

**INTER-WATERSHED COMPARISON OF THE EXISTING LAND USE
PATTERN – A CASE STUDY OF SOUTHERN SIKKIM, INDIA**

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ABSTRACT

The State of Sikkim has always drawn attention of natural and social scientists as well as fascinated general people for its uniqueness in terms of location, physiography, climate, biological richness and almost every features of this region. Small but beautiful, Sikkim situated in the lap of Eastern Himalayas spreads below the world's third highest mountain Kangchendzonga (8585m). Sikkim is separated by the Singalila range from Nepal in the west, Chola range from Tibet in the northeast and Bhutan in the southeast. Two features of Sikkim, the fragile mountain environment and the very rapidly growing population, are crucial in formulating future land use planning. The objective of the study is to find out the land use types of the three southern districts of Sikkim, and to compare and analyze the problems and prospects of the land utilization with special reference to the five sub-watersheds which the area comprises of. As it portrays significant characteristics, a comparative analysis of the land use types in the three districts of the southern half of the state and their consequent problems and prospects, has been approached as the theme of study. Suitable planning of land use with reference to the nature of land and needs of the community would provide maximum returns of optimum land resources. Thus, the planning of area development can be best tackled on the natural drainage unit that is the 'watersheds' with a view to develop resources in such a manner so as to provide maximum benefits to the people by maintaining ecological balance through continued long-term efforts and commitments.

KEY WORDS: Fragile environment, sub-watersheds, optimum land resources, ecological balance, degraded land cover.

INTRODUCTION

Sikkim is a small mountainous State situated in the lap of the Himalayas whose modern origin dates back to only 1642 A.D. when it was ruled by its first monarch. The territory of Sikkim was extended up to Limberwan in the west, Chumbi valley and parts of Bhutan in the east, and the entire Darjiling district in south. As per the treaty of India and Sikkim, which was signed in 1950, the Indian Government took over the administration of the Sikkim. However, Sikkim became the 22nd state of Indian Union on 16th May, 1975. The State is situated between 27°04'46" and 28°07'48" North latitude and 88°00'58" and 88°55'25" East longitudes. The state extends approximately 114 km from north to south and 64 km from east to west with a total geographical area of 7098 sq. km. Rivers and mountains define the boundaries of the state. The state has four districts and the districts are divided into nine sub-divisions. Almost half of the state is occupied by the north district and falls in the Greater Himalayan Zone, making the area inaccessible. The state is drained by the river Tista and its tributaries. The Southern half of Sikkim constituting of the districts of East, West and South Sikkim can also be broadly divided into 5 sub-basins or watersheds. These watersheds are the areas drained by

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the respective rivers and their tributaries. The Southern half of Sikkim is the most diversified area in respect of the varied physiographic, climatic and socio-economic features. All these have a genuine reflectance on land use pattern in the region. There are reserved forests, sanctuaries as well as sprawling human settlements and the imprints of their wide-ranging socio-economic activities, as untiring human efforts has been rapidly changing the natural landscape – turning the once most hostile and isolated area into a hospitable habitat.

Sikkim, the most diversified state of India in the Eastern Himalayas, is encircled by steep mountains and deep valleys. It roughly lies between latitudes 27°5′N to 20°9′N and 87°59′E to 88°56′E longitude covering an area of about 7100 sq.km. The state constitutes 0.22 percent of the total area of India. Almost half of Sikkim is the North district and is included in greater Himalayan zone, mostly an inaccessible area and remains snow capped almost all throughout the year, the Southern slope of the state is under South, East and West districts and lies in the lesser Himalayan zone. It is wedged between Nepal in the West and Bhutan in the East and China in the North and Northeast. Sikkim is naturally separated from Nepal by the Singalila Range in the West, from Tibet by the Chola Range in the Northeast and also from Bhutan in the Southeast. Essentially, a mountainous state without flat piece of land, Sikkim encompasses the lesser, central and the Tethys Himalaya. It is deeply cut into steep escarpments and leaving a few pocket zones, it is not populated.

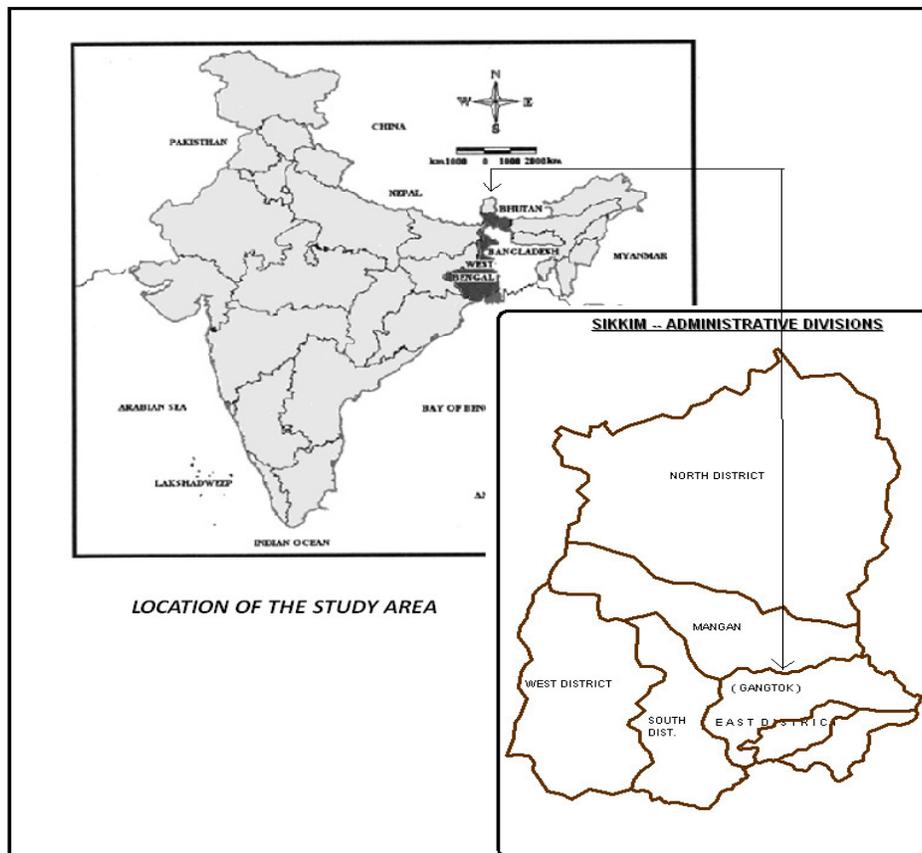


Fig. 1: Area of the Study – a brief Geo-environmental reference

In comparison, the southern Sikkim is more open and fairly well cultivated and since long, this portion is attracted by men and been configured for infrastructural uplift especially for economic and cultural renovation. The Southern districts contain more than 90% of the total population of the state. Hence these districts have large variations in land use patterns, great development of urbanization and ultimately a sprawling ground of multifarious problems in land use pattern and adverse effects on environment. This portion is formed of comparatively non-resistant, thin, slaty and half-schistose rocks which denudes rapidly. The study area is environmentally configured by the alignment and direction of the main drainage system i.e. the Tista and the Rangit, which form the main channels of drainage. The valleys cut by these rivers and their chief feeders are steeply dipping to the valleys. The southern part experiences heavy rainfall due to its proximity to the Bay of Bengal. To ascertain and distinguish the study area more rationally it has been divided into five sub basins viz. Upper Rangit, Lower Rangit, Lower Tista, Rongni Chhu and Rangpo Chhu.

OBJECTIVES, METHODOLOGY AND HYPOTHESES

The southern district of Sikkim is the most important area in terms of livelihood and habitation as well as from the view point of the existence of the natural resources of the area. The north district is extremely rugged and almost inaccessible; hence apart from the presence of picturesque landscape, it is less important from the view point of the imprints of human intervention which are most active in the southern part. The region is a biological hotspot. This has drawn people from time to time resulting in a wide range of alteration of the natural landscape. All these have culminated in varied land utilization pattern in the area. There are reserved forests, sanctuaries as well as sprawling human settlements and the imprints of their wide-ranging socio-economic activities.

Hence the objective of the study is to find out the: (1) Land use types of the three southern districts of Sikkim, and (2) To compare and analyze the problems and prospects of the land utilization with special reference to the five river basins which the area comprises of. So, the major hypotheses are to be assigned that the studied sub-watersheds are appearing as major units which represent varied geo-environmental phenomena and all those aspects are major controlling factors for varied land use pattern and change. In sight of the objectives of the study, some apposite secondary data have been collected from suitable sources. Finally, a number of modern and interactive techniques have been applied to analyze and interpret these data to make inferences of the study. Modern mapping tools and techniques have also been used to represent the data and to prepare the interactive maps of the area to make the study empirical.

OBSERVATION AND ANALYSIS

Land Use Pattern in the three Southern Districts Of Sikkim:

Before approaching the land use structure of an area, it is vital to understand the significance of land. It is a fundamental component of the environment, as it executes a highly sensitive system which provides the means of sustainability to almost all forms of life on earth. Hence, for any region, there should be enough attention from the concerned authorities and general mass towards this vital component of nature.

TABLE -1: EXISTING STATUS OF LAND

Land category In Hectares	East	West	South	State
Geographical Area	95400	116600	75000	709600
Net Sown Area	18122	166230	17552	620425
Fallow Land	7849	12239	8966	34651
Land not available For cultivation	4871	3392	2708	12504

Source: Land Utilization Statistics of Sikkim, Dept. of Agriculture, Govt. of Sikkim

Sikkim presents a unique bio-geographical region which is unparalleled in terms of every respect starting from its situation to each single component of its natural and human environment, possibly in the whole world. Terraced cultivated fields interspersed with streams along with bamboo and tree groves are the areas where the traditional hill agriculture is confined, to the elevations of 2000m. There are mountains and hills apart from growth of dense covering throughout huge parts of the state; this gives very less land for cultivation. Thus, only 15.37 percent of land is available for cultivation. The cropland area both irrigated and non-irrigated occupies about 55.57 percent of the total cultivated land and only 8.54 percent to the total geographical area. The forests cover the bulk about 82.32 percent land of the state. Only 17.68 percent of the area is available for other purposes of habitation as well as for cultivation. The following diagram shows the details of the land use pattern for the state of Sikkim. This existing land use pattern does not hold completely true for the southern half of Sikkim. As mentioned earlier, all form of life and activities is mainly concentrated in the three districts of west, south and east district of Sikkim occupying the southern half of the state. It can be seen that almost half of the east district is reserved forest lying in the eastern half of the district. However this district shows considerable area under cultivation and settlement, agriculture and allied activities continue to be the most important occupation of the State and form the main base of Sikkim’s economy. The south district portrays a similar picture where the reserved forests are concentrated in the northern half of the district slowly wedging between the cultivated and other form of land cover towards the south. The west district shows maximum area under reserve forests unlike the other two districts of the southern Sikkim, here cultivable land, settlement and land for other uses are concentrated in the south eastern part, and the rest are all reserve forests. There are also glaciers and moraines in the northern half of the district. (Fig. 2)

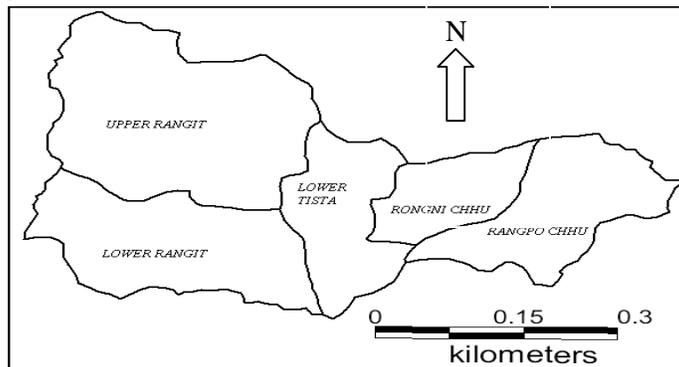


Fig: 2: Sub-Watersheds of the study Area

The map (Fig.3) illustrates a thorough picture of the land use pattern of the southern half of Sikkim. The Sub-watersheds of the studied area are drained by the respective rivers and their tributaries. The river basins in Sikkim hold particular significance from the stand point of land use planning for the country. The three southern districts are further subdivided by five river basins. The Tista is the principal river of the State. It runs almost in a north- south direction, dividing the State into two halves. The tributaries of this river and their networks have given rise to five river basins, of which the Rangpo Chhu and the Rongni Chhu has almost separated the east district from the south district. Whereas, the Lower Tista river basin has divided the south district into almost two halves. The other two river basins namely Upper Rangit and the Lower Rangit cover the whole of the West district of Sikkim; the former lying in the northern half and the latter in the southern.

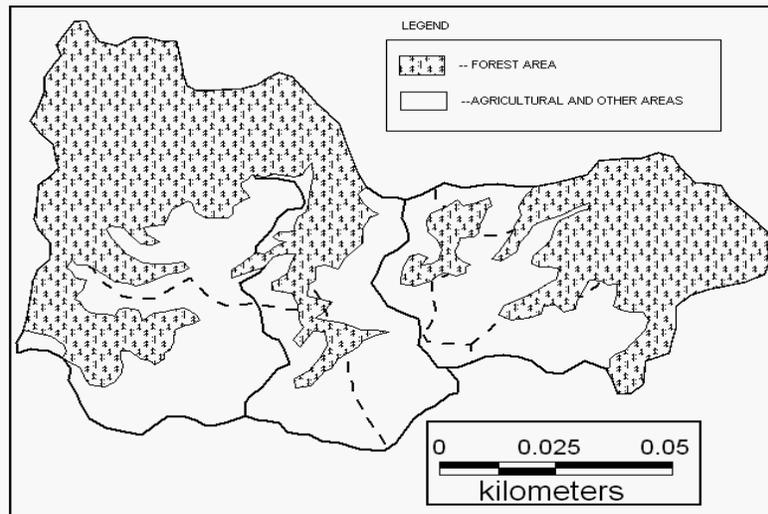


Fig.3: Broad Land Use Pattern of the studied Sub-Watersheds

The characteristics of the land use in the river basins highlight their specific significance. By studying each of the watersheds, it can be observed that Upper Rangit has almost 84 percent of its land cover under reserve forests and the rest 16 percent is available for other land use purposes. In contrast, the Lower Rangit lying in the same West District has almost 60 percent of its land under cultivation and other purpose and approximately 40 percent under reserve forests. In case of Lower Tista, only around 24 percent is under reserve forest and the rest is devoted for other land use types. Rongni Chhu lying in the East District has approximately 38 percent of its land under reserve forests and around 62 percent under settlements, cultivation and other forms of land use pattern. The river basin of Rangpo Chhu lying in the eastern part of the East District has the major part that is around 71 percent under forest cover and only about 29 percent under other land use schemes.

RESULTS AND DISCUSSION

A brief analysis of the problem and prospects of the watersheds

The southern part of Sikkim presents the most formidable character of land as the area symbolizes the dynamics of natural and cultural land use. Sikkim is essentially a fragile mountainous area being composed of non resistant rocks. There has been wide scale immigration after the merger of the State with India. The southern states are heavily populated as is evident from the land use pattern of the area. More and more forests are

cleared for making space for cultivation and human habitation. As a result, there are increasing rate of both natural and manmade hazards such as landslides, soil loss; environmental pollution due to heavy congestion in the towns and so on. The east and the south districts have the lowest man-land ratio, where as the west district with comparatively less population has a moderate man-land ratio which is evident from the land use pattern of the water sheds of the area. The land use pattern has been changed after the land reform was implemented. Prior to this, the traditional land lord families called the kazis owned considerable area of land, but after the reform land was redistributed to tenants, the farmers often go for crop sharing which is locally known as adhiya. There is rapid deterioration of forest cover due to encroachment and is effective in the change of land use cover. The increasing demand for land, coupled with the limitation in its supplies, is the major cause for more conflicts over land use in the area. The land use pattern of Sikkim is strongly influenced by the elevation, climate and mountainous terrain, especially in the field of agriculture and forestry. Hence, the river basin with the maximum land under different means of livelihood is under constant pressure. The lower Tista, the river basin situated partly in the east and partly in the south district is much vulnerable. All the other watersheds in the southern Sikkim excluding the upper Rangit are to meet similar fate if there is no rule for proper land use planning. Hence, the only tool to control the pressure on land is the change of land use pattern over time.

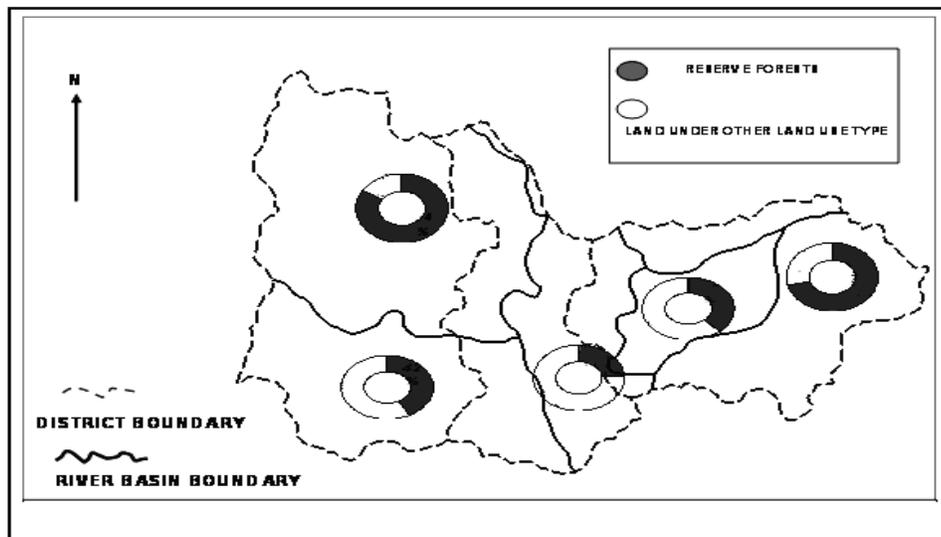


Fig. 4. Major Land use- Forest and other land category

CONCLUSION AND SUGGESTION

Forest is the main land use in the state of Sikkim. However, the increase in pressure on land is constantly turning the once virgin area of the state into degraded areas. The escalating demographic demands is resulting indiscriminate exploitation of precious natural land resources leading to devastating ecological imbalances and threatening their own means of survival through degradation of not only land but also of the biodiversity rich zone. Therefore, there should be a solemn effort to suggest suitable land utilization strategies for sustainability of the hill to increase the land productivity and restore the degraded land cover as well as to increase the quality of environments to preserve the

natural beauty for our present and future generations. Hence, Land use planning activities should actually start with the objectives to increase productivity and to improve the sustainability, i.e. to conserve the natural resources. There can be several approaches to reach the end:

- To evaluate the scope of the land
- Prepare models for simulation
- Process for generating the model
- Indices to carry out the test

Land use systems require constant monitoring and adaptation to maintain food security, minimize deforestation, conservation of biological diversity, protection of environments and enhancement of health and safety of human occupation to the changing social, economic and natural environments. People can change their pattern of consumption, land use practices and energy use to safeguard the environments. The sustainable land utilization of hills involves the management and conservation of natural resources (land, water and forest) to maintain the quality of environments for the benefit of the present and future households and communities' needs.

In order to plan the land use of an area, it is vital to understand the implications of land use planning at the outset. The land use planning is the systematic assessment of physical, social and economic factors in such a way so as to encourage and assist land users in selecting options that increase their productivity with sustainability and meet the needs of society (FAO, 1993). The planning decisions may not always be scientific because of conflicts among the interests of different sections, government policies and the priorities of landowners. Therefore, planning decisions for implementation should be based on mutual decision among several interests without risking the principles of land capability, sustainability and environmental security for agriculture, forests, horticulture, grasslands, urban development, mining, infrastructure facilities, recreation and others.

Suitable planning of land use with reference to the nature of land and needs of the community would provide maximum returns of optimum land resources. Thus, the planning of area development can be best tackled on the natural drainage unit that is the 'watersheds' with a view to develop resources in such a manner so as to provide maximum benefits to the people by maintaining ecological balance through continued long-term efforts and commitments e.g. maintenance of infrastructure, protection and judicious use of land, water and forest resources to meet the continued demands, etc.

In order to ensure optimum and proper utilization of land resources, State Land Use Board was constituted in 1984 to provide highest opportunity for policy, planning and coordination of all issues connected with healthy and scientific management of land resources. The Board is also taking initiative to create public awareness for environmental protection through support mobilization. The National Watershed Development Project for Rain fed Areas (NWDPR) is being implemented on micro watershed basis (500-800ha) at 12 sites, covering total area of 7691 hectares through 4700 farming families which aims benefit during 8th Plan. During 9th Plan 30 new watersheds are to be taken to implement the scheme with an area of 30,000 to 40,000 hectares.

Hence, to strategically maintain the land utilization of the southern part of Sikkim for effectively developing it as an area with the best possible habitation, the following schemes can be implemented:

- A combined approach to identify the priorities for research and technologies for better utilization of land and to maintain soil fertility and rehabilitation of the degraded land.

- Intensive soil conservation oriented agriculture within the agro-ecological units.
- Agro forestry for increasing production and managing ecological balance.
- Abundant scope for horticultural plantation crops to reduce soil erosion.
- Land use types should be decided in relation to the behaviour of the land systems and human societies in Sikkim hills.
- Involvement of local mass in identifying the problems of land resource, degradation, constraints and opportunities to change land use through research, extension and training for solution to their future generation's survival.
- Survey should be carried out and complete inventory of the landscape is to be prepared for crop and non-crop plants, forests, wild animals, fish, domesticated animals, catchments etc. as a holistic approach to check the habitat degradation.
- Development of eco-tourism as an alternative employment opportunity should be stressed upon at higher elevation, where land use and farming systems cannot provide quality of life and standard of living.
- There should be identification of alternative means of achieving objectives of production to carry out the task of conservation in relation to time, scale, location and choice of technology.
- In order to optimize land use in this part, assessment of climate and soil resource for alternative land use is prerequisite. Thus, suitable alternative cropping system can be developed which is ecologically feasible, economically affordable and socially acceptable for sustainable development of the region.
- Soil resource maps and other aids can be used for the purpose of rationalizing the land use pattern.

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