Introduction

Forests the main body of the terrestrial ecosystem, is a complete natural resource base, a stock of assets, serving as a source of scarce inputs that can yield utility through production or provision of goods and services. Forests are regulating climate, ameliorating weather pattern, regulating the hydrological cycle, protecting watersheds and vegetation, water flows, soils and providing a deluge of genetic information much of which has yet to be uncovered. The physical, chemical and biological environments of tropical trees are altered considerably over the recent decades. The increasing demand by human population has greatly threatened the forests and resources associated with them all over the world. For instance, between 1990 and 2000, the largest percent destruction of tropical forest occurred. It is a fact that more than 99% of the protected areas of the world are experiencing serious threats, including poaching, encroachment, agriculture, ranching, urban development, illegal and legal logging and collection of non timber forest products, pollution in environmental systems and global climatic changes. The forest fragmentation and increasing fire frequencies in Western Ghats are due to intensive human pressure. The increasing biotic pressure has led to the occurrence of forest fires, which resulted in fragmentation and degradation of the area and many of these fragmented forest landscapes are in highly endangered status and provide alarming signals of accelerated biodiversity loss. Soil erosion due to climatic as well as forest disturbance is on the increase in western ghats region. Forest cover change of Western Ghats region is quite considerable due to anthropogenic and natural reasons and this will lead to forest degradation.

Study area
Agasthyamala Biosphere Reserve (ABR) was notified on 12th November 2001 under UNESCO’s Man and Biosphere Programme. The Biosphere lies Between 8° 8’ to 9° 10’ North Latitude and 76° 52’ to 77° 34’ East Longitude. The ABR falls exclusively in Kerala covering an area of 1701 sq.km. The forest tracts of Neyyar, Peppara, Shendumey wildlife Sanctuaries and Achencoil, Thenmala, Konni, Punalur, Thiruvananthapuram Divisions and Agasthyavanam Special Division are included in ABR. Agasthyamalai Biosphere Reserve straddles the border of Kollam and Thiruvananthapuram Districts in Kerala and Tirunelveli and Kanyakumari Districts in Tamil Nadu, at the southern end of the Western Ghats. Agasthyamala, situated at the southern most end of Western Ghats is very unique in floristic wealth with a very rich and diverse vegetation, having high concentration of endemism. The
intensive field study as part of the present work was carried out in three sanctuaries. This include Neyyar (128 km²), Peppara (53 km²) and Shendurney (171 km²) wildlife sanctuaries located in Agasthyamala Biosphere Reserve. The average annual rainfall in the area is 1800-3000 mm with a dry season lasting for only one to two months. Major vegetation types of the study area include west coast tropical evergreen, southern hilltop tropical evergreen, west coast semi-evergreen, southern moist mixed deciduous forest, and Myristica swamp forest. Different types of flora and fauna are present in the study area. Ecological, economic and landscape beauty of the study area are the other attractions.

Present study
General objective

The general objective of the study is to characterise different forest degradation factors of Agasthyamala biosphere reserve of Western Ghats and to identify the vulnerable areas of different degradation factors and their effective Management. Five specific objectives are spelt out for the geospatial characterization of Agasthyamala biosphere and their management.

Specific objectives
The specific objective of the study include:

1. To analyse the forest cover change for the period 1973 – 2009.
2. To analyse soil erosion assessment and identify erosion prone area
3. To identify forest fire risk area and there management
4. To analyse the landscape ecological parameters and identify forest disturbance zones
5. To analyse the phytodiversity of the study area

Methodology
Extensive field survey was carried out and monthly observations were made in all the three study areas for a period of three years from November 2007 to October 2010. Detailed field notes were prepared covering aspects such as location name and geographic coordinates,
habitat system, degradation system, landcover of the area, trek path, settlement, fire affected area etc. Exact geographic coordinates of different spatial structures were recorded using a handheld GPS receiver. Spatial and temporal data such as drainage, contour, boundary, rainfall, temperature, humidity, litter density etc were collected for analysis purpose. Thirty six years of monthly data was analysed for the preparation of temperature, rainfall and humidity map. Multi-spectral remote sensing images captured by the MSS, ETM, TM and LISS III sensors of Landsat and IRS-P6 satellite were used to map the spatio-temporal variation of forest cover in different time periods of the study area. Phytodiversity assessment was done with the help of quadrate method of data collection and analysis techniques. Different types of diversity and dominance were analyzed and identified top five species in different forest types based on the Important value Index. For the identification of forest cover change, geographic analysis was carried out. Fuzzy based multicriteria analysis technique was used for the identification of forest fire risk area. For the identification of soil erosion prone area and soil erosion quantification, Universal Soil Loss Equation and multicriteria analysis was carried out. For the identification of forest disturbance area, landscape based expert analytical hierarchical process in conjunction with GIS analysis was employed. Image processing was done in ERDAS Imagine, landscape analysis was done with the help of FRAGSTAT software and the GIS analysis was done in ArcGIS software.

Results

The present study has identified the different threats to the forest ecosystem in Agasthyamala biosphere reserve. One of the important threats to the Agasthyamala biosphere reserve is the land cover change leading to deforestation. During the last 36 years (1973 – 2009) the extent of west coast tropical evergreen forest has decreased and the extent of grassland and southern dry mixed deciduous forest has gone up. This change is mainly due to the lack of conservation measures and anthropogenic activities. Occurrence of forest fire in this region also contributes to forest degradation. The geospatial characterization of soil erosion and identification and quantification of erosion prone area will be helpful in the sustainable management of forest ecosystem. The average annual soil loss of this area is 200 (tons/ha/Yrs). The soil erosion prone area maps show that only a few areas experience severe erosion. Deforestation and forest fire are found to accelerate the rate of soil erosion.
The change in the climatic factors and slope instability are also contributing to the erosion vulnerability of the area. Geo spatial characterization and identification of forest fire prone areas will be useful for the management of forest fires. The management strategies employing geospatial tools can reduce the severity of forest fires and reduce the extent of reduction of forest fire affected area.

The forest fire risk area map shows four classes including low, medium, high and severe. The present study has resulted in the identification of a suitable location for the construction of forest fire watch tower and check dam that are management strategies for controlling forest fires. The most important factor that contributes to the fire risk is anthropogenic activities. Forest destruction, climatic variation change in the land cover etc will increase the chance of occurrence of forest fire. The construction of forest fire watch tower will help the early identification of forest fire and its management. The study shows that geo informatics is a useful tool in the identification of fire risk areas and management of forest fires.

Forest disturbance analysis has become a pre –requisite for any forest management activity. The analysis of different landscape ecological parameters is useful for the identification of forest disturbance zones. Landscape ecological parameters provide a detailed account of the structure of the forest landscape. In high forest disturbance region, the anthropogenic activities and occurrence of forest fire and forest degradation is high. Most of the study area lies in medium disturbed zone. Proper management of landscape is needed for the reduction of forest disturbance, and thus ensuring the health of forest landscapes.

The phytodiversity assessment of the study area reveals that the maximum number of species belongs to southern hill top tropical evergreen forest followed by west coast evergreen forest. The stand density was found to be higher at southern hill top tropical evergreen forest. Shanon diversity index is also higher at southern hill top tropical evergreen forest. The west coast semi evergreen forest is found to have higher average basal area. Simpson index of diversity is also higher in southern hill top tropical evergreen forest. Simpson Index of dominance has a higher value in southern dry mixed deciduous forest. The phytodiversity assessment will provide information about the structure of the ecosystem. The study area is found to have fairly good diversity of plants.

Forest fire, forest cover change, soil erosion, forest disturbance and lose of diversity have a direct link between each other and the occurrence of any one factor will have a deteriorating