2007 - an Year of Landslides in the Kerala

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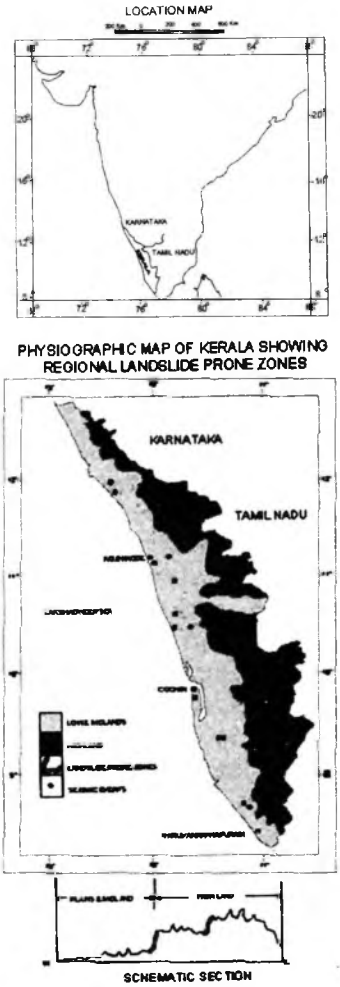
Abstract

In the year 2007, Kerala State witnessed a maximum number landslides resulting in loss of life and property. As per the records of IMD, the State has received 30% extra rain in 2007, during the southwest monsoon. Fifty one landslides have been studied and remedial measures were suggested to the revenue authorities of the state. The affected districts are; Kannur, Kozhikode, Wayanad, Palakkad, Malappuram, Thrissur, Idukki and Kottayam. Rapid urbanization in coastal and midland areas has led to raising up of the land value, forcing the migration of people to hilly terrain leading to change of land use. The anthropogenic activities in these areas have caused landslides. A multi-disciplinary approach is warranted to ensure stability of high slopes.

Introduction

The Western Ghats, the most prominent feature of peninsular India, occupies 47% of the area of Kerala state. (Fig. 1 and 2) and is the third most densely populated state in the country. During the monsoon the high ranges experience many landslides, most of them being debris flows. This phenomenon has led to loss of life and property to a significant degree and thus has attained a position of one of the most frequent disasters in the state. Rainfall is identified as the primary triggering factor for the landslides in Kerala. With an average precipitation of 3000mm, varying from 1000mm in the leeward side to 5000mm in the windward side of the Western Ghats, landslides are a common phenomenon during every monsoon in the region. Migration from the lowland towards the highlands for settlements by the people, extensive plantation activities for rubber, tea and cardamom in the hilly terrains have affected the slopes-stability. The removal of natural vegetation from the slopes, exposing them to heavy precipitation and monoculture has further aggravated the stability. The social concern over the scenario is evident when one notes that about 100 lives have been lost due to landslides and about 600 families have been rendered homeless along the Western Ghats during the period from 1965 to 1995.



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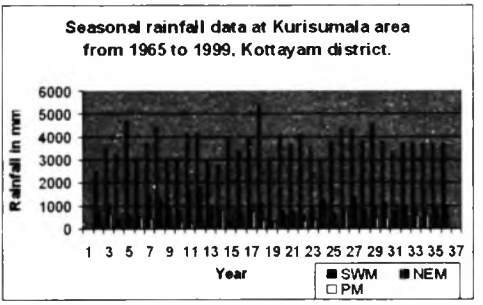
In 2007 alone, many landslides have occurred in Kannur, Kozhikode, Wayanad, Palakkad, Malappuram, Thrissur, Idukki and Kottayam districts of Kerala when 13 lives were lost, 10 were injured, 29 houses were damaged and 0.7 sq km area of agricultural and forest land was lost.

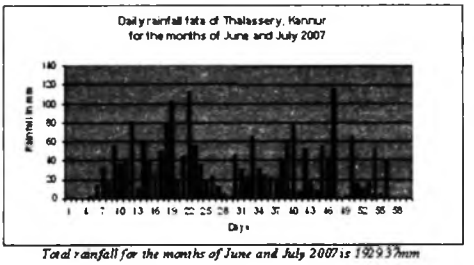
Contribution of rainfall

The South-West monsoon hits the Kerala coast during the first week of June and advances northeastwards till September. The retreating North-East monsoon starts in October and extends up to December. The former is more intense than the latter. The contribution of rainfall from the SW monsoon is relatively more in the north (83%) than in the south (46%) and the showers are more consistent in the northern parts of the state. The Western Ghats receives an average rainfall of <3500mm (Fig. 3).

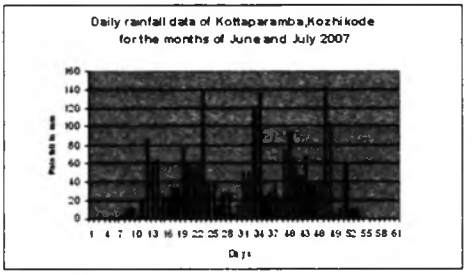
As per the records of IMD, the State has received 30% extra rain in 2007, during the SW monsoon alone. 8 out of the 14 districts of Kerala have been reported with several types of landslide occurrences. Rainfall data collected from different stations (SW monsoon) for the period from June-July 2007 is plotted (Fig. 4).

The triggering factor is an increase in pore water pressure resulting in decrease of shear strength and decrease in factor of safety to <1. Vegetation also plays a pivotal role in the initiation of a slide, by intercepting rainfall, reducing soil moisture through evapo-transpiration and increasing the stability by root induced cohesion (Greenway 1987). The observation that, infiltration and the resultant transient changes in the hydrogeological system would trigger a landslide (Van Asch et al. (1999) and Wasowski (1998)) is most relevant in the Kerala scenario. A sequential scheme of shallow landslide initiation is provided in fig-5 illustrating the role of rainfall and landslides. Thus it is inferred that a high slope area covered with sparse vegetation, with high precipitation, would be prone to landslide.

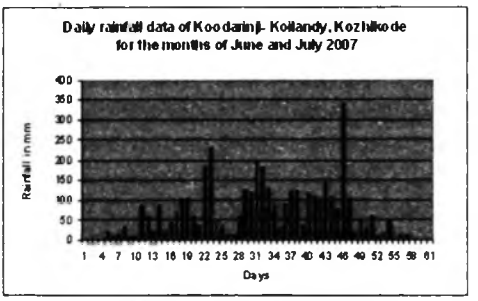




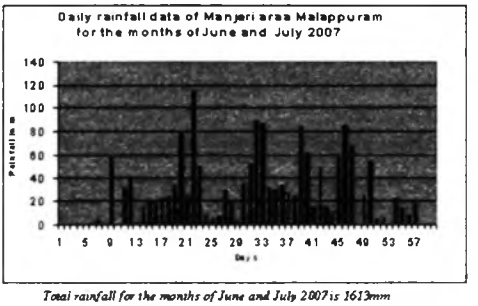
Total rainfall for the months of June and July 2007 is 1929.3mm



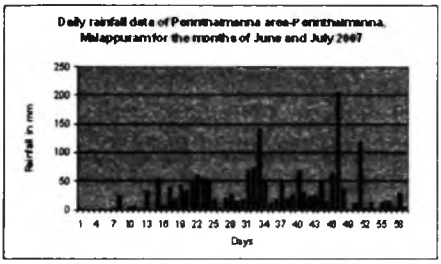
Total rainfall for the months of June and July 2007 is 2208.9mm



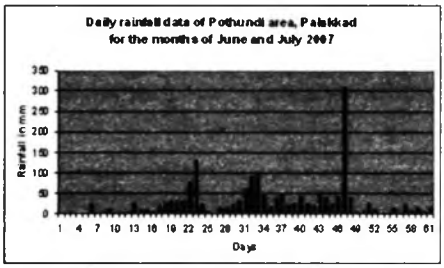
Total rainfall for the months of June July-2007 is 3969.5mm



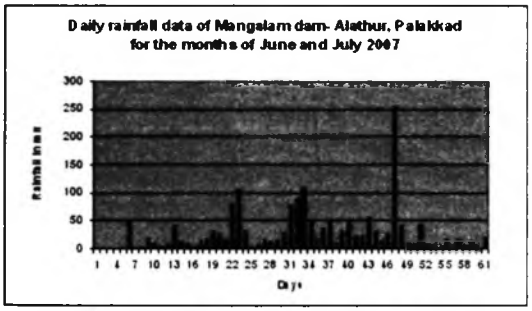
Total rainfall for the months of June and July 2007 is 1613mm



Total rainfall for the months of June and July 2007 is 1791.7mm



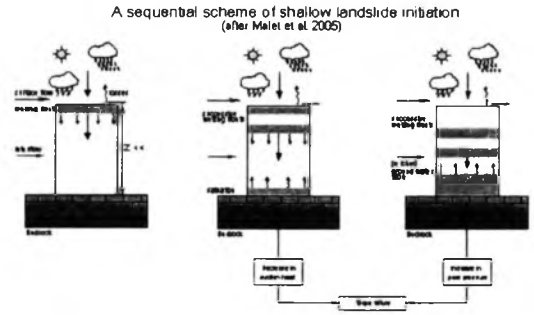
Total rainfall for the months of June and July 2007 is 1725mm



Total rainfall for the months of June and July 2007 is 1670mm

Landslide scenario of Kerala

The upland region of Kerala has been subject to perennial anthropogenic interferences right from the colonial era. Timber from the forest used to be exploited by the East India Company for laying railway sleepers and as construction material for various purposes and for export since the early 1730s (KSFWD 2004). The uncontrolled wood felling by the migrant settlers in the high ranges resulted in the total clearing of most of the natural forest cover. During the processes of migration, they practised tapioca cultivation together with coconut, which were later replaced by tea, coffee, rubber, cardamom and pepper plantations. Tapioca cultivation is well known for acceleration of soil erosion (Putthocharoen et al. 1998). Practising contour bunding in boulder packed slope



areas ignoring the natural drainage is a practice prevalent among the farmers of the hilly terrains. Now- a-days tapioca is replaced by rubber plantation in most parts of Kerala. Rubber has a crop life span of 20 years, after which they are felled and as a result, the soil is exposed to the high intensity rainfall for a period of more than 5 years thereby allowing decay of the root system. Thus, the infiltration rate in such areas increases and the inherent stability of the soil is lost. This indiscriminate practice of landuse-use leads to landslides loses life and property at time.

2007- Landslides in Kerala

In the year 2007, Kerala state witnessed the maximum number of rainwater-triggered landslides. 51 such landslides have been studied and reports suggesting mitigative measures to be adopted were submitted to the respective revenue authorities of the state. Eight out of 14 districts of Kerala experienced several types of landslide incidences. The affected districts are; Kannur, Kozhikode, Wayanad, Palakkad, Malappuram, Thrissur, Kottayam and Idukki. The present study encompasses 6 districts of Kerala. These landslides caused loss of 13 precious lives, injury to 10 persons, 29 houses were either destroyed or damaged and 0.67 sq km area of agricultural and forest land was lost. The fig-6 and the tables-1 and 2 illustrate the devastating effects of the landslides in Kerala during the year 2007. A few photographs given also portray the causes and extent of damages by the slides. It can be seen that all toe failures are mainly due to steep cutting of slopes for developmental

Table-2 District- wise Landslide incidence for the year 2007.

1. Kannur district

Place	Village	Taluk	Location	Date and time of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Parakkamala 1st slide	Ayyankunnu	Thalassery	12°3'51.7" 75°45'39" TS No. 48P/16	16.7.07 2100	Debris slide	L 200m W 35m H 3m	Nil	Nil	Agri.land	Nil	Incessant rain
Parakkamala 2nd slide	Ayyankunnu	Thalassery	12°4'14" 75°45'32" TS No. 48P/16	16.7.07 2100	Debris avalanche	L 1000m W 50m H 2m	Nil	Nil	Agri.land and road	Nil	Incessant rain
Palathumkadavu	Ayyankunnu	Thalassery	12°4'35" 75°47'20" TS No. 48P/16	June-July 2007	Slump	L 300m W 250m H 8m	Nil	Nil	Agri.land, road and house	2 houses got damaged	Incessant rain
Santhigiri	Kelakam	Thalassery	11°54'38" 75°51'38" TS No. 49M/13	17.7.07 Early morning	Slump	L 300m W 250m H -	Nil	Nil	Agri.land, Road and house	1 house got damaged	Incessant rain
Vendekumchal	Kelakam	Thalassery	11°54'46" 75°50'26" TS No. 49M/13	17.7.07	Debris avalanche	L 300m W 40m H 2m	Nil	Nil	Agri.land and road	Nil	Incessant rain
Chapamala	Kottiyoor	Thalassery	11°51'00.7" 75°51'33.2" TS No. 49M/13	16.7.07	Slump	L 500m W 200m H ----	Nil	Nil	Agri.land and road	1 house got damaged	Incessant rain
Kadavupara	Kottiyoor	Thalassery	11°53'39" 75°51'21.1" TS No. 49M/13	16.7.07	Rock fall	L ---- W ---- H ----	Nil	Nil	Agri.land	Nil	Incessant rain

2. Kozhikode district

Place	Village	Taluk	Location	Date and of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Tharadumala	Kanthaladu	Koilandy	11°29'33.7" 75°51'59.5" TS No. 49M/15	17.7.07 0350	Slump	L 200m W 80m H ----	Nil	Nil	Agri.land	1 house got damaged	Incessant rain
Oranjottukunnu	Kanthaladu	Koilandy	11°29'37.5" 75°53'24.7" TS No. 49M/15	21.7.07 1700	Slump	L 100m W 50m H ----	Nil	Nil	Agri.land	Nil	Incessant rain
Periyamala	Kanthaladu	Koilandy	11°31'00.9" 75°53'57.2" TS No. 49M/14	21.7.07 0350	Slump	L 100m W 80m H ----	Nil	Nil	Agri.land	Nil	Incessant rain
Mysoorpetta-Thottumukkam	Kodiyattur	Kozhikode	11°17'37.6" 76°03'01.5" TS No. 58A/3	17.7.07 0250	Debris slide	L 25m W 20m H 3m	2 children dead.	Nil	Agri.land,	1 house got destroyed	Incessant rain, toe erosion

Thottumukkam	Kumaranallur	Kozhikode	11°18'41.1" 76°02'00.8" TS No. 58A/3	17.7.07 0130	Debris avalanche	L 500m W 20m H 2m	Nil	Nil	Agri.land and road	1 house got destroyed and 7 cattle were died	Incessant rain
Panakkachal 1st slide	Koodarinji	Kozhikode	11°20'58.3" 76°03'44.0" TS No. 58A/3	17.7.07 0200	Debris flow	L 200m W 8m H 2m	Nil.	Nil	Agri.land,	1 house got destroyed	Incessant rain, toe erosion
Panakkachal 2nd slide	Koodarinji	Kozhikode	11°20'45.1" 76°03'33.7" TS No. 58A/3	17.7.07 0200	Debris flow	L 500m W 15m H 2m	1 dead	1 lady got injured	Agri.land,	1 house got destroyed	Incessant rain
Anayode	Koodarinji	Kozhikode	11°26'25.7' 76°04'05.5" TS No. 58A/3	17.7.07 0200	Debris slide	L 50m W 8m H 2m	1 dead	Nil	Agri.land,	1 house got destroyed	Incessant rain followed by toe erosion
Tinur	Valuk	Vadakara	11°44'52.7' 75°47'26.0" TS No. 49M/14	5.6.07 1845	Rock fall Debris slide	L 150m W 20m H 0.50m	1 dead	Nil	Agri.land,	Nil	Incessant rain

3. Malappuram district

Place	Village	Taluk	Location	Date and of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Chengara-Kottavumala	Kavanur	Eranadu	11°10'34.6" 76°04'56.0" TS No. 58A/4	17.7.07 0200	Slump	250m 200m 8m	Nil	Nil	Rubber plantation	Nil	Unscientific Landuse and incessant rain
Alapara	Vettilapara	Eranadu	11°16'33.1" 76°05'18.1" TS No. 58A/4	17.7.07 0200	Debris avalanche	1000m 15m 2m	1 dead	1 lady injured	Rubber plantation	1 house got destroyed	Unscientific Landuse and incessant rain
Odakkayam-Mupparimala	Vettilapara	Eranadu	11°16'18.5" 76°07'51.7" TS No. 58A/3	17.7.07 0700	Debris avalanche	500m 60m 2m	Nil	Nil	Agri-land	1 house got destroyed	Incessant rain
Chepili kunnu	Edavanna	Eranadu	11°09'04.7" 75°58'10.6" TS No. 49M/9	3.7.07 0300	Debris slide	20m 20m 3m	Nil	Nil	Agri-land	1 house got destroyed	Unscientific Landuse and incessant rain
Edavanna	Edavanna	Eranadu	11°12'47.9" 76°08'42.8" TS No. 58A/4	17.7.07 0230	Debris slide	30m 80m 8m	2 children dead	Nil	Rubber plantation	1 house got destroyed	Unscientific Landuse and incessant rain, toe erosion
Mannarmala	Kariyavattom	Perinthalmanna	11°00'03.2" 76°14'44.0" TS No. 58A/4	17.7.07	Debris avalanche	500m 30m 3m	Nil	Nil	Rubber plantation	Nil	Incessant rain
Kallala 102/800	Vazhikkadav	Nilambur	11°25'53.5" 76°23'20.5" TS No. 58A/7	2.9.07	Slump	400m 85m 24m	Nil	Nil	Forest, state highway	Nil	Incessant rain , toe erosion.

4. Palakkad district

Place	Village	Taluk	Location	Date and of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Kavalupara-Ladak	Kizhakkulamcherry-II	Alathur	10°00'28' 53.7" 76°31' 34.1" TS No. 58B/11	17.7.07 0230	Debris avalanche	300m 25m 3m	Nil	Nil	Forest	Nil	Incessant rain.
Kavalupara	Kizhakkulamcherry-II	Alathur	10°00'28' 51.8" 76°32' 08.5" TS No. 58B/11	16.7.07 0230	Debris avalanche	200m 50m 1m	Nil	1 got injured	Forest and agri-land	2 houses got destroyed	Incessant rain.
Kavalupara 2nd	Kizhakkulamcherry-II	Alathur	10°00'28' 58.8" 76°31' 43.0" TS No. 58B/11	21.7.07 0230	Debris avalanche	1000m 30m 1m	Nil	Nil	Forest and agri-land	Nil	Incessant rain.
Kadappara	Mangalam dam	Alathur	10°00'28' 11.5" 76°33' 51.1" TS No. 58B/11	17.7.07 0500	Debris slide	170m 10m 3m	1 boy dead	1 got injured	Agri-land	4 houses got destroyed	Incessant rain.
Poothamkuzhi	Mangalam dam	Alathur	10°00'29' 34.9" 76°33' 42.7" TS No. 58B/11	16.7.07 0500	Debris avalanche	600m 20m 1m	Nil	Nil	Agri-land	1 house got destroyed	Incessant rain.
Kairadi-Kaithachira	Kairadi	Chittur	10°00'32' 53.2" 76°34' 1.7" TS No. 58B/10	16.7.07 2350-0030	Debris slide	150m 20m 1m	1 boy dead	1 got injured	Agri-land	4 houses got destroyed	Incessant rain.
Kairadi- Naalaam kooppu 1st slide	Kairadi	Chittur	10°00'32' 54.2" 76°33' 44.1" TS No. 58B/10	16.7.07 0130	Debris slide	300m 10m 1m	Nil	Nil	Agri-land	Nil	Incessant rain.
Kairadi- Naalaam kooppu 2nd slide	Kairadi	Chittur	10°00'32' 58.0" 76°33' 40.4" TS No. 58B/10	16.7.07 1150	Debris flow	500m 70m 1m	Nil	Nil	Agri-land	Nil	Incessant rain.
Thekkekulambu	Kairadi	Chittur	10°00'33' 11.0" 76°33' 28.3" TS No. 58B/10	16.7.07 1150	Debris flow	400m 70m 1m	Nil	Nil	Agri-land, forest	1 house got destroyed	Incessant rain.
Kundaramchola-Cherunelli	Nelliyampathy	Chittur	10°00'31' 06.6" 76°37' 50.3" TS No. 58B/10	16.7.07	Landslip	30m 10m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Kundaramchola-Cherunelli 2nd slide	Nelliyampathy	Chittur	10°00'31' 30.8" 76°38' 20.9" TS No. 58B/10	16.7.07	Landslip	80m 20m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Kundaramchola-Cherunelli 3rd slide	Nelliyampathy	Chittur	10°00'31' 29.5" 76°38' 28.9" TS No. 58B/10	16.7.07	Debris flow	100m 5m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion
Cherunelli Estate	Nelliyampathy	Chittur	10°00'31' 29.5" 76°38' 28.9" TS No. 58B/10	16.7.07	Landslip	60m 25m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.

Cherunelli Estate 2nd slide	Nelliyampathy	Chittur	10°31'33.4" 76°39'24.1" TS No. 58B/10	16.7.07	Landslip	500m 70m 1m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Cherunelli Estate 3rd slide	Nelliyampathy	Chittur	10°31'40.9" 76°39'31.4" TS No. 58B/10	16.7.07	Debris flow	1500m 20m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Cherunelli Estate 4th slide	Nelliyampathy	Chittur	10°31'37.4" 76°39'37.2" TS No. 58B/10	16.7.07	Debris avalanche	400m 10m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Cherunelli Estate 5th slide	Nelliyampathy	Chittur	10°31'40.9" 76°40'3.1" TS No. 58B/10	16.7.07	Landslip	130m 25m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.
Cherunelli Estate 6th slide	Nelliyampathy	Chittur	10°32'3.1" 76°40'22.6" TS No. 58B/10	16.7.07	Debris flow	1500m 25m 2m	Nil	Nil	Agri-land, forest,road	Nil	Incessant rain and toe erosion.

5. Idukki district

Place	Village	Taluk	Location	Date and of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Edadumuttam I st slide	Elappally	Thodupuzha	9°44'27.3" 76°52'20.7" TS No. 58C/14	22.6.07 1500	Debris slide	42m 30m 3m	Nil	Nil	Agri-land, road	Nil	Incessant rain and toe erosion.
Edadumuttam 2 nd slide	Elappally	Thodupuzha	9°44'19.2" 76°52'31.7" TS No. 58C/14	22.6.07 0815	Debris avalanche	10m 7m 3m	Nil	1 got injured	Agri-land	Nil	Incessant rain
Churuli	Kanjikuzhi	Thodupuzha	9°54'44.3" 76°57'17.1" TS No. 58C/13	22.6.07	Debris avalanche	375m 25m 2m	Nil	2 got injured	Agri-land	1 house got destroyed	Incessant rain and toe erosion.
Chelachuvadu cutting	Kanjikuzhi	Thodupuzha	9°55'16.1" 76°58'05.2" TS No. 58C/13	22.6.07 1600	Debris avalanche	35m 13m 1m	Nil	1 boy got injured	Agri-land	1 house got destroyed	Incessant rain and toe erosion.
Periyar valley	Vathikkudi	Udumbanchola	9°56'03.9" 76°58'52.2" TS No. 58C/13	1.7.07	Debris slide	600m 47m 2m	Nil	Nil	Agri-land	Nil	Incessant rain
Kudikayathil	Vathikkudi	Udumbanchola	9°56'07.0" 76°58'45.1" TS No. 58C/13	1.7.07	Debris avalanche	300m 25m 2m	Nil	Nil	Agri-land	1 house got destroyed	Incessant rain

Rajapuram	Vathikkudi	Udumbanchola	9°55' 15.1" 76°58' 53.0" TS No. 58C/13	1.7.07 0700	Debris slide	15m 8m 2m	Nil	Nil	Agri-land	1 house got destroyed	Incessant rain and toe erosion
Konnathadi	Elappally	Thodupuzha	9°57' 07.3" 77°01' 30.4" TS No. 58G/1	1.7.07 0350	Debris avalanche	250m 20m 3m	Nil	Nil	Agri-land	1 house got destroyed	Incessant rain
Muthanmudi	Pallivasal	Devikulam	10°01' 34.5" 77°03' 48.8" TS No. 58F/4	1.7.07 0430	Debris avalanche	200m 20m 2m	Nil	Nil	Agri-land	3 houses got destroyed	Incessant rain and toe erosion

6. Wayanad district

Place	Village	Taluk	Location	Date and of incidence	Type of slide	Dimension of slide	No. of casualty	No. of Injured	Landuse/ landcover	Property/ house affected	Causes of slide
Valanthode	Thondar	Mananthavadi	11°43' 49.0" 75°49' 56.0" TS No. 49/14	22.6.07 0430	Debris flow	500m 25m 2m	4 from a single family dead	Nil	Agri-land, rubber plantation	2 houses got destroyed	Incessant rain and toe erosion

Table 1: District-wise general assessment of landslides in Kerala-2007.

Districts	No. of slides	No.of casualty	No.of injured	No.of cattles lost	No. of houses destroyed	No. of houses damaged	Total area affected (Sqkm)
Wayanad	1	4	-------	2	2	---	+0.0125
Idukki	9	-----	5	-----	6	1	0.0287
Kozhikode	9	4	1	7	4	1	0.0488
Kannur	7	------	------	----	3	5	0.1850
Malappuram	7	3	1	-----	4	-----	0.0896
Palakkad	18	2	3	-----	10	1	0.3081
Total	51	13	10	9	29	8	0.67 +

and cultural activities, which progressively tend to be future death traps in the absence of sustained management

From field observations and factor analysis at the various slide sites, it is inferred that all landslides in Kerala are triggered mainly by incessant rains in areas rendered vulnerable by unscientific landuse pattern especially in the hilly terrains. It has become the bounden duty of the Scientist to make the planners, local authorities and the public aware of the ground situation in all the landslide-prone tracts.

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