REPORT ON THE INVESTIGATION CARRIED OUT IN THE LANDSLIDE AFFECTED PUTHUSSERY AREA OF PALAKKAD DISTRICT

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INTRODUCTION

Landslides cause major socioeconomic impacts on people, their habitats and possessions, industrial establishments and lifelines - such as roads, and communications systems. Socioeconomic losses due to slope failures are great and apparently growing as the human activities expands into unstable hillside areas under the pressures of expanding populations. The western flanks of Western Ghats, covering considerable part of Kerala, (especially the study area) are identified as one of the major landslide prone areas in the country (Thampi et al., 1998; NDMD, 2004; Sankar, 2005; Vijith and Madhu, 2008; Kuriakose et al., 2009). These regions are characterized by rugged hills with long steep sided slopes on which the loose, unconsolidated soil and earth materials rest. The debris flows (here after referred as landslide), seasonally result in the development of new lower order streams on the slopes or widening of existing streams and subsurface seepages (Thampi et al., 1998). The characteristic pattern of this phenomenon is the swift and sudden down slope movement of highly water saturated overburden containing a varied assemblage of debris material ranging in size from soil particles to huge boulders destroying and carrying with it everything that is lying in its path.

Landslides represent a serious threat to human life and their socio-economical activities in most of the high mountain chains. The recognition of landslide prone topography is becoming increasingly important in environmental management and land use decisions and is vital for regional as well as local planning. The direct collection of information on landslide occurrence and factors those conditioning the terrain for the event were difficult to collect due the terrain nature. Hence, the development of modern earth observation techniques, in particular the multi-temporal high resolution all weather remote sensing systems, improves the mapping and monitoring possibilities in the high mountain chains. It offers many advantages for the examination of landslide potential; especially in less developed nations where resources are stretched and levels of environmental information are limited. The spatial information related to factors which are directly or indirectly making the terrain susceptible can be derived from remote sensing data, ground based information, and several other data sources (Aksoy and Ercanoglu et al., 2012; Reis et al., 2012) . These data sets in an efficient Geographic information system (GIS) can be used for the generation of accurate and effective susceptibility map generation and development of management strategies.

Puthussery Landslide Event

Puthussery west village, bordering Kerala and Tamilnadu, is an undulating mountainous area covered with deciduous forest patches and rock outcrops in the sloping segments. The major railway line, which connects Palakkad in Kerala and Coimbatore in Tamil Nadu passes through the foot hill region of southern slopes of the steep hills of the area. The landslide event, which is reported has occurred on 14th October, 2012 evening, after continues rainfall for last two days. The landslide event occurred was of huge dimension that initiated on the upper slopes and moved down along the existing stream transporting large sized boulders, silty-sand in slurry form and wooden-debris destroying everything on the way. A large area is reported to be filled up by the inflow of coarse and fine material. The check dam for diverting water for irrigation purposes was partly damaged. The destroyed agriculture and other items include mango plantation, ginger, plantain, coconut and paddy cultivation. The event also caused damage and disruption of transport for several days to the B railway line which connects Palakkad and Coimbatore. (Figures 1& 2: News paper clippings of the event. Ref:. Mathrubhoomi Daily). It took several days to remove the large tree trunks and debris material that filled the railway track.

The detailed investigation of the event was carried out on 5th January, 2013 by Sri. John Mathai, Scientist, Centre for Earth Science Studies, Dr. Vijith H, Sr. GIS Specialist and Mr. Pradeep G.S., Researcher, HVRA Cell., Kerala State Disaster Management Authority, Thiruvananthapuram. Officials of the revenue department accompanied the team.

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Figure 1 & 2 : News paper cuttings of the Puthusserry events reported.

Characteristics of the Area

The affected area is located on the south facing slope of a hill ridge with a maximum elevation of 1110 m above MSL. The upper slopes are steep to very steep with varying slopes and undulations. The affected area enclosed between 10^0 48′ 51.58″ to 10^0 50′ 24.41″ N and 76^0 45′ 18.33″ to 76^0 46′ 14.44″ E (Fig. 1) forms part of an elongated micro-watershed extending northwest-southeast covering an area of 2.65 km^2 (265.43 hectare). Generally the area experiences, dry climate in summer but during the monsoon seasons (southwest and northeast monsoons) the area receives rainfall with an annual average of 2000mm from about 130 rainy days. The minimum and maximum temperatures are 23°C and 35°C respectively.

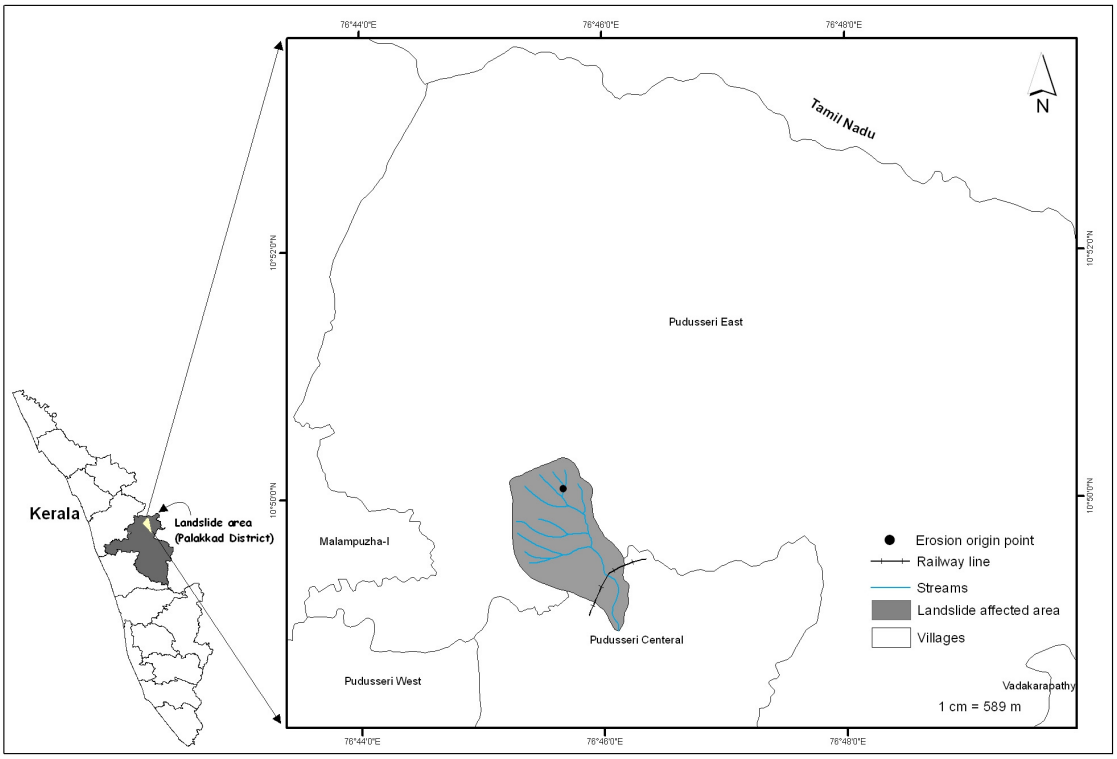

Figure 3. Map showing the study area with location of railway line, streams and neighbouring village.

The area falls within the South Indian Precambrian terrain and the major rock types present in the area are charnockite, biotite gneiss, pink/grey granite, hornblende biotite gneiss and amphibolites. The major geomorphological features of the area include structural hills, denudational hills, residual mounds, piedmont alluvium, valley fills and

pediment inselberg complexes. Land cover types of the area vary from natural vegetation in the upper slopes to agricultural crops in the foot slopes and valleys. Cleared areas, grasslands, degraded land with bushes and shrubs, barren rocks/stony wastes were also identified in the area.

Detailed Description of the Event Investigated

The area affected by the landslide was mapped with details of the all the features and characteristics and is given below in figure 4. It can be divided into four segments viz. a) zone of initiation b) zone of channel widening with removal of entire material on either banks c) widened channel with deposition of large boulders and d) zone of deposition of gravel and fine grained material. The event was initiated on the upper slope at about 500 m amsl from where thin of debris has been dislodged by heavy precipitation down the slope and the flow probably confined to a narrow section on either side of the existing stream. This is a steeply sloping segment which is relatively barren and exposes rock out crops. Sheet flow is the dominant process. The debris is negligible but the force of flow of water channelled on slope is high. Channel widening is evident down the slope from where the confluence of the main stream with other streams is seen. The thickness of debris increases from this point down the slope. The channel is widened with removal of entire overburden including all vegetation. Further down the channel shows further widening with removal entire material. 2-3 m thick material has been removed in a width of about 10 m on either side of the existing stream bed. Reduction in natural slope has further resulted in the accumulation of large size boulders brought from the elevated areas. Undulations in the stream bed with reduction in slope have caused blocking of these boulders but the finer material has been further washed down by the swift flowing waters. In this section there is a gradual reduction in the size of the boulders from higher elevation to lower elevation. However large tree trunks are rare in this zone. Further down there is abrupt change in gradient as well as direction of flow. From this point onwards gravel is seen deposited with fine grained material. The relatively flat land above the railway line where mango orchard is seen, 1-2 m thick sandy deposits are seen nearly levelling the land. Further down is the affected railway line located on the foot slope part which was damaged during the event. A stretch of 150 mts of railway line and some of the

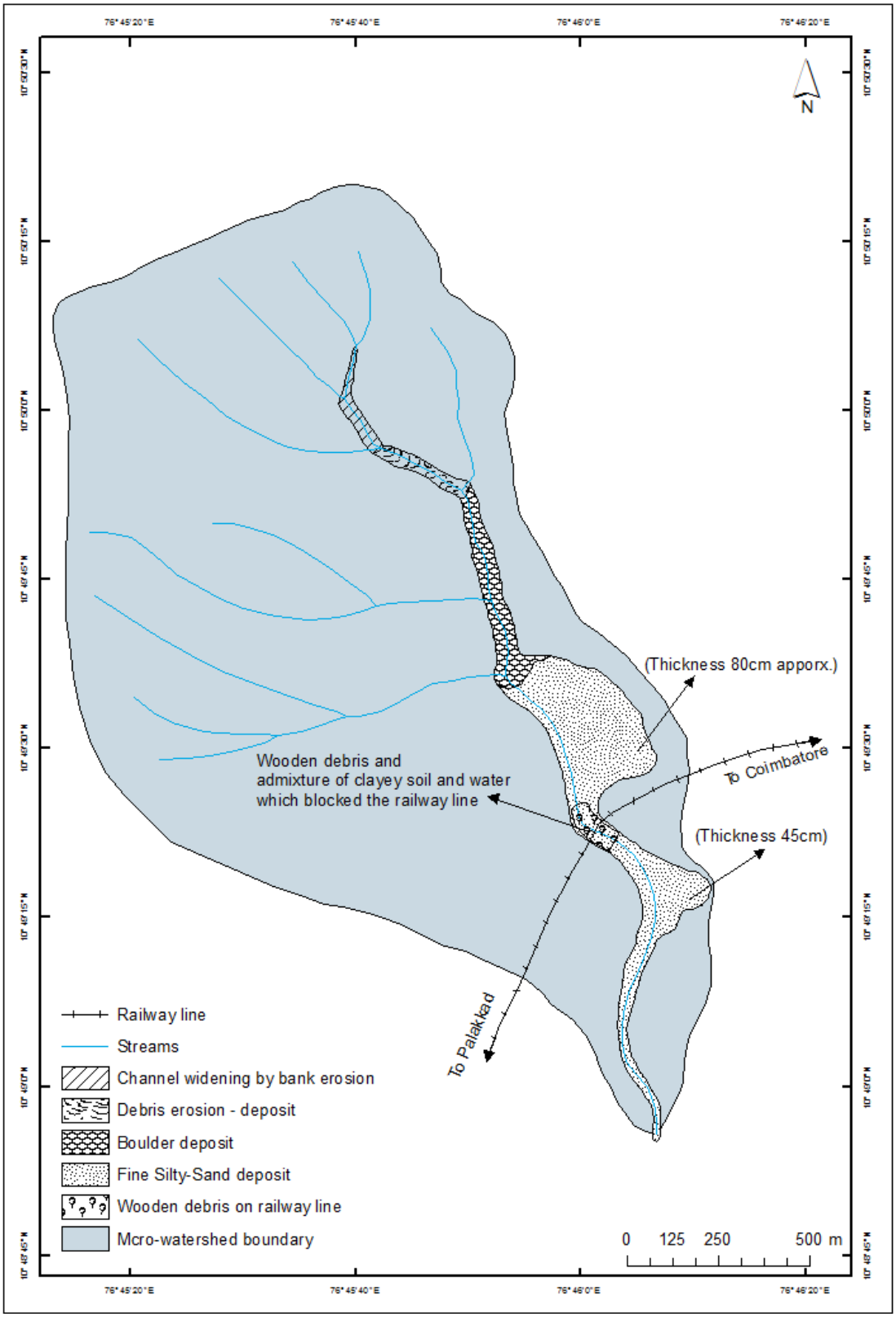

Figure 4: Detailed sketch of the event that occurred in the Puthussery village in Palakkad district.

Figure 5: Initiation point of erosion.

Figure 6: Release joints identified near to the initiation point.

Figure 7: Stream bed and bank erosion. Entire material in the stream bed and 5 meter thick sidewall was also removed.

Figure 8: Large boulders deposited in the stream bed.

Figure 9: Wooden debris and medium sized boulders over the stream channel.

Figure 10: Damaged check dam lower reach of the stream.

electric posts were damaged due to this event. Incoming flood waters along with fine material and tree trunks covered the track. At the time of the event, a goods train which was running to Coimbatore with full load of cement had to be stopped and all water and the slurry which entered into the wagons damaged all the material in the train. Support had to be given to the wagons to prevent derailment. Two days were taken to remove the slurry and muck from the railway line and to repair the damaged railway line and electric posts. The check dam for diverting the water for irrigation purposes was also damaged partly.

Figure 11: Fine grained sand and silt deposit in the relatively plain area near mango orchard. Note the thickness of the fine grained material deposited with sub-horizontal layering.

Figure 12: Photograph of the railway track affected by landslide. Note the large tree trunks brought from the upper slopes. The wagons in still in supported condition.

Further down the railway track Paddy fields are seen. The incomimg silty material got deposited in this area damaging the standing crops. As much as 1 m thick deposits are seen in the head region of the valley. The tanks in the area used for irrigation has been filled up. The flow of water and material was further channellised through the narrow depression for considerable distance.

Figure 13: Fine grained material deposited below the railway track. Paddy fields, plantain plantation and a pond in the areas were covered with the alluvium and was extended to the narrow channel further downward with less dimension.

From the careful examination in the area, it can be concluded that, the event that occurred in Puthussery village was not just a landslide limited to the source point. Extremely high rainfall with more than bank full discharge of a mountain stream resulted in the widening of the existing channel, removal of the debris mantled sides along with vegetation and deposition on the lower slopes and valleys. In this process the material was sorted with the boulders depositing on the widened stream bed, gravel on the lower slopes and finer material on the agricultural lands. Portion of the railway track was also covered with the material brought down from the upper slopes.

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