CHAPTER 6
SUMMARY AND CONCLUSION

Land is the primary resource base of the earth and it acts as a medium for human activities. It consists of crucial components which exhaust over space and time. Land has been transformed through temporary or permanent changes in its productive capacity mostly in highland regions by the influence of natural and cultural forces. Evidences show that the changes occurred in highland region led to land degradation. Hence it is necessary to evaluate the land use changes over time, the nature and extent of degradation of land, and the causes underlying the degradation with a view to environmental management.

Land is essential for the existence of life and is under tremendous stress due to ever increasing biotic pressure. In order to make suggestions to reduce the pace of degradation of land it is imperative to know the processes, physical or cultural, which are operating over the area that causes for the degradation of the land. Conservation of land is the prime requisite for sustainable development of any region.

Land degradation is not a recent phenomenon; it started whenever human beings hindered the natural environment on various amounts. Men opened the wilderness, nurtured new crops by clearing land surrounded by dense jungle. Arab connection to India has lead to the beginning of plantation history in Kerala. The first mention of a ‘plantation’ in south India was by Dr. Fancis Buchanan, who explored the land profile for future planters. With the struggle of pioneers, each cleared the jungle, built roads, altered the fast flowing rivers and established new townships. In Idukki, tea is the single largest plantation crop in Kannan Devan hills and areas west of Vandiperiyar, where the Anaimalai hills slope steeply to reach the plains in Idukki. Mundakkayam is noted as the home of Indian rubber with the advantage of surface topography.

Idukki, the greenest land in South India, which was once governed by dense jungles now has yielded its acres to man willing to co-exist with nature. Formerly there was lesser population density; there were a few hundred tribes, a
few thousand seasonal workers and a few dozen British Planters. Today population increased to form permanent population, who established villages, townships and towns. Early planters cleared hilly tracts, dense jungles and malaria infested marshes and developed them into giant estates of today.

Present investigation, mainly purported to examine land degradation in Idukki has made an attempt to analyse the interaction between physical and human elements on land use / land cover in the district. This region was selected because of its totality of the environment which comprises luxuriant growth of vegetation, landforms, drainage, rich soil conditions, wild life sanctuaries and hill stations characterised by amplitude of anthropogenic activities. The early history of Idukki district is quite ambiguous and unclear because of lack of evidences.

The modern history of Idukki district started with the advent of European planters, migrants from the surrounding districts and people from adjoining states to the unexplored areas of thick forests. Europeans and indigenous planters were the first migrants to the highland region causing destruction of dense forests with the development of agriculture, construction of hydroelectric projects, roads, settlements, and tourism. Agricultural intensification induced the application of high yielding variety crops and use of fertilizers. The present investigation revealed that the productivity has considerably declined in many areas and this gives the indication of land degradation. Though a number of studies were conducted on land use / land cover changes in highland, yet investigations on land degradation is limited in nature.

By considering all these aspects the investigation was directed to analyse the spatial and temporal changes of land use / land cover, the degree of vulnerability of the study area to land degradation, the extent of land already degraded and to suggest recommendations for the arrest of further degradation of the land.

The present investigation has been reported in six chapters. Introduction, conceptual background, studies on land degradation, study area, objectives, hypotheses, materials and methods, sources of data, analytical techniques,
organisation of the thesis and limitations of the investigation are explained in first chapter.

The Idukki district situated in the southern part of the Indian peninsula, forms one of the 14 districts of Kerala with a total geographical area of 4358 Km\(^2\) which is 11.2% of the total area of the state. It encompasses 52 panchayats and one municipality. Physiographically, the district falls in the midland and high land portion of the state. About 24% of the study area has an elevation of above 1200 metres and 56% of the total area falls between 600-1200 metres above mean sea level. More than 40% of the study area has a slope between 15\(^0\) - 40\(^0\) and above. More over 41% of the study area has a relative relief between 10-20 metres.

Idukki district generally experience a tropical humid climate. However areas situated at high altitudes have a cool temperate climate. The average temperature of the study area varies between 21\(^0\) C - 27\(^0\) C. The mean monthly maximum temperature ranges from 25.1\(^0\) C – 31.5\(^0\) C and mean monthly minimum temperature between 18.6\(^0\) C to 14 \(^0\) C. The estimated average annual rainfall of the district is 280 cms. As in most parts of Kerala, about 60% of the total rainfall is received during the south west monsoon period (June-September). Analysis of climatic data as well as discussion with the elder population of the district revealed that the climate of study area has undergone tremendous changes during the last 50 years. The groundwater regime fluctuates widely since the area experiences seasonal variations in climate. During the periods of pre monsoon and post monsoon, the level of groundwater fluctuates in east and west of the region.

Idukki district is constituted by portions of Periyar, Muvattupuzha, Pambar, Pamba, Manimala and Meenachil watersheds. The Periyar, Mulla river, Panniar, Thodupuzha river, Karinthiri river, Manimala river, Muthira puzha, Pambar river, and Pamba river are the major streams flowing through the study area.

Geologically, the district mostly consists of Charnockite, Migmatite, Peninsular Gneissic and acidic rocks of Achaean age. The geomorphology of the
region exhibits denudational hills, dissected plateau and valleys in all directions. About 63% of the study area has denudational hills, 19% dissected plateau and the remaining area exhibits lateritic plateau, valleys, reservoirs, islands and river channels. The relief, lithology and climate perform significant role in their process and development. The landforms are evolved by a combination of processes over the centuries.

The region is blessed with vastness of vegetation which are categorised into tropical evergreen, semi evergreen and deciduous in highland region. Although the region was formerly supported by virgin tropical forests, the natural vegetation is getting depleted every year with the conversion of forest land into plantations, estates and agricultural fields.

An analysis of the erosion proneness of the study area indicates that 24% of the total area in the district has very high erosion proneness, 33% has high, 27% has moderate and rest have low erosion proneness. Subsequent investigation has shown that 39% of the area suffers from moderate to severe soil erosion and 56% has moderate erosion.

The Idukki district has a population of 1,108,974 as per census 2011. The study area has registered a growth of -1.79%, ie the total population decreased from 11,29,221 in 2001 to 1,108,974 in 2011. This was exclusively due to the out migration of younger generation to the nearby urban centres due to the expansion of urbanisation in those areas. However it is to be noted that during the last 100 years, the population in the district has increased more than 23 times from 47666 in 1901 to 1,108,974 in 2011. The average population density of the study area was 11 persons / km$^2$ in 1901, but it has increased to 254 persons / km$^2$ in 2011.(Census 2011)

About 87% of the operational holdings in the district has less than 1 hectare in area whereas less than 1% has more than 10 hectares. Around 56% of the total cropped area of the district is occupied by food crops and 44% of the area devoted to non food crops. The percentage area under cultivation has considerably increased during the last 50 years at the expense of deforestation.
The various portions of the district are connected with national highway, state highway, district roads and panchayat roads. It has been noticed that more than 300 stone quarries are located in the various parts of the district.

THUS THE FIRST AIM OF “THE STUDY OF BIO-PHYSICAL AND CULTURAL ENVIRONMENT OF THE STUDY AREA HAS BEEN FULFILLED”.

THUS THE FIRST HYPOTHESIS THAT “THE GROWTH OF POPULATION HAS SIGNIFICANTLY ALTERED THE PHYSICAL ENVIRONMENT OF THE IDUKKI DISTRICT” HAS BEEN ESTABLISHED.

The study has brought out the magnitude of land use / land cover changes in the study area. The cause of the major changes in land use was the rapid growth of population by way of migration from nearby taluks as well as from adjacent states in the early decade of 20th century due to the introduction of plantation agriculture in the district. The natural growth of population in the subsequent decades also significantly altered the land use / land cover of the area for the construction of settlements, expansion of agricultural lands and for the development of infrastructure. Comparing the land use map of 1973 and 2011, a general picture of the major changes in the land use could be discerned. The simple and ecologically balanced land use practices which were followed till recent past has transformed in to a highly diversified one. Considerable progress was witnessed among built up areas, mixed crops with settlement and scrubland in Idukki district. Built up area has increased from 0.99% of the total area to 7.04%, mixed crops with settlement from 27.91% to 30.57%, and scrubland 2.35% to 2.61% between 1973 to 2011. Furthermore, a little increase has been seen in the plantations like eucalyptus 3.26% to 3.44%, rubber 1.55% to 2.18%, and teak 0.94% to 1.29% during the period. Comparative analysis of land use / land cover has shown decrease in area in the categories of forest cover, open forest and plantations like tea and cardamom. Forest cover has drastically decreased from 23.14% to 16.17%, open forest 12.80% to 7.85%, tea 6.89% to 5.78% and cardamom 9.32% to 7.24%, whereas five times increase noticed in scrubland
(2.35% to 12.61%) and grassland from 3.05% to 3.30% during investigation period.

THUS THE SECOND AIM OF THE INVESTIGATION TO “ASSESS THE TEMPORAL CHANGES OF LAND USE / LAND COVER OF THE STUDY AREA” HAS BEEN FULFILLED.

THUS THE HYPOTHESIS OF THE INVESTIGATION “THE LAND USE PATTERN IN IDUKKI DISTRICT IS HIGHLY DYNAMIC IN NATURE” HAS BEEN PROVED.

Degradation of portions of land in the Idukki district could be delineated through the study. About 14% of the forest have been degraded due to the deforestation occurred between 1973-2011. Another 14% of the area was degraded due to the destruction of the virgin land for the development of infrastructure and for mixed crops in the district. Degradation is progressing in the other 12% of the area due to unscrupulous activities of man in connection with the expanse of agricultural land in the form of plantations, mining activities and tourism.

THUS THE THIRD AIM TO DELINEATE THE DEGRADATION PORTION OF THE STUDY AREA HAS BEEN FULFILLED.

THUS THE HYPOTHESIS OF THE INVESTIGATION “THE ENSUING LAND USE PRACTICES IN IDUKKI DISTRICT ARE NOT IN RESILIENCE WITH THE NATURAL ENVIRONMENT OF THE AREA AND THE LAND USE PRACTICES FOLLOW IN IDUKKI DISTRICT CAUSES DEGRADATION TO THE LAND” HAS BEEN PROVED.

Based on the assessment of slope, drainage density, vegetation cover, population density and literacy an attempt has been made to understand the degree of vulnerability of the land comprising Idukki district. The analysis revealed that 18% of the total area of the district comprising Azutha, Devikulam, Elamdesom and Kattappana blocks are severely vulnerable to land degradation. About 44% of the study area comprising Azutha, Devikulam, Idukki and Adimali blocks has
been delineated as a zone highly vulnerable to land degradation, whereas 29% of the area included in Azhutha, Devikulam, Adimali, Nedumkandam and Idukki blocks and 9% of the area formed by parts of Azhutha, Idukki, Kattappana, and Thodupuzha blocks have moderate and low vulnerability respectively.

THUS THE FOURTH AIM “TO UNDERSTAND THE DEGREE OF VULNERABILITY OF THE AREAS TO LAND DEGRADATION WITHIN THE STUDY AREA AND CLASSIFY THEM HAS BEEN FULFILLED”.

6.1 RECOMMENDATIONS

Considering the vulnerability to land degradation of different parts of Idukki district and their consequences to land, the following recommendations were made:

- Administrative measures may be imposed for delineation of fragile areas and proper land use practices may be introduced for the sustenance of the land.

- Land development measures like soil and moisture conservation, contour bunding, bench terracing and afforestation on hill slopes may be initiated.

- Since the primary forest cover is relatively low and exists only on hilly tracts, it is necessary to initiate measures for regeneration of secondary forest on degraded land with the help of local people to stabilize the forest cover.

- Measures should be taken for cultivation of ecologically adapted crops on slopes.

- Plantation agriculture in Idukki dominated by monoculture of different species adversely affects the land quality. Hence it is essential to protect with naturally occurring species in some of the areas.

- Major part of the study area experienced high drainage density ranging between 3 - 4 Km/Km². Hence it is necessary to construct check dams
along river course and treatment of drainage lines with a combination of vegetative and engineering measures.

- Agro forestry, a way to manage diverse ecosystem in the study area spatially and specifically, can promote integrated tree-crop production thereby enhancing the sustainability of soil and reduction of soil erosion in the fragile areas.

- Hill crests may be protected because these areas were completely cleared for construction as part of tourism activities, consequently little chance for natural flow of streams which results in sliding of side slopes and ultimately to land degradation.

- Quarrying areas have increased in the investigating period, hence it is essential to regulate the further use and make use of the abandoned quarries for rain water harvesting and for pisciculture.

- Soil conservation measures have to be adopted for conserving the soil regime especially in the tribal areas with the assistance of central and state governments.

- Ensure awareness to people to protect the land for sustainable use and regulate the concentration of people and structures on ecologically sensitive areas.

THUS THE HYPOTHESIS OF THE INVESTIGATION “AN EXERCISE TAKING IN TO CONSIDERATION OF PHYSICAL AND CULTURAL FACTORS WOULD HELP THE RESEARCHER TO DELINEATE AREAS WHICH NEED IMMEDIATE ATTENTION TO PRESENT LAND DEGRADATION AND TO MAKE SUGGESTIONS FOR THE IMPROVEMENT OF THE AREA” HAS BEEN ESTABLISHED.
6.2 SCOPE FOR FURTHER STUDY

The present investigation is restricted to the Idukki district, one of the highland districts of Kerala State. Similar studies or investigation may be extended to the other highland districts of Kerala as these studies will provide more information on the physical as well as cultural processes that cause degradation to the highlands in Kerala. Such studies will help in the formulation of appropriate measures and policies for the sustainable development of natural resources of highland region of the Kerala State.