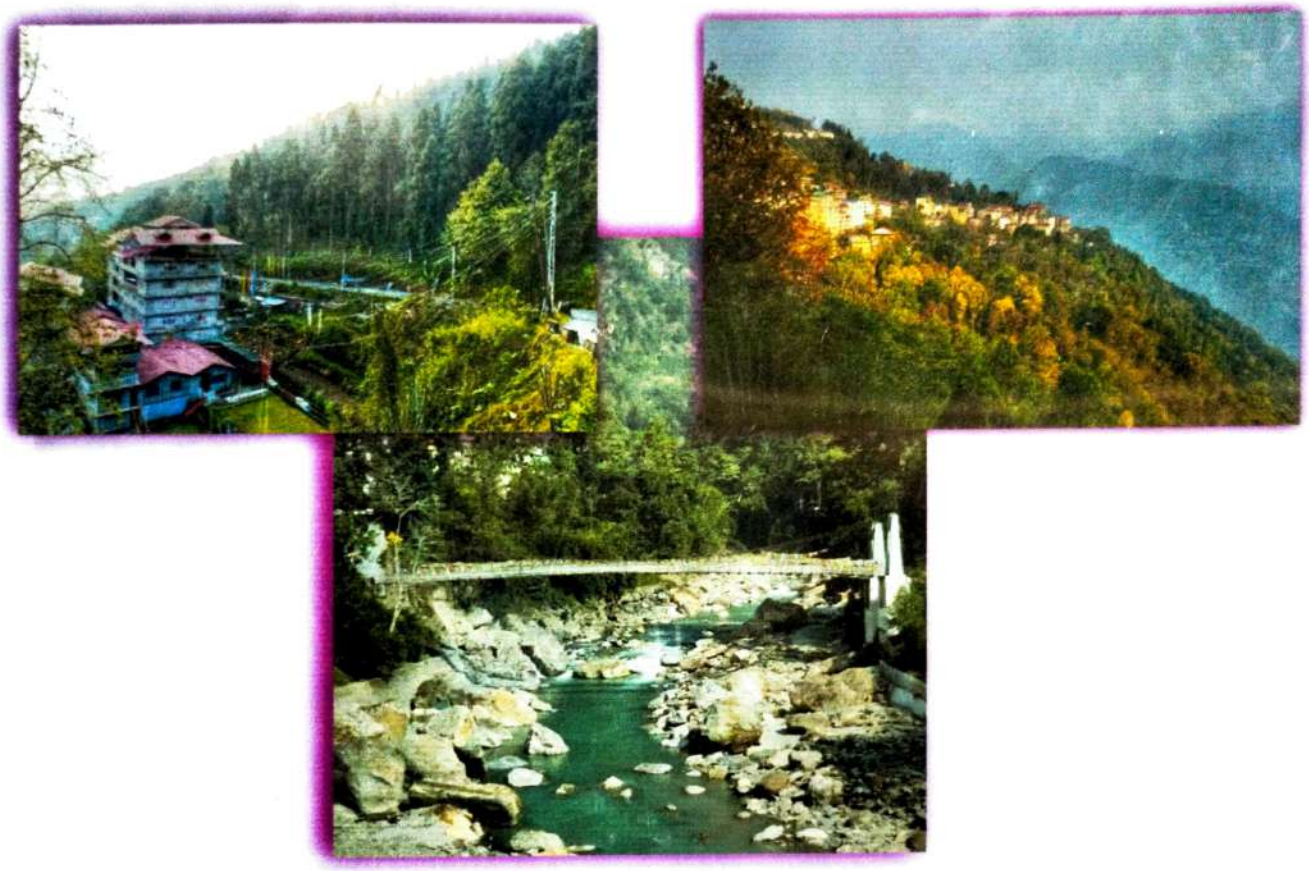
VIDYASAGAR UNIVERSITY

Report On

Landslide and Its Causes, Consequennces & Management : A Study in Some Parts of Sikkim Himalayas



B.SC HONOURS (GEOGRAPHY)

SEMESTER - VI

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Certificate

To whom it may concern

This is to certify that Susmita Gini,
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student of B. Sc., Sem-VI, Geography Honours of Swarnamoyee Jogendranath Mahavidyalaya for the session 2022-23; submitted his/her project report entitled as Landslide and its causes, Consequence and management: A study in some pards of sikkim Himalayas.
for partial fulfilment of the syllabus prescribed by Vidyasagar University. The report has been prepared under the supervision of Miss Arpita Majumder and may be placed before examiner for evaluation.

Date: 08/08/2023

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Finally, I would like to thank my parents, friends, staff of college and the local nesidents of Pelling in Wlest Sikkim, without their support and help, this assignment would not have been completed.

Place: Amdabad

Date: 6.08.2023

Susmita Giri

Signature

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1.0 Introduction :-

Disasters and natural hazards are common and occur not only in India but all over the world. India has been prone to natural disasters on account of geo-climatic conditions; disasters such as floods, earthquakes, droughts, cyclons and landslides have been major with in the country. (Kapur, R, 2018). A hazard may defined as the perilous conditions or events that are threatening or have the potential for causing, injured to life, property, or the environment (Dey & Singh, 2006). Hazards are of two kinds, natural and manmade, natural hazards are the ones that take place as a result of natural phenomena, these can be meteorological, biological and geological such as cyclones, tsunamis, earthquakes, landslide, floods, drought, and volcanic eruptions. On the other hand, manmade hazards are the ones that occur due to human negligence; these are associated with industries or energy generation power plants and include explosions, leakage of toxic wastes, pollution, dam failure, wars or civil strife or occurrence of fire (Dey & Singh, 2006).

Landslide is also called as semi or quasi natural hazard as it originate due to natural phenomena and also by human activities. Landslide is the common disaster in different parts of Sikkim.

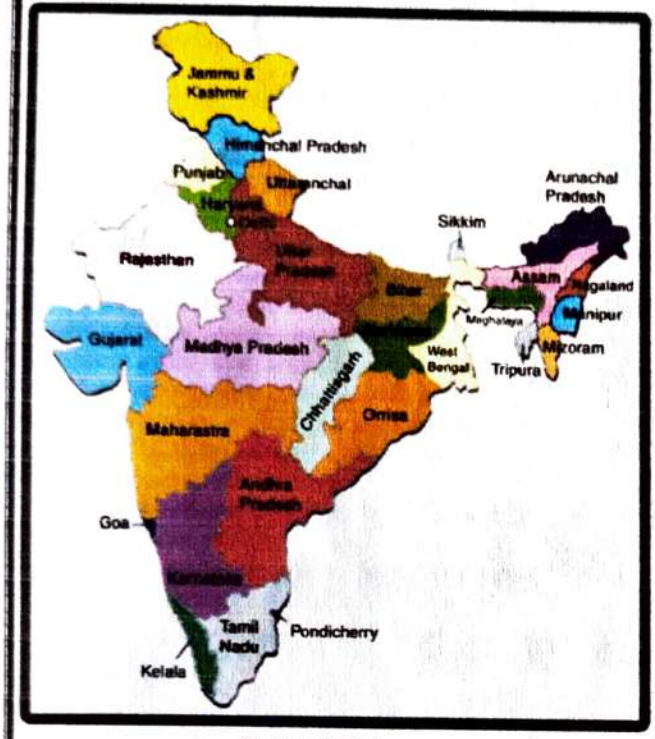
The high steep slope, making of the houses on constructional works in different of the hilly slope etc. causes are responsible for landslide in Sikkim. In the present project paper it is discussed about the causes, effects and management of Landslide Disaster in West and South Sikkim along with an overview of physical and socio-economic status of Sikkim as landslide also triggered by human activities along with natural phenomena.

1.2 Study Area :-

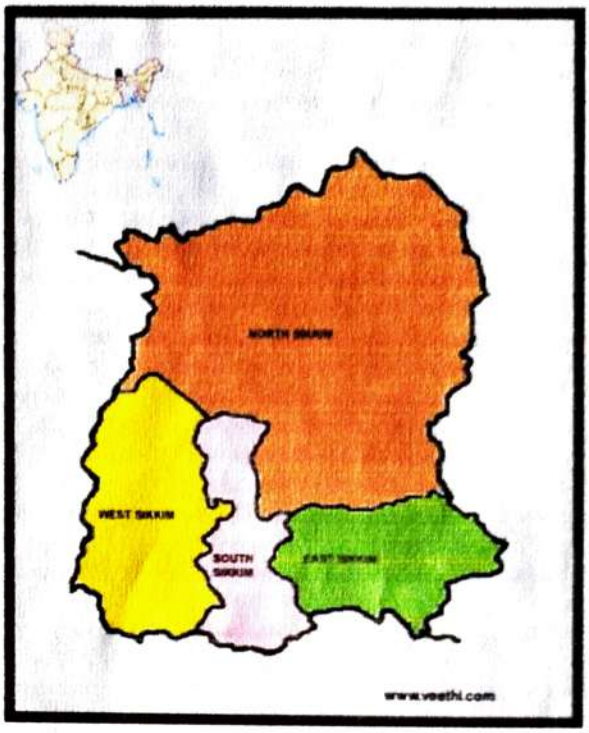
Sikkim is a small, extremely mountainous state in the Himalayas with sharply defined and extremely deep watershed. The state is situated between 27°04′ N to 28°07′ N and 88°01′E to 27°06′E. It is bounded by Nepal in the West by the vast stretches of Tibetan Plateau in the North and by Bhutan and Chumbi Valley of Tibet in the East. Darjeeling district of West Bengal stretches along its southern boundary. The state has a total area of 7096 sq. km. Sikkim is divided into four districts- East, West, North and South.

The state lies between very high and high Landslide Vulnerable zone on the basis of intensity of the controlling factors of landslide. Through north and East Sikkim are in very risk zone of landslide, South and West districts of Sikkim

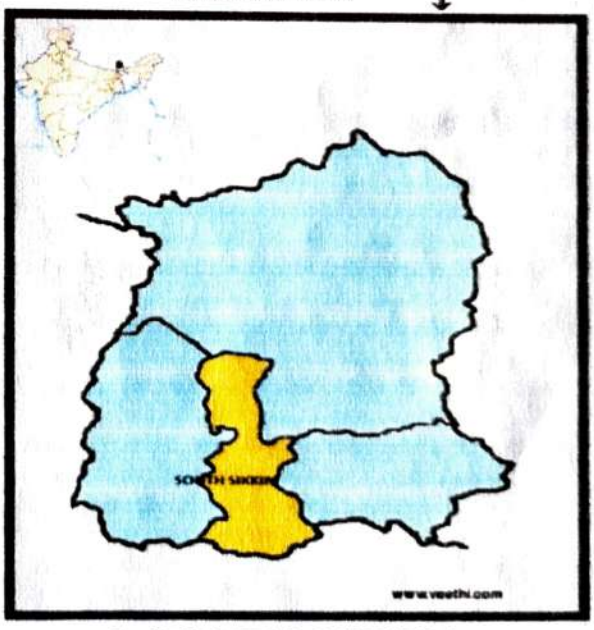
LOCATION MAP



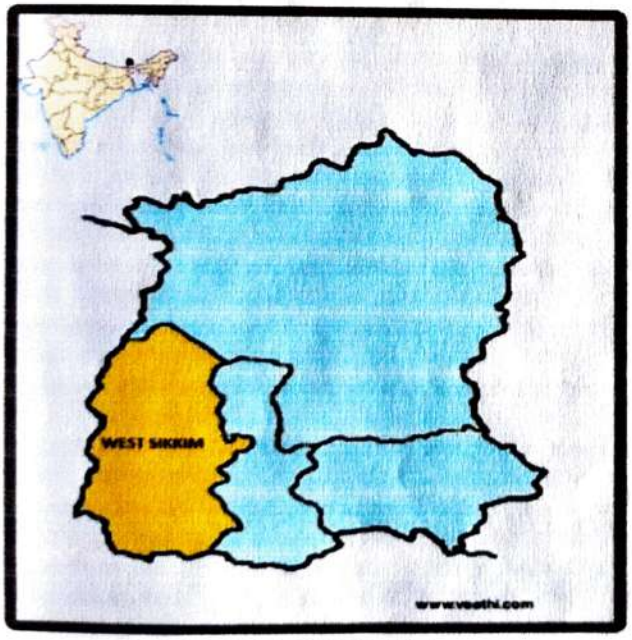
1. INDIA



2. SIKKIM



3. SOUTH SIKKIM



4. WEST SIKKIM

are also in high risk zone of landslide prone areas. West and South District of Sikkim lies at an altitude of more or less 400 meters to 2500 meters with unique countryside escape of endless waves of agricultural fields and the terraced slopes, intercepted by spring patched forests. Tourism development, road construction, increasing rate settlement triggering the rate of landslide every year. Hence in the present study South Sikkim and West Sikkim has been taken as special consideration in the study area to show the general scenario of the landslide with its causes, consequences and manggement

1.3 **Objectives :-**

The present project paper on landslide has been initiated to fulfill some basic objectives which are as follows:

- To study the general overview physical and economic, socio-cultural environment of the study area as both are very much related to landslide.
- To identify the major causes of landslide and its consequences in the study area specially in West and South Sikkim.
- To asses the effective landslide management techniques and to give some suggestive measures to prevent landslide in the study area.

1.4 ⊘ **Research Question :-**

(i) What is the nature of landslide in West and South Sikkim?

(ii) What are the main causes of landslide?

(iii) What are the effects of landslide on the lives of the local people?

(iv) What measures have been taken to prevent landslides from government?

1.5 ⊘ **Data base and methodology :-**

⟶ The data has been collected from two sources – Primary and Secondary. The primary data has been collected from hotel manager, car driver, local people, and seller of souvenir shop. The secondary data were collected from various book, article, different link from website, journal etc.

⟶ We collected data from hotel manager, car driver, local people and seller of souvenir shop through interview method, and we gain an understanding of landslides through the observation method while travelling near landslide prone area.

→ Different cartographic techniques have been chosen to represent the data properly. We used to bar and Line graph to show rainfall and temperature. To represent demography and literacy we have use pie and/ bar diagram.

1.6 **Limitation of the study :-**

Due to the limited time period surveyor were not able to collect data properly. Besides this some other problem such as poor financial condition, communication gap between respondent and surveyor due to different language etc. which was prevailed in that area. Hence the study was not dealt properly.

2.0 A general overview on physical and socio-economic environment of Sikkim :-

As landslide is called as semi or quasi natural hazard, it is originated by natural phenomena and triggered by human activities. Sikkim is one of the vulnerable state in India due to landslide. Geology, relief structure, nature of slope, type of rock and its resistance power to erosion, soil, climatic, nature (specially rainfall), vegetation cover etc. all are the controlling factors of landslide. Apart from these, human activities such as, economic activities, developmental works also affect on landslide. On the other hand, physical and socio-economic environment

of the region can be devasted due to landslide.

Hence, a brief introduction on physical and socio-economic environment of sikkim should in-through to know-the causes and consequences of landslide in-the study area.

2.1 Physical Environment :-

2.1.1 Physiography :-

Situated in-the Himalayan mountains, the state of Sikkim is characterised by mountainous terrain. Almost-the entire state is hilly, with an elevation region from 580 metress (920 ft) in the south at the border with West Bengal 8.586 metres (28,169 ft) in northern peaks near nepal and Tibet. The summit of Kangchenjunga the world's "third-highest peak. is the state" highest point, situated on-the border between Sikkim and Nepal. For-the most part the land is unfit agriculture because of-the rocky, precipitous slopes. However, some hill slopes have been converted into terrace farms.

2.1.2 Drainage :—

Sikkim is drained by large number of perennial rivers. Which merge into two prominent rivers the Teesta and the Rangit. Rest of other stream eventually joins one on the other. Rangit also joins the Teesta Just near the boundary between Sikkim and West Bengal.

The Rongit river and its tributaries originate in the Talung glacier in West Sikkim and after flowing for about 60 km. Joins Teesta below Malli near the border of Sikkim with West Bengal. River Rangit is a major tributary of River Teesta from the Wester Sikkim. Major tributaries of Rangit are Rimbi khola, Rathangchhu Kalej Khola. Ramam khola and the little Rangit.

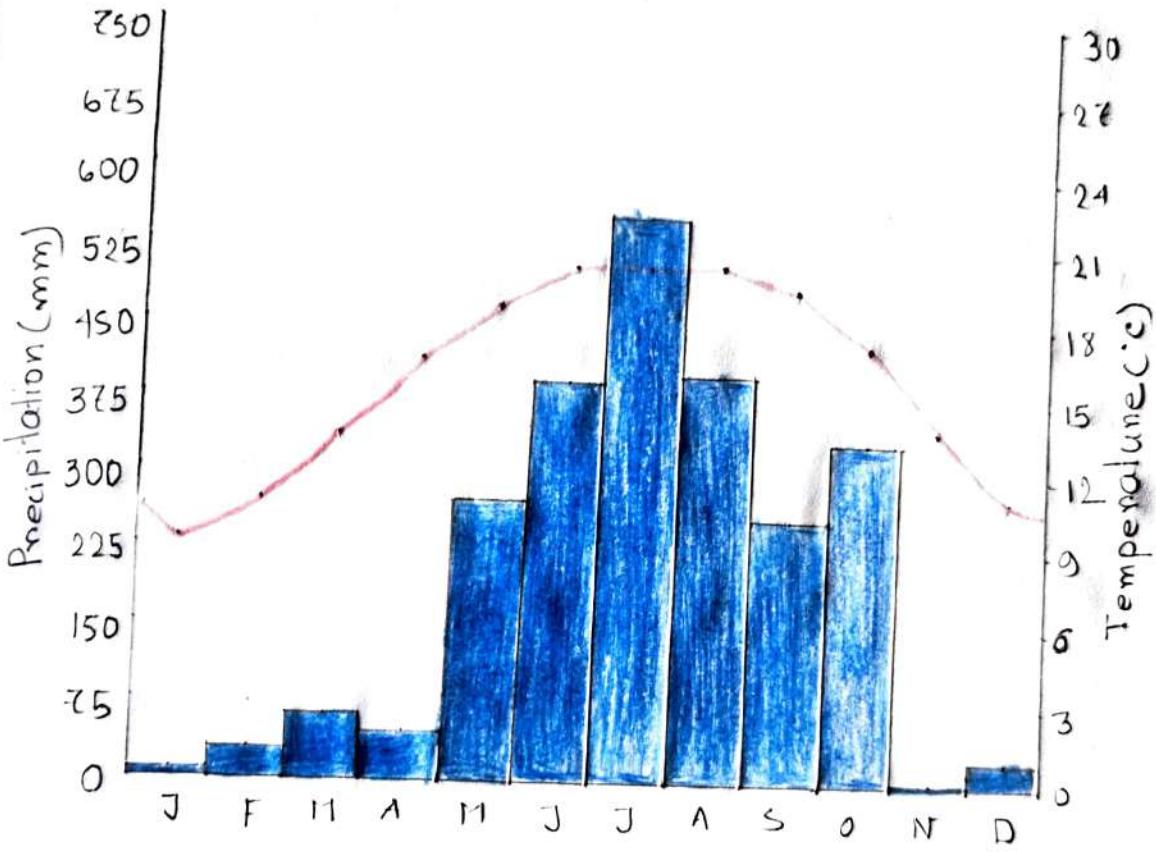
2.1.3 Soil :—

The hill of Sikkim mainly consist of gneiss and schist, which weather to produce generally shallow brown clay soil. The rock consists of phyllites and schists.

2.1.1 **Climate** :-

The state has five season: Winter, Summer, Spring, Autumn, and Monsoon season. Most of the inhabited regions of Sikkim experience a temperate climate, with temperatures seldom exceeding 28°c in Summer. The average annual temperature for most of Sikkim is around 18°c. During the monsoon, heavy rains increase the risk of landslides. The record for the longest period of continous rain in Sikkim is 11 days. Fog affects many parts of the state during winter and the monsoons, making transportation perilous. Temperatures in the mountain can drop to as low as -10° in Winter.

CLIMATE GRAPH FOR SIKKIM



SCALE	
Precipitation	1 cm 75 mm.
Temperature	1 cm to 3°C

LEGEND	
Precipitation	
Temperature	

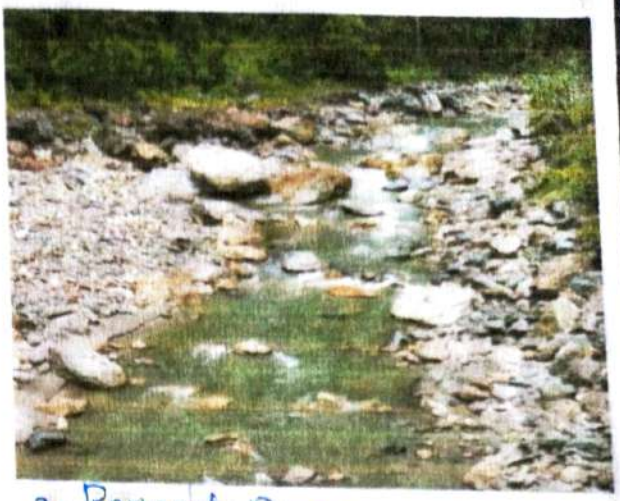
2.1.5 Flora and Fauna :-

Sikkim is situated in an ecological hotspot of the lower Himalayas, one of only three among the ecoregions owing to its altitudinal gradation, the state has a wide variety of plants from tropical species to temperate, alpine and tundra ones. Noble orchid is Sikkim state flower. Rhododendron bloom late April - mid may across the state.

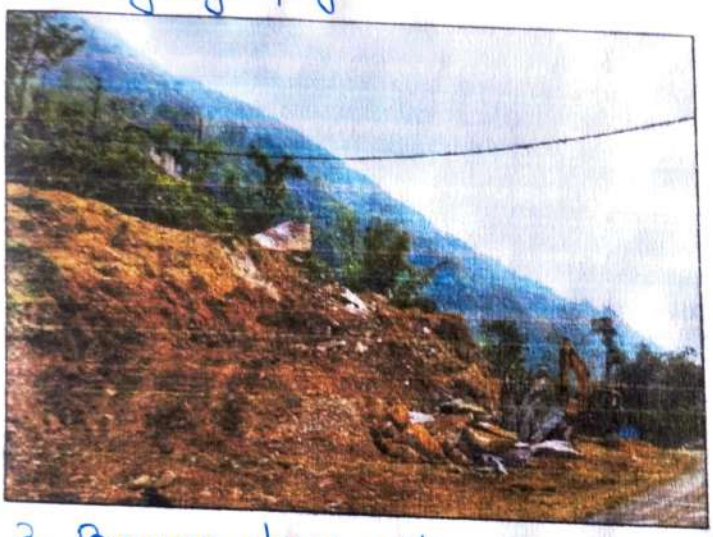
Sikkim is home to around 5000 species of flowering plants, 515 rare orchids, 60 primula species, 11 oak varieties, 23 bamboo varieties, 16 conifer species, 362 types of ferns and ferns allies, 8 tree ferns and over 900 medicinal plants. A relative of the poinsettia, locally know as "Christmas Flower", can be found in abundance in the mountainous state.

The Fauna of Sikkim include the snow leopard, muskdeer, Himalyan tahr, red panda goral, muntjac, common langun, Asian black beak clouded leopard, Marbled cat, leopared cat. dhole, Tibetan wolf, hog badger, binturong and Himalyan jungle cat. Among the animals more commonly found in the alpine zone are yaks, mainly reared for their milk, meat and as beast of burden. Sikkim has more than 550 species of birds. Some of which have been declared endangered. The red panda is the state animal of Sikkim.

1. Physiography.



2. Rangeet River.



3. Brown-clay soil

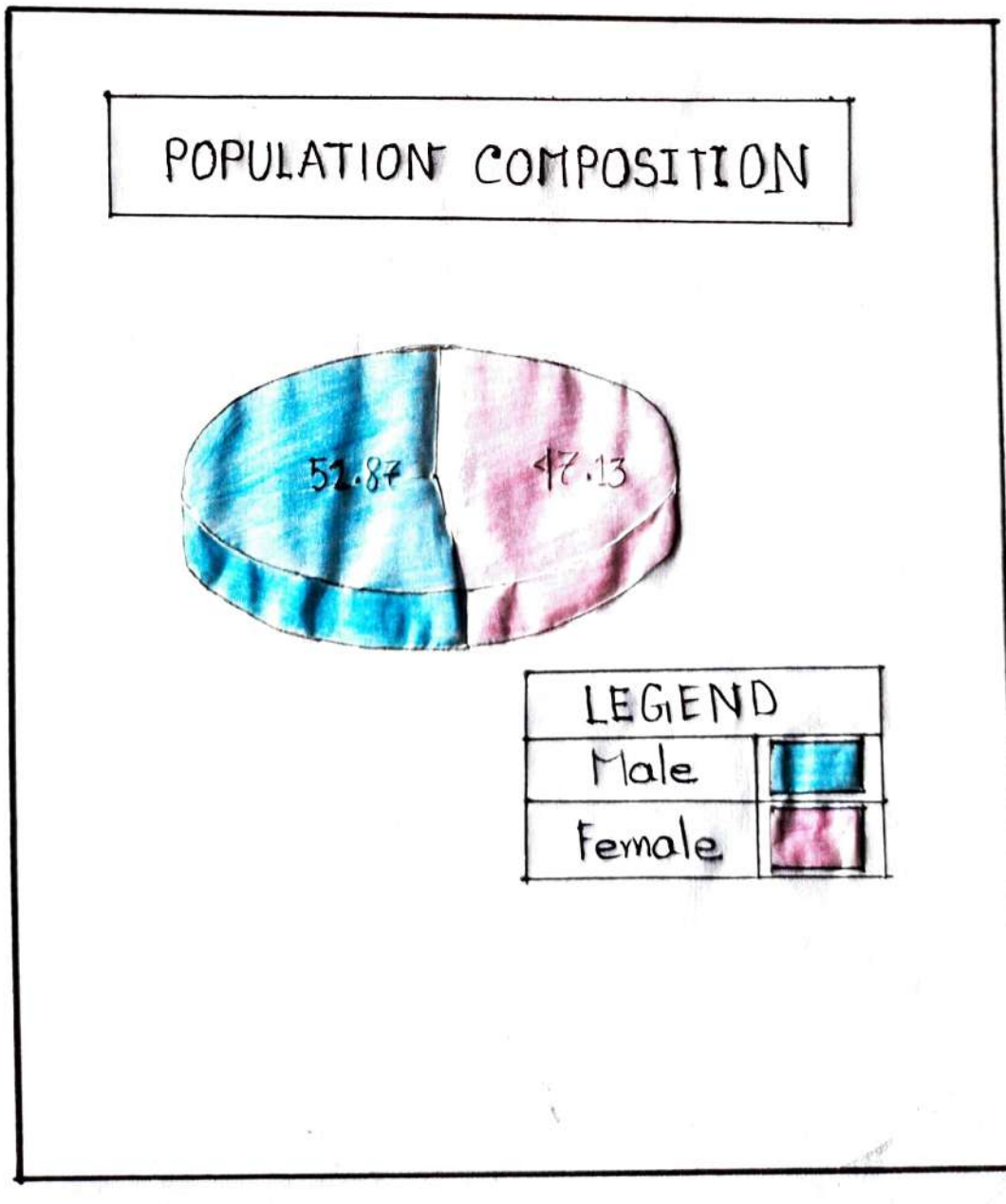
4. Rhododendron tree.

5. Red pand, state animale of Sikkim

2.2 Socio-Economic Environment :-

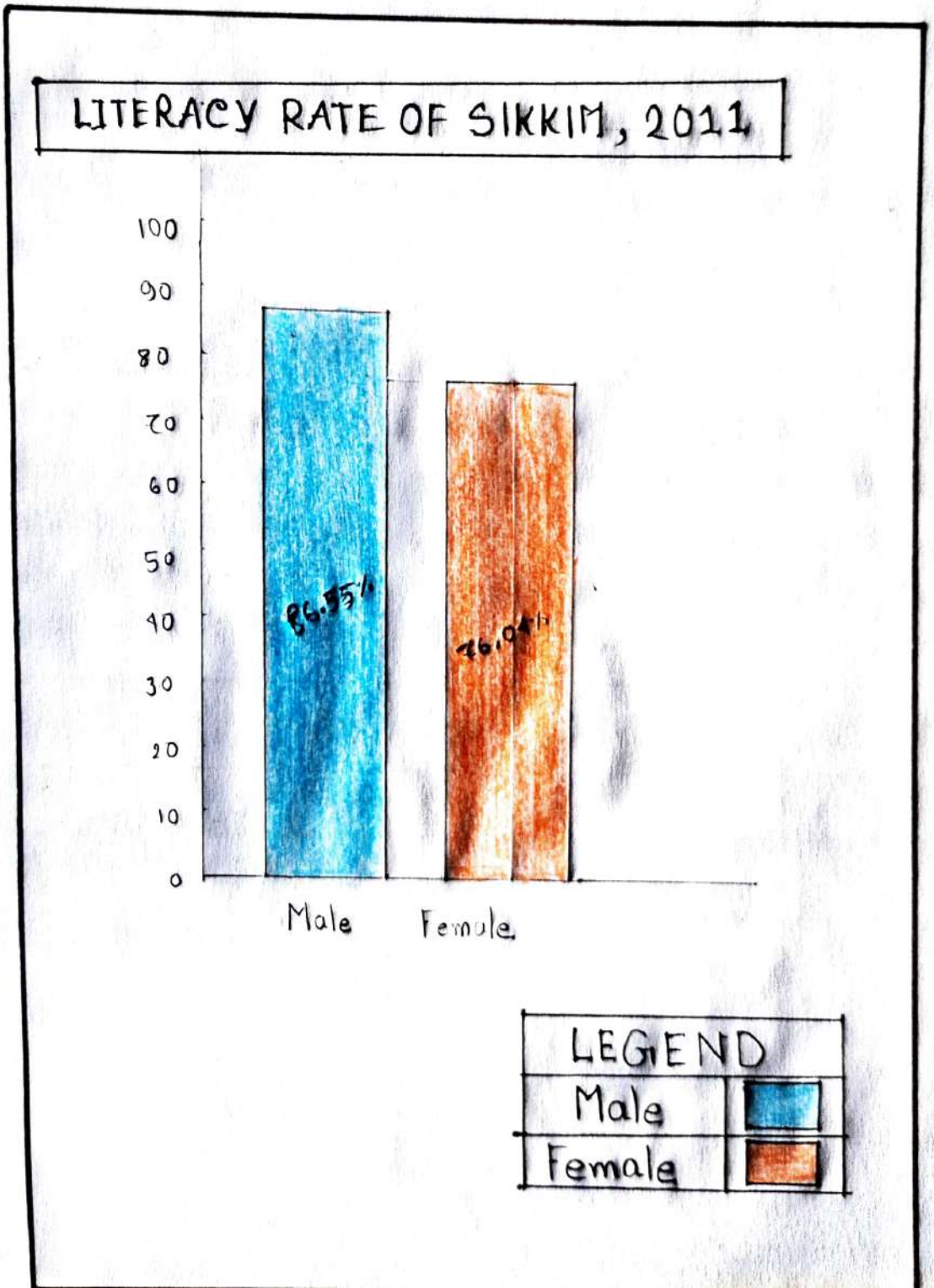
2.2.1 Demography :-

As per census of India, 2011 total population of Sikkim was 6.11 lakhs. Sikkim is the least populated state of India male 52.87% and female 47.05%.



2.2.2 Literacy :-

Literacy rate in Sikkim stood was at 81.42%. Where male literacy rate was at 86.55% and female literacy rate 76.04%. census of India, 2011



2.2.3 Culture :-

In Sikkim the leading communities are the Lepchas, Bhutias and Nepalese. The official language of the state are English, Nepali, Sikkimese and Lepcha. The Sikkimese are highly devout people and religions play major role in Sikkim. There are major two religions Bhuddhism and Hinduism. And Sikkim is multi-lingual state where people of many communities beside harmoniously.

2.2.4 Health :-

There are few hospitals, health centers, clinics and health facilities across the state of Sikkim. These medical facilities provide treatment both to the local patients and other patients from neighbouring phaces as weel.

Sl. No.	HEALTH INSTITUTION	EAST	*WEST	NORTH	*SOUTH	STATE
1	STATE REFERRAL HOSPITAL/ STAM HOSPITAL	1	.	.	.	1
2	DISTRICT HOSPITAL	1	1	1	1	4
3	* COMMUNITY HEALTH CENTRE	1	.	.	1	2
4	PRIMARY HEALTH CENTRE	6	7	5	6	24
5	PRIMARY HEALTH SUB-CENTRE	48	41	18	39	146
6	DISTRICT TUBERCULOSIS CENTRE, NAMCHI	.	.	.	1	1
7	CENTRE REFERRAL HOSPITAL MANIPAL TADONG (PVT)	1	.	.	.	1
8.	TOTAL	58	49	24	48	179

2.2.5 ECONOMY :—

The economy of Sikkim is mainly based on agricultural and animal husbandary and tourism. Sikkim's nominal state gross domestic product (GDP) was estimated in US$ 4.6 billion in 2019, with GDP per capita being $ 7,530 (₹ 5,50,000) thus constituting the thired- smallest GDP among India's 28 states.

2.2.5.1. Agriculture :—

Economy of Sikkim is largely agrarian based on the ternaced farming of rice and the cultivation of crops such as maize, millet, wheat, barley, oranges, tea and cardamom. Sikkim produces more cardamom than any other Indian state and it's home to the larges cultivated area of cardamom (88%). It is estimated that over 80 percent of the rural population depend on agriculture and allied sectors for economic food and national security.

2.2.5.2. Industry :—

Sikkim has long been agrobased society. The Govt. has formulated certain policies such as Sikkim Industrial Promotion and Incentive (SIPI) Act 2000 and its subsequent amendments in 2003 and 2007. Some of the Industries of Sikkim that deserves a spetial mention in this context are :— Pharmaceuticals, Cosmetic, Food processing, Flattness, Tea processing etc.

2.2.5.3. Eco-Tourism :—

In January 2016, Sikkim became India's first "100 percent Organic" state. The Directorate of Ecotourism under the forest, Environment and Wildlife Management Department has identified and demarcated 11 areas in Sikkim as ecotourism. Ecotourism in Sikkim started in the year 1995-96 with trainings, awareness, changes in regulations to adapt to the mountainous terrain and entry of foreign tourist in many of restricted and protected areas.

Protected parks and santuanies for ecotourism activities:— Kanchedzong National Park, Singba Rhododendron sanctuary, Fambong Lho Wildlife Santuary, Kyongnosla Alpine Santuary, Maenam wildlife santuary, Versey Rhododendron santuary.

2.2.6 Transport :—

National Highway 10 (NH 10; Formerly NH 31A) links Siliguri to Gangtok. Sikkim nationalised transport runs bus and truck services. Primately run bus, tourist taxi and jeep services operate throughout Sikkim and also connect it to Siliguri. A branch of the highway from Melli connects western Sikkim. Towns is eastern, southern and Western Sikkim are connected to the hill stations of Kalimpong and Darjeeling in northern

West Bengal. The state is Further more connected to Tibet by the mountain pass of Nathu La.

List of National Highways of Sikkim :—

Number	Length (km)	Length (mi)	Southern or western Terminus	Northern to Eastern Terminus
NH 10	52	32	Gangtok - Singtam - Rangpo - West Bengal Border.	
NH 310	87	54	Ranipool (NH-31A) - Burtuk - Menla - Nathula.	
NH 310A	55	34	Tashi view point - Phodong - Mangan	
*NH 510	70	43	Singtam - Damthang - Legship - Gyalshing.	
*NH 710	45	28	Melli - Manpur - Namchi - Damthang - Tarku.	
NH 717A	112	70	West Bengal Border - Rhenock, Ronathang pakyong a junction with new NH 10 at Ranipool near Gangtok.	
NH 717B	42	26	Junction with NH NO 717A at Rhenock - Rongli, Rolep - Junction with NH NO. 310 near Menla at Sherathang.	

West Bengal. The state is Further more connected to Tibet by the mountain pass of Nathu La.

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- **Airways** :-

There is just one airport is pakyong which is around 111.9 km from sikkim but Bagdogra is well connected to sikkim (about 125 km from Sikkim township.)

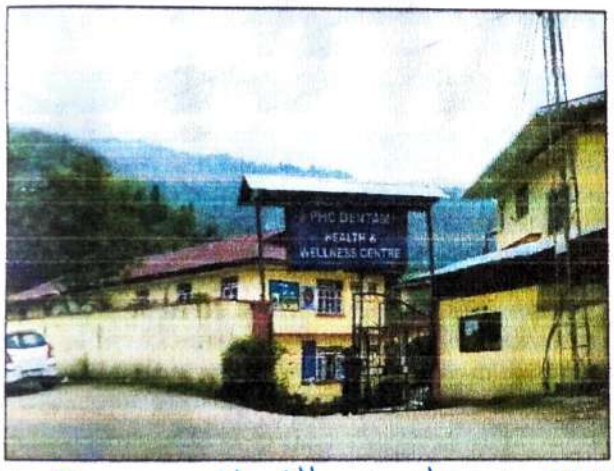
Here helicopter service started mainy for tourism purpose.

- **Railways** :-

The nearest railway station to Sikkim are New Jalpaiguri and siliguri station located in West Bengal.

1. Culture in Sikkim.

2. Culture in Sikkim.



3. Primary Health centre in DENTUM

4. Cardamom cultivation.

5. NH-10

3.0 Landslide in study area :-

The frequent occurance of landslide is a very common phenomena in Sikkim, Himalaya and one that causes the most damage to property and connectivity in the landlocked state and also loss of the lives and property. Apart from this, recent unplanned development activities, particularly road construction and ill planned settlements, have further aggravated the incidence of the landslide and subsidence.

3.1 Causes of Landslide :-

The frequent occurrence of landslide is a very common phenomena in Sikkim Himalaya In the Sikkim region can be caused by a variety of factors including geological, environmental and human-related. Here are some common causes that contribute to landslide-

A. Geological causes :-

Sikkim a state in north-eastern India, is located in a seismically active region and experiences various geological processes that can contribute to landslide.

1. Slope stability :-

steep slopes and unstable geological formation can contribute to landslides. For example, the Sikkim region is characterised by rugged terrain with steep slopes, especially in the Himalayan mountain range. The presence of weak rock formations and loose social can make these slopes prone to landslide.

2. Geological Formation :-

The geological formation of Sikkim consists of complex and varied rock type, including schits, gneisses, phyllites, and quartzites Some of these rocks have inherent

weaknesses and discontinuities, such as bedding plans, joints and faults which can act as potential sliding surfaces.

B. **Environmental causes** :—

Sikkim state is prone to landslide due to its rugged terrian and high rainfall. Several environmmental causes contribute to Landslide.

(1) **Heavy Rainfall** :—

Intense or proloenged rainfall can saturate the soil, increasing its weight and and reducing its stability. Sikkim experiences heavy monsoon rains, particularly during the month of June to September, The excess water can infiltrate the ground, leading to landslides, 6th August, 2020 jonethang Landslide in West Sikkim.

2. **Earthquakes** :—

Sikkim falls in a seismically active region due to its proximity to the Himalayan tectonic plate boundary. Earthquakes can generate ground shaking which can disturb the balanced of slopes and trigger land.

3. **Erosion** :—

Natural erosion processes such as riven erosion can undercut slopes and weaken their stability. Continous erosion removes support from the base of slopes, making them prone to landslide.

c. **Human-related causes** :-

Human activities can also contribute to the occurrence or exacerbation of Landslides. Here are some, man-made causes of landslide-

1. **Deforestration** :-

Cleaning large areas of forests for agriculture, logging or urbanisation reduces the stability of slopes. Tree roots help bind soil and prevent erosion, so their removal can make slopes more prone of landslide.

2. **Construction and Excavation** :-

Poor construction practices, improper grading of slopes and excessive excavation can alter the natural stability of the land. Building roads, highways or structures on steep slopes, with appropriate engineering measures can increase the risk of landslide.

3. **Defective Drainage systems** :-

Inadequate or poorly designed drainage systems can lead to the accumulation of water in the soil, increasing pore pressure and reducing the shear strength of slopes. This can result in slope failures and landslides.

3.2 Consequences of Landslide :-

A. Physical Effects :-

Damage to Infnastructure: The infrastructure facilities such as telephone and communication system, electricity supplies, water and oil pipelines, offices, furniture, commodities, transport system etc. are severely damaged and put out of gear by massive landslide.

B. Social Effect :-

1. Human casualities :-

If landslide occure in the inhabited areas, the first and foremost adverse impacts area on human population. If there is no timely forewarning of problem occurrence of landslide and if there is no proper timely evacuation, a large number of people are buried under enormous mass of debris of varying sizes and theine is heavy toll of human lives.

C. Economical Effect :-

1. Loss of agricultural farms and crops :-

At the very outset it may be pointed out that majority of settlements are built on the hill slopes and foothills in mountainous areas, and thus agriculture is also practiced on hill slopes and in the valleys, Generally, terraced cultivation is in practice.

D. **Environmental Effect** :—

- **Damming of rivers and flash floods** :—

Huge volume of debris produced by landslides of various sorts coming into the river forms temporary dams across the river and thus agriculture blocks river flow. In such situation substantial volume of water is impounded behind the temporary dam and some lakes are also formed.

E. **Effect on Ecosystem** :—

1. **Impact on water quality** :—

When landslide occur, they can seriously damage or destroy ecosystem. Sometimes the effects can last for thousands of years.

2. **Wipe out forest land** :—

What's more, these hazards can wipe out large tracts of forests, wildlife habitats and remove productive soils from slopes.

3. **Dam up or flood streams** :—

Also they can dam up rivers and streams. In so doing water flow is restricted. Marine and terrestrial organism that depend on the water flow may eventually die.

4. **Loss of lives and social disruption** :—

Landslide are responsible for a number of deaths, injury to people, damage to housing, infrastructure and agricultural land.

3.3 Some instances of landslide in the study area:-

1. **2007, 19th July :-**

Heavy rain triggered a landslide in Rabongla, South sikkim. The Singtam-Rabongla road has seen as many as 11 landslips while the Namchi-Rabongla route via Damthang has been closed because of an uprooted tree.

2. **2011, 23rd June :-**

A torrential spell of rain from 7.30 pm to a little past midnight on the 23 June 2011 triggered numerous small landslide in Pelling. Where 14 people perished on the Pelling-Dentam road in West Sikkim.

3. **2011, 18th September :-**

On September 18, 2011, a 6.9 magnitude earthquake struck the India-Nepal border region. According to news reports, impacts of the earthquake included landslides in the northern Indian state of Sikkim, between Nepal and Bhutan.

4. **2020, 21st June :-**

A landslide occured in Tatopani at 6PM on Friday. The road constructed across a steep terrain near Tatopani remains vulnerable to landslide especially during rainy season and recent back cutting initiated for the road expension has added to risk of landslide during on going monsoon season.

Legship- Nayabazar road was bloked near Tatopani due to the landslide. The commutens travelling from Jorethang to Gayzing, Yuksam and Tashiding were compelled to take Reshi-Rinchenpong route via Legship to reach their destination.

5. **2020, 22th June** :-

A landslide occured at National Hydropower Project of Corporation (NHPC) Teesta Stage-V dam on the left bank of the river in Dikchu. According to the local people of Jang and Tapdara, the landslide was occured due to the negligence of NHPC, and it could have been avoided with proper preventive work on time. The landslide has severly damaged the 55 metre high dam of the 510 MW Teesta Hydropower Project of NHPC.

6. **2020 6th August** :-

A massive landslide occured in Jorethang in South Sikkim. A road in Jorethang was also washed off due to heavy rainfall in the region. The IPCA laboratory in Mazhitar, Jorethang was badly damaged in the landslide. The house was also completely washed away due to the landslide triggered by heavy rainfall in the area.

7. 2022, 5th February :—

A landslide occured at Pathing village in Namchi district due to heavy rainfall 60 houses were damaged in this landslide.

8. 2023, 18th June :—

Multiple landslide induced by heavy rainfall have damaged over a hundred houses in West Sikkim district. The incessant rain has caused extensive damage to infrastructure and property in the state.

Some Instances of Landslide in the study area

1. A landslide occurred at Pathing village in Namchi district due to heavy rainfall

2. The IPCA laboratory was badly effected due to landslide

3. Teesta stage-V dam was broken due to landslide.

4. Landslide all over Sikkim due to earthquake.

5. 14 people died in pelling due to landslide.

6. Legship-Nayabazar road was damaged due to landslide.

7. Namchi-Rabongla road was closed due to landslide.

3.4 Management of landslide :-

These guidelines by the national Disaster Management Authority (NDMA) on management of landslides reduce the enormous destructive potential of landslides and minimize the consequential losses by institutionalizing the landslide hazard mitigation efforts.

Preventive and connective measures to l ssen the impacts of landslides. It may be mentioned that landslides cannot be stopped but their number, frequency, recurrence and severity can be minimized. Some preventive measures have been taken to manage landslide in the study area —

(i) Contour Bunding :-

Earthen embankment was constructed at intervals across the swope and along the contour line of the many landslides in Sikkim. A series of such bund is very useful in dividing the area into strips and act as barrier to the flow of water.

(ii) Bench Terrancing :-

Relatively steeps land was transformed into a series of level or nearly level strips or steeps running across the slope of many landslides in South Sikkim.

(iii) **Rock Slope Netting** :-

Rock Netting is used to coven an entire anea of unstable nock. The slope netting can be either draped or bolted in each cornen of each panel. Rock netting is used whene the unstable nock is big and blocky. It is a new technique of landslide contnol which is used for landslide contnol in Sikkim.

(iv) **Contour Trenching** :-

Senies of deep pit or trenches acnoss the slope at convenient distance was built within the landslide of south Sikkim. The soil excavated from the trenches was deposited on the lower edge of trenches whene forest trees were planted.

(v) **Sausage well** :-

Preference was given to sausage well among the mechanical method in every landslides was nearly checked by applying sausage wall.

SOME OTHERS PHOTOGRAPHS RELATED TO LANDSLIDE

1. Landslide prone area. unplaned settlement.

2. Landslide occured by heavy rainfall had devastated over a hundred houses in Sikkim

3. Uprooted tree due to landslide

4. Subsidence of slope.

5. Rock slope Netting

6. Bench terranceing.

3.5. Suggestive Measure :—

Along with the management system of landslide in Sikkim Himalaya some other measure should be taken—

(i) During pensuing of any disruption projects in the high nisk zone like Sikkim, should be proced with prudenee.

(ii) Environmental impact Assenment standards should be followed before mining or dam building.

(iii) Landslide mieno zoning method should be implemented in the extremely vulnerable area.

(iv) To strengthen disaster management potential more funding should be given to landslide planning and mitigation agencies.

(v) To strengthen hazard reduction and public awannes, locally available trained people should be enlisted.

(vi) Mitigation technique such as confining agriculture to valleys and places with moderate slopes, fostering lange-scale affonestation initiatives and building water bunds should be encouraged.

(vii) Encourage the use of effective landslide nehabilitation and mitigation techniques.

4.0 Conclusion

Physiography, climate and other natural phenomena of Sikkim Himalayas make it hazardous with frequent landslide. Human activities play the role as positive catalyst for this calamity. There are spatio-temporal variation in frequency of landslide throughout the disaster of Sikkim. In the study area landslides occur basically due to heavy rainfall along with some associated factors. Many time it creates massive and unwannanted loss of life and property. Therefore, there should be efficient management of the landslide hazard. There are necessities of the development of institutional capacity and training for geo-scientist, engineer and planners. It may be mentioned that landslide can not be stopped but their number, frequency, requnnence and severity can be minimized with some preventive and connective measure to lesser the impacts of landslides which will help to prevent water entering the hill slopes through joints and cracks, decrease water pressure in the rocks through shallow and sub-shallow drainage, place drainage trenches in order to reduce water pressure in the vicinity of hill slopes. The inhabitants of this area should be sensitized through awarness programme, and so on and the landslide prone area of Sikkim require special attention and vigilance to cope up with this calamity

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