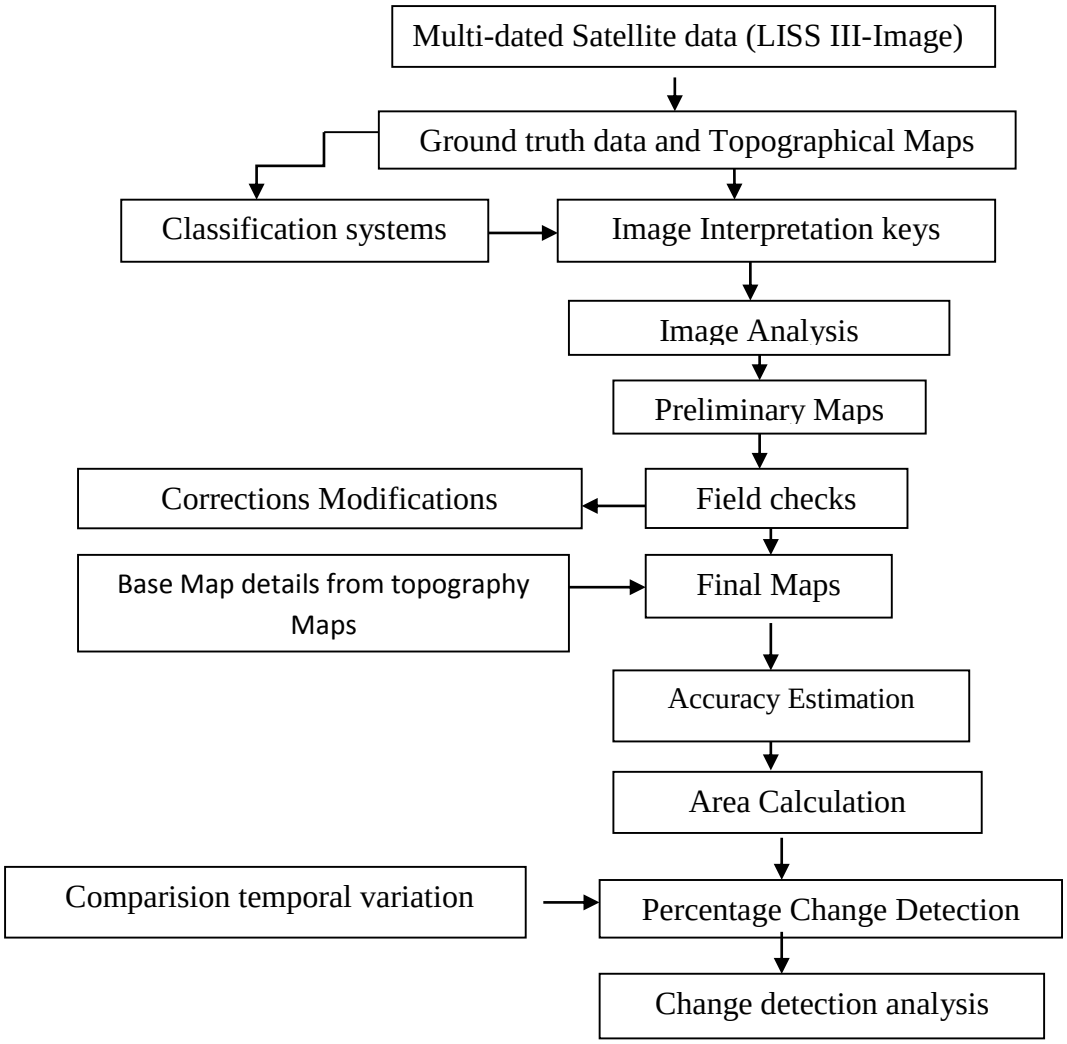

Figure 3.10 work flow for classification and change detection analysis in LULC class

3.5.2 Estimation of Normalized Differential Vegetation Index (NDVI)

The Normalized Differential Vegetation Index (NDVI) is used widely to assess and monitor the changes in vegetation cover, productivity, phenology, as well as vegetation health status at both e spatial and temporal scales (Myneni et al.1997,Sobrino and Raissouni 2000, Tucker et al2001, Nemani et a. 2003, Pettorelli et al 2005). It is found that upper asymptote of NDVI versus vegetation density usually occurs near 0.5-0.8 for dense vegetation and this upper limit depends on vegetation type, age, leaf, water content Calculation of Vegetation Indices by using satellite data makes use of Normalized Difference Vegetation Index (NDVI) and the following equation computes the density of plant growth on the land

$$\mathbf{NDVI = (NIR — VIS)/(NIR + VIS)}$$

Where, NIR is near-infrared radiation and VIS is visible radiation.

Calculations of NDVI for a given pixel always result in a number that ranges from minus one (-1) to plus one (+1); however, no green leaves gives a value close to zero. A zero means no vegetation and close to +1 (0.8 - 0.9) indicates the highest possible density of green leaves. NDVI maps are generated for the Georeferenced and UTM WGS 1984 projected multi temporal satellite data of 2006 and 2012 Year by running the NDVI veg.index model through Erdas imagine 9.2 and is analyzed for vegetation density for the two years compared, and the loss of vegetation was analyzed for the study area.

3.6 TO EVALUATE THE GEOGRAPHIC SETTING AND DISTURBANCE REGIMES OF SG.

Evaluating the Geographic setting and disturbance regimes aims to know the disturbance status of SG in the particular location where SG exists. It also aids to understand rate, time, and priority of the conservation measures each SG needs. Aiming for the conservation of SG, the process of Prioritization has been carried out based on the

methodology and principles used for prioritization of Key Biodiversity Area (KBA) as prescribed by IUCN. KBAs are locations of global significance for conservation of biodiversity and are identified using globally standard criteria and thresholds, based on the protective measures required in order to conserve biodiversity at the site scale. These criterias are based on the framework of species vulnerability and irreplaceability widely used in systematic conservation planning. In prioritization of KBA different priority levels are assigned based on the criteria of irreplaceability, species-based vulnerability and site-based vulnerability. In the Present study SG location data, attribute data, species occurrence and conservation status data are planned to bring into SG Geodatabase so as to get various reports and summary as per the requirement. The same methodology shown in 3.11 prescribed for the prioritization of KBA by IUCN is adopted for the prioritization of SGs, because IUCN considers existing protected areas equivalent to KBAs. Species-based vulnerability, site-based vulnerability and irreplacebility of threat triggered are identified and assigned suitable scores. Based on the IUCN conservation status each SG is analyzed for species based vulnerability and classified into four classes such as Extreme, High, Medium and Low (Table 3.7). Based on the impact score, which is given by considering the parameters like time, scope and severity of the threat selected, site based vulnerability of each SG is analyzed and classified into 3 categories such as High, Medium and Low categories as represented in Table 3.7. Based on the Irreplaceability value each SG is analyzed into classes such as Extreme, High, Medium, and Low as shown in Table 3.8. Based on the scores of site based vulnerability and irreplacebility, finally matrix score has been assigned as shown in Table 3.9. SGs are categorized into 5 classes such as Extreme, High, Medium, Low and Least and prioritized into 5 Levels from 1 to 5 which depict the rate of threat SGs experience and also help to decide priority , time and scope that a particular SG demands for the conservation.

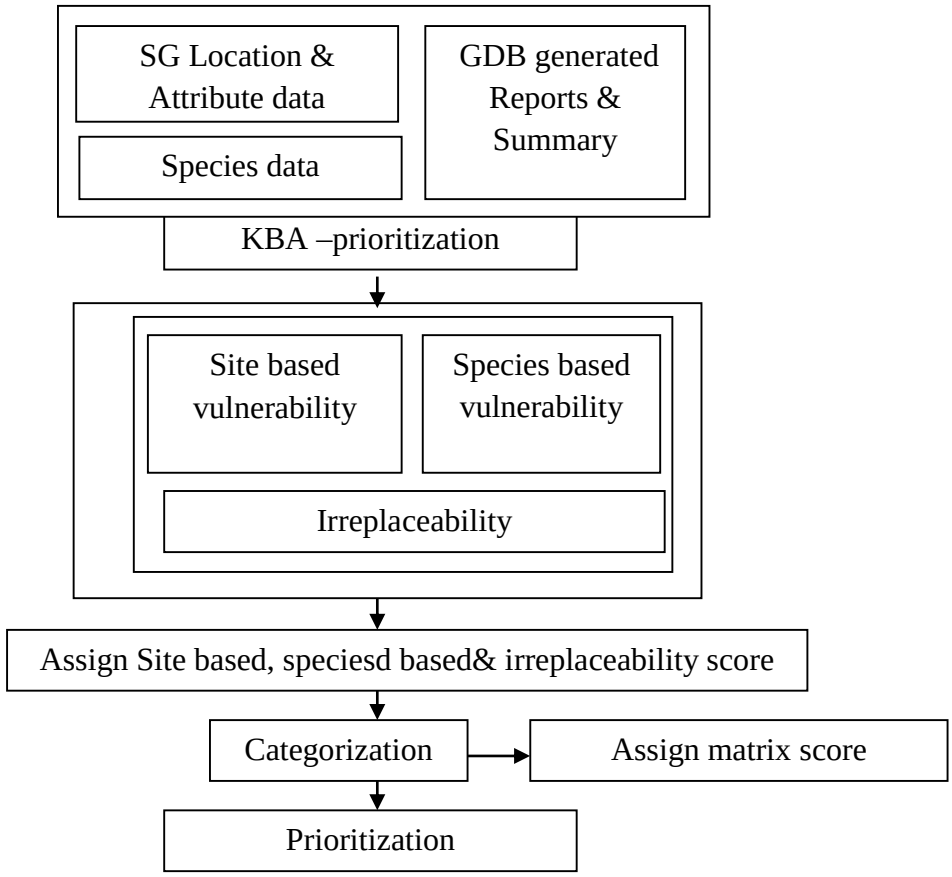

Figure 3.11 showing Flow Chart Methodology for Prioritization of SG

Table 3.7 Species-based vulnerability score and Sit -based score pattern

I. Species-based vulnerability	**Global threat status**
Extreme	Critically Endangered (CR)
High	Endangered (EN)
Medium	Vulnerable (VU)
Low	Near Threatened (NT),Least Concern (LC)
II. Site-based vulnerability	Impact score (Impact Score = Timing + Scope + Severity)
High	8–9
Medium	6–7
Low	0–5

Table 3.8 Irreplaceability score pattern

Irreplaceability score	'Population data' scenario	'No population data' scenario
Extreme	Sites known or inferred to hold ³ 95% of the global population of a species	Sites holding a species endemic to the country/region that is not known to occur at any other site
High	Sites known or inferred to hold ³ 10%but < 95% of the global population of a species	Sites holding a species endemic to the country/region that is only known to occur at 2–10 sites (OR)Sites holding a species that globally is only known to occur at 2–10 sites
Medium	Sites known or inferred to hold ³ 1%but < 10% of the global population of a species	Sites holding a species endemic to the country/region that is only known to occur at 11–100 sites (OR)Sites holding a species that globally is only known to occur at 11–100 sites
Low	Sites known or inferred to hold < 1% of the global population of a species	Sites holding a species endemic to the country/region that occurs at more than100 sites (OR)Sites holding a species that globally is known to occur at more than 100 sites

Table 3.9 Matrix score pattern

Irreplaceability	Species-based vulnerability	Site-based vulnerability			PRIORITIZATION		
		High	Medium	Low	High	Medium	Low
Extreme	Extreme	1	1	1			
	High	1	1	1			
	Medium	2	3	4			
	Low	3	4	5			
High	Extreme	2	2	3			
	High	2	3	4			
	Medium	3	4	5			
	Low	4	5	5			
Medium	Extreme	3					
	High	4					
	Medium	5					
	Low	5					
Low	Extreme	4					
	High	5					
	Medium	5					
	Low	5					

3.7 ESTIMATION OF GROUND WATER RECHARGE AND DISCHARGES AND ANALYSIS OF IMPACT OF SG ON THE RECHARGE AND DISCHARGE

The main objective is to estimate the ground water aquifer recharge and discharge is set to understand the dynamics of ground water recharge and discharge in the entire district and to estimate temporal variation in ground water recharge pattern in different parts of Kodagu district.

PRO-GRADE is an ESRI ArcGIS 9.2 plug-in package that consists of two separate tool kits: (1) the pattern recognition organizer for geographic information system (PRO-GIS) and (2) the ground water recharge and discharge estimator for GIS (GRADE-GIS). GRADE-GIS gives groundwater recharges and discharge estimations in steady state and two-dimensional aquifers based on the mass balance approach of Stoertz and Bradbury (1989). Data about hydraulic conductivity, ground water table and bedrock elevation data are fed into Grade GIS tool which calculates the rate of recharge and discharge based on the following assumptions and the mass balance equations given

below: 1. The groundwater system has horizontal two-dimensional flow under steady-state conditions in the aquifer with isotropic hydraulic conductivities.2. There are no source and sink terms except recharge and discharge (i.e., recharge and discharge are the lump sums for all source and sink terms).3. The water table is always higher than the bottom elevation. If the water table is less than, or equal to, the sum of the bottom elevation and the minimum saturated thickness, the cell is considered an inactive cell (NoData value in ArcGIS) and will be excluded from computation . 4. GRADE-GIS output raster will include NoData values, rather than recharge or discharge estimates, for cells having No Data values in any of the input raster fields. The Grid orientation and notation used for numerical computation to calculate recharge is as shown in Figure 3.12

i-1 , j+1	**I , j+1** Q_{in_north}	**i+1 , j+1**
i-1 , j Q_{in_west}	**I , j**	**i+1 , j** Q_{in_east}
i-1 , j-1	**I , j-1** Q_{in_south}	**i+1 , j-1**

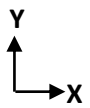

Figure 3.12 Grid orientation and notation for numerical computation

$$Q_{in} = -R_{i,j} \bullet \Delta x_{i,j} \bullet \Delta y_{i,j}$$

$$Q_{in} = \frac{dh}{dl} \bullet K \bullet A = Q_{in\_west} + Q_{in\_east} + Q_{in\_north} + Q_{in\_south}$$

$$Q_{in\_west} = \frac{h_{i-1,j} - h_{i,j}}{\Delta x_{i-1/2,j}} \bullet K_{i-1/2,j} \bullet b_{i-1/2,j} \bullet \Delta y_{i,j} = \frac{h_{i-1,j} - h_{i,j}}{\Delta x_{i-1/2,j}} \bullet T_{i-1/2,j} \bullet \Delta y_{i,j}$$

$$Q_{in\_east} = \frac{h_{i+1,j} - h_{i,j}}{\Delta x_{i+1/2,j}} \bullet K_{i+1/2,j} \bullet b_{i+1/2,j} \bullet \Delta y_{i,j} = \frac{h_{i+1,j} - h_{i,j}}{\Delta x_{i+1/2,j}} \bullet T_{i+1/2,j} \bullet \Delta y_{i,j}$$

$$Q_{in\_north} = \frac{h_{i,j+1} - h_{i,j}}{\Delta y_{i,j+1/2}} \bullet K_{i,j+1/2} \bullet b_{i,j+1/2} \bullet \Delta x_{i,j} = \frac{h_{i,j+1} - h_{i,j}}{\Delta y_{i,j+1/2}} \bullet T_{i,j+1/2} \bullet \Delta x_{i,j}$$

$$Q_{in\_south} = \frac{h_{i,j-1} - h_{i,j}}{\Delta y_{i,j-1/2}} \bullet K_{i,j-1/2} \bullet b_{i,j-1/2} \bullet \Delta x_{i,j} = \frac{h_{i,j-1} - h_{i,j}}{\Delta y_{i,j-1/2}} \bullet T_{i,j-1/2} \bullet \Delta x_{i,j}$$

where , $\Delta x_{i,j}$ and $\Delta y_{i,j}$ are horizontal cell dimensions [l];

$\Delta x_{i,j}$ and $\Delta y_{i,j}$ with ±1/2 in i and j notations are the lengths between centers of cell (i,j) and its four adjacent cells [l];

$R_{i,j}$ is recharge / discharge rate of grid(i,j) [l/t];

$h_{i,j}$ is the hydraulic head of grid(i,j) [l];

$K_{i,j}$ is hydraulic conductivity of grid(i,j) [l/t];

$b_{i,j}$ is saturated thickness and equal to hydraulic head minus bottom elevation [l];

$T_{i,j}$ is the transmissivity of grid(i,j), $T_{i,j} = K_{i,j} \bullet b_{i,j}$ for unconfined aquifer [l^2/t];

$T_{i+1/2,j}$ is the harmonic mean of transmissivity between grid(i+1,j) and grid(i,j) [l^2/t],

$\frac{1}{T_{i+1/2,j}} = \frac{\frac{1}{T_{i+1,j}} + \frac{1}{T_{i,j}}}{2}$ which means $T_{i+1/2,j} = \frac{2}{\frac{1}{K_{i+1,j} \bullet b_{i+1,j}} + \frac{1}{K_{i,j} \bullet b_{i,j}}}$;

If grid (i,j) is on the boundary, the flow rate from the neighboring inactive grid is equal to zero. For example, if the grid is located on the west boundary with i-1 = 0, $Q_{in\_west} = 0$ (Nziku et al., 2009).

The methodology adopted in the present study is shown in Figure 3.13. The grade output will be brought to the Pro GIS environment to identify the recharge and discharge zones for the district. The resulting map and location map for the SG together will be spatially analyzed to derive the role of SG in aquifer recharge.

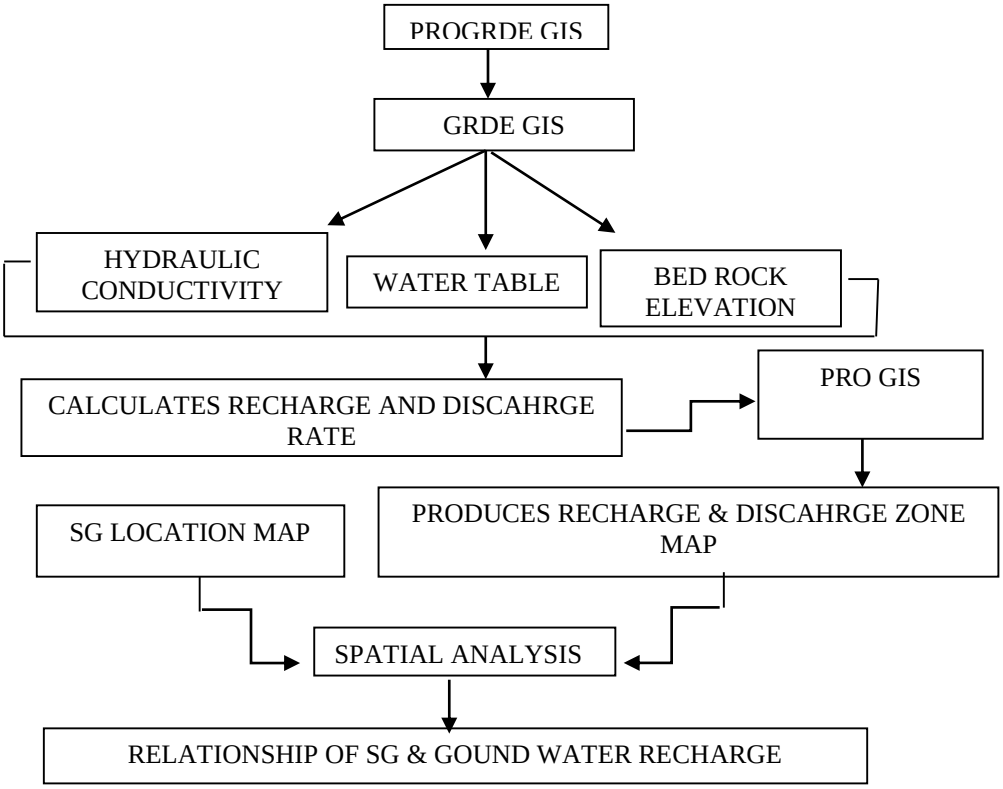

Figure 3.13 Flow Chart for Estimation of Ground Water Recharge and Discharge

3.8 WEB BASED SACRED GROVE INFORMATION SYSTEM THROUGH OPEN SOURCE GEO SUITE

OpenGeo Suite is a complete geospatial platform for managing data, building maps, and dessimination of information across the web. To run the data in OpenGeo suite application the metholdogy followed is as shown in Figure 3.15, where open source software from http://boundlesSGeo.com/solutions/opengeo-suite is downloaded and installed. OpenGeo suite has different components used for different functions such as 'Post GIS', 'Geo server', Geo explorer' and 'Geo web chache'.

Open Geosuite comprises of a dash board which is a single interface through which all the above components of OpenGeo Suite can be accessed including links to common tasks, configuration, and management.

Publication of the maps of SGs in internet involves five steps such as data preparation, loading of data to the server, viewing and editing the data, styling the layers and finally map composition.This can be achieved in the following manner. First, the dash board has been accessed through URL http://localhost:8080/dashboard. Then, work space has been created in Geoserver to which all the shape files required, to publish maps were imported. Then Geo explorer is made to run by navigating to URL (such ashttp://localhost:8080/geoexplorer). The data stored in geoserver will be made to run through a web application such as GeoExplorer .

Geo explorer application is composed of several tools which is used for composing, styling, and publishing maps. It also contains the query and measure tool where information can be queried, based on the area and attributes and map features can also be measured. The OpenGeo suite software is planned to utilize not only visualization of the maps but also to help in decision making process through queries.

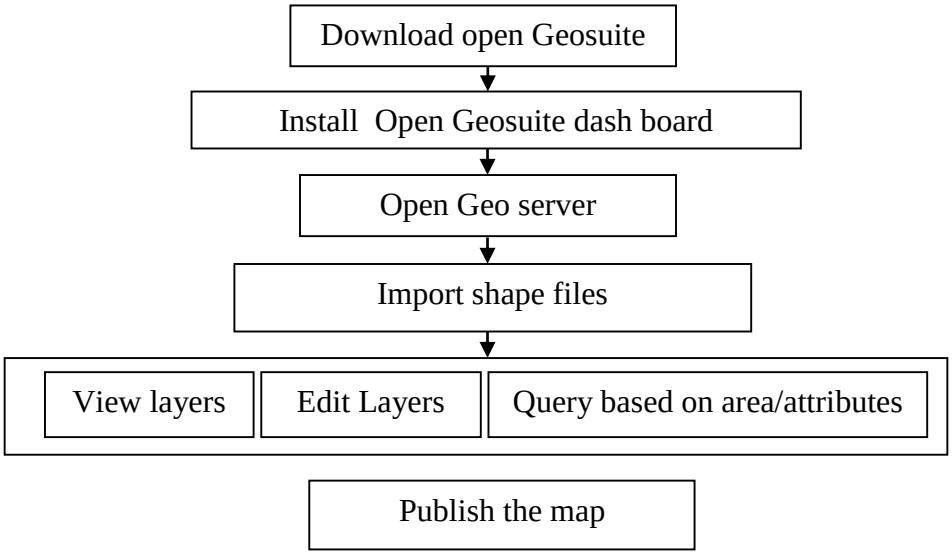

Figure 3.14 Work flow of publishing map through web based open Geosuite

3.9 SACRED GROVE MANAGEMENT PLAN

As defined and described by IUCN, Management plan is a "**process**, not an **event** i.e. it does not end with the production of a plan, but continues through its implementation and beyond that".The conservation plan explains significance of site and cultural significance can be retained and protected to its best .

Sacred Grove Management Plan (SGMP) has been prepared for the 85 SGs of Kodagu district aiming to protect, conserve and sustainable management. Development of SGMP plan requires the knowledge about the Location, extent and significance of the site with respect to cultural and sociological aspects forms the heart of a conservation plan. This approach has been useful in developing Management Plans for 'mixed sites' where natural and cultural heritage are found together and where an integrated approach is required.

In order to prepare this plan data such as (a) field data, (b) prioritization data, (c) biodiversity data and (d) data from various literatures has been made use of (Figure 3.15).

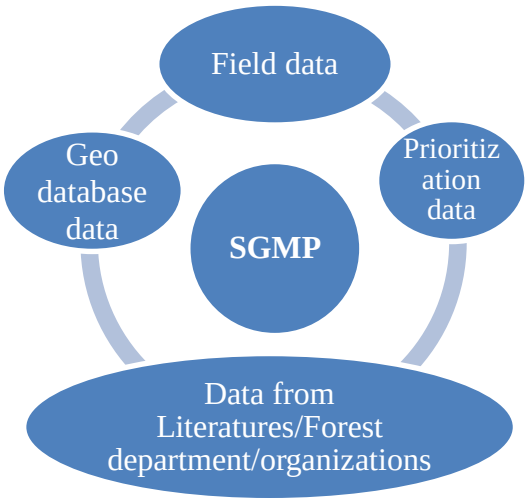

Figure. 3.15 Methodology for preparation of SGMP

(a) During the field visit, along with the spatial data the information about various aspects such as cultural, sociological and biological information are gathered in the specific questionnaire prepared. Apart from this observations and interactions with the local people made during field visit and problems pertaining to area and effectiveness of community

management actions have also been taken into consideration. The cultural and sociological data used for planning is as shown in Figure 3.15

(b) Successful planning requires identification and assessment of threat associated with sites, status of species and statistics about the status as well as the knowledge about conservation priority that each SG demands aids in better planning process.

(c) SG Geodatabase data is useful not only in providing the statistics about the flora and fauna but also in assessing the value of the particular SG from biodiversity point of view. It gives information about the conservation status and helps to formulate the plan so as to maintain the diversity in its virgin condition and conserve the most valuable floral and faunal species.

(d) The data from various literatures is useful in developing comprehensive management plan as it provides information on the past status of SG and successful management practices followed in other localities.

CHAPTER 4

RESULTS AND DISCUSSION

4.1. GENERAL

This chapter presents results which are obtained from the implementation of different methodologies prescribed to attain various objectives. In the beginning result obtained by the SG Geodatabase was described, which acts as data source for all other analysis and tasks. Then Various ecological indicies were applied on the data of SG Geodatabase in order to estimate biodiversity. Later Prioritization has been done and SGs are categorized and prioritized into different levels based on the method prescribed by IUCN. The data of SG Geodatabase has been utilized effectively for the development of web application through OpenGeo suite software. The temporal as well as spatial variation has been analyzed for LULC and NDVI pattern.The ground water recharge and discharge rate has been estimated for the study area and the respective zones have been identified which helps to analyze the distribution of ground water.

4.2 SG GEODATABASE

SG Geodatabase has been prepared to hold all the spatial and non spatial data related to SG that serves as foundation for all other analysis. SG Geodatabase was developed for 85 SG locations in the study area resulted with comprehensive spatial database holding a total of 2831 individuals of flora and fauna. Among those in SGs of Virajpet the highest number of floral and faunal individuals was found followed by Madikeri and Somvarpet.

The Geo database resulted in the identification of 838 individuals of flora and fauna in SGs of Madikeri taluk and among those 380 were trees, 152 were medicinal plants, 127 were animals and 179 were birds. Out of total 140 floral species, according to IUCN conservation status, 25 were Conservation concerned species and according to the FRLHT 27 were medicinal Plants and 85 were traded medicinal plants. Among the floral species 124 individuals of medicinal and 305 individuals of traded medicinal plants were observed in Madikeri taluk.

Totally 765 individuals of flora and fauna have been identified in Somvarpet taluk and among those 368 were trees, 96 were medicinal plants, 114 were animals and 187 were birds. Out of total 114 floral species, according to IUCN conservation status 21 were Conservation concerned species and according to the FRLHT, 27 were medicinal plants species and 77 were species of traded medicinal plants. Among the floral species 103 individuals of medicinal and 312 individuals of traded medicinal plants were observed in this Taluk.

1228 individuals of flora and fauna have been identified in Virajpet taluk and among those 542 were trees, 252 were medicinal plants, 165 were animals and 269 were birds. Out of total 150 floral species, according to IUCN conservation status 19 were Conservation concerned species, 55 were medicinal Plants species and 94 were traded medicinal plants species. Among the floral species, 184 individuals of medicinal and 460 individuals of traded medicinal plants were observed in Virajpet taluk

In this study both, small SG covering an area of 0.36 acres as well SG covering a large area of 1100 Acres have been studied and found almost all SGs were associated with water resource adajacent to it. Out of the 85 studied SGs, only 25-30% of SGs have been surveyed and fenced by the forest department and the rest needs to be protected immediately. Almost all SGs were managed and protected by SG committee. It also has been observed that, more than 90% of SGs and the associated deity were found be worshipped, only once in a year from Feb-April, during which scarifices of animals such as pig, cock and sheep will be given and different forms of dance/pooja were performed.So it is evident that SGs not only preserves biodiversity but also uphold cultural values and maintain harmony between various communities of people. Conservation status of flora and fauna of 3 different taulks are given in table from 4.1 to 4.12 and non spatial data collected during the field visit are given in table 4.13 to 4.15.Figure 4.1 shows thereports generated from SG Geodatabase and figure 4.2 represents the incorporated spatial and non spatial data in SG Geodatabase which can be serves as the foundation for various analysis.

Table 4.1 IUCN Conservation Status of floral species in SGs of Madikeri Taluk

SL.No	Scientic Name of Floral species	IUCN conservation status	Growth Height (mtr)
1	*Vateria indica l.*	Critically endangered	Upto 40 - 60
2	*Syzygium caryophyllatum (l.) Alston*	Endangered	Upto 6
3	*Holigarna arnottiana hook.f.*		Upto35
4	*Dysoxylum malabaricum bedd.*	Endangered / global	Upto 35
5	*Dalbergia latifolia roxb.*	Vulnerable	to 40
6	*Pterocarpus marsupium roxb.*		Upto40
7	*Mallotus tetracoccus (roxb.) Kurz*		Upto12
8	*Rhaphidophora pertusa schott*		0.5
9	*Myristica malabarica lam*		15m
10	*Cinnamomum macrocarpum hook.*	Vulnerable / global	Upto15
11	*Garcinia gummi-gutta (l.) Robs.*		Upto12
12	*Artocarpus hirsutus lam.*		Upto35
13	*Alstonia scholaris r.br.*	Low risk / least concern	Upto30
14	*Sapindus emarginatus vahl.*		Upto18
15	*Myristica dactyloides gaertn*	Lower risk/conservation depedendent	20
16	*Trichilia connaroides*	Least concern	Upto10
17	*Centella asiatica (l.) Urban*		0.2
18	*Mimosa pudica*		0.5
19	*Centella asiatica (l.) Urban*		0.2
20	*Aponogeton natans (l.) Engl. & krause*		0.40
21	*Michelia champaca l.*		Upto30
22	*Caryota urens l.*		8-12
23	*Artocarpus heterophyllus lam.*		Upto20
24	*Mangifera indica l.*	Data deficient	Upto35
25	*Diospyros ebenum koenig*		20 m to 25

Table 4.2 FRLHT Conservation Status of floral species in SGs of Madikeri Taluk

SL.No.	Scientic Name of Floral species	FRLHT status	Growth Height (mtr)
1	*Acrocarpus fraxinifolius*	Medicinalplants	30 to 60
2	*Ananas comosus (l.) Merr.*	Medicinalplants	1.0 to 1.5
3	*Antidesma bunius wall.*	Medicinalplants	Upto5
4	*Artocarpus lakoocha roxb.*	Medicinalplants	10 to15
5	*Bischofia javanica bl.*	Medicinalplants	Upto30
6	*Buchanania latifolia roxb.*	Medicinalplants	13 to 18
7	*Calophyllum polyanthum wall.*	Medicinalplants	Upto35
8	*Celtis tetrandra roxb*	Medicinalplants	10-25
9	*Dalbergia latifolia roxb.*	Medicinalplants	to 40
10	*Diospyros malabarica (desr.) Kostel.*	Medicinalplants	Upto15
11	*Diospyros montana roxb.*	Medicinalplants	18 to 24
12	*Ficus hispida l.f.*	Medicinalplants	Upto10
13	*Ficus mysorensis*	Medicinalplants	6 to 9
14	*Holigarna arnottiana hook.f.*	Medicinalplants	Upto35
15	*Lagerstroemia lanceolata wall.*	Medicinalplants	About 45
16	*Leonotis nepetaefolia r.br.*	Medicinalplants	3
17	*Litsea glutinosa (lour.) Robinson*	Medicinalplants	5
18	*Macaranga peltata*	Medicinalplants	16
19	*Pavetta indica l.*	Medicinalplants	Upto 4
20	*Phyllanthus distichus (l.)*	Medicinalplants	3
21	*Pinanga diksonii (roxb.) Bl.*	Medicinalplants	Upto5
22	*Plumbago rosea l.*	Medicinalplants	0.5-2
23	*Plumeria acuminata r.br.*	Medicinalplants	7 to 10
24	*Randia spinosa poir.*	Medicinalplants	Upto9
25	*Sapindus laurifolia vahl*	Medicinalplants	Upto30
26	*Trema orientalis bl.*	Medicinalplants	Upto18
27	*Urena lobata l.*	Medicinalplants	1 to 1.5
1	*Acacia chundra (roxb. Ex rottler) willd.*	Traded medicinal plants	12 to 15

2	*Acacia concinna (willd.)*	Traded medicinal plants	5
3	*Acacia sinuata (lour.) Merr.*	Traded medicinal plants	12 to 15
4	*Albizia lebbeck (l.) Benth.*	Traded medicinal plants	18 to 30
5	*Alocasia indica (lour.) Spach*	Traded medicinal plants	1 -2
6	*Alstonia scholaris r.br.*	Traded medicinal plants	Upto30
7	*Anacardium occidentale l.*	Traded medicinal plants	10 to 12
8	*Aponogeton natans (l.) Engl. & krause*	Traded medicinal plants	0.40
9	*Artocarpus communis j. & g. Forst.*	Traded medicinal plants	Upto26
10	*Artocarpus heterophyllus lam.*	Traded medicinal plants	Upto20
11	*Artocarpus integrifolia l*	Traded medicinal plants	Upto 15
12	*Asparagus racemosus willd.*	Traded medicinal plants	1 to 2
13	*Bacopa monnieri (l.) Pennell*	Traded medicinal plants	0.04
14	*Bambusa arundinacea willd.*	Traded medicinal plants	> 30
15	*Bauhinia malabarica roxb*	Traded medicinal plants	8-10
16	*Benincasa hispida (thunb.) Cogn.*	Traded medicinal plants	6
17	*Bombax malabaricum dc.*	Traded medicinal plants	>12
18	*Borassus flabellifer l.*	Traded medicinal plants	30
19	*Caesalpinia bonduc (l.) Roxb.*	Traded medicinal plants	17
20	*Caesalpinia pulcherrima*	Traded medicinal plants	8-10
21	*Calamus rotang l.*	Traded medicinal plants	10-15
22	*Callicarpa tomentosa (l.) Murr.*	Traded medicinal plants	5
23	*Careya arborea roxb.*	Traded medicinal plants	Upto15
24	*Caryota urens l.*	Traded medicinal plants	8-12
25	*Cassia fistula l.*	Traded medicinal plants	10 to 20
26	*Cassia tora l.*	Traded medicinal plants	0.3-0.9
27	*Cedrela toona roxb.*	Traded medicinal plants	Around 60
28	*Centella asiatica (l.) Urban*	Traded medicinal plants	0.2
29	*Cinnamomum verum pres*	Traded medicinal plants	10
30	*Coscinium fenestratum (gaertn.) Coleb*	Traded medicinal plants	0.4
31	*Croton oblongifolius roxb*	Traded medicinal plants	0.5
32	*Curcuma aromatica salisb.*	Traded medicinal plants	0.04

33	*Datura metel l.*	Traded medicinal plants	1.2 to 1.8
34	*Dillenia pentagyna roxb.*	Traded medicinal plants	Upto15
35	*Diospyros ebenum koenig*	Traded medicinal plants	20 to 25
36	*Diospyros malabarica (desr.)*	Traded medicinal plants	35
37	*Elettaria cardamomum maton*	Traded medicinal plants	Upto3
38	*Emblica officinalis gaertn.*	Traded medicinal plants	8 to 18
39	*Entada rheedei spreng*	Traded medicinal plants	7-10
40	*Ervatamia coronaria (jacq.) stapf*	Traded medicinal plants	3
41	*Ficus racemosa l.*	Traded medicinal plants	10 m to 16
42	*Ficus religiosasp.*	Traded medicinal plants	Upto30
43	*Garcinia indica (dup.)*	Traded medicinal plants	15 -18
44	*Jasminum angustifolium vahl*	Traded medicinal plants	Upto2
45	*Lantana camara l.*	Traded medicinal plants	Upto2
46	*Leucas aspera (willd.) Spreng.*	Traded medicinal plants	0.15-0.60
47	*Litsea chinensis lam*	Traded medicinal plants	Upto 5
48	*Litsea floribunda (bl.) Gamble*	Traded medicinal plants	Upto 10
49	*Litsea stocksii*	Traded medicinal plants	Upto8
50	*Magnolia champaca l.*	Traded medicinal plants	Upto30
51	*Mallotus philippensis (lam.) Muell.-arg.*	Traded medicinal plants	Upto12
52	*Mangifera indica l.*	Traded medicinal plants	Upto35
53	*Michelia champaca l.*	Traded medicinal plants	Upto30
54	*Mesua nagassarium (burm.f.) kosterm.*	Traded medicinal plants	Upto35
55	*Mimosa pudica*	Traded medicinal plants	0.5
56	*Mimusops elengi l.*	Traded medicinal plants	Upto35
57	*Mucuna pruriens (l.) Dc.*	Traded medicinal plants	4 to 5
58	*Myristica fragrans houtt.*	Traded medicinal plants	30
59	*Pongamia glabra vent.*	Traded medicinal plants	15 m to 25
60	*Pterocarpus marsupium roxb.*	Traded medicinal plants	Upto 40
61	*Rhaphidophora pertusa schott*	Traded medicinal plants	0.5
62	*Schleichera oleosa (lour.) Oken*	Traded medicinal plants	about 7
63	*Sapindus emarginatus vahl.*	Traded medicinal plant	Upto18

64	*Sida rambhifolia*	Traded medicinal plants	0.5 to 1.2
65	*Sida acuta burm.*	Traded medicinal plants	1-1.5
66	*Sida cordifolia l.*	Traded medicinal plants	1-2
67	*Solanum torvum swartz*	Traded medicinal plants	2 to 3
68	*Spondias pinnata (l.f.) kurz.*	Traded medicinal plants	to 25
69	*Stachytarpheta jamaicensis (l)*	Traded medicinal plants	1.-1.6
70	*Sterculia villosa roxb*	Traded medicinal plants	15-18
71	*Syzygium caryophyllatum (l.) Alston*	Traded medicinal plants	Upto6
72	*Syzygium cumini (l.) Skeels*	Traded medicinal plants	Upto20
73	*Tabernaemontana divaricata (l.)*	Traded medicinal plants	1to 15
74	*Terminalia alata heyne ex roth.*	Traded medicinal plants	35
75	*Terminalia bellerica (gaertn.) Roxb.*	Traded medicinal plants	Upto40
76	*Terminalia paniculata roth*	Traded medicinal plants	Upto20
77	*Toddalia asiatica (l.) Lam.*	Traded medicinal plants	10
78	*Triumfetta rhomboidea jacq.*	Traded medicinal plants	2
79	*Vateria indica l.*	Traded medicinal plants	Upto40 -60
80	*Vernonia cinerea less.*	Traded medicinal plants	1.5-2
81	*Vitex negundo l.*	Traded medicinal plants	1.5 to 3
82	*Wendlandia exerta d*	Traded medicinal plants	< 0.2
83	*Wrightia tinctoria r.br.*	Traded medicinal plants	10 to 30
84	*Zizyphus xylopyrus willd.*	Traded medicinal plants	12
85	*Zizyphus oenoplia mil*	Traded medicinal plants	1.5

Table 4.3 IUCN Conservation Status of animal species in SGs of Madikeri Taluk

SL.No.	Scientic Name of Animals species	IUCN conservation status
1	Elephas maximus indicus	NA
2	. Bos gaurus	Vulnerabale
3	Melursus ursinus	
4	Rusa unicolor	
5	Cuon alpinus	Endangered
6	Sus scrofa	Least concern
7	Herpestes javanicus	
8	Ovis ar ies	
9	Lepus nigricollis	
10	Vulpes vulpes	
11	Hystrix indica	
12	Sciurus vulgaris	
13	Muntiacus muntjak	
14	Hyena hyena	
15	Felis silvestris	
16	Macaca fascicularis	

Table 4.4 IUCN Conservation Status of bird species in SGs of Madikeri Taluk

SL.No.	Scientic Name of Bird species	IUCN conservation status
1	*Dicrurus paradiseus*	Least concern
2	*Melanerpes formicivorus*	
3	*Psittaciformes*	
4	*Centropus sinensis*	
5	*Anastomus oscitans*	
6	*Tyto alba*	
7	*Cynopterus sphinx*	
8	*Ocyceros griseus.*	
9	*Athene brama*	
10	*Bubo bubo*	
11	*Nisaetus cirrhatus*	
12	*Cuculus varius*	
13	*Gracula religiosa*	
14	*Gallus sonneratii*	
15	*Corvus culminatus*	
16	*Psittaula kramer*	
17	*Spilopelia senegalensis*	
18	*Terpsiphone paradisi*	
19	*Megalaima viridis*	
20	*Centropus bengalensis*	
21	*Haliastur indus*	
22	*Acridotheres tristis*	
23	*Spilopelia chinensis*	
24	*Pavo cristatus*	
25	*Ducula aenea*	

Table 4.5 IUCN Conservation Status of floral species present in SGs of Somvarapet Taluk

Sl. No	Scientic Name of Floral species	IUCN Conservation status	Growth height
1	*Vateria indica l.*	Critically endangered	Upto 40 - 60 m
2	*Hopea parviflora bedd.*	Endangered	Upto35 m
3	*Syzygium caryophyllatum (l.) Alston*		Upto6 m
4	*Dalbergia latifolia roxb.*	Vulnerable	to 40 m
5	*Mallotus tetracoccus (roxb.) Kurz*		Upto12 m
6	*Pterocarpus marsupium roxb.*		Upto40 m
7	*Cinnamomum macrocarpum hook.*	Vulnerable / global	Upto15 m
8	*Garcinia gummi-gutta (l.) Robs.*		Upto12 m
9	*Artocarpus hirsutus lam.*		Upto35 m
10	*Alstonia scholaris r.br.*	Low risk / least concern	Upto30 m
11	*Sapindus emarginatus vahl.*	Low risk-least concerned / regional	Upto18 m
12	*Mimosa pudica*	Least concern	0.5m
13	*Trichilia connaroides*		10m
14	*Centella asiatica (l.) Urban*		0.2 m
15	*Michelia champaca l.*		Upto30 m
16	*Artocarpus heterophyllus lam.*		Upto20 m
17	*Mangifera indica l.*	Data dificient	35-40 m

Table 4.6 FRLHT conservation status of floral species present in SGs of Somvarapet Taluk

Sl. No	Scientic name of floral species	FRLHT conservation status	Growth height (mtr)
1	*Acrocarpus fraxinifolius wight & arnolal*	Medicinal plants	30 m to 60
2	*Acrocarpus fraxinifolius wight & arnolal*	Medicinal plants	30 m to 60
3	*Annona reticulata l.*	Medicinal plants	2
4	*Bischofia javanica bl.*	Medicinal plants	Upto30
5	*Buchanania latifolia roxb.*	Medicinal plants	13 m to 18
6	*Calophyllum polyanthum wall. Ex choisy*	Medicinal plants	Upto35
7	*Dalbergia latifolia roxb.*	Medicinal plants	Upto 40
8	*Diospyros montana roxb.*	Medicinal plants	Upto15
9	*Ficus asperrima roxb.*	Medicinal plants	Upto18
10	*Ficus hispida l.f.*	Medicinal plants	Upto10
11	*Ficus infectoria sensu roxb.*	Medicinal plants	10 m to 12
12	*Ficus mysorensis*	Medicinal plants	6 m to 9
13	*Grewia tiliaefolia vahl*	Medicinal plants	Upto20
14	*Haldina cordifolia (roxb.)*	Medicinal plants	12
15	*Holigarna arnottiana hook.f.*	Medicinal plants	Upto35
16	*Lagerstroemia lanceolata wall.*	Medicinal plants	About 45
17	*Macaranga indica w.*	Medicinal plants	16
18	*Mallotus tetracoccus (roxb.) Kurz*	Medicinal plants	Upto12
19	*Phyllanthus distichus (l.)*	Medicinal plants	3
20	*Plumeria acuminata r.br.*	Medicinal plants	7 to 8
21	*Radermachera xylocarpa (roxb.) Schum.*	Medicinal plants	5 m to 20
22	*Randia spinosa poir.*	Medicinal plants	Upto9
23	*schefflera venulosa (wight)*	Medicinal plants	Upto6
24	*Solanum erianthum d.don*	Medicinal plants	4.9
25	*Sterculia guttata roxb.*	Medicinal plants	20
26	*Trema orientalis bl.*	Medicinal plants	Upto18
27	*Urena lobata l.*	Medicinal plants	1 to 1.5
1	*Acacia concinna (willd.)*	Traded medicinal plants	5
2	*Artocarpus communis j. & g. Forst.*	Traded medicinal plants	Upto26
3	*Artocarpus integrifolia l*	Traded medicinal plants	8 to 15
4	*Artocarpus integrifolia l*	Traded medicinal plants	Upto15
5	*Cedrela toona roxb.*	Traded medicinal plants	Upto60
6	*Dalbergia latifolia roxb.*	Traded medicinal plants	20-40
7	*Acacia sinuata (lour.) Merr.*	Traded medicinal plants	12 m to 15
8	*Acacia caesia (l.) Willd.*	Traded medicinal plants	Upto10
9	*Aegle marmelos*	Traded medicinal plants	Upto18

10	*Albizia lebbeck (l.) Benth.*	Traded medicinal plants	18 m to 30
11	*Alstonia scholaris r.br.*	Traded medicinal plants	Upto30
12	*Anacardium occidentale l.*	Traded medicinal plants	10 m to 12
13	*Anogeissus latifolia wall. Ex. Guill. & perr.*	Traded medicinal plants	20
14	*Artocarpus heterophyllus lam.*	Traded medicinal plants	Upto20
15	*Asparagus racemosus willd.*	Traded medicinal plants	1 m to 2
16	*Bambusa arundinacea willd.*	Traded medicinal plants	> 30
17	*Bauhinia malabarica roxb.*	Traded medicinal plants	Upto25
18	*Bombax malabaricum dc.*	Traded medicinal plants	12
19	*Borassus flabellifer l.*	Traded medicinal plants	30
20	*Boswellia serrata roxb.*	Traded medicinal plants	About 5
21	*Calamus rotang l.*	Traded medicinal plants	10-15
22	*Callicarpa tomentosa (l.) Murr.*	Traded medicinal plants	5m
23	*Calophyllum apetalum willd*	Traded medicinal plants	Upto30
24	*Cardiospermum halicacabum l.*	Traded medicinal plants	3
25	*Cassia fistula l.*	Traded medicinal plants	10 m to 20
26	*Catunaregum spinosa (thunb.) Tirvengadum*	Traded medicinal plants	Upto5
27	*Cedrela toona roxb.*	Traded medicinal plants	Around 60
28	*Centella asiatica (l.) Urban*	Traded medicinal plants	0.2
29	*Cinnamomum macrocarpum hook.*	Traded medicinal plants	Upto15
30	*Cinnamomum verum pres*	Traded medicinal plants	16
31	*Coscinium fenestratum (gaertn.) Coleb.*	Traded medicinal plants	2
32	*Curcuma aromatica salisb.*	Traded medicinal plants	0.40
33	*Cyclea peltata (lam.*	Traded medicinal plants	2-8
34	*Dillenia pentagyna roxb.*	Traded medicinal plants	Upto15
35	*Emblica officinalis gaertn.*	Traded medicinal plants	8 m to 18
36	*Ficus racemosa l.*	Traded medicinal plants	10 m to 16
37	*Ficus religiosa l.*	Traded medicinal plants	Upto30
38	*Ficus tsiela roxb.*	Traded medicinal plants	Upto 20
39	*Garcinia indica (dup.)*	Traded medicinal plants	15 -18
40	*Garuga pinnata roxb.*	Traded medicinal plants	About 15
41	*Garuga pinnata roxb.*	Traded medicinal plants	About 15
42	*Gmelina arborea l.*	Traded medicinal plants	Upto30
43	*Hemidesmus indicus (l.) Schult.*	Traded medicinal plants	2
44	*Jasminum angustifolium vahl*	Traded medicinal plants	Upto2
45	*Lagenaria siceraria (molina) standley*	Traded medicinal plants	3-6
46	*Lantana camara l.*	Traded medicinal plants	0.5-2
47	*Leucas aspera*	Traded medicinal plants	0.4

48	*Mangifera indica l.*	Traded medicinal plants	Upto35
49	*Mesua ferrea l.*	Traded medicinal plants	About 30
50	*Michelia champaca l.*	Traded medicinal plants	Upto30
51	*Mimosa pudica*	Traded medicinal plants	0.5
52	*Mucuna pruriens (l.) Dc.*	Traded medicinal plants	4 m to 5
53	*Olea dioica roxb. - oleaceae*	Traded medicinal plants	15
54	*Pongamia glabra vent.*	Traded medicinal plants	15 to 25
55	*Pterocarpus marsupium roxb.*	Traded medicinal plants	Upto40
56	*Rubia cordifolia l.*	Traded medicinal plants	1.5
57	*Santalum album l.*	Traded medicinal plants	4 to 9
58	*Sapindus emarginatus vahl.*	Traded medicinal plants	Upto18
59	*Schleichera oleosa (lour.) Oken*	Traded medicinal plants	About 7
60	*Sida acuta burm.*	Traded medicinal plants	1-1.5
61	*Solanum torvum swartz*	Traded medicinal plants	2 m to 3
62	*Solanum xanthocarpum schrad & wendl*	Traded medicinal plants	1.2
63	*Spondias pinnata (l.f.) kurz.*	Traded medicinal plants	To 25
64	*Stachytarpheta jamaicensis (l.*	Traded medicinal plants	1.-1.6
65	*Stereospermum chelonoides (l.f.) dc.*	Traded medicinal plants	50 m to 60
66	*Syzygium caryophyllatum (l.) Alston*	Traded medicinal plants	Upto6
67	*Syzygium cumini (l.) Skeels*	Traded medicinal plants	Upto20
68	*Terminalia alata heyne ex roth.*	Traded medicinal plants	35
69	*Terminalia bellerica (gaertn.) Roxb.*	Traded medicinal plants	Upto40
70	*Terminalia paniculata roth*	Traded medicinal plants	Upto20
71	*Toddalia asiatica (l.) Lam.*	Traded medicinal plants	10
72	*Tridax procumbens l*	Traded medicinal plants	1.8-6
73	*Vateria indica l.*	Traded medicinal plants	40 -60
74	*Vitex negundo l.*	Traded medicinal plants	1.5 to 3
75	*Wrightia tinctoria r.br.*	Traded medicinal plants	10 to 30
76	*Zizyphus xylopyrus willd.*	Traded medicinal plants	12
77	*Grevillea robusta*	Commercial tree	18 m to 35

Table 4.7 IUCN conservation Status of animal species present in SGs of Somvarpet Taluk

Sl.No	Scientific Name of Animals	IUCN Conservation status
1	*Cuon alpinus*	Endangered
2	*Melursus ursinus*	Vulnerable
3	*Rusa unicolor*	Vulnerable
4	*Sciurus vulgaris*	Least concern
5	*Sus scrofa*	Least concern
6	*Lepus nigricollis*	Least concern
7	*Hystrix indica*	Least concern
8	*Herpestes javanicus*	Least concern
9	*Ratufa indica*	Least concern
10	*Felis silvestris*	Least concern
11	*Ovis ar ies*	Least concern
12	*Vulpes vulpes*	Least concern
13	*Muntiacus muntjak*	Least concern

Table 4.8 IUCN Conservation Status of bird species present in SGs of Virajapet Taluk

Sl.No	Scientific_Name of Birds	IUCN_Status
1	*Gallus sonneratii*	Least concern
2	*Spilopelia chinensis*	Least concern
3	*Cuculus varius*	Least concern
4	*Melanerpes formicivorus*	Least concern
5	*Gracula religiosa*	Least concern
6	*Tyto alba*	Least concern
7	*Psittacula krameri*	Least concern
8	*Pavo cristatus*	Least concern
9	*Spilopelia senegalensis*	Least concern
10	*Dicrurus paradiseus*	Least concern
11	*Ocyceros griseus.*	Least concern
12	*Corvus culminatus*	Least concern
13	*Athene brama*	Least concern
14	*Bubo bubo*	Least concern
15	*Haliastur indus*	Least concern
16	*Centropus sinensis*	Least concern
17	*Cynopterus sphinx*	Least concern
18	*Egretta garzetta*	Least concern

Table 4.9 IUCN conservation status of floral species present in SGs of Virajapet Taluk

Sl. No	Scientic Name of Floral species	IUCN conservation status	Growth Height (mtr)
1	Vateria indica l.	critically endangered	Upto40 -60
2	Dalbergia latifolia roxb.	vulnerable	To 40
3	Pterocarpus marsupium roxb.		Upto40
4	Mallotus tetracoccus (roxb.) Kurz		Upto12
5	Cinnamomum macrocarpum hook.	vulnerable / global	Upto15
6	Garcinia gummi-gutta (l.) Robs.		Upto12
7	Artocarpus hirsutus lam.		Upto35
8	Tabernaemontana heyneana Wall.	low risk-near treatened / global	8
9	Myristica dactyloides gaertn	lower risk/conservation depedendent	20
10	Caryota urens l.	least concern	8-12
11	Michelia champaca l.	least concern	Upto30
12	Artocarpus heterophyllus lam.	least concern	Upto20
13	*Centella asiatica* (L.) Urban	least concern	0.15
14	Mimosa pudica	least concern	0.5
15	Centella asiatica (l.) Urban	least concern	0.2
16	Caryota urens l.	least concern	8-12
17	*Pongamia pinnata* (L.)	least concern	Upto20
18	*Nerium oleander* L.	least concern	2-6
19	*Myristica fragrans* Houtt.	datadeficient	5-13

Table 4.10 FRLHT conservation Status of floral species present in SGs of Virajapet Taluk

Sl.No	Scientic Name of Floral species	FRLHT conservation status	Growth Height (mtr)
1	*Acacia pennata (L.)*	Medicinal Plant	Upto5
2	*Acacia torta (Roxb)*	Medicinal Plant	1.3
3	*Acrocarpus fraxinifolius wight & arnolal*	Medicinal plant	30 to 60
4	*Acrocarpus fraxinifolius Wight*	Medicinal Plant	1.3-3
5	*Ailanthus malabarica DC*	Medicinal Plant	Upto15
6	*Albizia stipulata Boivin*	Medicinal Plant	10-13
7	*Annona squamosa L.*	Medicinal Plant	3-8
8	*Bischofia javanica BL*	Medicinal Plant	Upto20
9	*Buchanania latifolia roxb.*	Medicinal plant	13 to 18
10	*Cassia hirsuta L.*	Medicinal Plant	1-2
11	*Cassia sophera L.*	Medicinal Plant	Upto3
12	*Celtis tetrandra roxb*	Medicinal plant	10-25
13	*Clerodendrum infortunatum*	Medicinal Plant	1-12

14	*Colocasia esculenta (L.)*	Medicinal Plant	1-2
15	*Crotalaria calycina*	Medicinal Plant	Upto0 .75
16	*Dalbergia lanceolaria L.F.*	Medicinal Plant	Upto12
17	*Dalbergia latifolia roxb.*	Medicinal plant	to 40
18	*Datura metel L*	Medicinal Plant	Upto3
19	*Eupatorium odoratum L*	Medicinal Plant	1.5-2.0
20	*Ficus exasperata Vahl*	Medicinal Plant	Upto10
21	*Ficus glomerata Roxb*	Medicinal Plant	10 m to 15
22	*Ficus infectoria sensu roxb.*	Medicinal plant	10 m to 12
23	*Ficus mysorensis*	Medicinal plant	6 m to 9
24	*Grewia tiliaefolia*	Medicinal Plant	Upto20
25	*Haldina cordifolia (roxb.)*	Medicinal plant	12
26	*Holigarna arnottiana hook.f.*	Medicinal plant	Upto35
27	*Hopea parviflora Bedd*	Medicinal Plant	35-40
28	*Kydia calycina Roxb.*	Medicinal Plant	Upto20
29	*Lagerstroemia lanceolata wall.*	Medicinal plant	about 45
30	*Ligustrum perrottetii*	Medicinal Plant	Upto5
31	*Mallotus tetracoccus (roxb.) Kurz*	Medicinal plant	Upto12
32	*Melia dubia Hiern*	Medicinal Plant	Upto20
33	*Myristica dactyloides gaertn*	Medicinal plant	20
34	*Neolitsea zeylancia (Nees)*	Medicinal Plant	Upto20
35	*Persea macrantha (Nees)*	Medicinal Plant	Upto30
36	*Phyllanthus distichus (l.)*	Medicinal plant	3
37	*Plumbago rosea l.*	Medicinal plant	0.5-2
38	*Polyalthia longifolia Benth. & Hook. F.*	Medicinal Plant	10-20
39	*Pongamia pinnata (L.)*	Medicinal Plant	Upto20
40	*Psidium guyava L.*	Medicinal Plant	1-6
41	*Randia dumetorum Lam*	Medicinal Plant	Upto5m
42	*Ricinus communis L*	Medicinal Plant	2-3m
43	*Sapindus laurifolia vahl*	Medicinal plant	Upto30
44	*Sapindus trifoliatus L*	Medicinal Plant	Upto25
45	*Schefflera venulosa*	Medicinal Plant	Upto2
46	*Scoparia dulcis L.*	Medicinal Plant	Upto2
47	*Smilax wightii L*	Medicinal Plant	NA
48	*Spathodea campanulata P*	Medicinal Plant	Upto21
49	*Sterculia villosa Roxb.*	Medicinal Plant	Upto20
50	*Stereospermum tetragonum DC*	Medicinal Plant	15-20
51	*Swietenia mahagoni (L.)*	Medicinal Plant	Upto30
52	*Tamarindus indica L.*	Medicinal Plant	12-18

53	*Tectona grandis L.F*	Medicinal Plant	35-40
54	*Trema orientalis BL*	Medicinal Plant	Upto10
55	*Vitex altissima L.F*	Medicinal Plant	Upto 15
1	*Acacia sinuata (lour.) Merr.*	Traded medicinal plant	12 m to 15
2	*Bombax malabaricum dc.*	Traded medicinal plant	12
3	*Acacia concinna (willd.)*	Traded medicinal plant	5
4	*Litsea stocksii*	Traded medicinal plant	Upto8
5	*Sida cordifolia l.*	Traded medicinal plant	1-2
6	*Acacia sinuata (lour.) Merr.*	Traded medicinal plant	12 m to 15
7	*Achyranthes aspera L.*	Traded Medicinal Plant	Upto0.9
8	*Adhatoda vasica Nees*	Traded Medicinal Plant	Upto3
9	*Aegle marmelos*	Traded medicinal plant	Upto18
10	*Albizia odoratissima*	Traded Medicinal Plant	15 -25
11	*Argyreia nervosa (Burm.f.)*	Traded Medicinal Plant	1
12	*Aristolochia tagala Cham*	Traded Medicinal Plant	20
13	*Artocarpus heterophyllus lam.*	Traded medicinal plant	Upto20
14	*Asparagus racemosus willd.*	Traded medicinal plant	1-2
15	*Azadirachta indica A. Juss.*	Traded Medicinal Plant	Upto15
16	*Bambusa arundinacea willd.*	Traded medicinal plant	> 30
17	*Bombax malabaricum dc.*	Traded medicinal plant	over 12
18	*Bombax ceiba L.*	Traded Medicinal Plant	3 -5
19	*Butea monosperma (Lam.)*	Traded Medicinal Plant	15
20	*Caesalpinia pulcherrima*	Traded medicinal plant	8-10
21	*Careya arborea Roxb.*	Traded Medicinal Plant	5 -15
22	*Caryota urens l.*	Traded medicinal plant	8-12
23	*Cassia fistula l.*	Traded medicinal plant	10 m to 20
24	*Cassia tora l.*	Traded medicinal plant	0.03-0.9
25	*Cedrela toona roxb.*	Traded medicinal plant	Around 60
26	*Centella asiatica (l.) Urban*	Traded medicinal plant	0.2
27	*Cinnamomum malabathrum Batka*	Traded Medicinal Plant	Upto8
28	*Cinnamomum verum Presl*	Traded Medicinal Plant	10-15
29	*Clematis gauriana Roxb*	Traded Medicinal Plant	2-4
30	*Coriandrum sativum L.*	Traded Medicinal Plant	0.15to.40
31	*Curcuma aromatica salisb.*	Traded medicinal plant	0.4
32	*Cyclea peltata (LAM).*	Traded Medicinal Plant	2-8
33	*Dalbergia sissoo Roxb.*	Traded Medicinal Plant	Upto12
34	*Dillenia pentagyna roxb.*	Traded medicinal plant	30
35	*Dillenia pentagyna Roxb.*	Traded Medicinal Plant	Upto 30
36	*Diospyros melanoxylon Roxb*	Traded Medicinal Plant	Upto25

37	*Emblica officinalis gaertn.*	Traded medicinal plant	8 m to 18
38	*Euphorbia hirta L.*	Traded Medicinal Plant	Upto0.40
39	*Ficus religiosa l.*	Traded medicinal plant	Upto30
40	*Ficus tsiela roxb.*	Traded medicinal plant	to 20
41	*Ficus bengalensis L.*	Traded Medicinal Plant	Upto200
42	*Garcinia indica (dup.)*	Traded medicinal plant	15 -18
43	*Garuga pinnata roxb.*	Traded medicinal plant	about 15
44	*Hemidesmus indicus (L.) Schult.*	Traded Medicinal Plant	0.2
45	*Hibiscus rosa-sinensis L.*	Traded Medicinal Plant	3-4
46	*Ipomoea obscura Ker.-Gawl.*	Traded Medicinal Plant	Upto3
47	*Lannea coromandelica (Houtt.)*	Traded Medicinal Plant	Upto14
48	*Lantana camara l.*	Traded medicinal plant	Upto2
49	*Leucas aspera (willd.) Spreng.*	Traded medicinal plant	0.4
50	*Litsea floribunda (bl.) Gamble*	Traded medicinal plant	.15-0.60
51	*Mallotus philippensis (lam.) Muell.-arg.*	Traded medicinal plant	25
52	*Mangifera indica l.*	Traded medicinal plant	Upto35
53	*Mangifera indica l.*	Traded medicinal plant	35-40
54	*Melia dubia Hiern*	Traded Medicinal Plant	13-20
55	*Michelia champaca l.*	Traded medicinal plant	Upto30
56	*Mimosa pudica*	Traded medicinal plant	0.5
57	*Myristica fragrans Houtt.*	Traded Medicinal Plant	5-13
58	*Nerium indicum Mille*	Traded Medicinal Plant	2-6
59	*Nerium oleander L.*	Traded Medicinal Plant	2-6
60	*Ocimum basilicum L.*	Traded Medicinal Plant	0.30-0.150
61	*Olea dioica roxb. - oleaceae*	Traded medicinal plant	15
62	*Olea dioica Roxb.*	Traded Medicinal Plant	Upto15m
63	*Passiflora foetida L.*	Traded Medicinal Plant	5-6m
64	*Piper nigrum L.*	Traded Medicinal Plant	Upto10m
65	*Plumbago indica L.*	Traded Medicinal Plant	2-3m
66	*Plumbago zeylanica L.*	Traded Medicinal Plant	0.5-2m
67	*Pterocarpus marsupium roxb.*	Traded medicinal plant	Upto40
68	*Santalum album l.*	Traded medicinal plant	4 m to 9
69	*Shorea robusta Gaertn. f.*	Traded Medicinal Plant	Upto20
70	*Sida acuta burm.*	Traded medicinal plant	1-1.5
71	*Sida rhombifolia L.*	Traded Medicinal Plant	Upto1
72	*Solanum torvum swartz*	Traded medicinal plant	2 m to 3
73	*Solanum xanthocarpum schrad & wendl*	Traded medicinal plant	1.2
74	*Spilanthes acmella Murr.*	Traded Medicinal Plant	0.15-0.30
75	*Spilanthes paniculata Wall. ex DC*	Traded Medicinal Plant	0.15 to 0.30

76	*Spondias pinnata (l.f.) kurz.*	Traded medicinal plant	to 25
77	*Stachytarpheta jamaicensis (l.*	Traded medicinal plant	1.-1.6
78	*Sterculia urens*	Traded Medicinal Plant	Upto20
79	*Sterculia villosa roxb*	Traded medicinal plant	15-18
80	*Symplocos cochinchinensis S.Moore*	Traded Medicinal Plant	10-15
81	*Syzygium cumini (l.) Skeels*	Traded medicinal plant	Upto20
82	*Terminalia bellerica (gaertn.) Roxb.*	Traded medicinal plant	Upto40
83	*Terminalia paniculata roth*	Traded medicinal plant	Upto20
84	*Terminalia tomentosa (Roxb.)*	Traded Medicinal Plant	Upto35
85	*Toddalia asiatica (l.) Lam.*	Traded medicinal plant	10
86	*Toona ciliata Roem.*	Traded Medicinal Plant	10-30
87	*Tridax procumbens L*	Traded Medicinal Plant	1.8-4.6
88	*Tridax procumbens l*	Traded medicinal plant	1.8-6
89	*Vateria indica l.*	Traded medicinal plant	Upto40- 60
90	*Vitex negundo L.*	Traded Medicinal Plant	2-8
91	*Wrightia tinctoria r.br.*	Traded medicinal plant	10 to 30
92	*Zingiber officinalis (Roxb.)*	Traded Medicinal Plant	1-3
93	*Zizyphus xylopyrus willd.*	Traded medicinal plant	12
94	*Zizyphus oenoplia mil*	Traded medicinal plant	1.5

Table 4.11 IUCN conservation Status of animal species present in SGs of Virajapet Taluk

Sl.No	Scientic Name of Animal species	IUCN conservation status
1	*Rusa unicolor*	Vulnerable
2	*Lepus nigricollis*	Least concern
3	*Herpestes javanicus*	Least concern
4	*Sus scrofa*	Least concern
5	*Felis silvestris*	Least concern
6	*Sciurus vulgaris*	Least concern
7	*Hystrix indica*	Least concern
8	*Vulpes vulpes*	Least concern
9	*Muntiacus muntjak*	Least concern
10	*Ovis ar ies*	Least concern
11	*Ratufa indica*	Least concern

Table 4.12 IUCN Conservation Status of bird species present in SGs of Virajapet Taluk

SL.No	Scientic Name of Bird spcies	IUCN conservation status
1	*Cynopterus sphinx*	Least concern
2	*Egretta garzetta*	Least concern
3	*Terpsiphone paradisi*	Least concern
4	*Spilopelia senegalensis*	Least concern
5	*Dicrurus paradiseus*	Least concern
6	*Ocyceros griseus.*	Least concern
7	*Gallus sonneratii*	Least concern
8	*Corvus culminatus*	Least concern
9	*Ocyceros griseus.*	Least concern
10	*Athene brama*	Least concern
11	*Centropus sinensis*	Least concern
12	*Cuculus varius*	Least concern
13	*Anastomus oscitans*	Least concern
14	*Bubo bubo*	Least concern
15	*Haliastur indus*	Least concern
16	*Melanerpes formicivorus*	Least concern
17	*Gracula religiosa*	Least concern
18	*Tyto alba*	Least concern
19	*Psittacula krameri*	Least concern

Table 4.13 Non Spatial data about SGs of Madikeri Taluk

Sl No	SG ID	Water resource	Annual Fest	Time of fest	Cultures	Rituals	Vegetation	LULC Around SG	Road access	Fencing	Survey	SG Committee
1	SG-1	Well	Huthari festival	Nov - Dec	Decorating bullock & bullock fight	Sheep & cock sacrifice	Thick	Coffee plantations	Yes	No	No	Yes
2	SG-2	Well	VarshiKo thsava	End of may	Procession of god's idol & bullock fight	Sheep & cock sacrifice	Thick	Coffee plantations	Yes	No	Yes	Yes

3	SG-3	No	Varshiko Thsava	May	Worshipping of god	Cock sacrifice	Very thick	Agricultural lands	No	No	No	No
4	SG-4	A small stream	Bhadrakali uthsava	End of April	Bhoothakola	Cock & pig sacrifice	Very thick	Coffee plantations & banana plantations	Yes, but mud road	No	No	Yes
5	SG-5	No	No	No	No	No	Very thick	Coffee plantations	Yes, but mud road	No	No	No
6	SG-6	Well	Bhadra Kali uthsava	Feb - March	Worshipping & procession of god	Sheep & cock sacrifice	Very thick	Agricultural lands	No	No	No	Yes
7	SG-7	A small stream	Appandriyappa uthsava	April	Kodava nruthya	Cock sacrifice	Very thick	Agri cultural lands & coffee plantations	Yes	Yes	Yes	Yes
8	SG-8	Pond	Made madurappa varshika uthsava	April	Bullock race	No	Very thick	Agri cultural lands & coffee plantations	No	No	No	Yes
9	SG-9	No	Kshethrapala devara habba	April	Bhoothakolu	Sheep, cock sacrifice	Very thick	Agricultural lands & coffee plantations	Yes	No	No	Yes
10	SG-10	No	Uduvathu aiyyappa devara	April	Worshipping of aiyyappa	Sheep sacrifice	Very thick	Coffee plantations	Yes	No	No	yes
11	SG-11	Well	Edavattu	Feb – Mar	Worshipping & procession of god	Sheep & cock sacrifice	Very thick	Coffee plantations & Agricultural lands	yes	No	yes	yes
12	SG-12	A small stream	Huthari festival	Dec	Kolata mandhu	No	Thick	Agricultural lands & coffee plantations	Yes	No	No	No
13	SG-15	Pai suni	Aiyyapa swami jatre, sankramana pooje	Mar 14-15	Worshipping of aiyyappa god	Cock sacrifice	Very thick	Coffee plantations & built-up area	Yes	Yes	Yes	Yes
14	SG-16	Yes	Bhadrakali festival	April	Worshipping of bhadrakali	Sheep sacrifice	Thick	Agricultural land	Yes	No	Yes	Yes

15	SG-17	No	Aiyyapa swami ,kari choundi fest	Feb-20-25	Worshipping of aiyyappa god	Cock & pig sacrifice	Very thick	Human settlement	Yes	Yes	Yes	Yes
16	SG-18	Pond	Pooda fest	May	No	No	Thick	Coffee plantations & built-up area	Yes	No	No	Yes
17	SG-19	A small stream	Aiyyapa swami jatre,	Sept	Worshipping of aiyyappa god	Cock sacrifice	Very thick	Agricultural land	Yes	No	No	Yes
18	SG-20	Pond	Bhadrakali festival	Jan	Worshipping of snake	No	Very thick	Coffee plantations & built-up area	Yes	No	No	Yes
19	SG-21	small stream	Aiyyappa fest	Dec	Pooja of Aiyyappa	No	Thick	Coffee plantations	Yes	No	No	Yes
20	SG-22	Well	No	Nov-dec	No	No	Sparse	Coffee plantations & built-up area	Yes	No	No	Yes
21	SG-23	No	Aiyyappa fest	Dec	Worshipping of Aiyyappa god	No	Thin	Coffee plantations	Yes	No	No	Yes
22	SG-24	Well & a small stream	Aiyyappa fest	Jan	Worshipping of Aiyyappa	pig sacrifice	Thin	Coffee plantations	Yes	No	No	Yes
23	SG-25	Well	Varshikotsava	April	Worshipping of Bhagavathi	No	Sparse	Coffee and cardomom plantation	No	No	No	Yes
24	SG-26	Well	Varshikotsava	May	Worshipping of Bhagavathi	No	Sparse	Coffee plantations	No	No	No	Yes
25	SG-25	Kaveri stream	Talakaveri fest	Oct	Chjoundi kola	Cock sacrifice	Thick	Coffee plantations	No	No	No	Yes
26	SG-26	No	No	No	No	No	Sparse	Coffee plantations	No	No	No	Yes

Table 4.14 Non-spatial data regarding SGs of Somvarapet Taluk

Sl No	SG Id	Water re source	Annual Fest	Time Of Fest	Cultures	Rituals	Vege tation	LULC around SG	Ro ad acc ess	Fen cing	Sur vey	SG Co m m itte
1	SG-1	No	Kudre Habba	Dece mber	Worshipping of Aiyyappa	Cock sacrifice	Thick	Coffee plantations	Yes	No	No	Yes
2	SG-2	Pond	Varshi Kotsava	April-May	Worshipping of Aiyyappa	No	Sparse	Human settlement	No	No	No	No
3	SG-3	Pond	Varshi Kotsava	Mar	Jagarane	No	Very thick	Coffee plantations	Yes	Yes	yes	Yes
4	SG-4	No	Varshi Kotsava	Mar	Jagarane & folk dance	No	Thin	Coffee plantations	Yes	Yes	yes	Yes
5	SG-5	Stream	Aiyyap pa Fest	Mar	Worshipping of Aiyyappa	No	Thick	Coffee plantations & agricul tural land	Yes	Yes	Yes	Yes
6	SG-6	No	Aiyyap pa Fest	April-May	Worshipping of Aiyyappa	Cock sacrifice	Thick	Coffee plantations , Human settlement & Agricultural Land	Yes	Yes	Yes	Yes
7	SG-7	No	Aiyyap pa Fest	April-May	Worshipping of Aiyyappa	Cock sacrifice	Thin	Coffee plantations , Human settlement & Agricultural Land	yes	No	No	Yes
8	SG-8	No	Aiyyap pa Fest	Mar	Worshipping of Aiyyappa	Cock sacrifice	Thin	Coffee plantations	No	No	No	Yes
9	SG-9	No	Aiyyap pa Fest	April-May	Worshipping of Aiyyappa	Cock sacrifice	Thin	Coffee plantations , Human settlement & Agricultural Land	yes	No	No	Yes
10	SG-10	No	Maha lakshmi Devara pooje	25-Mar	Worshipping of Mahalaks hmi	No	Sprase	Coffee plantation	No	No	No	Yes
11	SG-11	No	Chamun di fest	Marc h -last week	Worshipping of chamundi	No	Thick	Coffee plantation	yes	No	No	Yes

12	SG-12	No	No	No	No	No	Thin	Coffee plantation, road	Yes	No	No	No
13	SG-13	No	Aiyyappa Fest	April-May	Worshipping of aiyyappa	No	Thin	Coffee plantations , & agricultural land	Yes	No	No	Yes
14	SG-14	Well	Mahashivaratri	Feb	Beedu habba	Cock sacrifice	Thick	Coffee plantations , & agricultural land	Yes	Yes	Yes	Yes
15	SG-15	Well	Ugadi Fest	March	Daily worship	No	Thin	Coffee plantations	Yes	Yes	Yes	Yes
16	SG-16	Stream	Aiyyappa Fest	April-May	No	No	Thin	Coffee plantations	Yes	Yes	No	Yes
17	SG-17	No	No	No	No	No	Sparse	Coffee plantations & human settlement	Yes	Yes	Yes	No
18	SG-18	No	Kutta Jatre	April	Procession of god's idol on elephant	Cock & sheeep sacrifice	Thin	Coffee plantations & human settlement	Yes	yes	Yes	Yes
19	SG-19	Well	Aiyyappa Fest	April-May	No	No	Sparse	School, Residence and Coffe estate	Yes	No	yes	Yes
20	SG-20	Well	Devara utsava	March	No	No	Sparse	Coffee plantations & agricultural land	Yes	Yes	Yes	No
21	SG-21	No	Chamundi habba	May	Harake	Cock & pig sacrifice	Sparse	Coffee plantations	Yes	Yes	Yes	No
22	SG-22	No	Aiyyappa Fest	Mar	No	No	Thin	Coffee plantations & agricultural land	Yes	No	No	Yes
23	SG-23		Kutti chatta Fest	May	No	Cock & pig sacrifice	Very thick	Coffee plantations & agricultural land	Yes	No	No	Yes
24	SG-24	Pond	Varshiko Tsava	Mar	No	Cock sacrifice	Sparse	Agricultutal Land and Residence	Yes	No	No	Yes
25	SG-25	Theerha Kola	Varshiko Tsava	Feb-Mar	No	Cock sacrifice	Thin	Agricultutal Land and Residence	Yes	Yes	Yes	No
26	SG-26	well	Vanabhadrakali utsava	April-May	No	Cock sacrifice	Thick	Agricultutal Land and Roa	Yes	No	No	Yes

27	SG-27	No	Aiyyappa Fest	Feb-Mar	No	No	Thick	Coffee plantations & agricultural land	No	No	No	Yes
28	SG-28	No	Mahadevara pooje	Feb-Mar	Cock sacrifice		Thin	Agricultutal Land and Residence	Yes	Yes	Yes	No
29	SG-29	No	Kudre Habba	Dec	Worshipping of Aiyyappa	Cock sacrifice	Thick	Coffee plantations	yes No	No	Yes	Yes

Table 4.15 Non-spatial data regarding SGs of Virajapet Taluk

Sl No	SG Id	Water re Source	Annual Fest	Time Of Fest	Cultures	Rituals	Vege tation	Lu Around SG	Road acces s	Fen cing	Surv ey	SG Co mm itte
1	SG-1	No	No	No	No	No	Spars e	Coffee plantations & built-up area	Yes	No	No	No
2	SG-2	Lake	No	No	No	No	Thick	Coffee plantations	Yes, but mud road	No	No	No
3	SG-3	No	Varshikothsava	April	Worshipping of Aiyyappa god	No	Thin	Coffee plantations	Yes	No	No	Yes
4	SG-4	No	Varshikothsava	April	No	No	Thick	Coffee plantations	Yes	No	No	Yes
5	SG-5	No	Varshikothsava	Dec	Worshipping of Aiyyappa god	No	Very thick	Coffee plantations	No	No	No	Yes
6	SG-6	No	No	No	No	No	Very thick	Coffee plantations	Yes	No	No	Yes
7	SG-7	Water tank	Bhadrakali varshikothsava	Mid of april	Worshipping of god & kolata	Sheep & cock sacrifice	Very thick	Coffee plantations	Yes	Yes	Yes	Yes
8	SG-8	Well & a natural spring	Bhadrakali uthsava	April	Decorating bullock, bullock fight, kombata	Sheep & cock sacrifice	Very thick	Coffee plantations	Yes	No	Yes	Yes

9	SG-9	No	No	No	No	No	Thick	Agricultural lands & coffee plantations	Yes	No	Yes	Yes
10	SG-10	Well	Varshikothsava	April	Worshipping of god	No	Very thick	Agricultural lands	Yes	No	Yes	Yes
11	SG-11	No	No	No	No	No	Thick	Coffee plantations	Yes	No	No	Yes
12	SG-12	No	Varshika maha pooje	March	Kodava nruthya & bullock fight	Cock & pig sacrifice	Very thick	Agricultural lands & coffee plantations	Yes	No	No	Yes
13	SG-13	No	Oora habba	May	Worshipping of god	No	Very thick	Coffee plantations	Yes	No	No	Yes
14	SG-14	No	Varshika bhoothadevara habba	May	Worshipping of god	Cock sacrifice	Very thick	Coffee plantations & built-up area	Yes	No	Yes	Yes
15	SG-15	No	No	No	No	No	Sparse	Resort	Yes	No	No	No
16	SG-16	Kaveri stream	Satyanarayana utsava	21-mar	Folk dance and utsava	No	Sparse	Coffee plantations & built-up area	Yes	No	No	Yes
17	SG-17	Kaveri stream	Satyanarayana utsava	22-mar	Folk dance and utsava	No	Sparse	Coffee plantations	Yes	No	No	Yes
18	SG-18	No	Mariyamma fest	Sept	Worshipping of Mariyamma	Cock & pig sacrifice	No	Coffee plantations	Yes	No	No	Yes
19	SG-19	No	Mariyamma fest	Oct.	Worshipping of Mariyamma	Cock & pig sacrifice	No	Coffee plantations	Yes	No	No	Yes
20	SG-20	No	Varshikotsava	Dec.	Worshipping of aiyyappa	No	Sparse	Coffee plantations	Yes	No	No	Yes
21	SG-21	No	Varshikotsava	March	Suggi devara fest	No	Thick	Coffee plantations	Yes	No	No	No
22	SG-22	No	Varshikotsava	April	Suggi devara fest	No	Thick	Coffee plantations	No	No	No	No
23	SG-23	Pond	Varshikotsava	April-May	Suggi devara fest	No	Thick	Coffee plantations	Yes	No	No	Yes
24	SG-24	Pond	Varshikotsava	April-May	Suggi devara fest	No	Thick	Coffee plantations	Yes	Yes	Yes	Yes
25	SG-25	Pond	Varshikotsava	April	Beera fest	Cock sacrifice	Very thick	Coffee plantations	No	No	No	Yes
26	SG-26	Malagaddekolli/str	Varshikotsava	Nov-Aug	Worshipping of brahma	Cock & pig sacrifice	Very thick	Coffee plantations	Yes	No	No	Yes

27	SG-27	Malagadde kolli or stream	Varshikotsava	Nov-Aug	Worshipping of brahma devarru	Cock & pig sacrifice	Very thick	Coffee plantations	Yes	No	No	Yes
28	SG-28	Small stream	Varshikotsava	Jan-March-April	Worshipping of gajalakshmi & brahma devaru	No	Thick	Coffee plantations	Yes	No	No	Yes
29	SG-29	No	Varshikotsava	April	Worshipping of chappeshwara	No	Thick	Coffee plantations	Yes	No	No	Yes
30	SG-30	No	Varshikotsava	Nov-August	Worshipping of brahma devaru	Cock & pig sacrifice	Thick	Coffee plantations	Yes	No	No	Yes

ALLABMT

SG_ID	SPECIE_TYPE	LOCAL_NAMES	ENVIS_INDIA	IUCNST
SG1	ANIMAL	GULLE NARI	NA	LEAST CONCERN
SG1	ANIMAL	MULLU HANDHI	NA	LEAST CONCERN
SG1	ANIMAL	KEMPU ALILU	NA	LEAST CONCERN
SG1	ANIMAL	KADAVE	NA	VULNERABLE
SG1	ANIMAL	KADUEMME	NA	VULNERABLE
SG1	ANIMAL	JINKE	NA	LEAST CONCERN
SG1	ANIMAL	MUNGUSI	NA	LEAST CONCERN
SG1	ANIMAL	KATTE KIRUBA	NA	VULNERABLE
SG1	ANIMAL	KADU KARADI	NA	VULNERABLE
SG1	ANIMAL	KADU NAAYI	NA	ENDANGERED
SG1	ANIMAL	AANE	NA	NA
SG1	ANIMAL	KADU MOLA	NA	LEAST CONCERN
SG1	ANIMAL	KADU KURI	NA	LEAST CONCERN
SG1	ANIMAL	KADU HANDHI	NA	NA
SG1	ANIMAL	KADU BEKKU	NA	LEAST CONCERN
SG1	BIRD	GIDUGA	DOES NOT APPLY	LEAST CONCERN
SG1	BIRD	KOGILE	DOES NOT APPLY	LEAST CONCERN

Figure 4.1 represents report generated from SG Geodatabase

OBJEC	SL_	SG_ID	TALUK	VILLAGE	SG	LATTITUDE	LONGITUDE	SPECIE_T	LOCAL_NAMES	COMMON	SCIENTIFIC_NAMES	ENVIS_INDIA	IUCNST	GROWTH_HEIGHT
566	59	SG1	MADIKERI	AREKAL	AREKAL AYYAPPA	12.514056	75.592944	TREE	BANASAMPIGE	NA	MICHELIA NILAGIRICA	NA	NA	40-45m
567	60	SG1	MADIKERI	AREKAL	AREKAL AYYAPPA	12.514056	75.592944	TREE	HANDI BETTHA	NA	CALAMUS THWAITESII BECC	NA	NA	<1m
568	61	SG1	MADIKERI	AREKAL	AREKAL AYYAPPA	12.514056	75.592944	TREE	ENNE MARA	NA	HYMENODICTYON ORIXENSE (R	NA	NA	20m
569	62	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	MAAVU	NA	MANGIFERA INDICA L	TRADED MEDICINAL	DATA DIFICIENT	up to 35 m
570	63	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	NELLI	NA	EMBLICA OFFICINALIS GAERTN.	TRADED MEDICINAL	NA	8 m to 18 m
571	64	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	KADU KANAGILE	NA	DILLENIA PENTAGYNA ROXB.	TRADED MEDICINAL	NA	UPTO 15m
572	65	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	DHOOPA	NA	VATERIA INDICA L	LOW RISK-NEAR TR	CRITICALLY EN	up to 40 m sometimes go
573	66	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	SEEGE	NA	ACACIA SINUATA	TRADED MEDICINAL	NA	5m
574	67	SG9	MADIKERI	ARUVATHOKLU	AYYAPPA DEVARAKADU	12.349694	75.664139	TREE	NA	NA	LITSEA STOCKSII	TRADED MEDICINA	NA	upto 8M
575	68	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	MAAVU	NA	MANGIFERA INDICA L	TRADED MEDICINAL	DATA DIFICIENT	up to 35 m
576	69	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	PUNAR PULI	KOKUM	GARCINIA INDICA (DUP.)	TRADED MEDICINAL	NA	15 -18m
577	70	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	KAKKE	GOLDEN R	CASSIA FISTULA L	TRADED MEDICINAL	NA	10 m to 20 m
578	71	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	SEEGE BALU	NA	ACACIA SINUATA	TRADED MEDICINAL	NA	4-5M
579	72	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	MALE GERU	NA	DILLENIA PENTAGYNA ROXB.	TRADED MEDICINAL	NA	30M
580	73	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	Thoombale	KADUCHA	LITSEA FLORIBUNDA (BL.) GAM	NA	NA	10M
581	74	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	PANPULI	NA	GARCINIA GUMMI-GUTTA (L.) RO	VULNERABLE / GLO	NA	up to 12 m
582	75	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	MALEKAKKADE	POTATO P	SCOLOPIA CRENATA (WT. & AR	NA	NA	UPTO 18m
583	76	SG10	MADIKERI	ARUVATHOKLU	MEDARA AYYAPPA	12.341889	75.647278	TREE	DEEVI HALASU	NA	ARTOCARPUS COMMUNIS J. & G	TRADED MEDICINAL	NA	UPTO 26m
584	77	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	BYNE	NA	CARYOTA URENS L	TRADED MEDICINAL	LEAST CONCER	8-12M
585	78	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	DHOOPA	NA	VATERIA INDICA L	LOW RISK-NEAR TR	CRITICALLY EN	up to 40 m sometimes go
586	79	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	NA	NA	LITSEA STOCKSII	TRADED MEDICINA	NA	upto 8M
587	80	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	MAAVU	NA	MANGIFERA INDICA L	TRADED MEDICINAL	DATA DIFICIENT	up to 35 m
588	81	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	HALASU	NA	ARTOCARPUS HETEROPHYLLUS	TRADED MEDICINAL	LEAST CONCER	up to 20 m
589	82	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	SEEGE BALU	NA	ACACIA SINUATA	TRADED MEDICINAL	NA	4-5M
590	83	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	DEEVI HALASU	NA	ARTOCARPUS COMMUNIS J. & G	TRADED MEDICINAL	NA	UPTO 26m
591	84	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	GULI MAVU	NA	PERSEA MACRANTHA (NEES)	NA	NA	up to 30 m
592	85	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	GOLI	NA	FICUS MYSORENSIS	MEDICINALPLANTS	NA	6 m to 9 m
593	86	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	HEBBALASU	NA	ARTOCARPUS HIRSUTUS LAM.	VULNERABLE / GLO	NA	UPTO 35m
594	87	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	SEEGE BALU	NA	ACACIA SINUATA	TRADED MEDICINAL	NA	4-5M
595	88	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	JAYIKAYI	NUTMEG	MYRISTICA FRAGRANS HOUTT.	TRADED MEDICINAL	NA	30m
596	89	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	Thoombale	KADUCHA	LITSEA FLORIBUNDA (BL.) GAM	NA	NA	10M
597	90	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	UPPALE MARA	NA	MALLOTUS TETRACOCCUS (RO	NA	VULNERABLE	up to 12 m
598	91	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	KUNKUMA	NA	MALLOTUS PHILIPPENSIS (LAM.)	TRADED MEDICINAL	NA	25m
599	92	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	DALCHINI	CINNAMOM	CINNAMOMUM VERUM PRES	TRADED MEDICINAL	NA	10m
600	93	SG12	MADIKERI	B. BADAGA	DEVARA BANA	12.367306	75.613111	TREE	KAARTIGE	NA	CELTIS TETRANDRA ROXB	MEDICINALPLANTS	NA	10-25m
601	94	SG11	MADIKERI	BADAGA	BHAGAVATI DEVARAKADU	12.342528	75.612694	TREE	BYNE	NA	CARYOTA URENS L	TRADED MEDICINAL	LEAST CONCER	8-12M
602	95	SG11	MADIKERI	BADAGA	BHAGAVATI DEVARAKADU	12.342528	75.612694	TREE	DHOOPA	NA	VATERIA INDICA L	LOW RISK-NEAR TR	CRITICALLY EN	up to 40 m sometimes go
603	96	SG11	MADIKERI	BADAGA	BHAGAVATI DEVARAKADU	12.342528	75.612694	TREE	NA	NA	LITSEA STOCKSII	TRADED MEDICINA	NA	upto 8M

1 (0 out of 865 Selected)

ABMT

Figure 4.2 showing attribute table of SG geodatabase

4.3 BIODIVERSITY ESTIMATION

The methodology described in section 3.5 of chapter 3 has been used for measuring biodiversity, and all the 4 types of species have been considered. In this study more than one diversity index has been used to characterize the diversity of the sampled region. Here both the number of taxa (species) and the number of individuals were considered for analysis.

(i) Biodiversity of Tree

Both species as well as individuals from all the three taluks were considered for estimation. Highest number of individuals were observed in SGs of Virajpet taluk which inturn showed highest dominance (18.68) followed by Madikeri (14.61) and Somavarpet (12.26) per sampled area. In the same way ecologically proven indices show Shannon-Wiener's index (H) is more in Virajapet followed by Madikeri and Somavarpet whereas Simpson's diversity index is the same for Madikeri and Somvarapet taluk and comparatively high for Virajapet taluk. Margalef's index shows that species richness is highest in Madikeri; evenness of species found to be progressive from Madikeri to Virajapet taluk this indicates that distribution of trees in SGs of Madikeri taluk is more even when compared to the other two taluks. Result of the biodiversity estimation for the tree species is shown in Table 4.16.

Table 4.16 Diversity indices for tree species of SG of Kodagu Dist.

Ecological indices	Sampled area		
	Madikeri	Somavarpet	Virajpet
No. of Taxa (species)	98	88	94
No. of Individuals	380	368	542
Dominance	14.61	12.26	18.68
Shannon-Wiener's index (H)	4.18	4.12	4.22
Simpson's diversity index (D)	0.97	0.97	0.98
Margalef's index	16.33	14.73	14.77
Equitability index	0.91	0.92	0.93

(ii) Biodiversity of medicinal plant

Highest number of individuals were observed in SGs of Virajapet taluk which, inturn showed highest dominance (8.68) followed by Madikeri (5.84) and Somavarpet (3.21) per sampled area. In the same way ecologically proven indices show Shannon-Wiener's index (H), Simpson's diversity index (D) and Margalef's index is more in Virajpet followed by Madikeri and Somavarpet. Evenness of medicinal plant species was found to be more in Madikeri than Somvarapet and Virajapet taluks. Biodiversity estimation for the tree species is as shown in table 4.17

Table 4.17 Diversity indices for medicinal plant species of SG of Kodagu District

Ecological indices	Sampled area		
	Madikeri	Somavarpet	Virajpet
No. of Taxa	42	26	56
No. of Individuals	152	96	252
Dominance	5.84	3.21	8.68
Shannon-Wiener's	3.41	2.95	3.60
Simpson's	0.95	0.93	0.96
Margalef's index	8.16	5.47	9.94
Equitability index	0.91	0.90	0.89

(iii) Biodiversity of animals

Highest number of individuals were observed in SGs of Virajapet taluk which inturn showed highest dominance (5.68) followed by Madikeri (4.88) and Somavarpete (3.81) per sampled area. Whereas ecologically proven indices show Shannon-Wiener's index (H), is high for Madikeri followed by Somavarpete and Virajpet taluk. Simpson's diversity index (D) is the same for Madikeri and Virajpet taluk and less for Somvarapet taluk, Margalef's index is more in Madikeri followed by Somavarpet and Virajapet, evenness in distribution of animals' species was found to be more in Virajapet less in Somvarapet and lesser in SGs of Madikeri taluk. This reveals biodiversity estimation for tree species which is as shown in Table 4.18.

Table 4.18 Diversity indices for animals species of SGs of Kodagu District

Ecological indices	Sampled area		
	Madikeri	Somavarpet	Virajpet
No. of Taxa (species)	16	13	11
No. of Individuals	127	114	165
Dominance	4.88	3.81	5.68
Shannon-Wiener's index (H)	2.35	2.24	2.26
Simpson's diversity index (D)	0.88	0.87	0.88
Margalef's index	3.09	2.53	1.95
Equitability index	0.84	0.87	0.94

(iv) Biodiversity of birds

Highest number of individuals were observed in SGs of Virajapet taluk which inturn showed highest dominance (9.27) followed by Madikeri (6.88) and Somavarpet (6.23) per sampled area. Where as ecologically proven indices show Shannon-Wiener's index (H) and Simpson's diversity index (D) is high for Madikeri followed by Virajapet and Somavarpet taluk. Margalef's index is more in Madikeri followed by Somavarpet and Virajapet evenness in distribution of animal species found to be common in Madikeri and Virajpet less in Somvarapet. This infers, the species richness and abundance can be seen in Madikeri taluk compared to other two taluks, the result of the biodiversity estimation for the tree species is shown in Table 4.19

Table 4.19 Diversity indices for Bird species of SG of Kodagu Dist.

Ecological indices	Sampled area		
	Madikeri	Somavarpet	Virajpet
No. of Taxa (species)	25	18	19
No. of Individuals	179	187	269
Dominance	6.88	6.23	9.27
Shannon-Wiener's index (H)	3.04	2.70	2.79
Simpson's diversity index (D)	0.94	0.92	0.93
Margalef's index	4.62	3.25	3.21
Equitability index	0.94	0.93	0.94

From the Shannon-Wiener's index (H) , Simpson's diversity index (D) and Equitability index it has been found that the species richness as well as species abundance and except

evenness in distribution of medicinal plant, evenness in all other type of species is more in Virajpet when compared to the other two taluks.

This high species richness and abundance is may be because, the SGs of this taluk lies in the dry deciduous, moist deciduous forest types and probably availability of abiotic factors such as sunlight and temperature (personal observation) which influences the diversity which is more in Virajapet taluk due to more openness of forest is more in Virajpet. The openness of forest might have supported more understorey plants then other two taluks. Even the sevierity of disturbance like encroachment and Cattle grazing was found to be less in Virajapet where as it was found to be more in Madikeri and Somavarapet.

The evenness in animals and birds may be due to the known fact that faunal diversity is depends on floral diversity. More evenness can be seen in case of medicinal plants of Madikeri, less in Somvarapet and least in Virajapet taluk, this is may be due to the opness in SG, which supports more understorey (herbs, shrubs and creepers) and these undestorey herbs would have contributed more to the diversity of species rather than evenness of the species when compared to other taluks.

Marglefs index of tree, animals and birds were found to be more in Madikeri because Marglefs index is mainly dependent on number of the speceies which is more in this taluk than in other two taluks and the species of medicinal plants of Virajapet are more in number compared to the other two taluks leading to the highest Marglefs index.

The dominancy of the floral and faunal species of SGs of all the three taluks has been represented by Using "*" (Star mark) and given in Tables 4.20 to 4.3

Species biodiversity may be used to indicate the 'biological health' of a particular habitat.

Low species diversity suggests:

i) Relatively few successful species in the habitat

ii) The environment is quite stressful with relatively few ecological niches and only a few organisms are really well adapted to that environment

iii) Food webs which are relatively simple

iv) Change in the environment would probably have quite serious effects.

High species diversity suggests

i)A greater number of successful species and a more stable ecosystem

ii) More ecological niches are available and the environment is less likely to be hostile

iii) Complex food webs

iv) Environmental change is less likely to be damaging to the ecosystem as a whole

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Table 4.20 Dominancy in SGs of Madikeri Taluk

Sl No.	Local name	Scienticfic name of tree species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Acacia	*Acacia chundra (roxb. Ex rottler) willd.*		*																									1
2	Seege balli	*Acacia sinuata (lour merr)*				*									*														2
3	Seege	*Acacia sinuata*																						*	*	*	*	*	5
4	Maples	*Acer pseudoplatanus*		*																									1
5	Balanji	*Acrocarpus fraxinifolius Wight & Arnolal*								*	*	*																	3
6	Honge	*Actinodaphne hookeri*																*											1
7	Baage	*Albizia lebbeck (l.) Benth.*											*																1
8	Haale	*Alstonia scholaris r.br.*									*		*																2
9	Geru	*Anacardium occidentale l.*	*												*												*		3
10	Ananas	*Ananas comosus (l.) Merr.*										*			*					*									3
11	Nayikutti	*Antidesma bunius wall.*							*																				1
12	Deevi halasu	*artocarpus communis j. & g. Forst.*																							*	*	*		3
13	Halasu	*Artocarpus heterophyllus lam.*			*	*	*	*	*	*	*	*			*	*	*	*	*	*					*	*	*		17
14	Hebbalasu	*Artocarpus hirsutus lam.*	*	*	*		*		*		*	*	*		*		*			*	*					*	*		14
15	Vaatepuli	*Artocarpus lakoocha roxb.*				*						*																	2
16	Gujje	*Artocarpus integrifolia l*																*								*		*	3
17	Bamboo	*Bambusa arundinacea willd.*		*			*																						2
18	Basavana pada	*Bauhinia malabarica roxb*																					*						1
19	Kumbala	*Benincasa hispida (thunb.) Cogn.*								*																			1

20	Neeli	*Bischofia javanica bl.*			*	*		*	*				*		*	*													**7**
21	Buruga	*Bombax malabaricum dc.*									*																		**1**
22	Byne	*Borassus flabellifer l.*	*		*				*		*	*	*	*		*			*							*	*	*		**12**
23	Kulur maavu	*Buchanania latifolia roxb.*								*	*								*											**3**
24	Handi bettha	*Calamus thwaitesii becc*													*															**1**
25	Arathi soppu	*Callicarpa tomentosa (l.) Murr.*															*	*							*	*			*		**5**
26	Siri honne	*Calophyllum polyanthum wall. Ex choisy*									*																				**1**
27	Kari dhoopa	*Canarium strictum roxb*													*																**1**
28	Dhaddaala mara	*Careya arborea Roxb.*									*		*																		**2**
29	Byne	*Caryota urens l.*																							*						**1**
30	Golden rain tree/kakke	*Cassia fistula l.*																								*					**1**
31	Noga	*Cedrela toona roxb.*			*	*	*	*		*																					**5**
32	Kaartige	*Celtis tetrandra roxb*																											*		**1**
33	Karpa chakke	*Cinnamomum macrocarpum hook.*						*	*		*		*	*		*	*					*	*		*	*	*	*	*		**14**
34	Dalchini	*Cinnamomum verum pres*																	*									*			**2**
35	Mara arasina	*Coscinium fenestratum (gaertn.) Coleb*													*																**1**
36	Beete	*Dalbergia latifolia roxb.*				*		*	*				*		*																**5**
37	K. kanagile	*Dillenia pentagyna roxb.*							*		*	*										*		*	*						**6**
38	Baale	*Diospyros ebenum koenig*							*																						**1**
39	Betta nandi	*Diospyros montana roxb.*										*																			**1**
40	Houlitupre	*Diospyros malabarica (desr.)*	*					*	*		*			*	*																**6**
41	Devadharu	*Dysoxylum malabaricum bedd.*																	*												**1**
42	Rudrakshi	*Elaeocarpus ganitrus roxb*													*	*									*						**3**
43	Nelli	*Emblica officinalis gaertn.*																*													**1**

44	Kallathi	*Ficus hispida l.f.*																			*					*		**2**
45	Arali	*Ficus religiosa sp.(ashwath)*							*									*	*	*	*	*		*				**7**
46	Goli	*Ficus mysorensis*				*	*	*	*	*	*				*						*				*	*	*		**11**
47	Panpuli	*Garcinia gummi-gutta (l.) Robs.*	*	*	*	*	*	*	*		*	*					*							*	*			*	**13**
48	Punar puli	*Garcinia indica (dup.)*																						*					**1**
49	Silver oak	*Grevillea robusta*		*			*					*																	**3**
50	Kadu geru	*Holigarna arnottiana hook.f.*			*			*	*	*																	*		**5**
51	Enne mara	*Hymenodictyon orixense (roxb)*														*													**1**
52	Kadu mallige	*Jasminum angustifolium vahl*											*		*														**2**
53	Nandi	*Lagerstroemia lanceolata wall.*				*		*	*			*	*		*						*						*		**8**
54	Thoombale	*Litsea floribunda (bl) Gamble*													*	*		*	*	*	*		*	*	*	*	*		**11**
55	Lakki	*Litsea glutinosa (lour.)Robinson*					*		*		*	*	*	*	*	*					*								**9**
56	Na	*litsea stocksii*																*						*	*	*	*		**5**
57	Bolpale	*Lophopetalum wallichii kurz*													*														**1**
58	Uppalige	*Macaranga peltata*							*						*	*	*				*								**5**
59	Kumkuma	*Mallotus philippensis (lam.) Muell.-arg.*			*												*				*	*				*	*	*	**7**
60	Uppale mara	*Mallotus tetracoccus (roxb.) Kurz*													*			*			*					*	*	*	**6**
61	Maavu	*Mangifera indica l.*		*		*	*	*	*			*			*					*	*	*	*	*	*	*	*		**15**
62	Kenda sampige	*Michelia champaca l.*			*			*			*				*	*													**5**
63	Banasampige	*Michelia nilagirica*													*														**1**
64	Renjala	*Mimusops elengi l.*							*																			*		**2**
65	Dodda jayikayi	*Dodda jayikayi*																*												**1**

66	Kadu jayikayi	*Myristica dactyloides gaertn*												*													**1**
67	Jaikai,jaiphala	*Myristica fragrans houtt.*																						*			**1**
68	Durvasane mara	*Nothapodytes nimmoniana (grah.)*														*											**1**
69	Nidle	*Pavetta indica l.*						*																			**1**
70	Gulimavu	*Persea macrantha (nees)*														*							*	*	*		**4**
71	Pauli	*Phyllanthus distichus (l.)*				*				*	*	*															**4**
72	Chitramoolike	*Plumbago rosea l.*															*										**1**
73	Kadu sampige	*Plumeria acuminata r.br.*						*																			**1**
74	Gowri mara	*Polyalthia fragrans*												*													**1**
75	Korengi	*Pongamia glabra vent.*																	*								**1**
76	Honne	*Pterocarpus marsupium roxb.*												*				*		*					*	*	**5**
77	Kaare kayi	*Randia spinosa poir.*									*	*									*						**3**
78	Antuvala	*Sapindus emarginatus vahl.*	*		*									*					*								**4**
79	Antuvaala	*Sapindus laurifolia vahl*	*		*			*			*		*	*					*								**7**
80	Chaakate	*Schleichera oleosa (lour.) Oken*																				*					**1**
81	Malekakkade	*Scolopia crenata (wt. & arn.) Clos*				*	*	*			*			`	*	*				*	*	*	*	*	*	*	**14**
82	Amte	*Spondias pinnata (l.f.) kurz.*						*	*										*								**3**
83	Kotte kayi	*Sterculia alata*												*													**1**
84	Kuntu nerale	*Syzygium caryophyllatum (l.) Alston*			*				*																		**2**
85	Nerale	*Syzygium cumini (l.) Skeels*			*	*	*	*	*				*		*	*					*					*	**10**
86	Kokkekai	*Tabernaemontana divaricata (l.) Roem. & schult.*		*			*																				**2**

87	Slate mathi	*Terminalia alata heyne ex roth.*							*			*																	**2**
88	Thari	*Terminalia bellerica (gaertn.) Roxb.*	*		*								*		*								*						**5**
89	Hulve	*Terminalia paniculata roth*													*														**1**
90	Kaadu baje	*Trema orientalis bl.*																		*		*		*				*	*	**5**
91	Kora	*Trichilia connaroides*																		*	*		*			*	*		**5**
92	Baralu kaddi mara	*Urena lobata l.*	*			*	*	*	*			*			*					*		*		*		*	*	*	**13**
93	Dhoopa	*Vateria indica l.*													*														**1**
94	Na(vernonia arborea)	*Vernonia arborea*																								*			**1**
95	K.hogesoppu	*Vernonia cinerea less.*					*				*		*		*	*													**5**
96	Paale	*Wrightia tinctoria r.br.*											*		*														**2**
97	Churi mullu	*Zizyphus oenoplia mil*																					*						**1**
98	Chotte mara	*Zizyphus xylopyrus willd.*											*						*										**2**
		Total	**9**	**8**	**14**	**14**	**14**	**15**	**26**	**10**	**19**	**18**	**17**	**5**	**37**	**13**	**10**	**10**	**9**	**12**	**18**	**8**	**14**	**13**	**15**	**19**	**26**	**7**	**380**

Table 4.21 Dominancy of Medicinal plants in SGs of Madikeri Taluk

Sl. No.	Local Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Manda seege	*Acacia concinna (willd.)*															*	*					*		*			*	**5**
2	Genasoo	*Alocasia indica (lour.) Spach*																	*	*	*								**3**
3	Neeru balli	*Aponogeton natans (l.) Engl. & krause*																					*						**1**
4	Aashaadi baeru,shatavari	*Asparagus racemosus willd*					*		*			*		*													*	*	**6**

5	Neer brahmi	*Bacopa monnieri (l.) Pennell*																				*						**1**
6	Beggar's tick	*Bidens pilosa*																						*				**1**
7	Kulur maavu	*Buchanania latifolia roxb.*						*	*																			**2**
8	Gajagadha kudi	*Caesalpinia bonduc (l.) Roxb.*				*		*	*		*				*													**5**
9	Ratnagandhi	*Caesalpinia pulcherrima*																					*					**1**
10	Betthada balli	*Calamus rotang l.*																					*					**1**
11	Chagate	*Cassia tora l.*																			*	*						**2**
12	Ondhelaga	*Centella asiatica (l.) Urban*						*	*	*	*				*	*	*				*	*	*	*	*	*	*		**14**
13	Mandaka balli,	*Cissus pallida (wight & arn.) Planchon*																								*	*	*	**3**
14	Somare	*Croton oblongifolius roxb*													*														**1**
15	Kaadu harasina	*Curcuma aromatica salisb.*																	*					*			*		**3**
16	Ummatha	*Datura metel l.*		*			*			*		*																	**4**
17	Yelakki	*Elettaria cardamomum maton*						*	*						*	*	*				*	*	*	*	*	*	*		**12**
18	Ganapi balli	*Entada rheedei spreng*																						*		*			**2**
19	Nandi batlu	*Ervatamia coronaria (jacq.) Stapf*																								*			**1**
20	Pundi soppu	*Hibiscus sabdariffa l.*								*		*			*														**3**
21	Kaadu genasu	*Ipomoea pandurata*				*	*	*	*	*	*		*		*	*	*			*				*		*	*		**14**
22	Kadu mallige	*Jasminum angustifolium vahl*	*		*																								**2**
23	Kadu rose	*Lantana camara l.*				*		*							*														**3**
24	Male thumbe	*Leonotis nepetaefolia r.br.*						*	*								*	*								*			**5**
25	Beeli tumbe	*Leucas aspera*														*		*	*	*			*			*			**7**
26	Nagasamige	*mesua nagassarium (burm.f.) kosterm.*																			*								**1**
27	Nachike mullu	*Mimosa pudica*											*	*													*	*	**4**

28	Sokh maddu	*Mucuna pruriens (l.) Dc.*		*			*								*	*	*											**5**
29	Kaadu karibevu	*Murraya paniculata (l.) Jack*																							*	*	*	**3**
30	Garuda pathala	*Ophiorrihza mungos l*												*														**1**
31	Kedage	*Pandanus odoratissimus l.f.*																								*	*	**2**
32	Kaadu adike	*Pinanga diksonii (roxb.) Bl.*							*																			**1**
33	Mara kesu	*Remusatia vivipara schott*																					*					**1**
34	Dodda tipali	*Rhaphidophora pertusa schott*												*														**1**
35	Garga	*sida cordifolia l.*																	*				*	*				**3**
36	Kurunthoti	*Sida rambhifolia*			*			*																				**2**
37	Bheemana kaddi	*Sida acuta burm.*												*		*	*							*				**4**
38	Sundekkayi	*Solanum torvum*							*					*	*		*			*	*			*				**7**
39	Kaadu uttanrani	*Stachytarpheta jamaicensis (l.*																	*					*	*	*		**4**
40	Kadu menasu	*Toddalia asiatica (l.) Lam.*						*	*		*	*			*	*		*										**7**
41	Jottotte	*Triumfetta rhomboidea jacq.*													*		*						*					**3**
42	Harake	*Wendlandia exerta d*												*														**1**
		Total	**1**	**2**	**2**	**3**	**4**	**10**	**10**	**4**	**4**	**4**	**1**	**2**	**14**	**8**	**7**	**8**	**2**	**6**	**5**	**5**	**9**	**7**	**10**	**6**	**12**	**6**	**152**

Table 4.22 Dominancy of animals in SGs of Madikeri Taluk

Sl. No.	Local name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Kadu naayi	*cuon alpinus*						*	*		*	*			*														**5**
2	Kadu bekku	*felis silvestris*		*			*			*		*	*		*	*											*	*	**9**
3	Mungusi	*herpestes javanicus*	*	*		*	*	*	*	*	*		*	*	*		*	*		*				*	*			*	**17**
4	Kadu mola	*lepus nigricollis*	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**24**
5	Kadu karadi	*melursus ursinus*										*			*	*													**3**
6	Kaduemme	*. Bos gaurus*													*	*													**2**
7	Aane	*Elephas maximus indicus*													*														**1**
8	Katte kiruba	*Hyaena hyaena*													*														**1**
9	Mullu handhi	*Hystrix indica*						*	*		*	*			*	*										*		*		**8**
10	Manga	*Macacafascicularis*																		*									**1**
11	Jinke	*Muntiacus muntjak*													*														**1**
12	Kadu kuri	*Ovis ar ies*	*		*			*	*	*	*	*	*		*	*	*	*	*	*						*	*		**16**
13	Kadave	*Rusa unicolor*													*														**1**
14	Kempu alilu	*Sciurus vulgaris*						*	*		*	*		*	*	*				*	*	*	*	*	*	*	*	*	**16**
15	Kadu handhi	*Sus scrofa*	*	*	*		*	*	*	*		*	*			*	*	*		*						*	*		**15**
16	Gulle nari	*Vulpes vulpes*		*					*	*		*	*		*												*		**7**
		Total	**4**	**5**	**2**	**1**	**4**	**7**	**8**	**6**	**6**	**9**	**6**	**3**	**14**	**8**	**4**	**4**	**2**	**6**	**2**	**2**	**2**	**3**	**4**	**4**	**7**	**4**	**127**

Table 4.23 Dominancy of birds in SGs of Madikeri Taluk

Sl. No.	Local Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
1	Gora hakki.	*Acridotherestristis*											*		*		*												**3**
2	Kokkare	*AnastomusOscitans*			*					*	*	*					*	*									*		**7**
3	Kanina hakki	*Athene brama*					*			*		*		*	*	*													**6**
4	Komba hakki	*Bubo bubo*					*	*		*		*		*	*														**6**
5	Kage suli	*Centropus bengalensis*								*		*			*														**3**
6	Kembhootha	*Centropus sinensis*		*	*	*	*	*	*		*																		**7**
7	Kage	*Corvus culminatus*								*		*		*	*	*			*			*	*	*	*	*	*	*	**13**
8	Kogile	*Cuculus varius*								*		*			*		*	*									*	*	**7**
9	Bavali	*Cynopterus sphinx*					*			*		*			*	*							*	*	*	*	*	*	**11**
10	Jatakuruli	*Dicrurus paradiseus*	*							*		*			*					*									**5**
11	Nage chore hakki	*Ducula aenea*																					*	*	*				**3**
12	Kadu koli	*Gallus sonneratii*								*		*			*	*	*			*	*		*	*	*	*	*		**12**
13	Myna	*Gracula religiosa*								*		*		*	*		*			*							*		**7**
14	Kootu hakki	*Haliastur indus*								*		*		*	*														**4**
15	Marakutika	*Melanerpesformicivorus*	*				*			*	*	*		*	*	*	*		*	*			*	*	*	*	*	*	**17**
16	Hasiru kutra	*Megalaima viridis*								*		*			*														**3**
17	Giduga	*Nisaetus cirrhatus*							*	*	*	*			*		*												**6**

18	Kaldal hakki	*Ocyceros griseus.*					*			*		*		*	*														**5**
19	Peacock	*Pavo cristatus*															*			*								*		**3**
20	Bore / more hakki	*Psittaula kramer*								*	*	*					*													**4**
21	Parrot	*Psittaciformes*	*	*	*		*			*	*	*			*	*	*	*	*	*		*						*		**15**
22	Kadu parivala	*Spilopeliachinensis*															*			*									*	**3**
23	Chore hakki	*Spilopeliasenegalensis*								*	*	*			*										*	*	*			**7**
24	Bheema raja	*Terpsiphone paradisi*								*		*			*	*														**4**
25	Owl	*Tyto alba*					*	*	*	*		*		*	*	*	*	*	*	*					*	*	*	*	*	*	**18**
		Total	**3**	**2**	**3**	**1**	**8**	**3**	**3**	**20**	**7**	**20**	**1**	**8**	**19**	**9**	**12**	**4**	**4**	**8**	**1**	**2**	**7**	**7**	**7**	**5**	**10**	**6**	**179**

Table 4.24 Dominancy of Tree in SGs of Somvarapet Taluk

Sl No	Local Name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	Deevi halasu	*Artocarpus communis j. & g. Forst.*																												*	**1**
2	Gujje	*Artocarpus integrifolia l*																		*			*							*	**3**
3	Bilibhootahala	*Schefflera venulosa (wight)*																		*											**1**
4	Agaru beete/beete	*Dalbergia latifolia roxb.*																			*										**1**
5	Seege	*Acacia sinuata (lour.) Merr.*				*	*	*	*											*	*		*	*		*	*				**10**
6	Antarike	*Acacia caesia (l.) Willd.*																										*			**1**
7	Balanji	*Acrocarpus fraxinifolius*							*		*	*			*	*					*										**6**

8	Bilwa	*Aegle marmelos*																				*								**1**
9	Baage	*Albizia lebbeck (l.) Benth.*										*	*						*			*								**4**
10	Haale	*Alstonia scholaris r.br.*								*				*									*				*			**4**
11	Geru	*Anacardium occidentale l.*	*		*					*	*								*	*	*	*	*							**9**
12	Dhindlu	*Anogeissus latifolia wall. Ex. Guill. & perr.*		*		*																								**2**
13	Halasu	*Artocarpus heterophyllus lam.*	*	*	*			*		*		*	*	*	*	*	*		*	*	*	*	*	*						**17**
14	Hebbalasu	*Artocarpus hirsutus lam.*					*	*	*			*			*																**5**
15	Basavanapaada	*Bauhinia malabarica roxb.*				*																									**1**
16	Neeli	*Bischofia javanica bl.*									*		*	*														*	*		*	**6**
17	Buruga	*Bombax malabaricum dc.*			*																											**1**
18	Byne	*Borassus flabellifer l.*			*		*	*	*	*	*	*	*	*															*			**11**
19	Chite	*Boswellia serrata roxb.*										*																			*	**2**
20	Kulur maavu	*Buchanania latifolia roxb.*						*	*			*																				**3**
21	Arathi soppu	*Callicarpa tomentosa (l.) Murr.*																		*			*								**2**
22	Siri honne	*Calophyllum polyanthum wall. Ex choisy*										*			*																**2**
23	Bobbi mara	*Calophyllum apetalum willd*																											*			**1**
24	Kari dhoopa	*Canarium strictum roxb*																													*	**1**
25	Kana kaayi	*Cardiospermum halicacabum l.*										*																				**1**
26	Golden rain tree/kakke	*Cassia fistula l.*		*											*																*	**3**

27	Kaari	*Catunaregum spinosa (thunb.) Tirvengadum*		*																										**1**
28	Noga	*Cedrela toona roxb.*					*	*						*	*						*		*								**6**
29	Kaartige	*Celtis tetrandra roxb*																												*	**1**
30	Karpa chakke	*Cinnamomum macrocarpum hook.*			*	*		*	*				*	*	*	*				*	*		*	*	*			*		*	**15**
31	Dalchini	*Cinnamomum verum pres*																		*			*	*	*	*	*				**6**
32	Beete	*Dalbergia latifolia roxb.*	*		*				*						*							*									**5**
33	Kadu kanagile/male geru	*Dillenia pentagyna roxb.*													*															*	**2**
34	Jaglaganti	*Diospyros montana roxb.*		*	*																										**2**
35	Garagatti	*Ficus asperrima roxb.*						*			*		*		*																**4**
36	Kallathi	*Ficus hispida l.f.*										*	*																*	*	**4**
37	Atthi	*Ficus racemosa l.*	*							*			*						*			*	*	*	*	*			*	**10**
38	Arali	*Ficus religiosa l.*			*				*					*		*		*	*			*	*	*	*	*			*	**12**
39	Bili basari	*Ficus tsiela roxb.*				*													*			*	*	*	*	*			*	**8**
40	Basari	*Ficus infectoria sensu roxb.*							*						*														*	**3**
41	Goli	*Ficus mysorensis*		*	*				*		*	*	*			*				*			*	*	*	*	*			*	**14**
42	Panpuli	*Garcinia gummi-gutta (l.) Robs.*							*		*																			*	**3**
43	Punar puli	*Garcinia indica (dup.)*																			*							*			**2**
44	Godda	*Garuga pinnata roxb.*	*		*						*		*	*							*	*									**7**
45	Kuli / shivani	*Gmelina arborea l.*		*																											**1**

46	Silver oak	*Grevillea robusta*	*																											**1**
47	Thadasalu	*Grewia tiliaefolia vahl*		*	*	*																								**3**
48	Harishina thega	*Haldina cordifolia (roxb.)*				*												*												**2**
49	Kadu geru	*Holigarna arnottiana hook.f.*						*							*				*											**3**
50	Thapsi	*Holoptelea integrifolia (roxb.) Planchon*												*																**1**
51	Kiralbhogi	*Hopea parviflora bedd.*					*		*																					**2**
52	Kadu mallige	*Jasminum a ngustifolium vahl*								*			*																	**2**
53	Kaadu sore	*Lagenaria siceraria (molina) standley*																											*	**1**
54	Nandi	*Lagerstroemia lanceolata wall.*	*		*	*	*	*	*		*			*	*	*				*		*			*		*		*	**15**
55	Kadu thumbe	*Leonotis nepetaefolia r.br.*								*																				**1**
56	Thoombale	*Litsea floribunda (bl.) gamble*																		*					*	*	*				**4**
57	Uppalige	*Macaranga indica w.*						*																*	*	*	*			*	**6**
58	Upplige	*Macaranga peltata*																											*	*	**2**
59	Uppale mara	*Mallotus t etracoccus (roxb.) Kurz*																							*	*	*				**3**
60	Maavu	*Mangifera indica l.*							*			*							*	*		*		*	*					*	**8**
61	Irupu	*Mesua ferrea l.*							*																						**1**
62	Sampige	*Michelia champaca l.*			*	*	*	*				*						*		*											**7**
63	Durvasane mara	*Nothapodytes nimmoniana (grah.)*																												*	**1**

64	Vaate bidiru	*Ochlandra ebracteata*											*																	**1**
65	Tadale; kalluthodli	*Olea dioica roxb. - oleaceae*																	*			*	*							**3**
66	Pauli	*Phyllanthus distichus (l.)*													*				*											**2**
67	Deva kanagile	*Plumeria acuminata r.br.*				*						*		*	*	*											*	*			**7**
68	Honge	*Pongamia glabra vent.*			*	*		*	*	*	*																				**6**
69	Honne	*Pterocarpus marsupium roxb.*	*	*	*	*			*		*																				**6**
70	Oodhi	*Radermachera xylocarpa (roxb.) Schum.*	*																												**1**
71	Kare	*Randia spinosa poir.*		*								*																			**2**
72	Goni mara	*Salvadora persica l*																			*										**1**
73	Shrigandha	*Santalum album l.*																												*	**1**
74	Antuvala	*Sapindus emarginatus vahl.*	*		*	*			*		*				*	*			*									*		*	**10**
75	Chaakate	*Schleichera oleosa (lour.) Oken*								*		*			*					*								*			**5**
76	Amte/marahunise	*Spondias pinnata (l.f.) kurz.*		*																									*		**2**
77	Jenu kathala, hulitaradu mara.	*Sterculia guttata roxb.*																				*									**1**
78	Mallalli	*Stereospermum chelonoides (l.f.) dc.*						*	*				*																		**3**
79	Nerale	*Syzygium cumini (l.) Skeels*	*									*	*		*					*		*	*	*	*	*			*	**11**
80	Mathi/slate mathi	*Terminalia alata heyne ex roth.*		*	*	*	*	*	*											*										**7**
81	Thari	*Terminalia bellerica (gaertn.) Roxb.*			*	*									*		*		*			*						*		*	**8**
82	Hulve	*Terminalia paniculata roth*				*																									**1**

83	Ame/bende/goraku	*Trema orientalis bl.*			*			*	*				*		*															5
84	Kora	*Trichilia connaroides*																					*						*	2
85	Baralu kaddi mara	*Urena lobata l.*											*																	1
86	Dhoopa/guugli	*Vateria indica l.*					*	*	*			*				*												*	*			7
87	Paale	*Wrightia tinctoria r.br.*					*		*																						2
88	Chotte mara	*Zizyphus xylopyrus willd.*											*								*							*	*		*	5
		Total	**11**	**12**	**19**	**16**	**10**	**17**	**23**	**7**	**12**	**16**	**12**	**15**	**19**	**15**	**2**	**2**	**5**	**22**	**12**	**7**	**17**	**16**	**12**	**12**	**14**	**12**	**3**	**28**	**368**

Table 4.25 Dominancy of Medicinal Plants in SGs of Somvarapet Taluk

	Local Name	**Scientific name**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**Total**
1	Manda seege/ sheekakayi	*Acacia concinna (willd.)*																					*		*	2
2	Ram phala	*Annona reticulata l.*	*																							1
3	Shatavari	*Asparagus racemosus willd.*			*										*										*	3
4	Bamboo	*Bambusa arundinacea willd.*																		*	*	*	*			4
5	Betthada balli	*Calamus rotang l.*																	*							1
6	Ondhelaga	*Centella asiatica (l.) Urban*																			*	*	*		*	4
7	Maraharishina balli	*Coscinium fenestratum (gaertn.) Coleb.*						*		*	*															3
8	Kaadu harasina	*Curcuma aromatica salisb.*			*										*	*		*								4
9	Haade balli,	*Cyclea peltata (lam.*								*	*															2
10	Haalu balli	*Hemidesmus indicus (l.) Schult.*				*																				1
11	Kaadu genasu	*Ipomoea pandurata*													*					*	*	*				4

12	Lantana	*Lantana camara l.*		*		*	*	*		*	*		*	*										*	**9**
13	Beeli tumbe	*Leucas aspera*																	*	*	*	*	*			**5**
14	Nachike mullu	*Mimosa pudica*			*	*	*		*	*	*		*		*	*		*	*	*	*	*	*	*	*	**17**
15	Sonkhadha balli	*Mucuna pruriens (l.) Dc.*		*																						**1**
16	Kaadu karibevu	*Murraya paniculata (l.) Jack*													*											**1**
17	Manjista	*Rubia cordifolia l.*																		*	*	*	*			**4**
18	Bheemana kaddi	*Sida acuta burm.*								*	*															**2**
19	Chunde	*Solanum torvum swartz*					*			*																**2**
20	Kallante/ nelagulla/ramgulla	*Solanum xanthocarpum schrad & wendl*														*				*	*	*	*			**5**
21	Kaadu uttanrani	*Stachytarpheta jamaicensis (l.)*			*				*						*	*		*								**5**
22	Kadu menasu	*Toddalia asiatica (l.) Lam.*																	*	*	*	*	*		*	**6**
23	Adike gida	*Tridax procumbens l*																	*							**1**
24	Lokki	*Vitex negundo l.*	*									*														**2**
25	Kadu sunde	*Solanum erianthum d.don*																							*	**1**
26	Kedage	*Pandanus odoratissimus l.f.*			*		*		*						*	*		*								**6**
		Total	**2**	**2**	**5**	**3**	**4**	**2**	**3**	**6**	**5**	**1**	**2**	**1**	**7**	**4**	**1**	**4**	**5**	**7**	**8**	**8**	**8**	**1**	**7**	**96**

Table 4.26 Dominancy of Animals in SGs of Somvarapet Taluk

SL No.	Local Name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	Kempu alilu	*Sciurus vulgaris*	*	*	*	*		*		*		*	*	*	*	*												*	**12**
2	Kadu handhi	*Sus scrofa*		*				*	*		*	*	*	*	*	*			*		*	*	*	*	*	*		*	**17**
3	Kadu kuri			*				*	*		*		*					*	*	*	*	*							**10**
4	Kadu naayi	*cuon alpinus*		*	*			*				*							*										**5**

5	Kadu mola			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	`	*	*		*	24
6	Mullu andhi	*Hystrix indica*			*	*			*	*	*	*	*						*		*							*	10
7	Kenjjiri	*Ratufa indica*			*	*				*																			3
8	Mungusi	*herpestes avanicus*			*	*				*	*	*	*		*	*			*		*	*	*	*	*	*	*	*	17
9	Kadu bekku	*felis silvestris*							*										*		*	*	*	*	*	*		*	9
10	Gulle nari	*Vulpes vulpes*																	*		*								2
11	Kadave	*Rusa unicolor*																	*		*								2
12	Jinke	*Muntiacus muntjak*																	*		*								2
13	Kadu karadi	*Melursus ursinus*																	*										1
		Total	**1**	**5**	**6**	**5**	**1**	**5**	**5**	**5**	**5**	**6**	**6**	**3**	**4**	**4**	**2**	**2**	**11**	**2**	**9**	**5**	**4**	**3**	**4**	**4**	**1**	**6**	**114**

Table 4.27 Dominancy of birds in SGs of Somvarpet Taluk

SL No.	Local Name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	19	20	21	22	23	24	25	26	27	28	29	30	Total al
1	Kadu parivala	*Spilopelia chinensis*	*	*				*																							3
2	Kogile	*Cuculus varius*	*	*			*	*	*											*	*		*	*	*	*	*	*		*	14
3	Marakutika	*Melanerpesformicivorus*	*	*	*	*	*	*	*		*	*	*	*	*				*	*	*	*	*	*	*	*	*	*	*	*	24
4	Myna	*Gracula religiosa*		*			*	*			*	*							*							*	*	*		*	10
5	Owl	*Barn owl*		*			*	*	*	*	*	*		*					*	*	*	*	*	*	*	*	*	*	*	*	20
6	Parrot	*Psittacula krameri*		*			*										*	*								*	*	*	*	*	9
7	Peacock	*Pavo cristatus*		*																						*	*	*	*	*	6
8	Chore hakki	*Spilopelia senegalensis*			*	*				*	*	*	*	*																	7
9	Jatakuruli	*Dicrurus paradiseus*			*	*					*	*	*																		5
10	Kadal hakki	*Ocyceros griseus.*			*	*	*		*	*	*	*	*											*	*	*	*	*		*	14
11	Kadu koli	*gallus sonneratii*			*	*	*			*	*	*		*	*	*		*		*	*	*	*	*	*			*	*	*	19
12	Kage	*Corvus culminatus*			*	*	*		*	*	*	*			*		*		*	*	*	*	*	*	*	*	*	*	*	*	21
13	Kanina hakki	*athene brama*			*	*				*	*	*																			5

14	Komba hakki	*bubo bubo*			*	*				*	*	*																		5
15	Kootu hakki	*haliastur indus*			*	*				*	*	*																*			6
16	Kembhootha	*Centropus sinensis*					*																				*	*	*		*	5
17	Bavali	*Cynopterus sphinx*						*							*				*	*	*	*	*	*	*						*	10
18	Bellahakki	*egretta garzetta*																									*	*	*		*	4
		Total	**3**	**7**	**9**	**9**	**9**	**6**	**5**	**8**	**11**	**11**	**4**	**4**	**4**	**1**	**2**	**2**	**5**	**6**	**6**	**5**	**6**	**7**	**7**	**10**	**10**	**12**	**6**	**12**	**187**

Table 4.28 Dominancy of trees in SGs of Virajpet Taluk

SL No	Local Name	Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total
1	Seege	Acacia sinuata (lour.) Merr.	*		*		*	*	*	*	*							*							*				*	*	*	12
2	Balanji	Acrocarpus fraxinifolius wight & arnolal	*		*	*	*												*													5
3	Honge	Actinodaphne hookeri									*					*	*	*					*			*						6
4	Bilwa	Aegle marmelos			*	*	*										*			*												5
5	Devadaru	Ailanthus malabarica DC					*																									1
6	Bilwara	Albizia odoratissima	*																	*					*							3
7	Pottu bage	Albizia stipulata Boivin																		*												1
8	Seethaphala	Annona squamosa L.																		*												1
9	Halasu	Artocarpus heterophyllus lam.	*		*	*	*	*	*	*	*	*			*		*	*		*	*	*	*	*	*	*		*	*	*	*	23
10	Hebbalasu	Artocarpus hirsutus lam.			*	*	*	*	*	*	*	*	*	*		*	*															12
11	Gujje	Artocarpus integrifolia l			*	*											*			*	*	*	*		*	*						9
12	Baevu	Azadirachta indica A. Juss.					*	*	*										*													4
13	Bamboo	Bambusa arundinaceawilld.					*	*									*														*	4
14	Buruga	Bombax malabaricum dc.	*					*				*							*												*	5

15	Kempuburaga	Bombax ceiba L.																		*		*			*					**3**
16	Kulur maavu	Buchanania latifolia roxb.			*	*					*													*		*				**5**
17	Mutthugada mara	Butea monosperma (lam.)	*	*	*																								*	**4**
18	Arathi soppu	Callicarpa tomentosa (l.) murr.					*							*		*		*					*							**5**
19	Kari dhoopa	Canarium strictum roxb					*	*	*	*		*			*	*		*							*		*	*	*	*	**13**
20	Dhaddaala mara	*Careya arborea Roxb.*				*																									**1**
21	Byne	*Caryota urens l.*	*		*	*	*	*	*	*	*	*	*	*			*	*		*		*	*		*	*	*	*	*			**21**
22	Golden rain tree	*Cassia fistula l.*	*		*	*	*											*	*	*	*						*			*	**10**
23	Noga	*Cedrela toona roxb.*					*																	*							**2**
24	Kaartige	*Celtis tetrandra roxb*						*				*						*			*		*	*	*						**7**
25	Karpa chakke	*Cinnamomum macrocarpum hook.*					*	*	*							*															**4**
26	Daalchinni,	*Cinnamomum malabathrum batka*	*					*								*		*		*											**5**
27	Kanagina mara,	*Dalbergia lanceolaria l.f.*	*								*	*					*				*										**5**
28	Beete	*Dalbergia latifolia roxb.*	*		*	*													*	*		*	*								**7**
29	Kari mara	*Dalbergia sissoo roxb.*																						*							**1**
30	Kadu kanagile	*Dillenia pentagyna roxb.*						*		*			*				*				*			*							**6**
31	Nelli	*Emblica officinalis gaertn.*	*		*	*	*				*				*														*	*	**8**
32	Arali	*Ficus religiosa l.*	*		*	*	*							*				*												*	**7**
33	Bili basari	*Ficus tsiela roxb.*	*							*								*	*	*					*					*	**7**
34	Ala	*Ficus bengalensis L.*	*	*	*	*	*									*			*	*											**8**
35	Garaganta	*Ficus exasperata VAHL*								*										*											**2**
36	Atti mara	*Ficus glomerata roxb*			*	*													*							*					**4**

37	Basari	*Ficus infectoria sensu roxb.*	*																										*	**2**
38	Goli	*Ficus mysorensis*	*			*	*				*	*	*						*					*		*				*	**10**
39	Panpuli	*Garcinia gummi-gutta (l.) Robs.*						*	*	*	*													*	*	*					**7**
40	Punar puli	*Garcinia indica (dup.)*					*	*																							**2**
41	Godda	*Garuga pinnata roxb.*					*																								**1**
42	Thadasalu	*Grewia tiliaefolia*													*	*										*					**3**
43	Harishina thega	*Haldina cordifolia (roxb.)*	*		*										*														*	**4**
44	Kadu geru	*Holigarna arnottiana hook.f.*			*	*	*	*	*			*	*	*											*						**9**
45	Kiral bogi	*Hopea parviflora BEDD*													*																**1**
46	Bende mara	*Kydia calycina roxb.*	*																											*	**2**
47	Nandi	*Lagerstroemia lanceolata wall.*	*		*	*	*				*	*			*			*	*	*	*	*		*		*				*	**15**
48	Kooli	*Ligustrum perrottetii*					*																			*	*				**3**
49	Thoombale	*Litsea floribunda (bl.) gamble*	*				*	*	*				*	*		*		*										*	*		**10**
50	Na	*litsea stocksii*						*																					*	*		**3**
51	Uppalige	*Macaranga peltata*	*	*				*		*		*	*			*							*	*	*		*	*		*	*	**14**
52	Kumkuma	*Mallotus philippensis (lam.) Muell.-arg.*						*			*						*	*					*	*	*	*	*			*		**10**
53	Uppale mara	*Mallotus tetracoccus (roxb.) Kurz*	*	*	*		*	*	*		*	*					*	*	*	*			*	*				*	*	*	*	**18**
54	Maavu	*Mangifera indica l.*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*			*	*		*	*	*		*	*	*	*	**24**
55	Hebbevu,	*Melia dubia Cav.*	*																*												*	**3**
56	Kenda sampige	*Michelia champaca l.*	*	*	*	*	*	*	*	*	*	*	*	*		*		*		*	*	*			*	*	*			*	*	**22**
57	Kadu jayikayi	*Myristica dactyloides gaertn*																										*	*	*		**3**

58	Jaikai,jaiphala	*Myristica fragrans houtt.*							*	*		*	*									*	*	*							**7**
59	Neeli	*Bischofia javanica BL*										*												*							**2**
60	NA	*Neolitsea zeylancia (Nees)*						*	*	*																					**3**
61	Tadale	*Olea dioica roxb.*												*	*															*	**3**
62	Gulimavu	*Persea macrantha (Nees)*							*															*							**2**
63	Pauli	*Phyllanthus distichus (l.)*					*		*																						**2**
64	Chitramoolike	*Plumbago rosea l.*						*																							**1**
65	Batta, batti	*Pongamia pinnata (L.)*													*									*							**2**
66	Honne	*Pterocarpus marsupium roxb.*	*			*	*				*	*							*					*						*	**8**
67	Kaare kayi	*Randia dumetorum Lam.*	*																												*	**2**
68	Shrigandha	*Santalum album l.*	*				*				*				*									*							*	**6**
69	Antuvaala	*Sapindus laurifolia vahl*	*		*		*					*			*												*				*	**7**
70	Antavala	*Sapindus trifoliatus L*	*		*	*	*								*																*	**6**
71	Bili bhutala	*Schefflera venulosa*	*																											*	*	**3**
72	Kaabbu	*Shorea robusta Gaertn. f.*																						*	*							**2**
73	Jeerkolavi kayi	*Spathodea campanulata p*			*				*							*				*	*	*	*			*						**8**
74	Amte	*Spondias pinnata (l.f.) kurz.*			*	*					*					*	*															**5**
75	Bhoothali	*Sterculia urens*																							*							**1**
76	Kalsoge	*Sterculia villosa roxb.*	*				*	*																							*	**4**
77	Malaili	*Stereospermum tetragonum DC*				*														*		*										**3**
78	Mahaagoni	*Swietenia mahagoni (L.)*													*																	**1**
79	Lodha	*Symplocos cochinchinensis S .Moore*												*																*		**2**
80	Nerale	*Syzygium cumini (l.) Skeels*			*	*		*	*		*				*						*	*		*		*		*	*		**12**
81	Bilikodsalu	*Tabernaemontana heyneana*						*			*							*														**3**

		Wall.																												
82	Hunase mara	*Tamarindus indica L.*			*	*																								**2**
83	Tega	*Tectona grandis L.F*													*				*		*					*				**4**
84	Thari	*Terminalia bellerica (gaertn.) Roxb.*	*		*	*					*														*			*		*	**7**
85	Hulve	*Terminalia paniculata roth*	*		*	*	*									*					*									*	**7**
86	Matti	*Terminalia tomentosa (Roxb.)*	*		*	*					*								*		*					*		*	*			**10**
87	Daevadaari,	*Toona ciliata Roem.*																		*		*	*	*			*					**5**
88	Kaadu baje	*Trema orientalis bl*													*		*											*				**3**
89	Dhoopa	*Vateria indica l.*					*	*	*								*									*						**5**
90	Naviladi,	*Vitex altissima L.F*														*										*						**2**
91	Nirgundi	*Vitex negundo L.*						*																								**1**
92	Paale	*Wrightia tinctoria r.br.*																		*						*						**2**
93	Chotte mara	*Zizyphus xylopyrus willd.*	*		*														*												*	**4**
94	Na	*Vernonia arborea*												*	*	*																**3**
		Total	**37**	**5**	**31**	**28**	**35**	**29**	**20**	**12**	**21**	**20**	**10**	**8**	**11**	**25**	**18**	**15**	**14**	**21**	**16**	**12**	**15**	**10**	**32**	**12**	**19**	**11**	**12**	**13**	**30**	**542**

Table 4.29 showing the dominancy of Medicinal Plants in SGs of Virajpet Ttaluk

Sl. No	Local Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total
1	Seege balli	*acacia concinna (willd.)*					*	*	*	*	*					*																6
2	Garga	*sida cordifolia l.*									*					*							*									3
3	Kaadu seege	*Acacia pennata (l.)*																		*					*							2
4	Uttarani	*Achyranthes aspera L.*																		*												1
5	Aadsoge	*Adhatoda vasica nees*																		*												1
6	Samudra haale	*Argyreia nervosa (burm.f.)*					*																									1
7	Dodda eeshvari balli,	*Aristolochia tagala cham*																							*							1
8	Shatavari aashaadi baeru	*Asparagus racemosus willd.*						*	*													*										3
9	Bamboo	*Bambusa arundinacea willd.*	*													*	*			*							*	*				6
10	Ratnagandhi	*Caesalpinia pulcherrima*									*																					1
11	Na	*Cassia hirsuta l.*														*																1
12	Aloori gida	*Cassia sophera L.*	*														*		*													3
13	Chagate	*Cassia tora l.*	*		*	*	*	*	*								*	*		*					*	*						11
14	Ondhelaga	*Centella asiatica (l.) Urban*	*	*			*	*	*	*	*					*	*	*	*	*					*		*	*		*	*	17
15	Chakke	*Cinnamomum verum Presl*						*			*		*		*	*								*		*	*					8
16	Na	*Clematis gauriana roxb*																					*									1
17	Basavanapada	*Clerodendrum infortunatum*	*				*						*	*		*	*	*		*									*	*	*	11

18	Arasina ele	*Colocasia esculenta (L.)*		*														*												**2**
19	Kothambari	*Coriandrum sativum* L.																	*						*						**2**
20	Hullu saaranga gida	Crotalaria calycina																*													**1**
21	Kaadu harasina	Curcuma aromatica salisb.						*	*	*	*																				**4**
22	Haade balli,	*Cyclea peltata* (Lam)						*								*		*							*				*	*	*	**10**
23	Datura	*Datura metel* L	*																	*												**2**
24	Roopani	*Eupatorium odoratum* l					*								*	*	*															**4**
25	Achchegida,	*Euphorbia hirta* l.					*									*	*				*						*					**7**
26	Hale beru balli	*Hemidesmus indicus* (L.) *Schult.*				*																										**1**
27	Dasavala	*Hibiscus rosa-sinensis* L.													*									*								**2**
28	Kaadu genasu	Ipomoea pandurata						*			*																					**2**
29	Bilichita bogari	*Ipomoea obscura* ker.-gawl.														*					*											**2**
30	Kaadu gulabi	*Lantana camara* l.	*				*	*	*							*	*			*			*		*	*			*	*	*	**13**
31	Thumbe	Leucas aspera (willd.)	*				*				*											*						*	*				**6**
32	Nachike mullu	Mimosa pudica	*	*	*	*	*	*		*	*	*	*	*		*	*	*	*	*	*			*		*	*	*	*		*	*	**23**
33	kanagile,	*Nerium indicum* mille													*					*													**2**
34	Kadu tulasi	*Ocimum basilicum* l.	*		*	*	*	*	*								*														*	**8**
35	Kala thulasi	*Ocimum sanctum* l.					*									*	*			*			*									**5**
36	Garuda Pathaala	Ophiorrihza mungos l	*				*																								*	**3**
37	Kukke balli	*Passiflora foetida* l.														*																	**1**
38	Kaadu menasu	*Piper nigrum* l.							*															*								**2**
39	Kempu chithra moola	*Plumbago indica* l.																*														**1**

40	Agnipaavaka	*Plumbago zeylanica* l.					*																								**1**
41	Manda, oudla	*Ricinus communis* l																*	*												**2**
42	Anithumbe gida	*Scoparia dulcis* l.				*									*	*	*											*	*		**6**
43	Bheemana kaddi	Sida acuta burm.						*								*	*	*	*		*							*	*		**8**
44	Broom weed,	*Sida rhombifolia* l.																				*						*			**2**
45	Na	*Smilax wightii* l												*																	**1**
46	Sundekkayi	*Solanum torvum*					*			*						*		*	*	*											**6**
47	Kallante	Solanum xanthocarpum schr ad & wendl	*			*	*	*		*					*	*	*	*		*		*	*	*	*			*	*	*	**17**
48	Sarahattika	*Spilanthes acmella* murr.					*	*								*															**3**
49	Kaadu uttanrani	Stachytarpheta jamaicensis	*		*	*	*	*														*								*	**7**
50	Benne balli,	*Thunbergia fragrans* roxb					*																								**1**
51	Kadu menasu	Toddalia asiatica (l.) Lam.				*	*	*	*	*											*					*	*				**8**
52	Adike gida	Tridax procumbens l				*									*																**2**
53	NA	*Vitex negundo* L.						*																							**1**
54	Kadushunti	Zingiber officinalis roxb.																							*						**1**
55	Churi mullu	Zizyphus oenoplia mil																							*						**1**
56	Antitike	*Acacia torta* (roxb)												*		*				*		*		*							**5**
		Total	**13**	**3**	**4**	**9**	**20**	**17**	**9**	**5**	**11**	**1**	**3**	**2**	**6**	**18**	**17**	**9**	**9**	**16**	**6**	**5**	**12**	**2**	**12**	**6**	**6**	**5**	**8**	**9**	**9**	**252**

Table 4.30 Dominacy of animals in SGs of Virajapet Taluk

Sl. No	Local Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	18	19	21	22	23	24	25	26	27	28	29	Total
1	Kadu mola	lepus nigricollis	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**25**
2	'Kenjjiri'	Ratufa indica																								*	*	*	**3**
3	Gulle nari	Vulpes vulpes					*	*	*		*				*	*	*		*			*		*	*	*			**12**
4	Jinke	Muntiacus muntjak													*	*	*		*					*	*	*			**7**
5	Kadave	Rusa unicolor													*	*	*		*					*	*	*			**7**
6	Kadu bekku	felis silvestris	*		*	*	*	*	*		*				*	*	*		*		*	*		*	*	*			**16**
7	Kadu handhi	Sus scrofa	*		*	*	*	*	*	*	*				*	*	*	*	*		*	*	*	*	*	*	*	*	**21**
8	Kadu kuri	Ovis ar ies													*	*	*		*			*		*	*	*	*	*	**10**
9	Kempu alilu	Sciurus vulgaris	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**26**
10	Mullu handhi	Hystrix indica	*				*	*		*	*				*	*	*		*		*	*	*	*	*	*	*	*	**17**
11	Mungusi	herpestes avanicus	*		*	*	*	*	*		*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	**21**
		Total	**6**	**1**	**5**	**5**	**7**	**7**	**6**	**4**	**7**	**2**	**2**	**2**	**10**	**10**	**10**	**4**	**10**	**3**	**6**	**8**	**5**	**10**	**10**	**11**	**7**	**7**	**165**

Table 4.31 showing the dominancy of Birds in SGs of Virajpet Taluk

Sl. No	Local Name	Scientific Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	21	22	23	24	25	26	27	28	29	Total
1	Bavali	*Cynopterus sphinx*	*		*	*	*	*		*	*					*	*	*		*		*	*	*	*	*	*			17
2	Bellahakki	*egretta garzetta*	*		*	*										*	*	*		*		*	*							9
3	Bheema raja	*terpsiphone paradisi*					*	*	*	*	*												*							6
4	Chore hakki	*Spilopeliasenegalensis*					*	*	*	*	*	*	*		*	*	*	*		*	*	*	*	*	*	*	*	*	*	21
5	Jatakuruli	*Dicrurus paradiseus*					*	*	*	*	*															*	*	*	*	10
6	Kadal hakki	*Ocyceros griseus.*																				*	*	*	*	*	*	*	*	8
7	Kadu koli	*gallus sonneratii*	*		*	*	*	*		*	*					*	*	*		*	*	*	*	*	*	*	*	*	*	**20**
8	Kage	*Corvus culminatus*	*	*	*	*	*	*		*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**25**

9	Kaldal hakki	*Ocyceros griseus.*	*		*	*	*	*	*	*	*					*	*	*		*	*				*	*	*	*	*	**18**
10	Kanina hakki	*athene brama*																							*	*	*	*	*	**5**
11	Kembhootha	*Centropus sinensis*	*		*	*										*	*	*		*		*	*							**9**
12	Kogile	*Cuculus varius*	*		*	IR	*	*	*	*	*	*	*		*	*	*	*		*		*	*	*	*	*	*			**21**
13	Kokkare	*Anastomus oscitans*																					*							**1**
14	Komba hakki	*bubo bubo*																					*	*	*	*	*	*	*	**7**
15	Kootu hakki	*haliastur indus*		*																			*	*	*	*	*	*	*	**8**
16	Marakutika	*Melanerpesformicivorus*	*		*	*	*	*		*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**24**
17	Myna	*Gracula religiosa*	*	*	*	*										*	*	*		*	*	*	*	*	*	*	*	*	*	**17**
18	Owl	*Tyto alba*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	**25**
19	Parrot	*Psittacula krameri*	*	*	*	*										*	*	*	*	*	*	*	*	*	*	*	*	*	*	**18**
		Total	**11**	**4**	**11**	**11**	**10**	**10**	**6**	**10**	**10**	**5**	**4**	**2**	**5**	**12**	**12**	**12**	**4**	**12**	**8**	**12**	**16**	**11**	**15**	**15**	**15**	**13**	**13**	**269**

4.3.1. Land Use Land Cover Classification

One of the important aspects of this study is to compute and analyze the distribution of spatial features and their temporal variation by using multi dated satellite data. The Investigations have been carried out based on the interpretative parameters and ground truth values. The methodology adopted for LULC classification is described in detail in the section 3.5.1. of chapter 3. The LULCs were categorized for the entire Kodagu district for the year 2006 - 2012 and the areas of each categories were calculated and the trend of change in LULC classes has been observed by performing change detection analysis.Table 4.32 shows the extent of area for each LULC class covers and the percentage difference in LULC classes between the year 2006-2012.

Table 4.32 Land Use Land Cover categories in 2006-2012

Sl.No	LULC Class	Area in Sq.Kms 2006	Area in Sq.Kms 2012	Difference in %
1	Built_up_area	317.17	371.7	54.53
2	Dense_Forest	1416.47	1400.5	-16
3	Sandy_area	75.04	42.997	-32
4	Scrub_Land	639.82	620.49	-19.3
5	SG	714.6	708.1	-6.5
6	Water_body	79.96	67.914	-12
7	Agricultural Land(Crop/Plantation)	858.95	890.77	31.82
	Total	4102.01	4102.5	0

Seven different LULC classes were obtained by performing the supervised classification, their area and the comparison values between the year 2006-2012 is as given in table 4.32. Out of the 7 classes of LULC categories, built up and crop land has been increased by 54.53% and 31.82%, respectively. Built up land has been increased in locations such as Madikeri, Somvarpet, Virajpet towns, and in places like Kushalnagar, Suntikoppa, Bhagamandala,Siddapura, Ponnampet and surrounding villages due to the increase in migrated population from other states to work in coffee plantations and also because of developing tourism. Agricultural area (Crop/Plantation) also showed

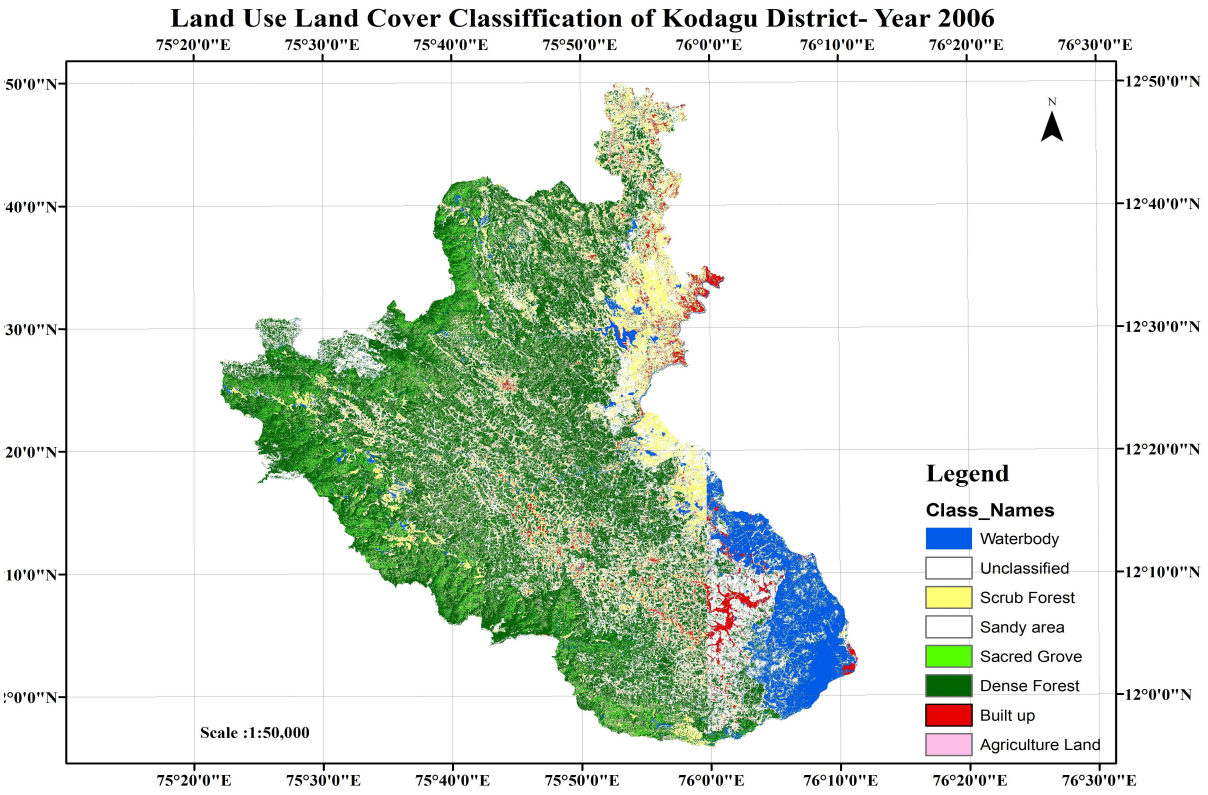

Figure 4.3 Classified LISS – III Image –year 2006

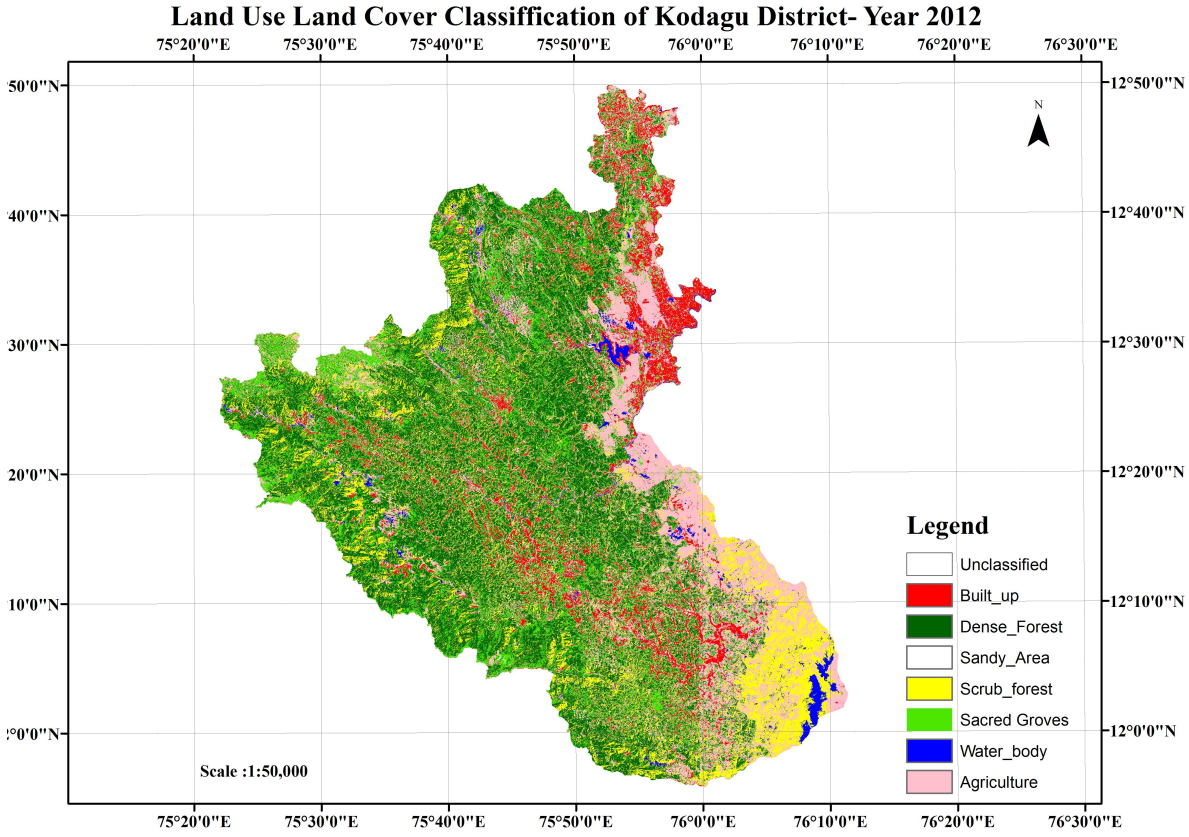

Figure 4.4 Classified image – year 2012

increasing trend due to the economic profits they provide. The scrub land in central part and eastern part of the district was observed to be converted as agricultural land. Rest of the classes like dense forest, water body, sandy area, and scrub land have been decreased by 16%, 12%, 32% and 19.3%, respectively. The Forest (both dense and scrub) area which covered the east and the west borders of the district boundary has been converted into agricultural land (Crop/Plantation) due to the expansion of agriculture or due to the encroachment of plantations.

In a span of 6 years the increase in demand or over exploitation of water resource has lead to the decrease in water body. Growth of population and expanding urban settlements caused the reduction in the extent of the sandy area. In this classification, the SGs have also been categorized and studied for their distribution extent and SGs occupy more than 700Sq Km and have been reduced by 9% of the total area classified due to encroachment of plantations and urbanization. Accuracy assessment has been performed for the classification and the assessment resulted in overall "classification accuracy" of 71.87% for the year 2006 and 77.59% for the satellite image of year 2012. Figure 4.3 and 4.4 represents the LULC map for the year 2006 and 2012, respectively.

4. 3.2. NDVI Classification

The NDVI values are the representation of vegetated mass in a given area and the value has been computed by following the equation given in section of 3.5.2 of chapter3. In this analysis, the application of NDVI is limited just to assess the vegetation cover and difference in the vegetation cover during a span of six years. The computation has been performed for LISS III image of Feb 2006 and Feb 2012.The red and infrared bands were used to generate the NDVI indices map using Erdas imagine software and the NDVI images obtained are shown in Figure 4.3. and 4.4. The entire district has been divided into 2 classes such as unvegetated and vegetated based on the ranges of values obtained.The pixel values range from -0.938 to 0.60396 for the image of 2006 and values range from -0.775 to 0.492 for the image of year 2012. Then the area is calculated for each class and change in vegetation pattern is observed given in Table 4.33

Table 4.33. Statistics of NDVI analysis for the year 2006 and 2012

Satellite Imagery (LISS III)	Year -2006	Year- 2012	Difference in Sq.Km
Class name	Area (sq.km)	Area (sq.km)	
Un vegetated	821.78	999.30	177.53
Vegetated	3277.7	3099.91	-177.77
	4099.5	**4099.22**	

The results of NDVI analysis showed that the vegetation cover is decreased along the east border and south west parts of the district. In these areas, the vegetation is replaced by built up area. The results show that, 177.53 Sq.Km of vegetated area has been converted to unvegetated area. This decrease in vegetation may be attributed to expansion in urbanization, removal of canopy cover in order to build settlement for migrants. NDVI maps for the study area are shown in Figure 4.5 and 4.6.

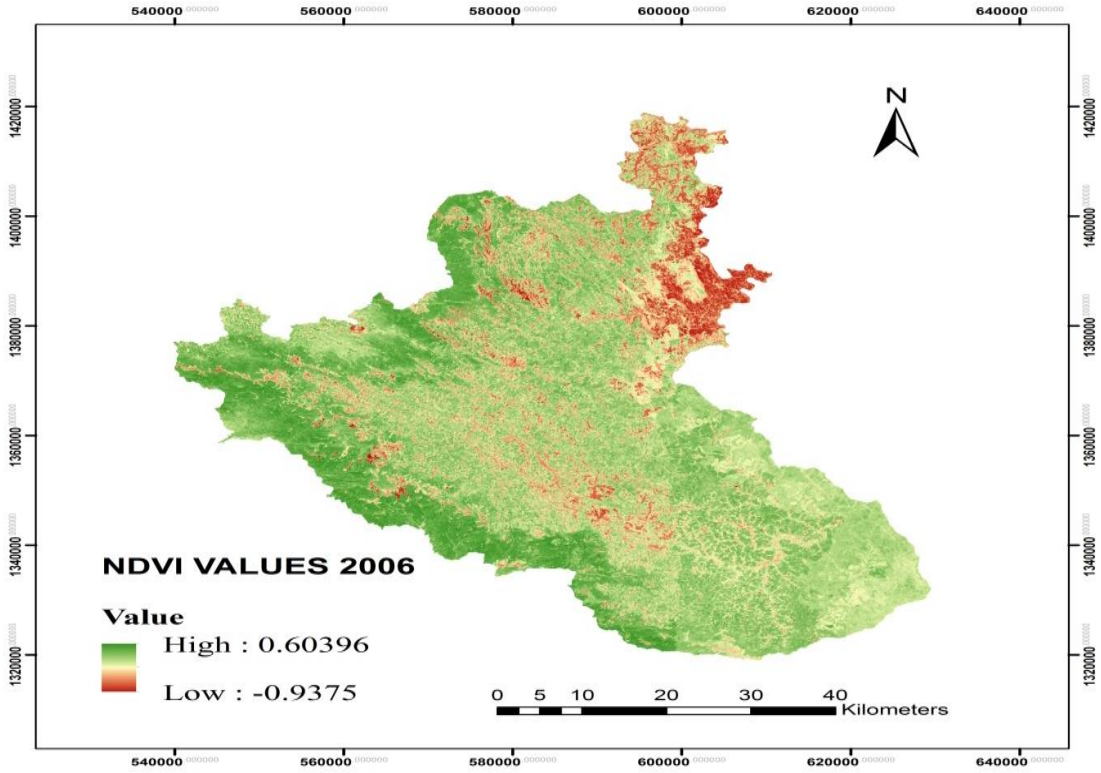

Figure 4.5 Analysis of NDVI for 2006

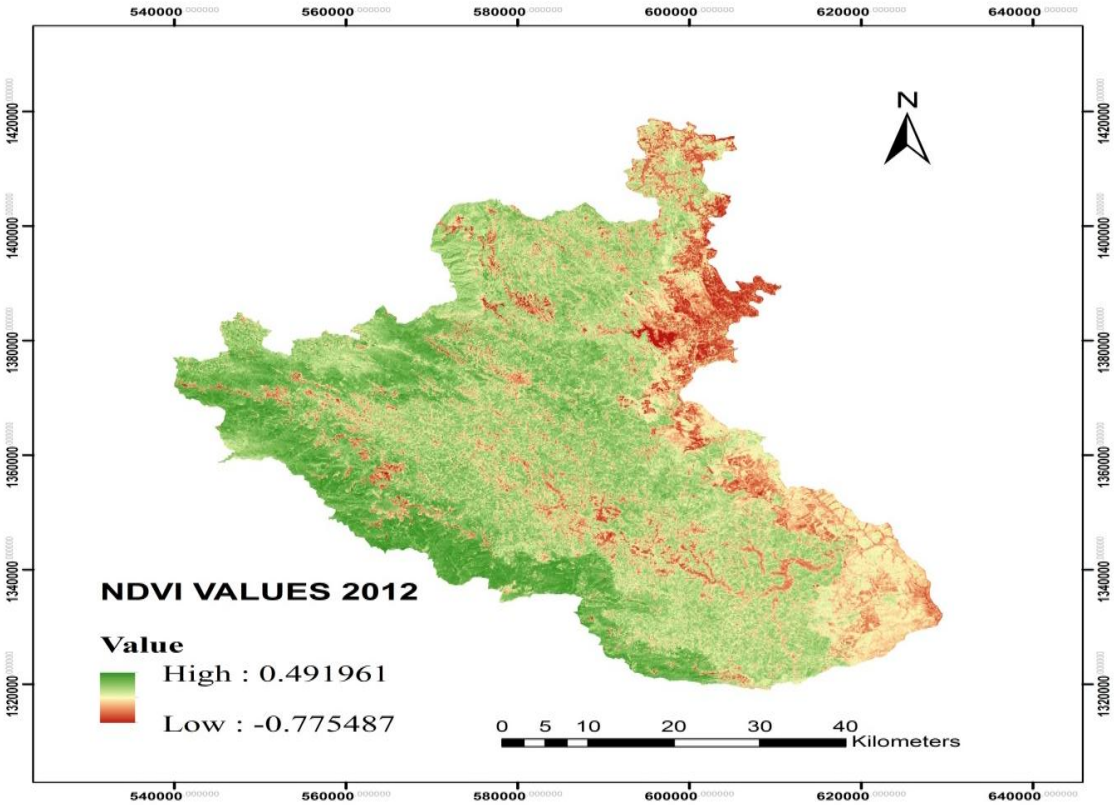

Figure 4.6 Analysis of NDVI for 2012

4.4 PRIORITIZATION:

Prioritization has been done aiming to assess the threat status of SGs and to identify where and to which SGs conservation Priority should be given first and to which SG can be given Priority later. Using the Methodology prescribed in section the conservation Priority has been assessed for all the 85 SGs of study area which clearly indicates the status and alarms the community as well as Government to fill the lacunae which is very much essential for successful conservation of SGs. Depending on the total impact score obtained and based on the category to which the particular SG belongs, SGs have been categorized into 5 categories viz., Extreme, High, Medium, Low and Least. Accordingly Priority levels are assigned from Level 1 to 5. Figure 4.7 represents the severity of threats experienced by SGs of Madikeri. Out of 26 SGs of this taluk three SGs belong to Extreme category and Priority level 1 has been assigned. Five SGs belong to High category and Priority level 2 has been assigned. Six SGs belong to Medium category and Priority level 3 have been assigned. Eleven SGs belong to Low category and priority level 4 have been assigned and only one SG belong to Least category and assigned with Priority level 5.

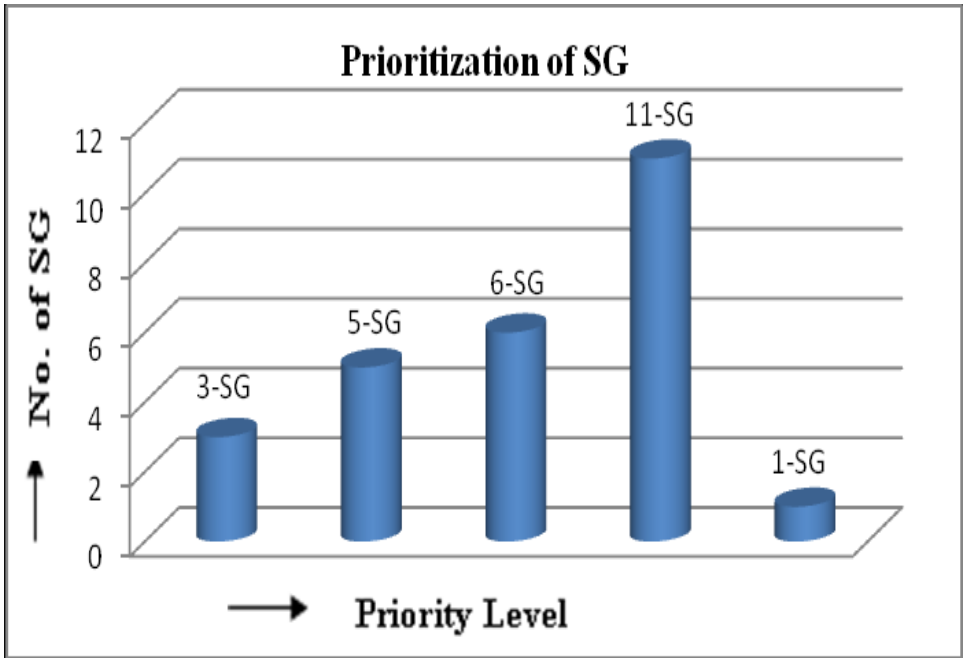

Figure 4.7 Statistics of Madikeri SGs under different Priority levels

Figure 4.8 shows, the severity of threats experienced by SGs of Somvarpet Taluk. Out of 30 SGs of this six SGs belong to Extreme category and Priority level 1 has been assigned. Two SGs belong to High category and Priority level 2 has been assigned. Seven SGs belong to Medium category and Priority level 3 has been assigned. Eleven SGs belong to Low category and Priority level 4 has been assigned and four SG belong to Least category and has been assigned with Priority Level 5.

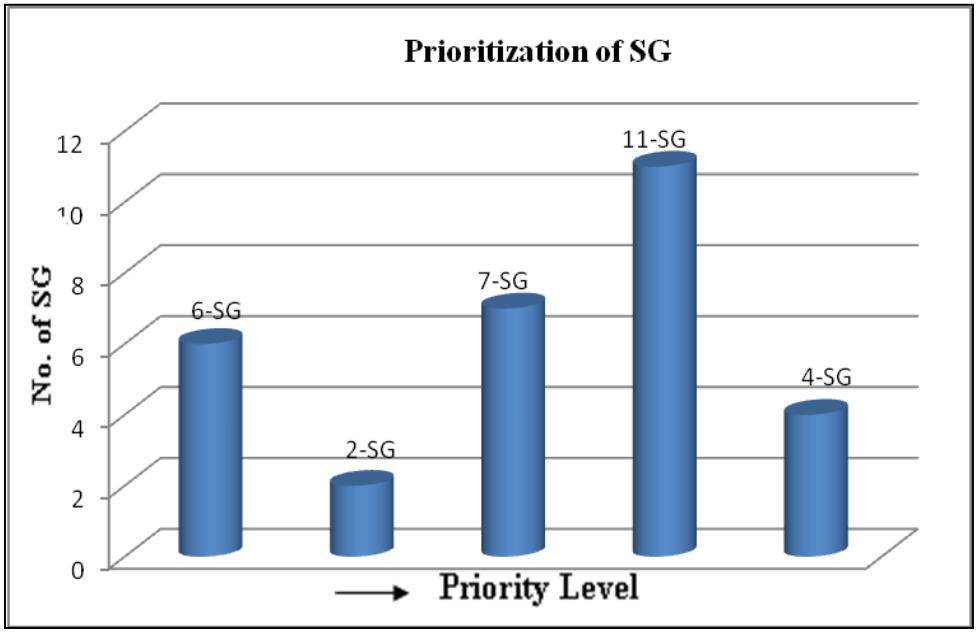

Figure 4.8 Statistics of Somvarpet SGs under different Priority levels

Figure 4.9 shows, the severity of threats experienced by SGs of Virajpet taluk. Out of 29 SGs of this Taluk no SG belong to Extreme and least category. Seven SGs belong to High category and Priority level 2 has been assigned. Twenty one SGs belong to Medium category and Priority level 3 has been assigned. One SGs belong to Low category and Priority level 4 has been assigned.

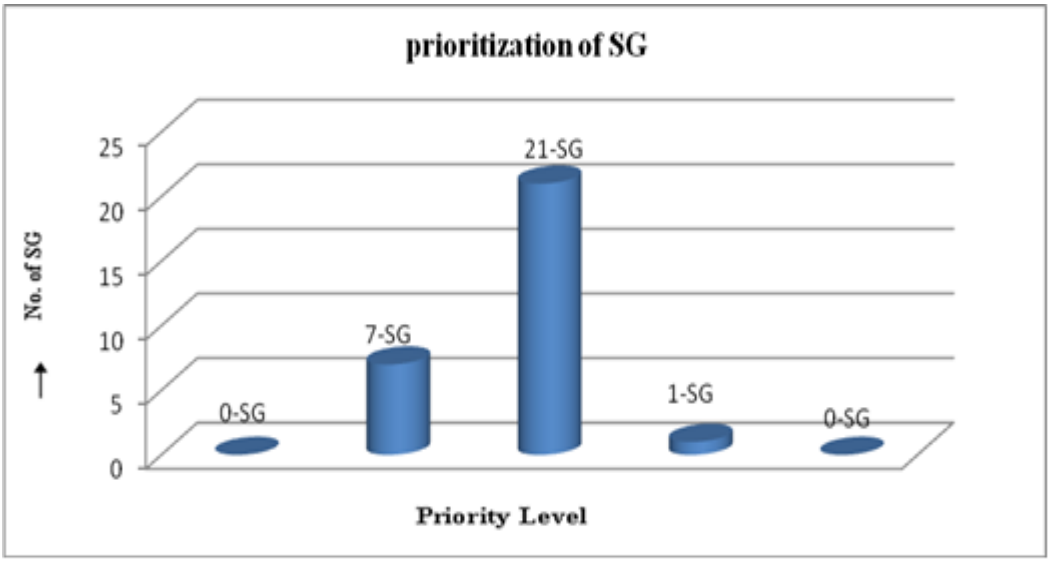

Figure 4.9 Statistics of Virajpet SGs under different Priority levels

Figure 4.10 represent the severity of threats experienced by SGs of Kodagu district. Out of 85 SGs considered for the study, Nine SGs belong to Extreme category and Priority level 1 has been assigned. Fourteen SGs belong to High category and Priority level 2 has been assigned. Thirty four SGs belong to Medium category and Priority level 3 has been assigned. Twenty three SGs belong to Low category and Priority level 4 has been assigned and five SGs belong to Least category and has been assigned with Priority levels 5.

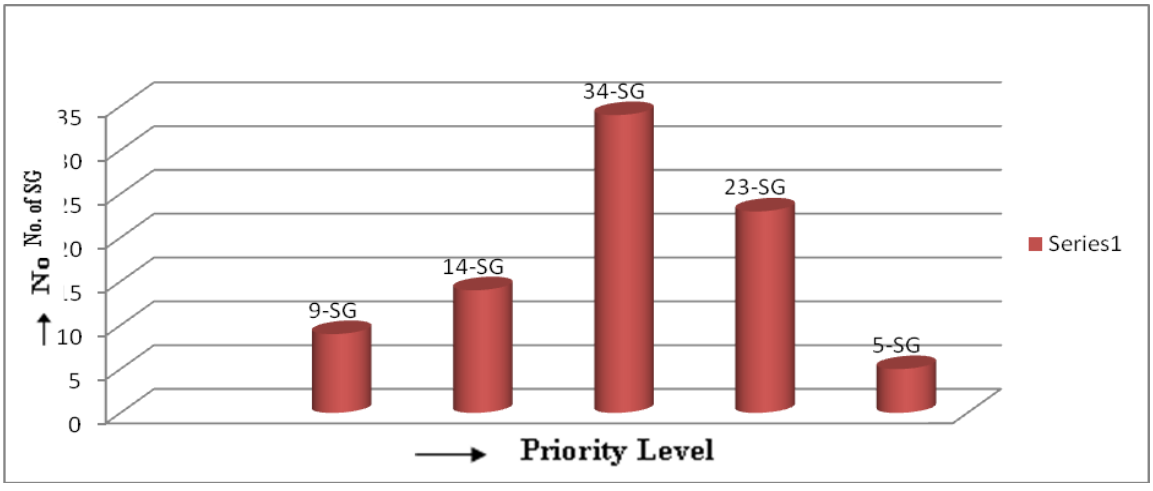

Figure 4.10 Statistics of Kodagu SGs under different Priority levels

Table 4.34-4.36 shows the categories and Priority levels of the SGs in Kodagu district. The 4 SGs located in villages of Somvarpet taluk viz Aiyyappa Devarakadu of Abhyathamangala, Sri Bhadrakaleshwari Devarakadu of Kedakal, Nadamma Devarabana (Povvedi / Mahadeva Devarakadu) of Garvale, Bhootha Devarakadu Kumbur and only one SG called Aiyyappa Devarakadu located in Arekal of Madikeri Taluk were found to be free from any human intervention and are preserved in their virgin condition even for the present day whereas 9 SGs such as Ayyappa Devarakadu, Medara ayyappa Devarakadu of Aivatoklu and Bhagavati Devarabana of B Badaga belonging to Madikeri Taluk and Doddammana Bana of Basavanahalli, vishnumurthy, Bhagavathi Devarakadu, Vishnumurthy Devarakadu as well as Mariyamma Devarakadu of Nelli hudukeri, Mariyamma Devarakadu and Aiyyappa Devarakadu of Kudlu chettihalli belonging to Somvarpet taluk were found to be facing Extreme threat rates. In These SGs it has been observed, Encroachment by localities and Small holder plantations, Sanskritization and Removal of Biomass have become the main reason behind the deterioration of these SGs and severity of threats have reached to such an extent that these SGs have remained as just symbolic representation of the ancestral tradition. 6 SGs of Madikeri taluk and 7 SGs of Somvarpet taluk and 21SGs of Virajpet taluk have been found to be encountering medium rates of threat as shown in table 4.8 Threats such as deforestation, encroachment and sanskritization, cattle grazing and removal of biomass have been found to be leading towards the destruction of SGs gradually and lack or ignorance on conservation measures may push these SGs into higher or next category.

The scenario of SGs of Kodagu district is changing mainly because of 5 reasons.viz.

1. Growing population always demands more and more natural resources such as land for building houses or settlements and raw materials that are needed for construction and other raw materials needed for development
2. Unplanned developmental activities was found be threatening the existence of SG.It was observed in Virajpet taluk few SGs found to be removed/deforested for the construction of Road and schools.
3. The economic profits of Coffee plantations are luring the people to encroach the SGs
4. Changes in belief system and ignorance towards the importance of SG are leading SG towards the deterioration.
5. The non availability of natural resource for food, fodder and other then SGs there is no source of income for the survival of the poor localities is also causing the diminution of SG.

4.34 Prioritization of SGs of Madikeri Taluk

SL NO	SGID	THREATS	SHP	ENC	COL	SAN	RMS	CAT	TOTAL	IS	CATG	PRI
1	SG-1	Sanskritization & Cattle grazing	0	0	0	1	0	1	2	6	Medium	LEVEL -3
2	SG-2	Sanskritization & Removal of bio-mass	0	0	0	1	0	0	2	6	Medium	LEVEL -3
3	SG-3	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
4	SG-4	Encroachment, Colonization & Cattle grazing	0	1	1	0	0	1	3	8	High	LEVEL -2
5	SG-5	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
6	SG-6	Encroachment, Sanskritization & Cattle grazing	0	1	0	1	0	1	3	8	High	LEVEL -2
7	SG-7	Encroachment & Colonization	0	1	1	0	0	0	2	6	Medium	LEVEL -3
8	SG-8	Encroachment, Removal of bio-mass & Cattle grazing	0	1	0	0	0	1	3	9	High	LEVEL -2
9	SG-9	Encroachment & Cattle grazing	0	1	0	0	0	1	2	6	Medium	LEVEL -3
10	SG-10	Encroachment & Cattle grazing	0	1	0	0	0	1	2	6	Medium	LEVEL -3
11	SG-11	Encroachment ,Sanskritization & Cattle grazing	0	1	0	1	0	1	3	5	Low	LEVEL-4
12	SG-12	Encroachment & Cattle grazing	0	1	0	0	0	1	2	6	Medium	LEVEL -3
13	SG-15	NO	0	0	0	0	0	0	0	0	Least	LEVEL-5
14	SG-16	Encroachment & Cattle grazing	0	1	0	0	0	1	2	5	Low	LEVEL-4
15	SG-17	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
16	SG-18	Encroachment, Colonization & Cattle grazing	0	1	1	0	0	1	3	8	High	LEVEL -2
17	SG-19	Encroachment	0	1	0	0	0	0	1	2	Low	LEVEL-4
18	SG-20	Encroachment	0	1	0	0	0	0	1	2	Low	LEVEL-4
19	SG-21	Encroachment	0	1	0	0	0	0	1	2	Low	LEVEL-4
20	SG-22	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
21	SG-23	Small holder plantation, Colonization & Cattle grazing	1	0	1	0	0	1	3	10	Extreme	LEVEL-1
22	SG-24	Small holder plantation,Colonization & Cattle grazing	1	0	1	0	0	1	3	10	Extreme	LEVEL-1
23	SG-25	Encroachment & Cattle grazing	0	1	0	0	0	1	2	8	High	LEVEL -2
24	SG-26	Small holder plantation, ncroachment, Colonization & C.grazing	1	1	1	0	0	1	4	11	Extreme	LEVEL-1
25	SG-25	Encroachment & Cattle grazing	0	1	0	0	0	1	2	5	Low	LEVEL-4
26	SG-26	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4

Table 4.35 Prioritization of SGs of Somvarpet Taluk

SL NO	SG ID	THREATS	SHP	ENC	COL	SAN	RMS	CAT	TOTAL	IS	CATE	Priotization
1	SG-1	Small holder plantation & Encroachment	1	1	0	0	0	0	2	6	Medium	LEVEL -3
2	SG-2	Encroachment & Cattle grazing	0	1	0	0	0	1	2	7	Medium	LEVEL -3
3	SG-3	Small holder plantation, Encroachment, Colonization & Cattle grazing	1	1	1	0	0	1	4	10	High	LEVEL -2
4	SG-4	Small holder plantation, Encroachment, Colonization T & Cattle grazing	1	1	1	0	0	1	4	10	High	LEVEL -2
5	SG-5	NO	0	0	0	0	0	0	0	0	Least	LEVEL-5
6	SG-6	Encroachment	0	1	0	0	0	0	1	2	Low	LEVEL-4
7	SG-7	NO	0	0	0	0	0	0	0	0	Least	LEVEL-5
8	SG-8	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
9	SG-9	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
10	SG-10	NO	0	0	0	0	0	0	0	0	Least	LEVEL-5
11	SG-11	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
12	SG-12	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
13	SG-13	Cattle grazing	0	0	0	0	0	1	1	3	Low	LEVEL-4
14	SG-14	NO	0	0	0	0	0	0	0	0	Least	LEVEL-5
15	SG-15	Small holder plantation, Encroachment & Sanskritization,	1	1	0	1	0	0	3	11	Extreme	LEVEL-1
16	SG-16	Small holder plantation, Encroachment, Sanskritization & Removal of Biomass	1	1	0	1	0	1	5	14	Extreme	LEVEL-1
17	SG-17	Small holder plantation, Encroachment,	1	1	0	1	0	0	3	14	Extreme	LEVEL-1

		Sanskritization & Removal of Biomass										
18	SG-18	Small holder plantation, Encroachment, Sanskritization & Removal of Biomass	1	1	0	1	0	0	3	14	Extreme	LEVEL-1
19	SG-19	Small holder plantation, Encroachment, Sanskritization & Cattle grazing	1	1	0	1	0	1	5	14	Extreme	LEVEL-1
20	SG-20	Small holder plantation, Encroachment, Sanskritization & Cattle grazing	1	1	0	1	0	1	4	14	Extreme	LEVEL-1
21	SG-21	Small holder plantation, Encroachment & Cattle grazing	1	1	0	0	0	1	3	6	Medium	LEVEL -3
22	SG-22	Encroachment & Cattle grazing	0	1	0	0	0	1	2	5	Low	LEVEL-4
23	SG-23	Small holder plantation, Encroachment & Cattle grazing	1	1	0	0	0	1	3	5	Low	LEVEL-4
24	SG-24	Encroachment & Cattle grazing	0	1	0	0	0	1	2	4	Low	LEVEL-4
25	SG-25	Small holder plantation,,Encroachment & Cattle grazing	1	1	0	0	0	1	3	7	Medium	LEVEL -3
26	SG-26	Small holder plantation,,Encroachment & Cattle grazing	1	1	0	0	0	1	3	7	Medium	LEVEL -3
27	SG-27	Small holder plantation,,Encroachment & Cattle grazing	1	1	0	0	0	1	3	6	Medium	LEVEL -3
28	SG-28	Encroachment	0	1	0	0	0	0	1	2	Low	LEVEL-4
29	SG-29	Sanskritization,	0	0	0	1	0	0	1	2	Low	LEVEL-4
30	SG-30	Encroachment & Cattle grazing	0	1	0	0	0	1	2	7	Medium	LEVEL -3

Table 4.36 Prioritization of SGs ofVirajpet Taluk

SL NO	SG ID	THREATS	SHP	ENC	COL	SAN	RMS	CAT	TOTAL	IS	CATG	PRI
1	SG-1	Encroachment & Sanskritization	0	1	0	1	0	0	2	8	High	LEVEL -2
2	SG-2	Small Holder Plantation, Colonization & cattle Grazing	1	0	1	0	0	1	3	7	Medium	LEVEL -3
3	SG-3	Sanskritization & catttle grazing	0	0	0	1	0	1	2	7	Medium	LEVEL -3
4	SG-4	Sanskritization	0	0	0	1	0	0	1	7	Medium	LEVEL -3
5	SG-5	Encroachment, Removal of Biomass & Cattle grazing	1	0	0	0	1	1	3	8	High	LEVEL -2
6	SG-6	Encroachment & Cattle grazing	0	1	0	0	0	1	2	8	High	LEVEL -2
7	SG-7	Small Holder Plantation ,Encroachment & Sanskritization	**1**	1	0	1	0	0	3	8	High	LEVEL -2
8	SG-8	Encroachment & Cattle grazing	0	1	0	0	0	1	2	7	Medium	LEVEL -3
9	SG-9	Encroachment, Colonization & Sanskritization	0	1	1	1	0	0	3	7	Medium	LEVEL -3
10	SG-10	Small Holder Plantation ,Encroachment &Cattle grazing	1	1	0	0	0	1	3	7	Medium	LEVEL -3
11	SG-11	Encroachment & Cattle grazing	0	1	0	0	0	1	2	7	Medium	LEVEL -3
12	SG-12	Small Holder Plantation ,Encroachment & Sanskritization	1	1	0	1	0	0	3	7	Medium	LEVEL -3
13	SG-13	Small Holder Plantation ,Encroachment & Sanskritization	1	1	0	1	0	0	3		Low	LEVEL-4
14	SG-14	Deforestation ,Encroachment & Sanskritization,cattle grazing & removal of biomass	1	1	0	1	1	1	5	7	Medium	LEVEL -3
15	SG-15	Deforestation ,Encroachment & Sanskritization,cattle grazing & removal of biomass	1	1	0	0	0	0	2	8	High	LEVEL -2

16	SG-16	Encroachment	0	1	0	0	0	0	1	7	Medium	LEVEL -3
17	SG-17	Encroachment	0	1	0	0	0	0	1	7	Medium	LEVEL -3
18	SG-18	Encroachment ,Small holder plantation ,cattle grazing and removal of biomass	0	1	0	0	0	0	1	7	Medium	LEVEL -3
19	SG-19	Deforestation & Encroachment	1	1	0	0	0	0	2	7	Medium	LEVEL -3
20	SG-20	Deforestation ,Encroachment & Sanskritization,	1	1	0	1	0	0	3	7	Medium	LEVEL -3
21	SG-21	Deforestation/small holder plantation ,Encroachment & Sanskritization,	1	1	0	1	0	0	3	7	Medium	LEVEL -3
22	SG-22	Small holder plantation,Encroachment & Sanskritization,	1	1	0	1	0	0	3	7	Medium	LEVEL -3
23	SG-23	Small holder plantation,Encroachment & Sanskritization,	1	1	0	1	0	0	3	8	High	LEVEL -2
24	SG-24	Deforestation/small holder plantation ,cattle grazing ,Encroachment & Sanskritization,	1	1	0	1		1	4	7	Medium	LEVEL -3
25	SG-25	Encroachment	0	1	0	0	0	0	1	7	Medium	LEVEL -3
26	SG-26	Encroachment,Deforestation & Sanskritization	1	1	0	1	0	0	3	7	Medium	LEVEL -3
27	SG-27	Encroachment	1	0	0	0	0	0	1	7	Medium	LEVEL -3
28	SG-28	Encroachment	1	0	0	0	0	0	1	7	Medium	LEVEL -3
29	SG-29	Encroachment & Sanskritization	1	0	0	1	0	0	2	8	High	LEVEL -2

4.5 WEB BASED SACRED GROVE INFORMATION SYSTEM MODULE USING GIS.

Development of Web based Sacred Grove Information System module (SGIS) using GIS is considered as the research objective as awareness and knowledge about the problem, plays a very essential role towards achieving the goal of conservation. The Spatial Layers such as district boundary, taluk and Village boundaries, road network, and drainage network, SGs species data which depicts the richness of biodiversity in SGs and prioritization data of SGs which aids to understand the conservationPriority of SG were prepared in the shapefile format and imported into Geoserver. Then the data in the Geoserver was loaded, edited and styling was done to publish the map in the internet through Geoexplorer.The Figure 4.11 to 4.18 are the snapshots of OpenGeo suite application software which can be used to publish the maps.

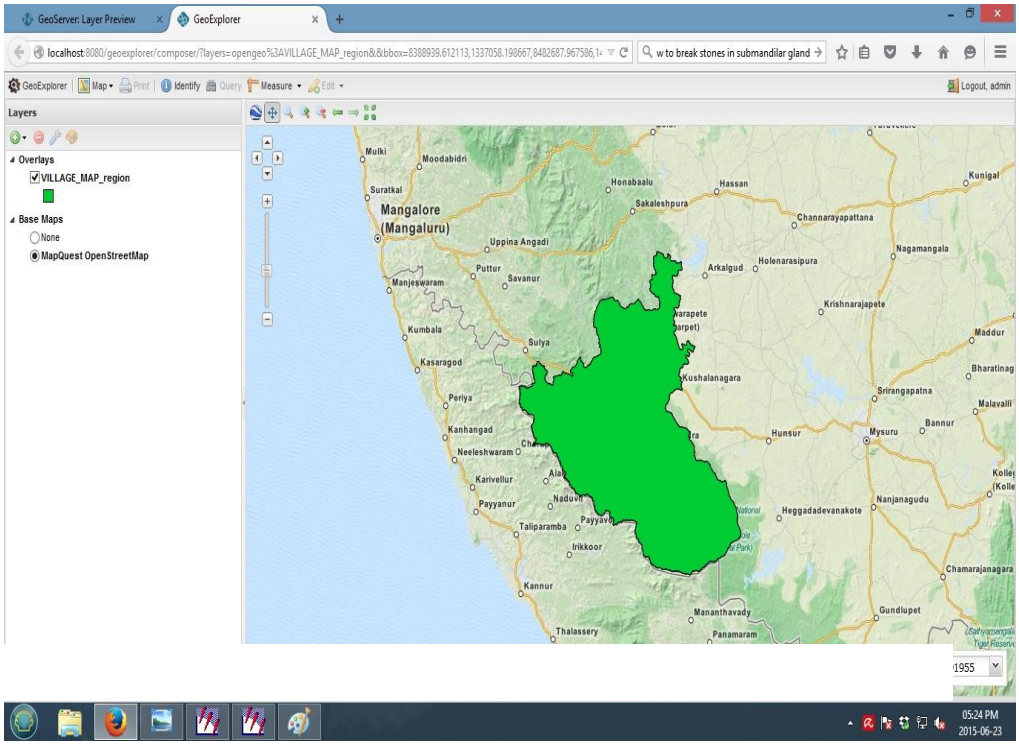

Figure 4.11 Kodagu District boundary on Geoexplorer

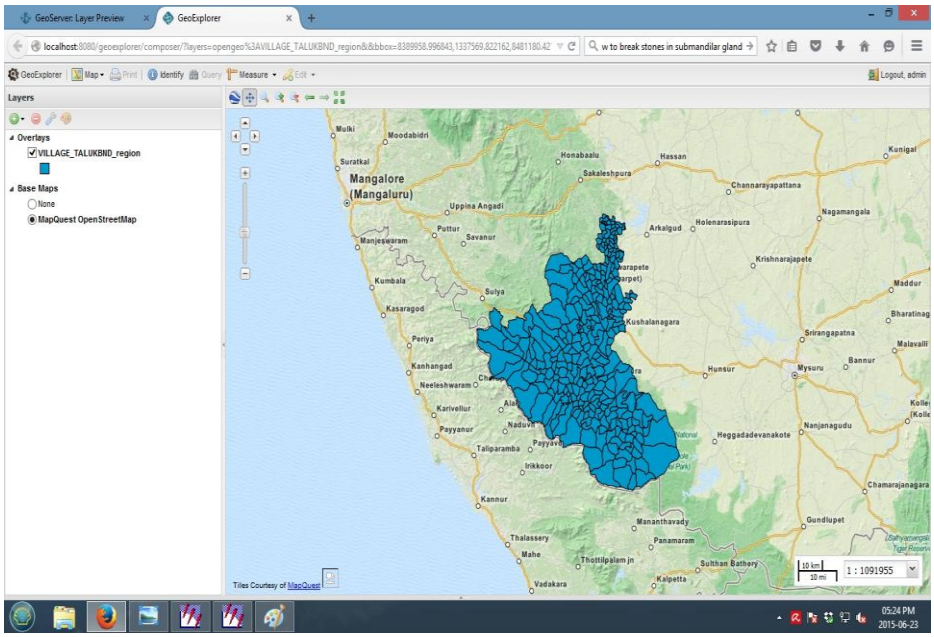

Figure 4.12 Village boundary of Kodagu District on Geoexplorer

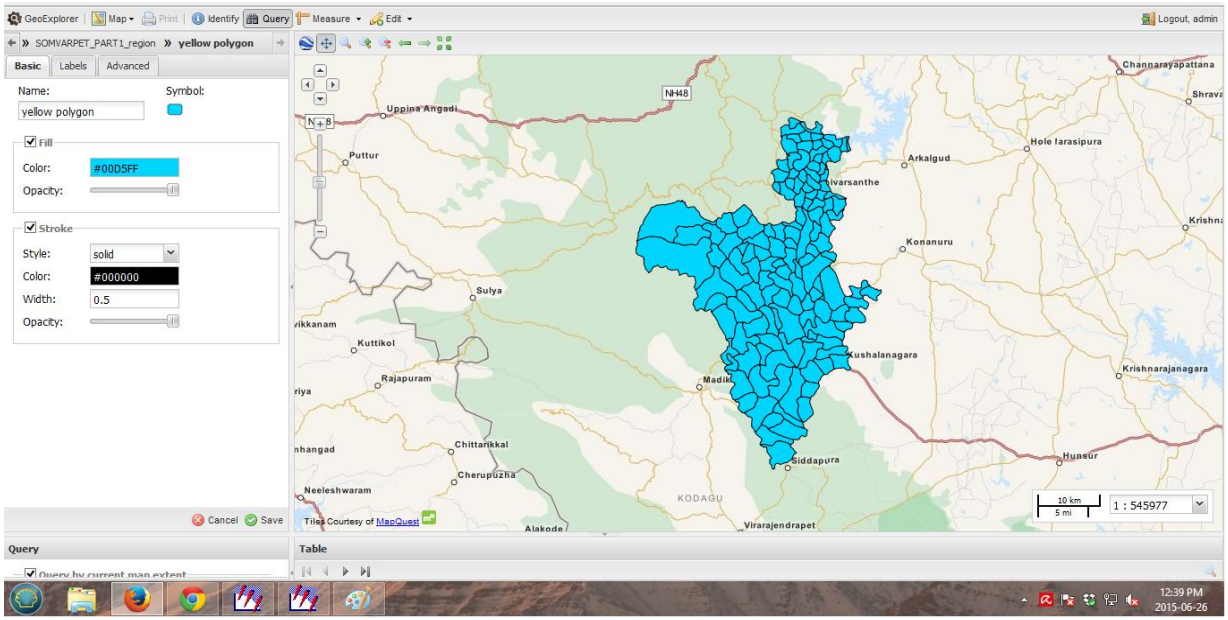

Figure 4.13 Madikeri Taluk boundary on Geoexplorer

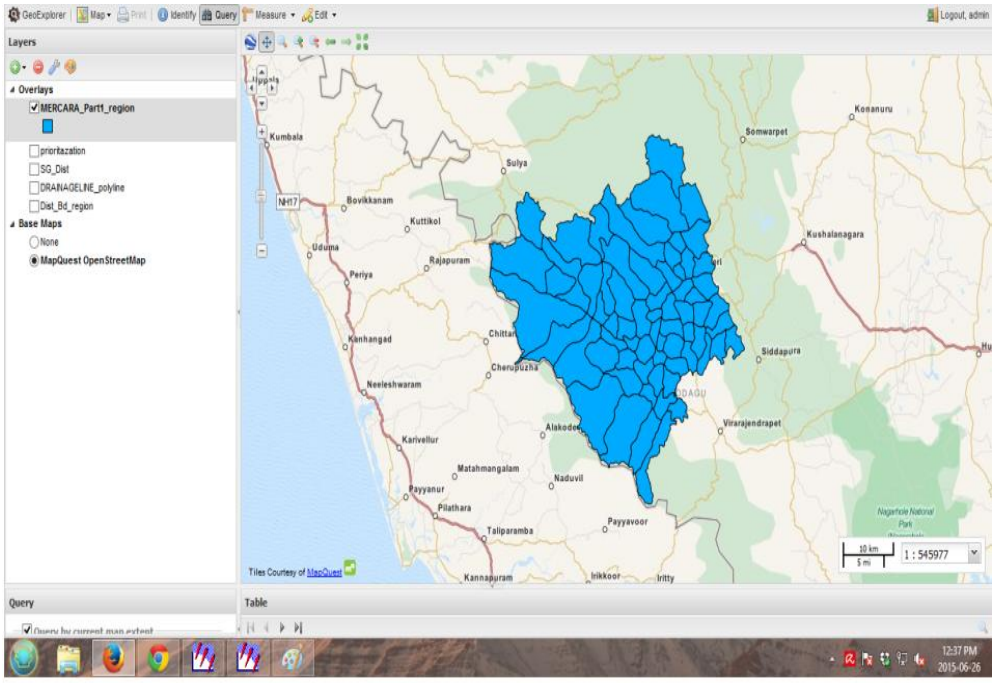

Figure 4.14 Somvarpet Taluk boundaries on Geoexplorer

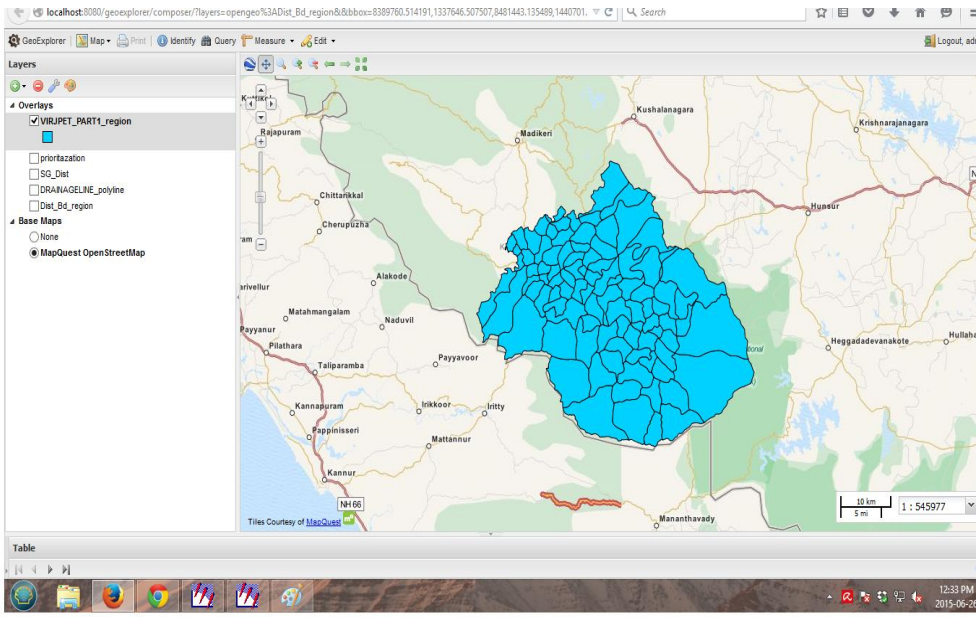

Figure 4.15 Virajpet Taluk boundary on Geoexplorer

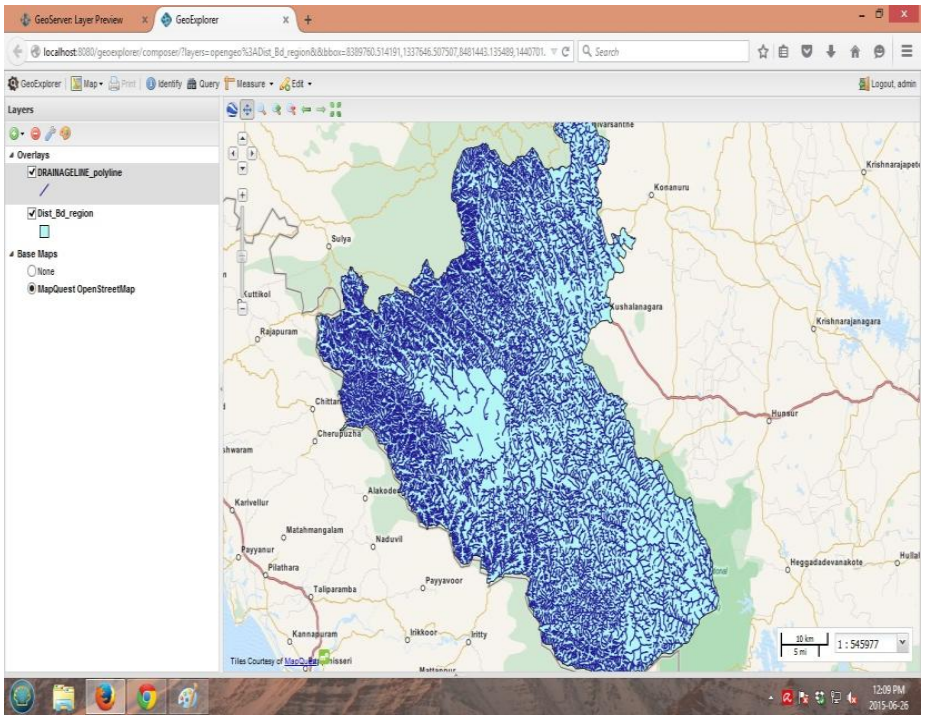

Figure 4.16 Drainage Network on Geoexplorer

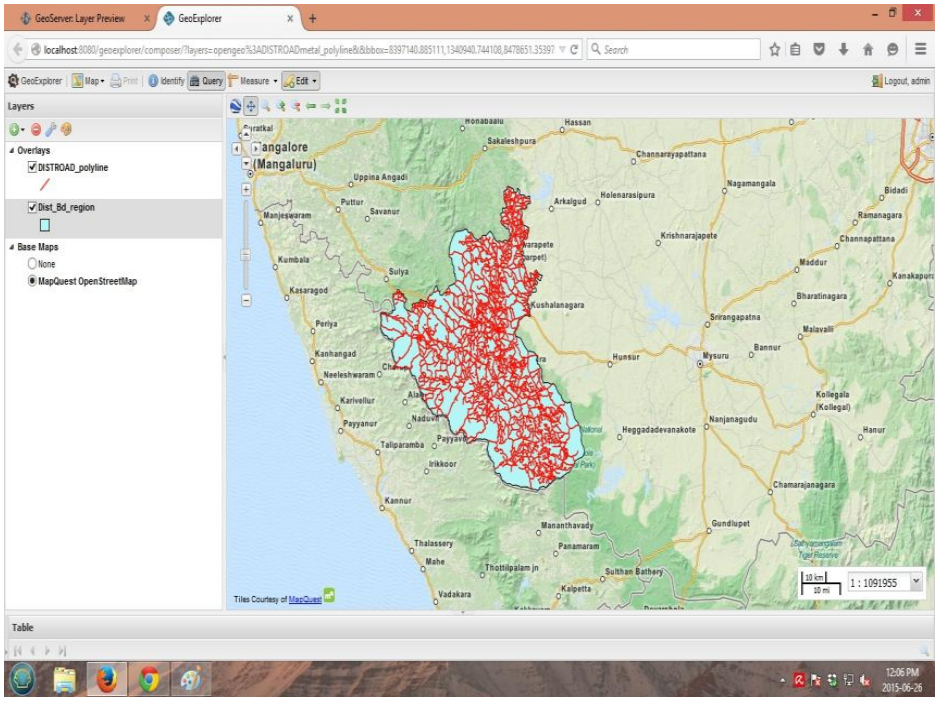

Figure 4.17 Road Network on Geoexplorer

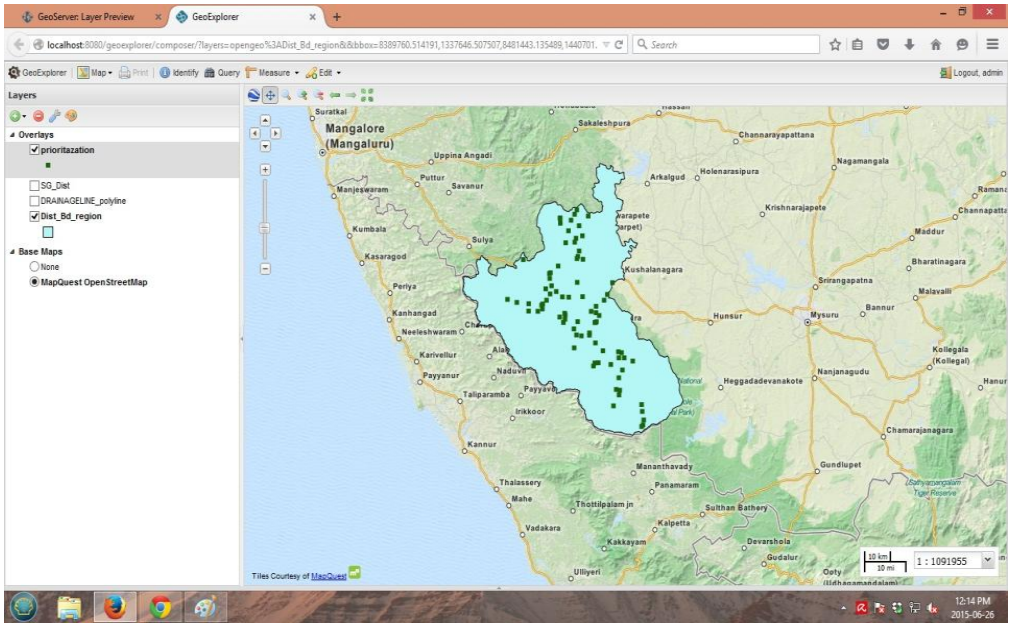

Figure 4.18 SG of Kodgagu in Geoexplorer

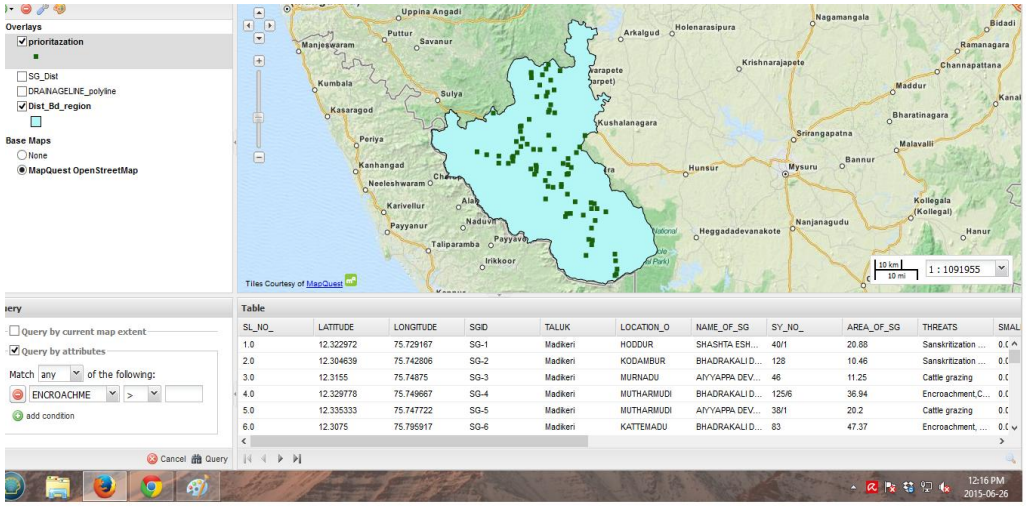

Figure 4.19 Query of SG prioritization in Geoexplorer

4.6 To estimate the ground water aquifer Recharge and Discharge

Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation. The ground water development in the district is 22.10%. The entire district comes under '**safe**' category. Though the district falls in the high precipitation zone 17 death cases were due to crop failures. Maximum farmers' suicide cases of about 11 have occurred in Somawarpet taluk followed by 5 in Virajpet taluk and 1 Madikeri taluk. (CGWB report -2013). The objective of research is to estimate the ground water aquifer recharge and discharge. This is objective is set to understand the dynamics of ground water recharge and discharge in entire the district and also to estimate temporal variation in ground water recharge pattern in different parts of Kodagu district. This section explains the effectiveness of the ArcGIS plug in tool for the quick estimation of groundwater recharge and discharge rates in different zones of the study area. The research has been carried out with two separate data sets which were obtained from Central and State Government Department for the different periods to assess the changing trend of ground water recharge and discharge rates as well as to visualize the respective zones.

The methodology and the assumptions prescribed in section 3.8 of chapter 3 is followed in order to estimate the ground water recharge and discharge rates.. Prograde GIS plug in is inbuilt with two tools such as PROGIS and Grade GIS which can be used for computation of ground water recharge and discharge rates. The three data sets such as I) Grids of bed rock elevation, ii)water table and iii) hydraulic conductivity were brought into the Grade GIS environment in raster format. These 3 raster Grid inputs were processed in Grade GIS and the estimates were drawn from each pixel. The result showed that the values ranges from –ve (which indicates discharge) to +ve value (which indicates recharge). These obtained values have been categorized based on the user

defined values into 5 zones (a) Very High Discharge (b) High Discharge (c) Medium Recharge (d) High Recharge (e) Very High Recharge zone.

i) Very High Discharge zone is the area or locations where the rate of discharge of water is very high whereas rate of recharge of ground water is very low. ii) High Discharge zone is the area or locations where the rate of discharge of water is high whereas rate of recharge of ground water is low iii) Medium Recharge zone is the area or locations where the rate of discharge of water is medium whereas rate of recharge of ground water is also medium) High Recharge zone is the area or locations where the rate of discharge of water is low whereas rate of recharge of ground water is high v) Very High Recharge zone is the area or locations where the rate of discharge of water is very low whereas rate of recharge of ground water is very High when compared to the other locations.

Grade GIS estimates area and the pixels cover of this area was counted for each zone for the year 2011 and 2014. The result showed that in a span of 3 years the ground water sources have undergone considerable changes in the rate of ground water recharge and discharge. It was analyzed that 37.38 and 115.4 sq km of area has been reduced to 0.74 and 30.3 sq.km for very high and high recharge rate, respectively. High discharge rate was increased from 135.1 to 198 sq km. Very high discharge rate was moderately decreased from 14.6 to 10.3 sq.km area and the most of the land i.e, more than 3700 sq km area out of the classified 4099 sq km in study area experiences medium recharge rate as shown in Table 4.37.

Table 4.37 Ground water Recharge and Discharge rate for year 2011 and 2014

Classes	Rate of Recharge/Discharge	Year -2011		Year 2014		Difference in the area (Sq.Km)
		No.of pixels	Area (Sq.Km)	No.of Pixels	Area (Sq.Km)	
1	Very high recharge	553	37.38	11	0.74	-36.64
2	High recharge	1707	115.4	448	30.3	-85.11
3	Medium recharge	56168	3797	57102	3860	63.14
4	High discharge	1999	135.1	2929	198	62.86
5	Very high discharge	216	14.6	153	10.3	-4.25
	Total	60643	4099	60643	4099	0.00

From the table 4.37 it is clear that in a span of three years of time, both 'Very high and high recharge rate' has been decreased whereas 'High discharge' rate has been increased and the land with these characteristics has been converted to area of 'Medium recharge' rate. The area belonging to this zone has increased by 63 sq km.

Only 4.25 sq.km of area shows decrease in 'Very High discharge' rate in a span of 3 years, this may be due to changes in land use pattern or due to some ground water development schemes adopted by the government.

The Grade GIS output image forms the input image for PROGIS. In order to generate 'Recharge and Discharge Maps' PROGIS made to work with 2D moving (generalization) image processing technique. In this, the image was processed to calculate the 2D avg. by following the 'Focal statistics method' which in turn resulted into the generation of ground water 'Recharge and Discharge zone Maps'. These maps were found to be useful for the identification of ground water Recharge and Discharge Zones as shown in Figure 4.18 and 4.19. The zonation map for both 2011 and 2014 was prepared which clearly depicts the rates of Ground water discharge and recharge. From

these maps it was found that in entire district ground water 'Recharge' is in medium rate and more Discharge can be found in Somvarpet and Madikeri taluks and comparatively less 'Discharge' can be found in Virajpet taluk. The recharge sites was found to be very less in 2014 image when compared with the 2011 image and the sites of discharge has been increased in 3 years and it is also observed that discharge is more near surrounding to Madikeri and Somvarpet towns and increase in Very high discharge zones was identified near Somvarpet town.

This result was also used to analyze the relationship between the SGs and based on the ground conditions various researchers as explained in chapter 2 reveals the association between ground water recharge and SGs which describes that the presence of SGs helps in ground water recharge.

In the study area almost all the villages are having at least one SG and this may be the reason for more than 90% of area of the district is having moderate amount ground water recharge rate and the district comes under "SAFE" category as per CGWB Reports. And the Figure 4.18 shows that even in the year 2014 discharge rate in VIrajpet taluk is considerably low when compared to Somvarpet and Madikeri taluk as Virajpet is having highest number of SGs (as per table 1.2) when compared to the other two taluks of the district. Even though the SGs present in all the villages of district, in certain areas the map shows the presence of discharge zones, which is due to the factors such as, the changing land use pattern or due to urban expansion explained in section 3.5.1 of chapter 3. This increase in discharge sites is may be due to deterioration in the size and number of plant species of sacred groves, to an extent that it has remained just as the symbolic representation of the SG, that has to be conserved so as to sustain the groundwater resources in good condition.

Based on the study it is evident that PROGRADE GIS is capable of computing and generating values of ground water Recharge and discharge which aids in ground water resource management. This kind of analysis can also be used as initial estimates for other modelling. This is also found to be cost effective when compared to the other

conventional techniques which use labor-intensive and time-consuming field recharge and discharge measurements. Figure 4.20 ,4.22 shows the ground water recharge and discharge pattern of Kodagu district for the year 2011 and 2014 and Figure 4.21 and 4.23 shows the presence of SGs in different with respect to ground water recharge and discharge for the year 2011 and 2014 respectively.

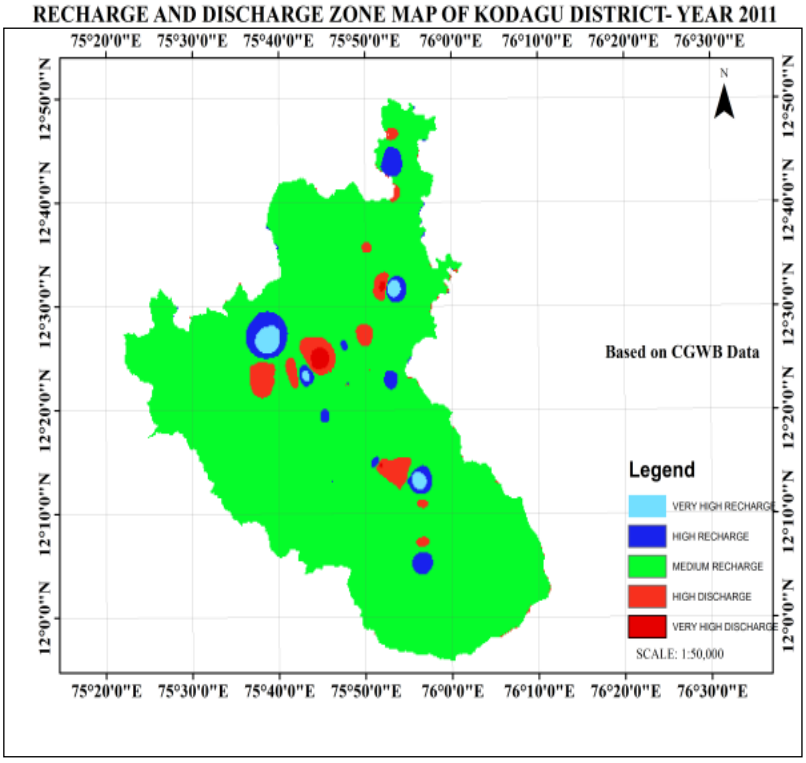

Figure 4.20 Recharge and Discharge Zonation Map for the year 2011

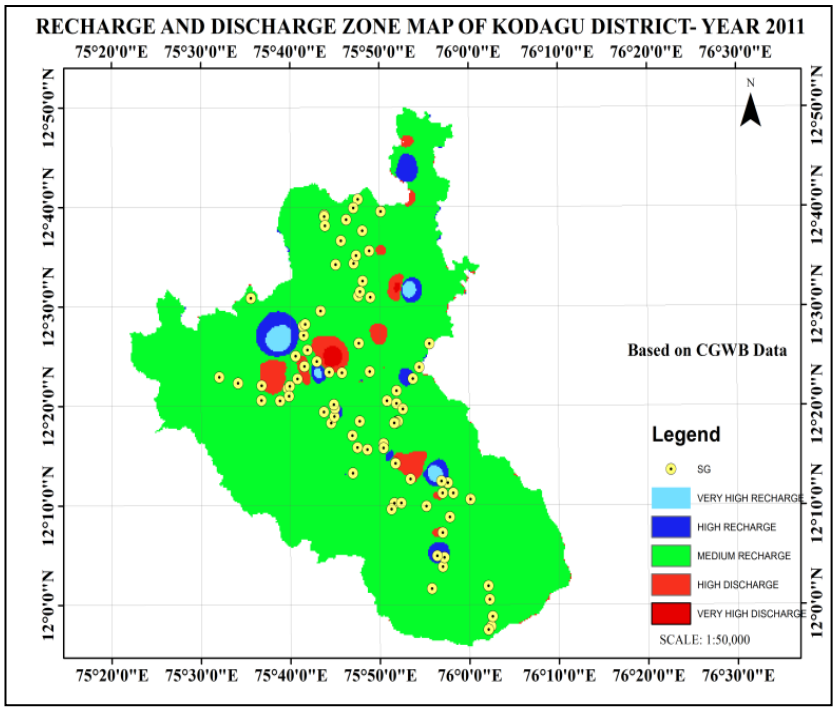

Figure 4.21 Distribution of SG, Recharge and Discharge areas for the year 2011

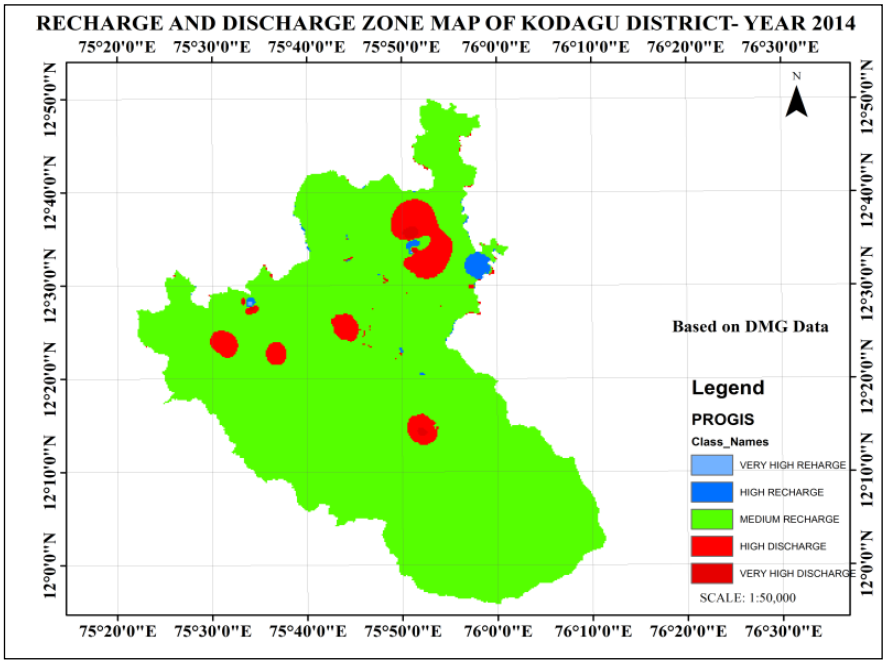

Figure 4.22 Recharge and Discharge areas for the year 2014

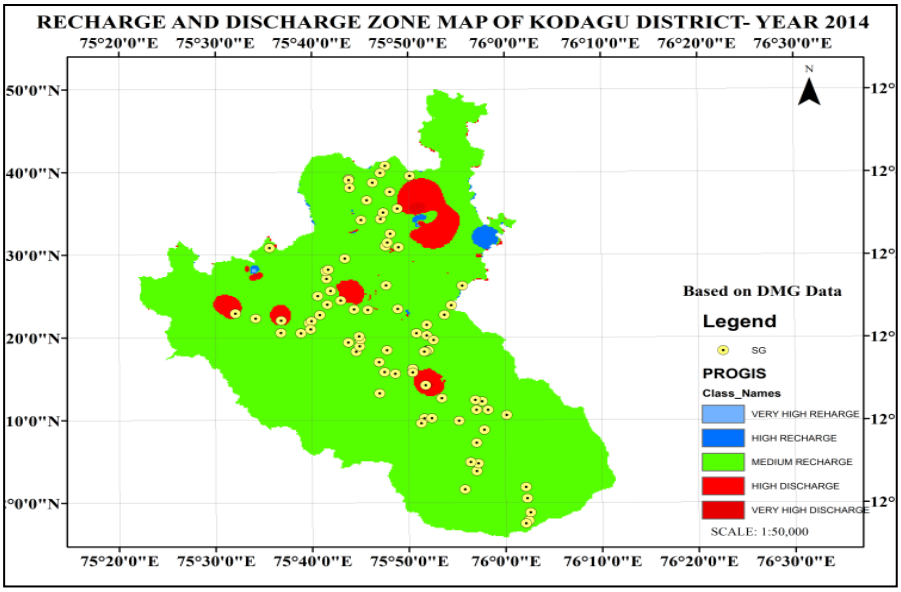

Figure 4.23 Distribution of SG, Recharge and Discharge areas for the year 2014

4.7 SACRED GROVE MANAGEMENT PLAN

To meet the goal of conservation based on the conservation status and prioritization and based on the problems identified in the field two categories of plan were developed such as General plans and Special Plans.

Sacred Grove Management Plan	
Sl.No.	**General plans**
1	Identification of SG, surveying and bringing it to the Governament records to avoid future manipulation records, and by bringing it to the knowledge of public thorugh a display board.
2	protection of the SG through fencing
3	The encroached land should be brought back to SGs through implementing new rules and laws
4	Regeneration of fauna of SG using only SGs species.
5	Documentation of Spatial and non spatial Information
6	Estmation of biodiversity and documentation of conservation concerned, endangered/threatened species
7	commercial plantations or planting social forestry from the forest department should be avoided in SGs
8	Digital records about should be made and should be brought into the GIS environment for conservation or to dessimination of data throughout the globe.
9	SGs should be managed by local SG Committee
10	Lawful management power of the SGs should be given to the local commmitte which should be under the control of the forest department to avoid the misuse of power by committee members
11	Sanskritization of SG should be discoraged isnstead nature worship should be encouraged with the help of the local SG committee.
12	Depending on the extent of the SG, local poor persons should be assigned with a job of gaurding the SGs and should be paid incentives
13	Illegal actions like theft of natural resources are to be penalised or punished according to the law

14	New legal policies should be framed which should involve the committee and forest department aiming for the protection from encroachers
15	Awareness about the ecological, hydrological, and economical value of SG should be spread among the youth as well as community people by conducting seminars and shows in schools, colleges and among local community
16	Study trips should be encouraged and allowed only for schools and colleges as well as universities so as to improve the research about SG and all the researches and findings should be collected and stored in the library of the forest departement, as well as with the committee, both in the form of soft and hard copy to avoid unncessary repetition of study of the single aspect by many researchers and to provide basement for conducting advanced studies.
17	SGs should be given for adoption for limited years for those who want to protect them and are willing to spend the necessary money required towrds the preservation action.
Sl.No.	**Special Plans**
1	SGs are considered as repositaries of rare and valuable medicianl plants also store houses of many economically important floral species. So the SGs which are open and where flora has been destroyed, there threatened plants should be regenerated.
2	Conservation Imporatnt plants should be identified and the board should be displayed about the importance of the particular species in oder to protect it.
3	Cattle grazing should be avoided as it diminishes the microflora which is very important for the survial of many micro faunal species.
4	The saplings of SGs species should be provided instead of other species, as SG species are good in carbon sequestration as explained in chapter 2.
5	Awareness should be brought among the local people also about the conservation status of trees and their biodiversity values
6	Publicity should be given in media about the protection of the SGs and the organisations or schools/colleges which volunteer the conservation action of the particular SG should be encouraged.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 GENERAL

The study reveals that SGs are of immense value as they safeguard many conservation concerned species and Medicinal and traded medicinal plants and. From this it is evident that SGs protect biodiversity. The non spatial data in the Geodatabase shows that SGs symbolizes the cultural diversity and richness of the study area, and that they provide ecological services and help to maintain social harmony with the different communities. The presence of SGs indicates that tradition of SGs is still alive in the study area and is maintained by local committee and which preserved mainly due to cultural beliefs. But the present scenario reflects that the SGs can not be maintained based on religious belief only, human population and other anthropological activities caused SGs to face many a types of threats.

5.2 SUMMARY AND CONCLUSIONS

- Aiming for conservation and sustainable management of SGs, the study was carried out for randomly selected 85 SGs of Kodagu district and the following conclusions are drawn:
- SG geodatabase was developed for 2831 individuals of flora and fauna.
- Among the total floral species, 80%, 89% and 81% were medicinal plants in Madikeri, Somvarapet and Virajpet taluk respectively.
- Out of the 5 ecological indices studied, in SGs of Virajpet taluk it was found that Shannon-Wiener's index (H) is 4.22 for trees, 3.60 for medicinal plants and 2.26 for animals, which is the highest when compared to the other taluks which makes it clear that floral diversity and abundance is more in this taluk.

- Prioritization process of SGs and the results of ecological indices show that severity of threats is low in Virajpet taluk; as out of 29 SGs studied, 21 SGs face moderate threats. No SG of this taluk falls under extreme threat category.
- LULC classification shows decrease in the extent of SG, dense forest, scrub forest and increase in built up land.
- NDVI analysis shows that, 177 sq km of area of vegetated land has been decreased and the same has been converted into unvegetated land.
- The results of ground water recharge and discharge estimation shows that, in a span of 3 years i.e, from 2011-14, the rate of very high recharge and high recharge has decreased from 37.38 to 0.74 sq.km area and discharge rate has increased from 135.1 sq.km to 198 sq.km. The zonation map clearly shows the absence of high discharge zone and presence of high to medium recharge zones surrounding the SG location. This proves that SGs helps for the recharge of ground water.
- Application of OpenGeo suite for web based SGIS proves that open source extension of GIS is user friendly, economic as well as easy to handle and manage data of SG which is stored in SG Geodatabase.
- These above findings have resulted in development of SGMP which can be used by people of different sectors from policy makers to folk in order to conserve SGs.
- Based on all the above facts, it is clear that use of RS and GIS with its advantage to capture, store, manage, manipulate, and analyze the spatial as well as non spatial information of SG, is need for the hour as the technology supports the various aspects needed for the conservation and management of SGs. The technology and its tools should be made use of because they are perfect for the management of vast amount of data in an economic way and help to bring out the effective strategy plans in order to conserve the age old tradition.

5.3. LIMITATIONS OF STUDY

- Out of 1412 SGs of the district only 85 SGs has been considered for the study assuming the SGs of the district will not vary much in social, cultural, ecological or biological values
- NDVI analysis has been carried out only to measure the vegetation and types of vegetation based on the NDVI values has not been assessed.
- SGIS has been developed by using Open source GIS software rather than using any other software programme, as dissemination of data and assessing the applicability of GIS was main concern of the research.
- Estimation of Ground water discharge and recharge has been carried outand has been validated based on the findings of CGWB rather than any model due to non-availability of validation models.

5.4 SCOPE FOR THE FUTURE STUDIES

- Further detailed studies of all 1412 SGs of the district are necessary to conceptualize the conservation and sustainable management.
- Biodiversity of these SGs has to be fully explored and assessed as these SGs may reveal many species of biological and conservational importance.
- Prioritization of all SGs has to be found out and awareness has to be spread which aids the conservation process.
- Scientific studies have to be conducted about the role of SGs in enhancing soil fertility, carbon sequestration and there by maintaining ecological balance.

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