Occurrence of Landslides in Araku Valley and its Environs, Vishakapatnam District, Andhra Pradesh

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Abstract

The occurrences of Landslides in the Araku valley and its environs of Vishakapatnam district of Andhra Pradesh have been studied. The slides occurred in a rugged hilly terrain forming a part of Eastern Ghats Mobile Belt. The slides are predominantly debris slides of varying dimensions and occurred in khondalitic country in slopes of the order of 30°. The debris is mostly of scree, soil, boulders and weathered rock. The study reveals the important causative factor of triggering slides manifested in heavy rainfall due to cyclonic storm. The predominant causes of the slope failure include toe erosion, debris accumulation resulting blockade, overtopping and changes the course of streams. The present study is aimed to identify damage assessment, magnitude of slides and causes of slides and an attempt has been made to suggest some long term corrective and control measures in the area.

Key words: Landslides, triggering factor, weathering,

Introduction

Landslides are one of the natural disasters in the fragile ecosystem. The present paper deals with the occurrence of landslides in the Araku valley of Vishakapatnam district of Andhra Pradesh which took place at Kodipunjavalasa village about 2 km from Araku valley in the night of 3rd /4th of August 2006 where loss of 18 precious lives in one single instance. At the time of devastation the area was experiencing a cyclonic storm and incessant rains. The slides occurred in the area located in a rugged hilly terrain forming a part of Eastern Ghats Mobile Belt. The damages due to a few other sympathetic slides are partly to communication corridors in the same area and the rest of the slides have occurred in far-flung areas away from the habitation. The slide also caused other problems related to dwelling units, part of communication corridors and drainage system. The slides observed to be predominantly debris slides of varying dimensions which have occurred in khondalite terrain in slopes of the order of 30° in a media made up of scree, soil and weathered rock.

The present study on Kodipunjuvalasa slide, Araku Valley mandal was taken up with an objective of carrying out damage assessment, assessing magnitude of slides, investigating causes of slides and recommending immediate or emergency corrective and control measures, so as to underline the necessity of a detailed study to arrive at long term measures.

Location, accessibility and geomorphology

The study area (Latitude 18° 18' 14" and Longitude: 82° 51' 30") located in the Araku valley in Vishakapatnam district is well connected with rail and roads. The Vishakapatnam -Bhubaneswar railway line also connect Araku valley. Geomorphologic point of view, the area is blanketed with numerous hill ranges as strike ridges with dome and basin structures interspersed with

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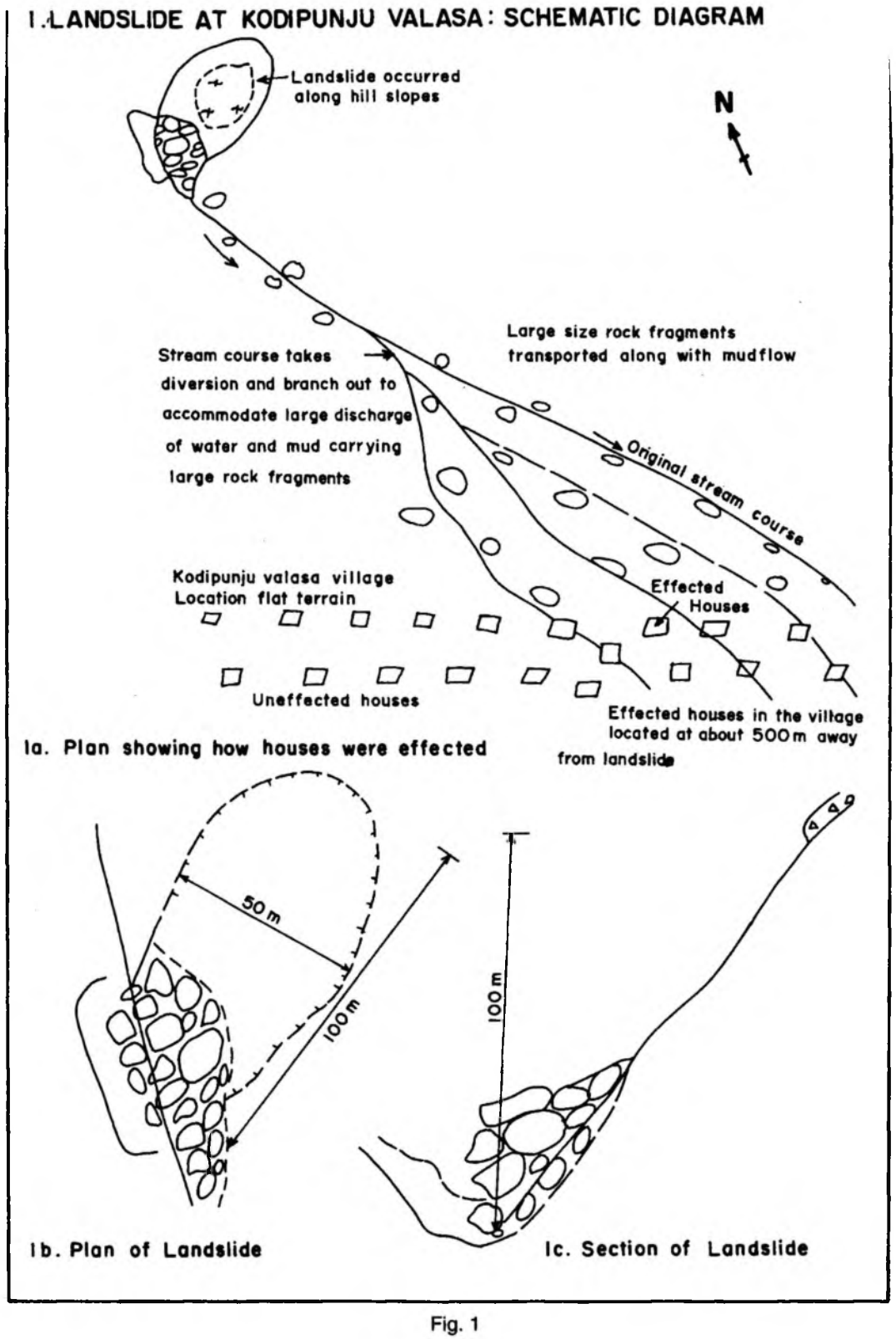
I. LANDSLIDE AT KODIPUNJU VALASA: SCHEMATIC DIAGRAM
Landslide occurred along hill slopes
N
Large size rock fragments transported along with mudflow
Stream course takes diversion and branch out to accommodate large discharge of water and mud carrying large rock fragments
Original stream course
Kodipunju valasa village Location flat terrain
Effected Houses
Uneffected houses
Effected houses in the village located at about 500m away from landslide
Ia. Plan showing how houses were effected
50 m
100 m
100 m
Ib. Plan of Landslide
Ic. Section of Landslide

Fig. 1

narrow valleys. The general elevation ranges from around 800m to 1200m and the principal drainage or the trunk stream that drains the area is Muchkund river with two tributaries viz.,Pathal river and Andar vagu. The drainage density of the area is moderate to high and the pattern is sub- trellis to trellis. The ephemeral streams draining the area display steep bed slope as a consequence to which erosion is the most predominant ongoing geomorphic process. The terraces that have developed are essentially cut and fill terraces. Depositional terraces are confined to the valley portions only. The bed load of the streams in general contains coarser clastics comprising huge boulders, cobbles and pebbles in a matrix of coarse to fine grained sand.

Regional Geology

The area is a part of Eastern Ghat mobile belt, comprised of foliated Khondalite, Charnockite and Migmatite Group of rocks capped at places by laterite, soil and scree material. Development of laterite profile ranging from saprolite to duricrust with the presence of typical lithomarge, more so at the ridge tops. The Khondalite Group consists of garnet-sillimanite gneiss, calc-silicate rocks and quartzites while the Migmatite group of rocks comprises garnetiferous quartzo-feldspathic granulites and gneisses,hypersthene-biotite granulites and gneisses. Younger intrusives comprising gabbroic rocks, pegmatite and quartz veins are also observed.

Description, Causes of the Landslide event

The slides were studied and reported as fresh slides occurring on the slopes at about mid height with most of the slides classified as sheet debris slides essentially translational in type. The general slopes 30 °-45° are made up of scree, thin veneer of soil, completely weathered rock transformed into soil slumps noticed and the slides have occurred predominantly in khondalitic country. Rainfall, stream erosion due to flash floods, consequential material movement and blockade are identified to be the triggering/ causative factors for majority of the slides that occurred away from the habitation.

Kodipunjuvalasa slide, Araku Valley Mandal

The slide occurred on the night of 3rd/4th August 2006 killing 18 people and destroying 10-15 houses. The settlement is located nearly half a kilometer away from the slide and located in a relatively stable, flat area. The slide occurred in the uphill direction of the village where the confluence of two 1st order streams join with a second order ephemeral stream. A discharge of 10-15 litres of water flowing along the stream was observed issuing from where the stream emerges into the plains from the hills indicating development of pore water pressure even after a lapse of 2 months period after the occurrence of the event. The slide had occurred on the left flank of the second order stream measuring 100m long, 50m wide and the zone of accumulation happened to be the riverbed (Fig. 1). The failed area was grass covered with wild shrubs and with occasional isolated trees. The pre failure slope of the failed area was of the order of 30° and the slope forming material made up of scree, soil including high to moderately weathered rock. The country rock as exposed in the riverbed is garnetiferous biotite gneiss. The slide is essentially identified to be a translational slide failing along the interface of soil and weathered rock and classified as debris avalanche due to rapidity of its movement. The crown scar is of the height of 1.5 m to 2 m while the side scars are about 1.5 m to 2 m. The failure is triggered by toe erosion as the stream could have been in spate and occurred in the convex bend of the stream or the cross over. The failure extends upto the mid slope and shallow in nature.

It is estimated that about 15,000 cu.m of material got slided and blocked the stream course leading to natural damming during

continuous and incessant rain in the area received owing to cyclonic weather. It is inferred that the dam burst occurred within a short time and the flood discharge containing suspended load and huge rock boulders impinged on the village on account of the change in course of the stream and increase in velocity and also possibly due to lack of accommodation of such a discharge by the original 2nd order stream. The hydraulic head difference between the slide area in the valley and the affected portion of the village is estimated to be of the order 60 m. The impact has resulted in complete devastation of the mud walled houses burying people alive in its wake. The run up of flood waters is estimated to be of the order of 2 m as witnessed by slush marks in a tree trunk and perched boulders on roof top of house. In the case of two cement concrete houses only the window grills were bent and the boulders strewn over the rooftop of these two houses ((Plate-III) Photos 1-8). No damage due to settlement or damage due to erosion and scouring was observed. A well, located further towards the valley, which remained disused, has not provided any information on the increase in water level.

The damages to elements are not directly related to the slide but a freak occurrence and providential happening where sliding and natural dam burst in a far away area on the uphill appears to have resulted the catastrophe.

Control and corrective measures

It is recommended that the failed area i.e.., the zone of depletion, be covered by turfing and also by growing vegetation that can help in run off than infiltration. It should be done after easing the side and crown scars to the pre existing levels. Provision of a berm at mid level can be contemplated to prevent retrogressive failure. Any open crack observed may filled with impervious material locally available.

It is also suggested that huge boulders resting at the toe of the slide blocking the waterway be cleared by breaking them in place by labour intensive methods and the material thus harvested be utilized for river training to prevent bank erosion, and overtopping leading to flooding.

River training works in the form of guide wall gabions can be provided in places particularly at the convex bend of the stream to prevent erosion and scouring as well as in the other bank. The bank cuts wherever it is considerably protected by boulder pitching or by masonry pitching. In all the endeavors the local people can be gainfully employed and the administration can render requisite support.

The District administration has already identified an area for relocating the village to a safer location where construction activity is in progress.

Discussion and Conclusions

Based on the above studies it is required to understand the causative factors and triggering mechanism and suggest recommendations to take up immediate or emergency measures and to suggest Medium and Long term corrective and control measures.

The studies have revealed that the slides that had taken place are essentially debris slide or avalanche, shallow and translational type where the pre existing place of interface between soil and weathered rock has led to the dissociation and the consequential movement.

Most of the slides located in a hilly terrain have been climatically triggered by the rainfall and, the drainages having steep bed slope in spate led to toe erosion due to increase in velocity of water resulting in slides.

The slide mass in several cases resulted in the blockade and caused change in the courses of the ephemeral streams, culminating in the damages. In fact the losses that have occurred at Kodipunjuvalasa is also a freak accident and could not be attributed to regular sliding, as the settlement

itself has been existing in a stable area. The slides had occurred mainly in Khondalitic country due weatheribility of these rocks where development of soil is considerable and no rockslides were observed during the course of study.

The studies have also revealed that the area manifests numerous paleo slides having dense vegetation in zone of accumulation showing the regional vulnerability to mass wasting.

During the course of discussion it has emanated that the Administration is intending to relocate several of the villages owing to the threat of this natural hazard. It is advisable that shifting be considered as the last resort not only for the cost but also due to inherent difficulties, latent problems and spreading anthropogenic activities in an already existing fragile environment.

Recommendations

1. To take up studies on geotechnical evaluation by a scientific agency on the list of villages whose stability against landslide hazard exists and inquire in to the consequential corrective and control measures. Wherever relocation is considered inevitable the revised location should also be assessed by the same agency to recommend protective measures, if required.
2. Several of the existing practices of encroaching into the river bed for cultivation, restricting the flow of the seasonal streams for acquiring more land for cultivation, shifting cultivation or what is locally called as Podu Cultivation, terrace cultivation are to be severely restricted as they pose the threat of inducing landslides in areas by rendering critical equilibrium to supercritical status.
3. Drilling a series of bore wells for provision of assured drinking water can facilitate in relieving build up pore pressure.
4. A lined drain in conjunction can also prevent the area getting saturated and leading to prevention of development of pore pressure. Arrival of proper land use pattern is another area of concern, which can lead to a proper and stable area for living.

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