Possible early warning for landslides in Sri Lanka using ”Antecedent Daily Rainfall Index”: A case study of Meeriyabedda landslide on 29th October 2014

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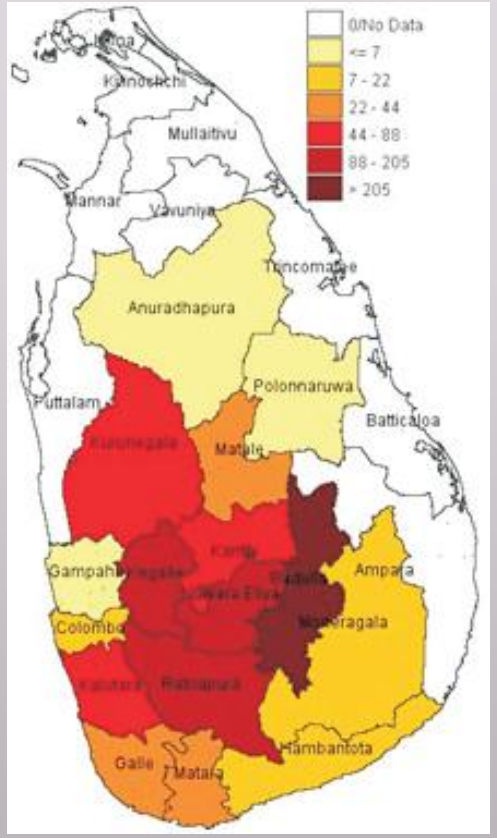
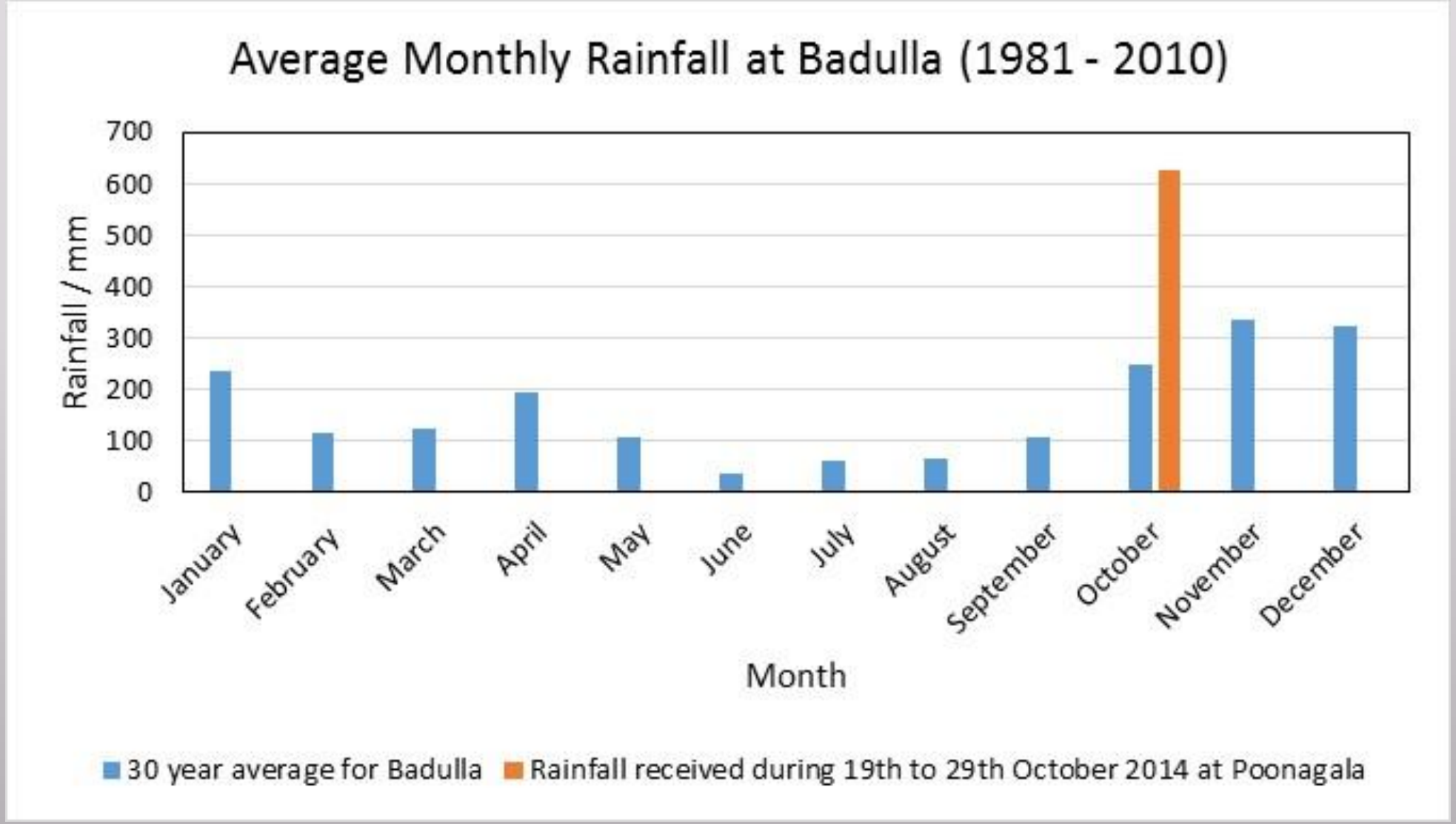
INTRODUCTION

- *Causes of landslides in Sri Lanka –*
  - *— Manmade*
    - *—drainage pattern*
    - *— land use patterns*
  - *— Natural*
    - *— Rainfall*
    - *— Bedrock geology*
    - *— Slope angle*
    - *— Landform*
    - *— Overburden soil cover*



Spatial Distribution of Landslides: 1974 - 2008

Sri Lanka receives highest rainfall during 2nd inter monsoon and NE monsoon (October to November and December to February)



- **Parameters considered in rainfall triggered landslides –**

— *Rainfall duration*

— *Rainfall intensity*

— *Cumulative event rainfall*

— *Antecedent rainfall*

—*One day heavy rainfall*

The word ANTECEDENT simply means

"PRECEDING CONDITIONS“

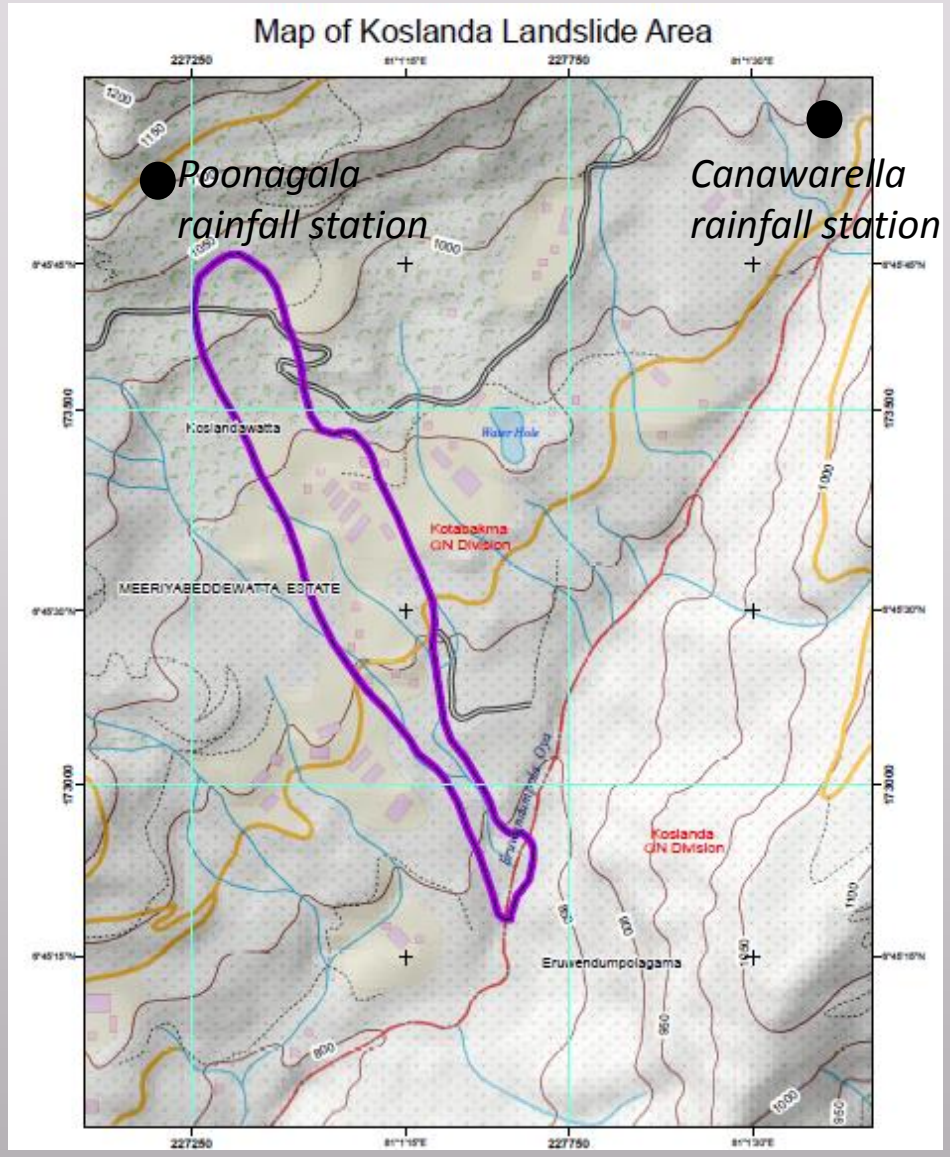
Antecedent precipitation means rainfall received prior to the considering date of an event

- **In this study –**

—*Correlation between Antecedent rainfall and landslides is studied in* **BADULLA DISTRICT**

—**MEERIYABEDDA** *landslide (on 29.10.2014) was taken as the* **CASE STUDY**

- *Meeriyabedda Landslide (29.10.2014 at 7.45 a.m.) –*



Legend

- Koslanda Landslide Area
- GN Boundary
- Secondary Road
- Jeep/Cart Track
- Footpath
- Homesteads/Garden
- All Waters area
- Scrub land
- Tea

Prepared by Survey Department
Data Source : DMC, NBRO
2014-10-30

Antecedent Daily Rainfall Index

$$R_0 = k\,R_1 + k^2 R_2 + k^3 R_3 + \cdots + k^n R_n$$

Where,

R_0 - Antecedent Daily Rainfall Index on day of event

R_1 to R_n - Daily rainfall for the past n days prior to the landslide

k - Arbitrary constant ($0 < k < 1.0$)

k value should be determine by applying the equation for historical events because it varies with soil type.

eg: k= 0.84 for Ottawa, USA, Crozier and Eyles (1980) and Bruce and Clark (1966)

k= 0.8 for Ratapura district, Sri Lanka, Akatsu (2010)

DATA AND METHODOLOGY

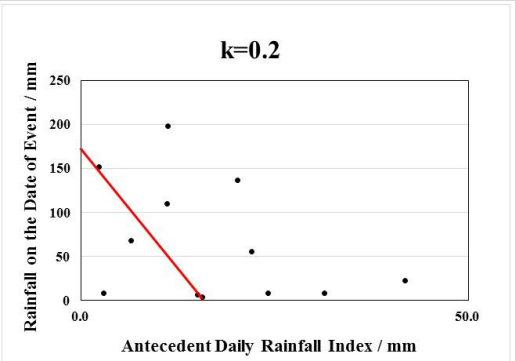
- *Historical events*

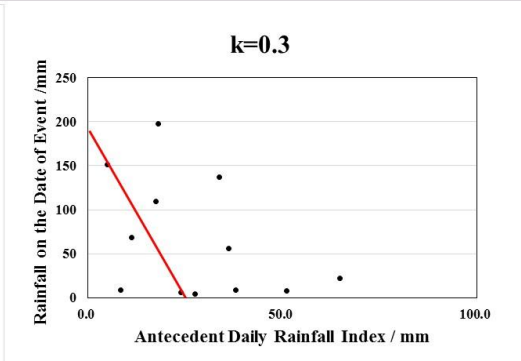
Place of the landslide event	Date
Agarathenna	*1986.01.10*
Viharagala	*1992.11.16*
Passara – Namunukula road	*1993.12.18*
Welimada	*2004.12.18*
Galahitiyawa	*2006.12.20*

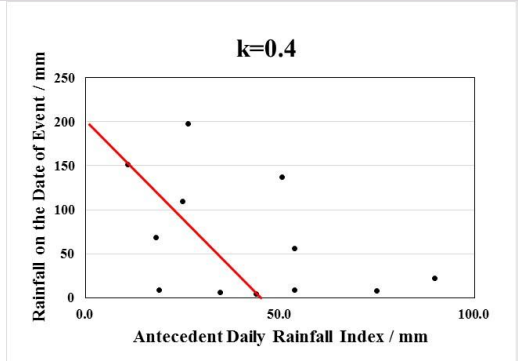
- *Only above 5 cases were selected because of the unavailability of rainfall data near to the landslide location and because of the landslides occurred due to other reasons*
- *Since there's only 5 cases, previous day of the landslide was also considered as a landslide probable day*
- *Equation was applied for 6 days and 10 days prior to the landslide for k values 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.85, 0.9, 0.95*

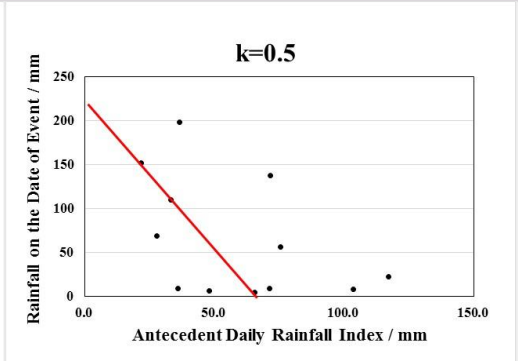
RESULTS AND DISCUSSION

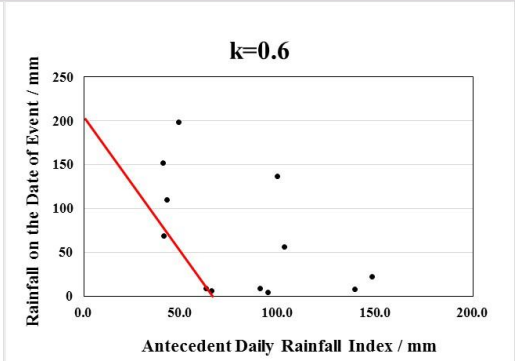
Scatter plot of Rainfall on the day of event Vs Antecedent rainfall index for 6 days

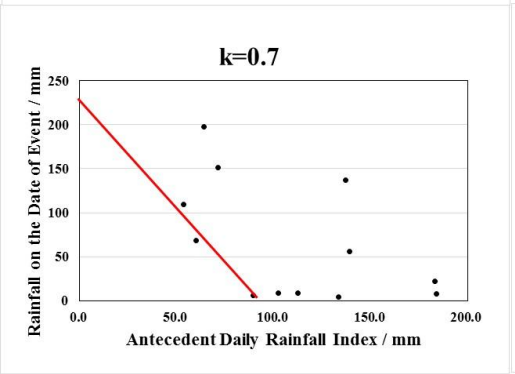


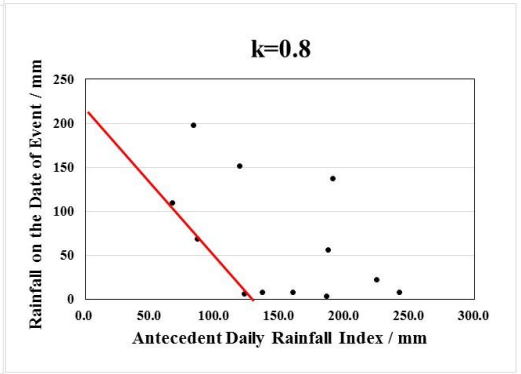


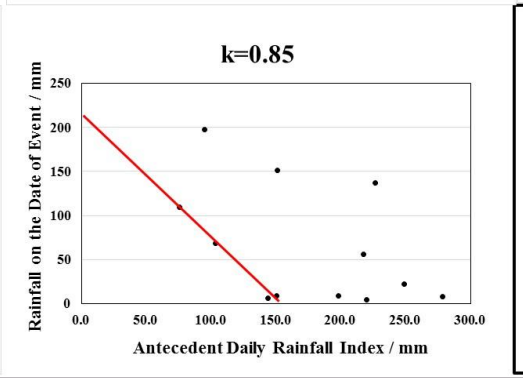


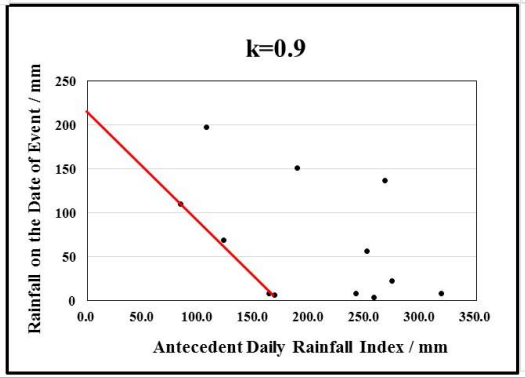


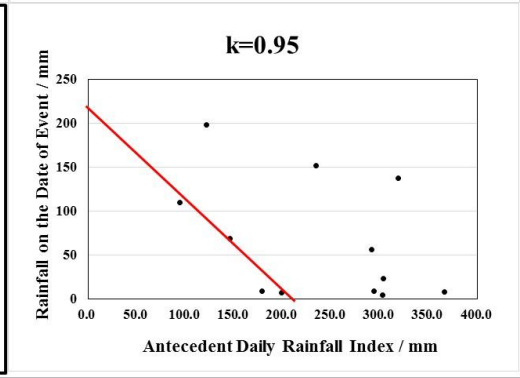




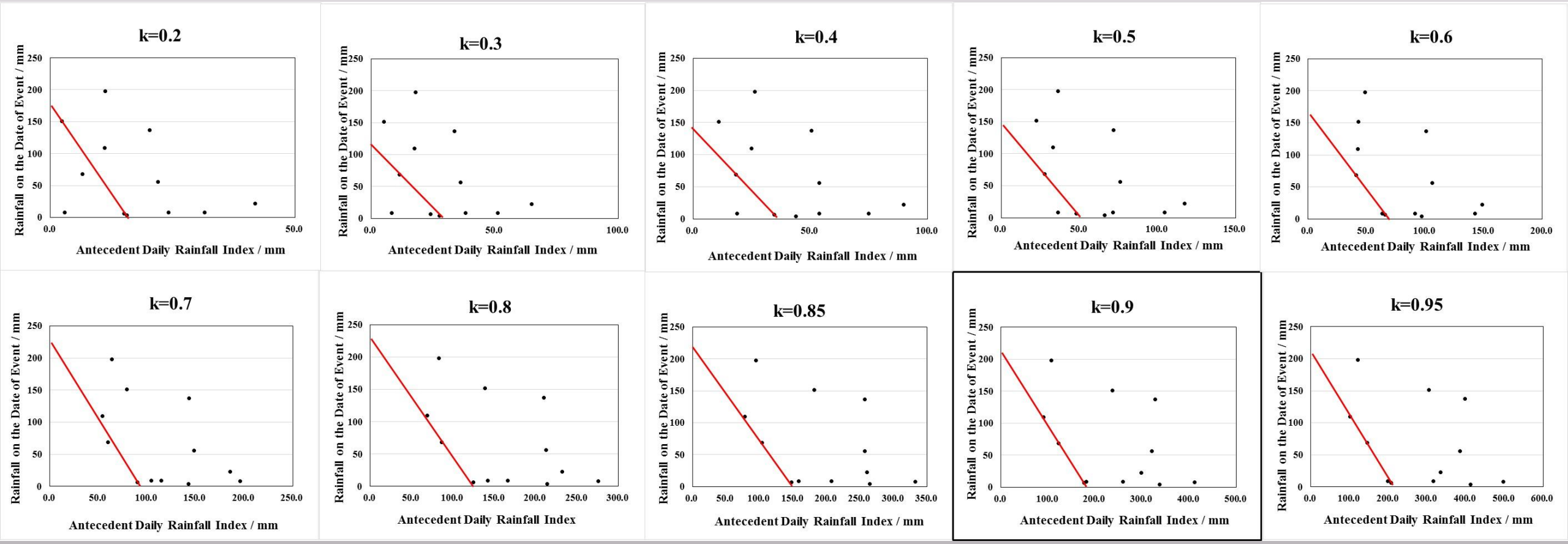




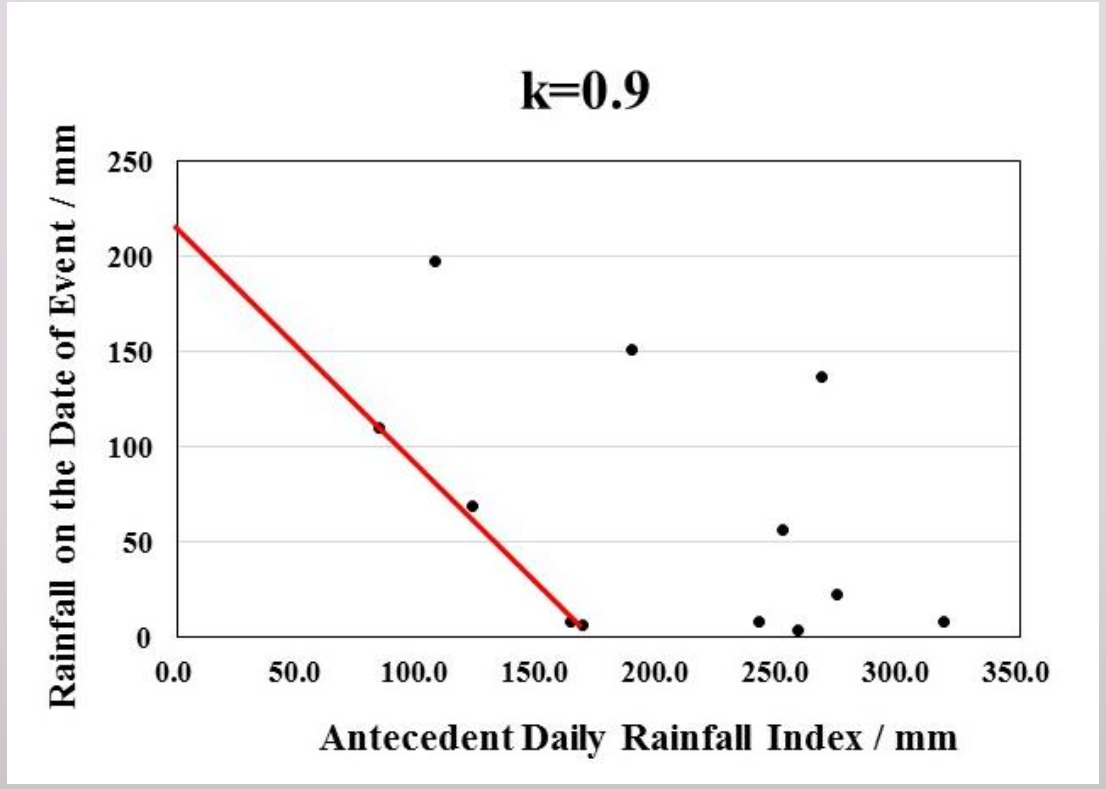




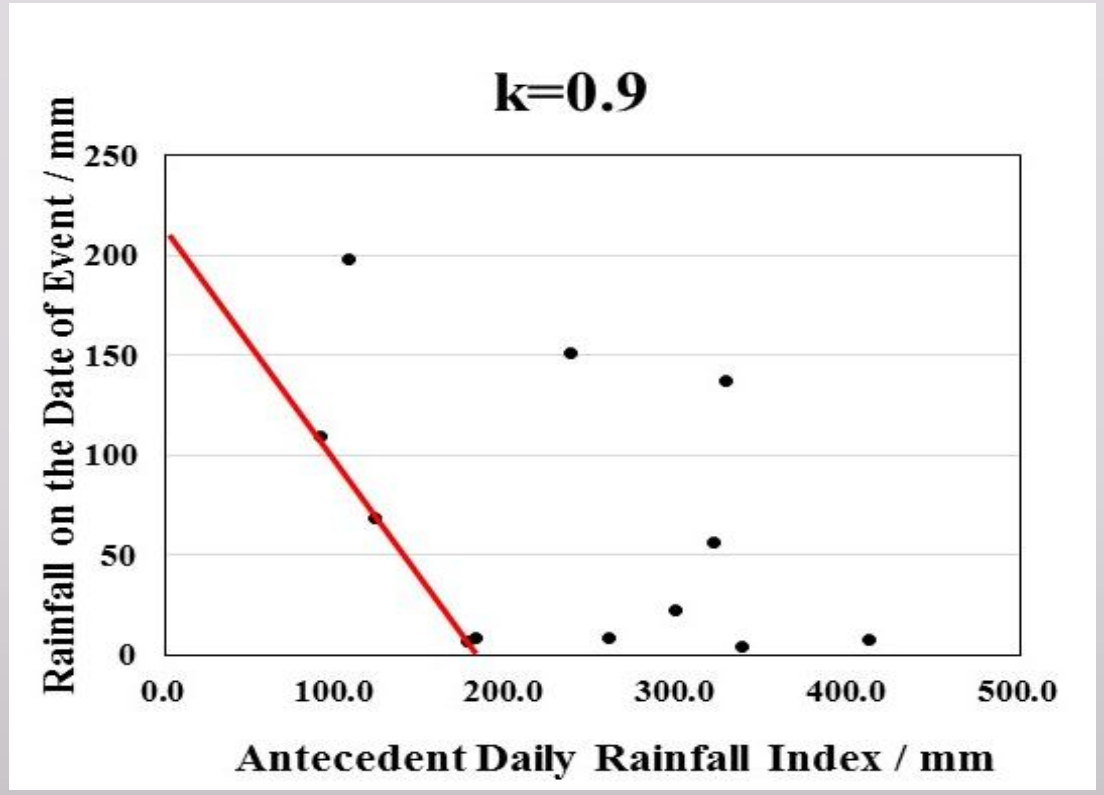
Scatter plot of Rainfall on the day of event Vs Antecedent rainfall index for 10 days



Best value for **k is 0.90** in Badulla area

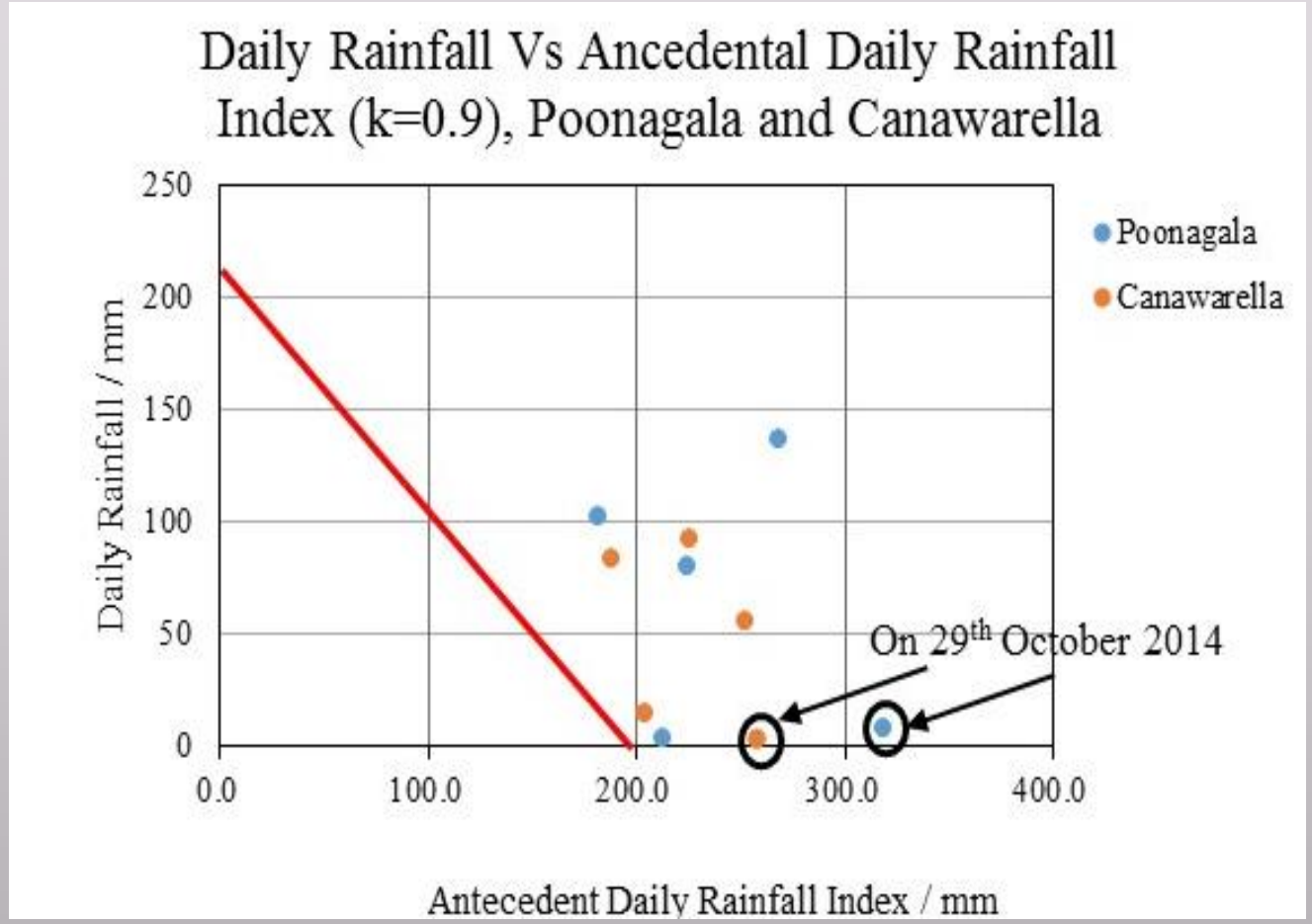


6 day analysis



10 day analysis

Scatter plot of daily rainfall Vs antecedent daily rainfall index for Poonagala and Canewarella on 29th October 2014 and 4 days prior to the landslide occur (k=0.9 for 10 days)



CONCLUSION

- *When there's significant continuous rainfall, it is better to calculate antecedent rainfall index*

- *Threshold value of antecedent rainfall index for Badulla district can be consider as 200.0 mm*

SUGGESTIONS

- *More automated rainfall stations should be installed in identified landslide prone areas*
- *k value should be fine tuned by using more cases*
- *The study should be extended to other landslide prone areas and identify k values for those areas*

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THANK YOU!!!