LAND RESOURCE MANAGEMENT OF WEST DISTRICT, SIKKIM

Dr. Bedhas Ujjwal Mandal
Assistant Professor in Geography
Shyampur Siddheswari Mahavidyalaya, Ajodhya, Howrah
Email: bedhasmandal@gmail.com

Abstract:
The present paper comprises about the land resource management of West District, Sikkim with particular emphasis on land use pattern. The West district of Sikkim is situated in the western part of Sikkim which is marked by its complex geological formations and presence of aesthetic resource. The entire area is drained by mainly little Rangit and its tributaries. The study area is full of land resources mainly forest resources and agricultural activities which influence the land use pattern as well as economic status. The north western part is full of protected and reserved forests; only the south eastern part along the road side and river valleys agricultural activities in form of step cultivation, seasonal farming, lumbering and newly developed floriculture and horticulture have developed. Land resources play a strategic role in determining man’s cultural progress of the region. However due to the dynamic fluvial activities, tectonic action gradually are changing the land use scenario of the West Sikkim. Recent role of human beings i.e. anthropological factors has also been considered in the preparation of land use map and land resource management of West district area.

Key Words:
Himalayan terrain, Land use pattern, Land resources, their development and Management, Environmental hazards.

Prologue:
The present research work is concerned with a study of land resources and their proper management with respect to West district of Sikkim. Under the discipline of Applied
Geography, the present study is an important subject to embody the distinct findings and observation of environmental appraisal and land resource management of the existing area. The area under study is situated in the seismo-tectonically unstable undulating region of West Sikkim. It has produced an array of magnificent elements of fluvial landscapes both physical and cultural particularly varied land use patterns. These involve multicycles of fluvial erosions along with the occurrences of several environmental hazards manifested in the development of a complex type land resource characteristics of the Sikkim Himalayan terrain.

**Location:**
Physiographically, West district of Sikkim belongs to the eastern Himalayan mountainous region, bounded by Rangit river in the east, Rammam Khola in the south, Kunchengunga range in the west and Greater Himalaya in the northern portion. Politically, this region is belonging to the state of Sikkim which is one of small state of north-eastern India and is bounded by North district(Sikkim), South district(Sikkim), Darjeeling district(W.B.) and Nepal in the north, east, south and western direction respectively. The latitudinal and longitudinal extension of this region ranges between(27°0' N to 27°35'N) and (88°0' E to 88°25' E) respectively.

**Objectives:**
The primary objectives of the research work area are as following:

1. To identify the fluvio-geomorphological landforms and geo-tectonic condition of West district, Sikkim
2. To reveal the major land resources of the study area
3. To identify the changing land use pattern of the area
4. Probability of land resource development
5. The present worker would also made attempt to find out the major causes of the occurrences of environmental hazards e.g. landslides, flash floods, earthquakes along with deforestation, soil erosion including the accelerated soil erosion.

6. It is particularly related to the land use and development programme, improvement of micro river irrigation system towards agricultural development, tourism development of West district, Sikkim with an inter-disciplinary approach both in time and space.

**Methodology:**
In order to fulfill the objectives of the research work, this worker has adopted modern methods, techniques, intensive field works, data collection, information and evidences to fulfill the aforesaid objectives of the research work. He has also incorporated the current data and information with the help of efficient geomorphic tools i.e. Topographical maps of Survey of India (S.O.I.), Air photographs, Landsat imagery, Geological maps (G.S.I.), DPMS map (N.A.T.M.O.) etc. Due emphasis is placed on the procurement collected data mainly from the primary sources and field works in terms of (i) Pre-field work, (ii) Field work and (iii) Post-field work (Mukhopadhyay, 1980-82).

**General Geology:**
It is essential to evaluate briefly the general geological aspects including structure, lithology, stratigraphy, tectonics of the study area. The crescent shaped Himalaya including the eastern Himalayan terrain is confirmed as a result of continent-continent collision and complex geological structure is found to be developed over the entire West district, Sikkim. The eastern Himalayan region belonging to Tista drainage system is marked by the development of very complex geomorphic entity and seismo-tectonically unstable region. The major geological formations of this region comprise of Kanchenjanga gneiss, Daling schist, and Chungthan H. grade Daling in the west, east and north to north-eastern portion of the study area respectively. This region is marked by a
series of fault, thrust, inter-bedded, complex folded structure etc. The general trend of planer element is E-W with dip towards SE, regardless of whether these are of sedimentary, metamorphic or thrust origin.

**Physiography:**
The West district and its adjacent undulating Eastern Himalayan region being interspersed with Rangit river and its series of tributaries like Rathang Chu, Kalej Khola, Rammam river etc. is endowed with rich natural resources like forest, water, arable land, mineral resources etc. The present study area comprises of variegated landscape-elements has become a conspicuous geomorphic units in the eastern Himalayan zone. River Rangit, flowing along the eastern boundary of West district with its tributaries is directed towards the south and south-east following the general trend of slope of relief sculpturing the typical fluvio-geomorphological landscape by continuous dominant erosionalon activities on this undulating topography. This rugged mountainous topography of West district is ornamented with various landforms of fluvial environment, e.g. gorge, narrow V-shaped valley, interlocking spur, incised meander, terraces etc. along the long profile of the major river valleys which have a remarkable influence on the distribution of major land resources and their management.

**Climate:**
Climate is a dominating factor which plays the decisive role in fashioning the land surface and the corresponding land resources within this present mountainous region. Variations in the elements of climate have been manifested in geomorphic processes to produce the characteristic natural land resources. The study area falls under the tropical monsoon type of climate with an average temperature of 5°C to 25°C and an average precipitation of 1500 mm to 2500 mm where August and September are the rainiest month. The season of this area may be divided into three phases-(i) Pre-monsoon (ii) Monsoon and (iii) Post-monsoon. Western and northern portions of the West district are characterized by colder and drier climatic condition and temperature falls below 0°C.
during winter. Some parts of west and northern portions experience winter snowfall and the ground remains snow covered during December to March.

Soil and Vegetation Cover:
The western portion of the Sikkim state is covered with numerous types of soil. Most of the soil profiles are immature in character due to the presence of undulating or rugged topography around almost whole portion of West district. The mature soil is hardly found in some riverine terrains. Soil is generally characterized by coarse to fine, sandy to loamy types insisting mostly high infiltration rate and low water holding capacity. In this region, there are the dominance of Inceptisol group of soil. Entisols are found in few proportions along Rangit and Rangbong Khola rivers and Mollisols in few patches of western and northern portions soil erosion is a common phenomenon, occurs mostly during monsoon season.

Natural vegetation of the West district is generally deciduous, especially moist deciduous to coniferous in character. In the low altitude (below 2000m) and along some riverine terrains numerous types of deciduous vegetations are found as generally low to moderate forest cover. Coniferous vegetation is found on the moderate to high altitude terrain and mountainous slope, especially in the northern and western portion of the study area. There are so many Reserved Forest in the northern and southern portion of this district to protect the ecological balance of this region except river valleys. There is the dominance of cultivable land along Rangit, Kalej Khola and Rangbong Khola rivers. Open scrub and grassland are hardly found in this area. The vegetation types of West District are given below:

a. Very moist Sal bearing Forest
b. East Himalayan Sub-Tropical Wet Hill Forest
c. East Himalayan Wet Temperate Forest
d. Oak Rhododendron Forest
e. East Himalayan Mixed Coniferous Forest
f. Alpine Scrub Pasture 
g. Cultivable and other Land 
h. Snow covered Area / Glacial Alpine Barren.

**Land Units and Land Resources:**
The major point of thrust of the present study is the study and interpretation of the major land resources and their proper management procedures of West district, Sikkim. To discuss the aforesaid topic the concept of land units is a very important parameter. Generally four types of land units are found in this Eastern Himalayan mountainous district of Sikkim.

(i) Mountainous Terrain
(ii) Settlement Area on Mountainous Terrain and Slope
(iii) Forest Land
(iv) Glaciated Area or Waste Land.

**Major Land Resources:** The resources which are land-origin or belong to the land surface are termed as ‘Land Resources’. The major land resources of the present author’s study area are as following:

a. Forest Resources 
b. Agricultural Resource 
c. Soil Resource 
d. Mineral Resource 
e. Aesthetic Resources 

From the given statistical data, Census report and intensive field observations, it can be said that number of land resources present in this region is low and their quantity and quality differs with the spatial and temporal variations. **Utilization of Land:** Above 60% of the area of the West district falls under forest land and glaciated land. Forest land, in the form of Reserved Forests, Wild life Sanctuaries etc. are found in the vast southern and northern portion of the district except river valleys and the waste land or glaciated areas are found along the narrow western and northern margins of the study area. There is the major use of this forest through lumbering and collection of forest by-products and
spices. Few portion of the total area (30%) is used as arable land and settled areas, generally along the low to high terrains of the major river valleys. They are used for grain crop, vegetable cultivation. The district head-quarter of Gyalshing is situated in such a high terrain of river Kalej Khola. Rest 10% land falls under the transport and communication system. Here, some state highways are the major medium of road transport and some power lines and telephone lines across the mountain are the major medium of communication.

**Land Use System:** The term, land use is very much related to land resource. The system of land use is dominantly depending upon the quantity, quality and the distribution of the various types of land resources in any region on the earth surface. The characteristics of the land resources differ from high mountainous region of western and northern portions with the central and south-eastern moderate-low altitude terrains of the study area.

Land Use System consists of three major parameters:

a. Land Unit
b. Land Utilization Type
c. Land User

\[
\text{Land Use System} = \text{Land Unit} + \text{Land Utilization Type} + \text{Land User}
\]

Land use systems are of four types. They are as following:

i. **Single Land Use System:** This is the configuration whose performance is analyzed in assessment of land suitability

ii. **Multiple Land Use System:** More than one crops on a field at one time

iii. **Compound Land Use System:** i.e., single or multiple systems in rotation

iv. **Farming System:** Consists of one or more land uses system practiced by one household or management unit.

**Forest Resources:**

Sikkim is called the ‘Biotic State’ of India. This term is perfectly represented by West district of Sikkim. Natural vegetation or forest resource is one of the dominant land
resources and almost the maximum portion of this district is covered by the moderate to
dense deciduous, coniferous and alpine forest covers from low-moderate altitude river
valleys to high mountainous slopes and terrains of this study area. The local inhabitants
generally use the forest for the purpose of lumbering, collection of forest by-products,
foods, fuels etc. The tribes of this region totally depend on the forest for their livelihood.
Overall, the ecological balance of the natural environment sustains on the basis of these
forest covers.

The various Reserved Forests and Wild Life sanctuaries in the northern and southern
portion of this district are found to protect the ecological balance and wild life of this
region except river valleys. Barsey Rhododendron Wildlife Sanctuary, Sungri RF, Rimbi
RF, Hee Patal RF, Yuksam RF, Kalijhar RF etc. are the remarkable ones.
The natural forest types of West District are given below:
a. Very moist Sal bearing Forest
b. East Himalayan Sub-Tropical Wet Hill Forest
c. East Himalayan Wet Temperate Forest
d. Oak Rhododendron Forest
e. East Himalayan Mixed Coniferous Forest
f. Alpine Scrub Pasture.

But now a day, deforestation in this region due to natural and dominantly the spreading of
cultivable land and settlement is the burning problem of this region.

**Agricultural Resources:**
West district has very diverse ecological conditions which on one hand prevent adoption
of common crops and varities over wide region and on the otherhand favour cultivation
of many kinds of fruits, vegetables both on and off seasons and also provide conductive
agro-climatic situations for growing commercial crops like cardamom, ginger etc. Sikkim
including West district though very small in size has great potential for growing all kinds
of crops with success in the mountainous terrain. Agricultural resources mainly involve
various types of crops, vegetables, fruits etc. They are tabulated below:
Cropping Intensity:
Cropping intensity is closely associated with the altitude. At lower altitudes, it is possible to multiple cropping, at mid altitudes double cropping and at high altitudes only mono-cropping. Due to rugged steep terrain of almost the entire study area, agriculture is a very difficult and tedious task needing very hard manual labour and in general, net gain per unit area in case of cereals in not as remunerative as in the plains.

Table: 1 Major Agricultural Resource

Source: Agricultural Census, Govt. of Sikkim, 2014-15

Table: 2 Area, Production And Average Yield Of Various Crops West District During 2013-14

<table>
<thead>
<tr>
<th>Types of Crops</th>
<th>Name of the Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>Rice, Wheat, Maize, Finger millet, Barley, Buckwheat etc.</td>
</tr>
<tr>
<td>Pulses</td>
<td>Urd, Other Pulses.</td>
</tr>
<tr>
<td>Oil seeds</td>
<td>Rapseed, Mustard, Soybean, Other Oilseeds.</td>
</tr>
<tr>
<td>Fruits</td>
<td>Mandarin, Other Fruits.</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Rabi, Kharif, Off Season.</td>
</tr>
<tr>
<td>Spices</td>
<td>Large Cardamom, Ginger, Turmaric</td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>Potato, Others.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area in '000 hectares</th>
<th>Production in ‘000 tonnes</th>
<th>Yield / Hectare in Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>5.5</td>
<td>8.35</td>
<td>1518.18</td>
</tr>
<tr>
<td>Wheat</td>
<td>2.10</td>
<td>3.5</td>
<td>1666.67</td>
</tr>
<tr>
<td>Maize</td>
<td>13.0</td>
<td>21.3</td>
<td>1638.46</td>
</tr>
<tr>
<td>Finger millet</td>
<td>1.5</td>
<td>1.45</td>
<td>953.33</td>
</tr>
<tr>
<td>Barley</td>
<td>0.39</td>
<td>0.5</td>
<td>1282.05</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>0.77</td>
<td>0.75</td>
<td>974.02</td>
</tr>
<tr>
<td>Urd</td>
<td>1.8</td>
<td>1.41</td>
<td>783.33</td>
</tr>
<tr>
<td>Other pulses</td>
<td>0.81</td>
<td>1.0</td>
<td>1107.88</td>
</tr>
<tr>
<td>Rape-mustard</td>
<td>1.5</td>
<td>1.14</td>
<td>760.0</td>
</tr>
</tbody>
</table>
Soyabean | 1.35 | 1.16 | 859.26

Source: Agricultural Census, Govt. of Sikkim, 2014-15

Soil And Mineral Resources:

Soil Resource:
There is no scarcity of soil, but there is the lack of fertile soil through the entire West district of Sikkim. Due to the presence of undulating or rugged topography around almost whole portion of West district the soil profiles are almost immature in character. The mature soil is hardly found in some riverine terrains. Soil is generally characterized by coarse to fine, sandy to loamy types insisting mostly high infiltration rate and low water holding capacity. In this region, there are the dominance of Inceptisol group of soil. Entisols are found in few proportion along Rangit and Rangbong Khola rivers and Mollisols in few patches of western and northern portions. Moderately fertile soil resource for agriculture is fewly found along some river terraces like Rangit, Kalej Khola etc.

Mineral Resource:
The study area of West district is moderately enriched in some valuable mineral resources. The major minerals available in this region are as following:

i. Copper - It is abundantly found in the south and south-eastern portion of the West district.

ii. Limestone - It is available in few amount near south-eastern portion of the study area.

iii. Dolomite - A few amount is found along Rangit river.

iv. Graphite - It is available in the western margin of West district.

Aesthetic Resources:
Land resources are not only concentrated just on the forest, agriculture etc. but also on the aesthetic resources which include scenic beauty of the nature, beautiful natural environment, landscape and so on which attract the tourists to enjoy it and to fulfill their
satisfaction and pleasure of mind. The entire West district along with river basins have an ample scope for the development of the tourism industry depending on the aesthetic resources. Green hilly tracts of Gyalshing, Pelling, Jungle of Pine, Sprus near Pemiangste, beauty of Kheciperi lake, waterfalls along Rimbi Khola, Kalej Khola, Hee Khola, magnificent view of confluences of Dentam Khola-Kalej Khola near Dentam, Kalej Khola-Rangit near Legship, scene of ice-capped mountain near Zongri, Rhododendron Sanctuary in Uttare, Barsey and so on aesthetic beauties are spread over the entire study area. These are one of the most important land resources and source of attraction to the internal and international tourists for this ‘Organic State’ of India.

**Water Resource:**
Besides land resources, water resource is also an important source of development both in domestic and agricultural perspective which leads to the entire economic growth of the study area. Water resources mainly include the use of water, availability of water and management for sustainable land resource development. The main source of water is rainfall which is followed by ground water, snow melt water and see page water. The entire study area is drained by numerous perennial, non-perennial and semi-perennial rivers like Rangit, Kalej Khola, Rathang Chu, Rammam Khola, Dentam Khola, Rimbi Khola etc. which are the major sources of water. During the monsoon period, this area receives maximum amount of water but the problem arises during Kharif period when vegetables and horticulture plots lead proper irrigation. With the scarcity of rain water, ground water level also decrease; only snow melt water along with see page water are available in minimum amount.

So, for the better land resource management, authorities and local people should concentrate on scientific water resource management.

**Management and Development:**
For the development and sustainability of the land resources we need proper procurement and systematic management of the resources. Recently GO and NGOs are working for the
betterment of the processes. But considering the hazards problems of the area resources should be utilized in a convenient and scientific way with local peoples awareness.

Forest Resources Management:

i. Deforestation should be prevented

ii. Pasture of cattles should be limited in the forest

iii. Forest should be protected from the harmful effect of insects

iv. Precautions should be taken for the forest-fire.

v. Jhum cultivation should be prevented

vi. To prevent the illegal slashing of trees Govt. should take legal punishment

vii. Overall, to protect the ecological balance of the forest resource, public consciousness both local inhabitants and outcomers/tourists of the West Sikkim is an important one.

Agricultural Resources Management:

It may be stated that Sikkim including West district is not self sufficient in the production of agricultural resources. Therefore, the management and development procedure which can be adopted in this mountainous region are as given below:

i. Contour farming / step cultivation should be given priority.

ii. Jhoom cultivation must be prohibited.

iii. Irrigation facilities will be increased in Rabi season through Micro-hydel power projects.

iv. These projects one side will fulfill the electricity demand and on the other side irrigation will be continuously provided. It will simultaneously solve the problem of drinking water.

v. Government will take steps for providing good quality local seeds, plants and HYV seeds for agricultural development.

Aesthetic Resources Management:
The entire West district from north to south is full of aesthetic resource. They can be managed through the following procedures:

i. These resources should be managed and used for the development of tourism industry.

ii. Considering the landslide-prone areas, roads will be developed scientifically avoiding the fault-affected unstable areas.

iii. Hotels and rest houses will be managed and constructed in proper gentle sloped areas.

iv. Announcement as ‘No Plastic Zone’ of this ecologically sensible Himalayan terrain and to make free from land pollution.

v. Forests of wet deciduous and coniferous trees along the mountainous terrains of the study area which are one of the important parts of the aesthetic resources should be conserved as Reserved Forest, Wild Life Sanctuary etc.

vi. Preservation of the mountainous terrain and beautiful lakes from the degradation by natural and anthropogenetic interferences.

vii. Maintenance and conservation of ecological balance and sensible biodiversity in this famous eastern Himalayan mountainous region.

**Water Resource Management:**

It can be experienced that that there is no scarcity of water in the across the entire Sikkim state including my study area. But there is the lack of proper development and management procedure of the water resource. Therefore, the management of this valuable resource some favorable steps can be adopted:

i. Preservation of river water for the dry period constructing the suitable dam.

ii. Rain water harvesting in some pockets of western and northern portion of the study area.

iii. Construction of mini hydel power project in micro level.

iv. Micro watershed management for the agricultural development.

v. Purification of river and spring water for the drinking purpose.

**Concluding Remarks:**
It is not possible to keep the environmental ecosystems completely undisturbed by maintaining balance in the natural processes where man is involved. As a part of ecosystem, he has to use of it to his best advantages, but what is expected to him is not to adopt the role of plundering the environment. A clear perception of natures renewal processes or the feedback system is likely to make him more aware of his own perilous role, which he has taken up of late with modernization. Indiscriminate destruction of vegetation for bringing more and more land under plough has its long run effects, which take disastrous shapes in occasional changes in river-courses. The rapid growth of population with the enhancement of Tourism and its impact on economy causing the biological and ecological problems are increasing. It is necessary to carry out an intense investigation on herbal plants and effective remedial measures for environmental hazards to protect the land resources of the area under consideration. As stated earlier, geomorphology primarily involves the interactions of aggradational and degradational processes with geo-materials and resultant geo-environmental problems arising out of such interaction including human activities.

Regarding the detail field work of West district, the area is marked by with the series of undulating unstable tectonically active hilly terrain, deep vertical erosion, varied land use potentiality with several problems. The diversified topography, steep slope, forest cover and insufficient irrigation create several problems in respect of optimum land use of the study area. The area has potentiality of horticulture especially the floriculture which may become the major economic backbone of this economically backward area. There is a further scope for a systematic development of tourism industry with proper arrangement of transport and communications. These are essential to protect the valuable land resources of the area under consideration. Proper management of these resources in this eastern Himalayan terrain of West district should be given priority for the sustainable development.

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References:
PLATE 1: FOREST RESOURCE ON MOUNTAINOUS SLOPE

PLATE 2: KHECHIPERI LAKE SURROUNDED BY DENSE FOREST COVER

PLATE 3: CROP FARMING AS STEP CULTIVATION

PLATE 4: AESTHETIC RESOURCE OF WEST DISTRICT