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Article :Study on Landslide Incidents of Paglajhora and Adjacent Areas –An Overview; Kurseong Block, Darjeeling, India

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Prelude telling

Building up and maintenance of the roadway linkages in the Himalayan and sub Himalayan regions have been a major problem for the engineers and Planners. During the incessant rains of monsoon period, these roadways get blocked due to landslides sometimes for uncounted days affecting the natural mobility of hill lifeline. Due to limited number of roadways in the region and absence of alternate route, people as well as essential commodities get stranded on the road during such natural calamities (Sengupta.A, Gupta.S & Anbarasu, and K). The Himalayan regions are susceptible to extremely steep and corrugated slope dispositions with frequent instability over the unsaturated and solifluctional plasticized mass of rocks. Most of the studies conducted on the Himalayan regions include the demarcation of sensitive landslide susceptibility areas.

Aims and objectives:

The following are the main objectives of the present study

I) Identification of the important causes of land slide

II) Establishment of cause effect relationship of landslides

III) Analysis of relationship of landslide effects and its impact on social lifestyle

iv) Sketch building and generalization of important landslide types

Methodology:

The following are the important methodologies which were used

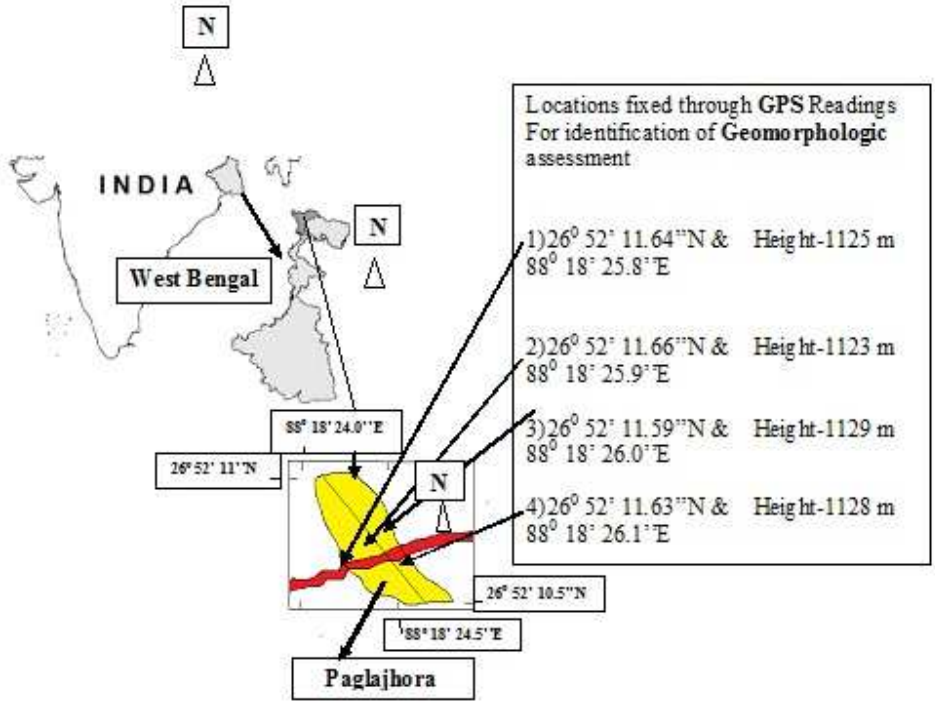
I) Field observation at about 15 spots of the recent Paglajhora landslide spot

II) On spot field sketches

III) GPS readings at specific spots

IV) In-depth study of different secondary source maps, literatures, memoires, field conversations, group consultancy with expertise persons and oral information etc

Study Area: The area affected by such type of erosion is located at and around Shiva Khola area of Paglajhora in Kurseong Block of Darjeeling District. The most severely affected area is between 30-40 Kms patch of NH-55 situated at South East part of Kurseong block of Darjeeling District comprising about 1.75 Sq. Km areas and is susceptible from the last 60 years triggered by serious processes of landslide.



Map 01: Location Map of Paglajhora landslide area

Geographical set up: The landslide is receiving the following main geographical

features regarding its natural calamity sensitivity having a head elevation of 1540m (approx) and a toe elevation of 780m.Most vulnerable width is about 500 m along the curvature of devastative roadway. Thus the wound length is about 760m with a long axis of slide.

General geology

Sikkim as a state and Darjeeling district of West Bengalis present entirely within the Shiwalik Himalayas and are predominantly covered by two major litho-tectonic units,

a) The Higher Himalayan Crystalline Sequence (HHCS), and

b) The Lesser Himalayan Sequence (LHS),

These two are distinctive because of a major ductile shear zone called the Main Central Thrust (MCT). The HHCS is consisting of quartz and feldspar of the origin of both igneous and sedimentary that suffered high grade metamorphism. The LHS is dominated by garnets, biotites, micaschists and chloritified schist in the upper part, and slates and Phillies in the lower part. The general geology establishes the fact of highly weathered rock materials with the time series effects of liquefaction and solifluctional movements of rocks downward. Gravitational compelled slope failures are the so called long drawn history of this area.

Understanding the issue:

Some of the factors identified to be responsible for the frequent landslides in these regions are

i) Steep slope Angles with unsaturated mass

ii) Toe Cut erosion by jhoras and streams

iii) Unprecedented and heavy rainfall strokes

IV) Vegetal disappearance

v) Earthquake and tremor shocks

VI) Uncontrolled quarrying for building purposes and

vii) Unplanned and haphazard urbanization.

But very few site-specific observations reveal the actual ground reality in a micro level investigation.

Human responses

To respond to the situation following are the most important aspects of implementation

1. Preparation of gabion walls and benches along the slopes of the roads
2. Construction of surface and subsurface chutes to takeout the surface runoffs
3. Construction of walls at the toe of the slopes to prevent toe erosions
4. Building up of aquaduct to steadily pass out rain water under the roadways
5. Tie down loose rocks and boulders with jute geogrid to restrict over toppling and sliding etc.

   Though, these preventive techniques are not the permanent solution a few monsoon seasons.

Important Factors of recent Paglajhora slide

The following reasons have been categorized below

1. Moderate to high steep slopes, sometimes $>40^0$
2. Effects of nearest MCT
3. Dynamic toe erosion and contiguous instability near the toe
4. Supersaturated top mass with fractured and sheared alignment of bed rock.
5. Precariously out tending exposed bedrock of granetoidal origin
6. Accumulation of thick cover of anisotropic material of lesser shearing strength

7. Semicircular topographical outcome of the Paglajhora slide

8. Scouping of unsaturated mass of rock with subsurface mobile water flowage

9. Step to step hydrostatic stress upon the rock strata

10. Development of kholas due to slope changes (Shiva Khola)

11. Mobile and fragile slopes associated with heavy structures

12. Anthropogenic interventions with improper drainage practices along roadway

Field work Analysis

On the basis of above methodological practice, in the following paragraph the analysis and

Ground trusting of the exigency of the calamity of the slide has been evident through the Photographs, Checklist, Statistical technique, diagrams etc.

The main motive was to find out the major landslide types with a view to assess the nature of failure and to make a causal relationship between the processes involved and their concentration of slumping, jumping, sliding, creeping, flowage, etc. Here the mobile Rapid flow and the slow flow types were identified to attempt the nature of jump in response to the gravitational pull.

In the following Photograph scenario of 10 May Paglajhora slide has been conceptually evaluated.

Paglajhora/14th Mile landslide on NH55 on 10May2011
The landslide dwarfs a huge earth moving vehicle working to clear the debris

In the following Photograph scenario of 10 May Paglajhora slide has been conceptually evaluated.

Site .No.	**Slope angles(^{0} d)**	**lithology**	**Fracture types**	**Rocks types**	**Drainage Density**	**Rock Hardness**	**Rating Values**
01	40-45	Mixed soil matrix	Vertical and moderate	loose	moderate	low	5
02	45-50	Weathered schist	High	Semi compact	high	low	4
03	35-45	Sandstone and soil in mobile d fashion	High	Very loose	high	medium	4
04	30-35	Small stones and unconsolidated soils	Moderate	Very much loose	low	low	6
05	45-50	Granetoidal rocks	Moderate	Comparatively strong	moderate	high	3
06	45-50	Disintegrated Shales,gniess	Moderate	Medium prone	High	low	4
07	45-50	Fractured gneiss	High	Rolling polygonal debris	High	low	7
08	45-50	Quartz and gneiss	High	Creeping polygonal stone chips with soil flow	Moderate	moderate	3
09	35-45	Sandstones, granites	High	Susceptible to slump	low	low	5

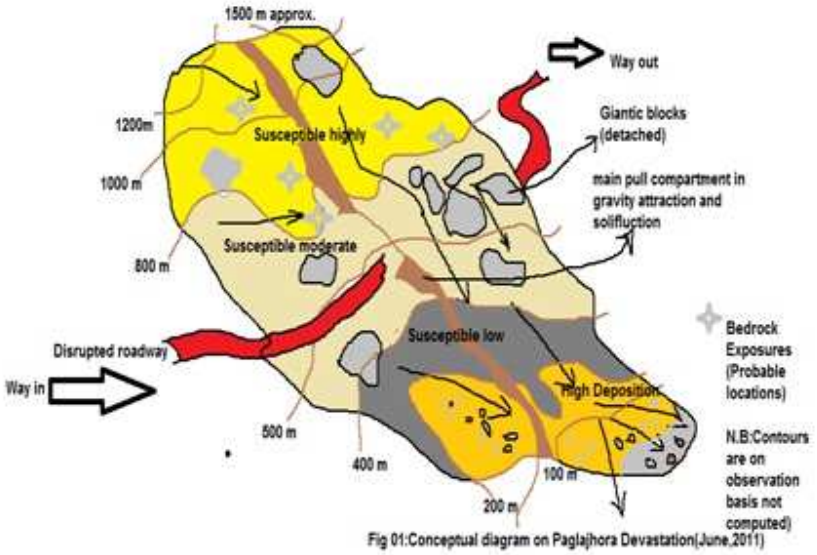
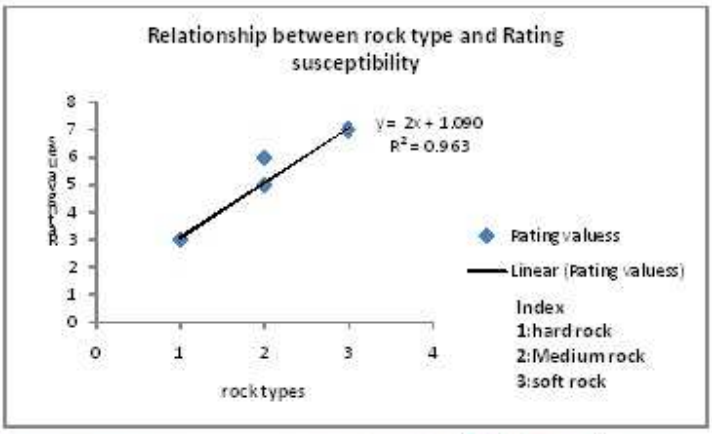


Fig 01:Conceptual diagram on Paglajhora Devastation(June,2011)

Plate: 05

Plate 06



In the above regression analysis the relationship betweenRating values on landslide susceptibility and types of rocks on the basis of their general hardness character has been presented and a high positive relationship between the two variables has been found with a view to assume that only a single scatter value has been noticed located at distant place.Tus the relationship is found compact and most firm.The value of co-efficient of determinant isalso validating the positivity of the occurance to be of more thgan 90%

Theoretical Explanations

On the basis of the observed direction and type of movement the following main subtypes were identified following the modified scheme of R.J.Chorley et.al, 1985

A) *Vertical Movement*

1. Fall:

It is indicative of falling of earth materials from a very escarpment like and precipice type of hill cliff, scarping in general and downfall is aggravated by sub surface water movement.

These fall types have been observed at Paglajhora

a) Earth fall (Ref: Plate 01)

b) Debris Fall (Ref: Plate 07)

c) Semi toppling (Ref: Plate 07)

2. Subsidence:

Five locations along the disrupted roadway at Paglajhora were observed tending to the downward sinking of the slided material due to subsurface collapse. Mainly two types of subsidence have been observed: Collapse and undermined settlement (favored by water disposability propelled by gravity).

B) *Lateral Movement*

1. Slides

Down moving rock masses were observed along the diagonally developed fractured line of gravity response, mainly due to composition of varying rocks of differential resistance of withstanding like, Gneiss, Schist Mica schist, quartz, Squeezed Micacious deposits etc.Main features of downfall is as follows

a) Block Slide: Witnessed downward movement of erratic chunks of rock along the lubricated subsurface plane of detachment.

a) Cambering: Imprints of draping of sedimentary sandstones, schist, Micacious band of rocks etc covering patches of enclosed slope areas. (Ref: Plate 02)

b) Sucking: Spreading of rock elements at the crest of slide may have been recognized but with slower intensification and propensity.

C) ***Diagonal Movement***

1. Creeping rock mass

a) Creeping rock mass

Observed and identified chemically weathered materials of micaschists Phyllites, and odorous shale proved the process in operation

b) Creeping soil mass

Overmastered and highly saturated top soil matrix in downward movement observed for about 10 times with very slow flowage propensity.

c) Creeping talus mass

Havocs of scree deposits of multiple edged, polygonal and diagonal base material accumulations were observed at least at 5 spots as per the investigator's looking for.

2. Slide

The following important slides were witnessed

a) Rock Slides

Rocks of varying sizes have been imprinted along sliding channels have registered their presence.

b) Debris Slides

Down slope movement of rocks with muddy soil content sliding over unsaturated slope plane is also a very common phenomenon here.

c) Slumping

Movement of fine to finer materials along curved planes has been observed predominantly either as mud flow of soil flow accompanied by polygonal scree products. (Ref: Plate 08)

3. Flow

Actually water is playing the dominant role of flowage either in the form of mud or soliflucted soil matrix combined with rock detritus and composite debris. Thus, it was of 3 main types

a) Mud Flow-Flow of muddy and turbid water.

b) Debris Flow-downward flow of detritus as dominant material

c) Earth flow-flow of mixed earthen saturated substances.

Concluding Remarks

It can thus be stated that different landslide categories create their distinctive morphological features on hill slopes (Singh.S, 1999) along the avenues of rock channels with temporary to ephemeral stream lines during differential time factors. With the triggering effects of threshold culmination of safety factor the probability

aggravates. There is always a balanced requirement of slope stress and strain against slope resistance which is an inert character of the subsurface rock types or strata present as geological fashion. Whenever there is imbalance of the stress – resistance factor (F) denoting the threshold value of more than 01 there is association of any exigency of triggering and the result is a menace specially over the semi cohesive, loose and depositional Siwalik rocks found over approximately last 300 years of creation in the form of lobes of deposited material cones many a time. The need is to keep pace with sustainable development and ecological development regarding all human deeds over greed at times in this type of mobile slope zones to arrest the future incessation of mass failure.

REFERENCES:

- **Chorley, R.J. and B.A. Kennedy, (19712):** *Physical Geography: A System Approach*; Printice Hall, London.
- **Goudie, A., (1981):** *Geomorphological Techniques,* George Allen and Unwind, London
- **Holmes, A and D.I. Homes, (1978):** *Principles of Physical Geography*, 3rd Edtn., London.
- **Ghosh, S, Sarkar .K.N. and Paul.C (2006):** *GIS-based slope stability evaluation– case Study from Paglajhora landslide complex, Darjeeling Himalaya, India,* Engineering Geology Division, Geological Survey of India (Eastern Region Kolkata).Kolkata, ppt display.
- **Sarkar, S. and Kanungo, D. P.:** *Landslide disaster on Berinag–Munsiyari Road, Pithoragarh District, Uttarakhand,* Commentary (Jr.), Periodic, Current Science, vol. (98), and No. (7), 10 April 2010. Pp.900-903
- **Valdiya, K.S (1980):** Geology *of the Kumaun Lesser Himalaya*, Wadia Institute of Himalayan Geology, Dehradun, pp.291-292.
- **Gupta R.P., and Joshi B.C(1990):** *Landslide Hazard Zoning Using the GIS Approach- A Case Study From the Ramganga Catchment, Himalaya,*

Eng.Geol., Vol. (28), , pp. 119-131.

- **Singh, S. (1999):** *Geomorphology, Edtn.2002, 3rd* revised. & enlarged, Prayag Pustak Bhawan, Allahabad-02, vol. (01), pp.247-266

- Sengupta.A, A., Gupta, S. & Anbarasu, K. (2010): *Landslides - Investigations and Mitigation in Eastern Himalayan Region,* Indian Roads Congress (Jr.), Paper no. 560, Edtn. July-September, pp.133-142