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Rainfall Intensity-Duration Curves Based On Telemetric Raingauge System

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Abstract

The establishment of these telemetric rain gauge centres ,farmers and intrested will not only receive rain reports on their cell phones for every 15 minutes, even they can base their crop cultivation based on the rain recordings received from these rain gauge system

As flood estimation is an important step in the hydrological designs, intensity studies play a very important role. In the present work, plotting of the Intensity - Duration curves has been done for the Malnadu region located in Western Ghats in Karnataka. This area has some special characteristics - it gets continuous rainfall throughout the day, on many days in monsoon Usually, Intensity - Duration is plotted storm - wise, but in the present study it is plotted day-wise. 15 minute data from three stations in the Malnadu region has been considered for the studies. Three years rainfall data is used to plot Intensity - Duration and Depth - Duration curves

Keywords: *Raingauge System, Telemetric*

INTRODUCTION

Precipitation is the only phenomenon nature has bestowed man with to bring him fresh water, which is absolutely necessary for life to survive on this planet. Since rainfall is the only important form of precipitation in the region of interest in the present study, the two terms, Precipitation

and Rainfall are used synonymously hereafter. Precipitation adds to soil moisture which plants use to produce food and oxygen. Rainfall feeds rivers and streams, which distribute water to places where rainfall alone would not be sufficient. It also replenishes ground water storage, which contributes to flow in streams over long periods and provides water for drinking and irrigation even during extended dry periods in a major portion of the inhabited World.

However, precipitation in its quantity, pattern and distribution over time and space varies greatly over the globe. Hence, a knowledge about these features of precipitation over a region of human inhabitants is of great importance in planning and utilization of the water resources. In this present study, an attempt has been made to investigate the rainfall characteristics pertaining to the distribution of rainfall within the rainy days to provide a perspective of the pattern of the maximum intensity in the region present in the Western Ghats. Intensity of rainfall is the depth recorded in a period and it is a very important parameter in hydrological analysis and watershed management. Studies on this character of the rainfall in the region of Western Ghats in the Karnataka can be considered important because this region supplies a major portion of stream flow in Karnataka, Kerala and Goa and a number of Water Resource Development projects are being planned in this region. The rainfall intensity depends upon mechanisms of rainfall. Hence, a discussion on this topic is given below.

THE PRESENT STUDY AND ITS OBJECTIVES

The Western Ghats, which run through the length of the coast of the state almost parallel to the coastline and nearly perpendicular to the direction of the Southwest monsoon winds, form a huge barrier to the moist laden winds from the Indian Ocean and the Arabian Sea. They, hence, result in exceptionally high amounts of rain in the hilly (Western Ghats) areas of the State. The Malnadu region is situated in Western Ghats (Figure 1.2) and it has some special characteristics as far as its rainfall is concerned; it receives continuous rainfall throughout the day and it receives 200 cm up to 750 cm of rainfall in a year in different stations.

Specific objectives of the present study are as follows:

1. To Plot Depth-Duration and Intensity-Duration curves for individual days and carryout

regression analysis for establishing the best fit curves;

2. To compare rainfall intensity and intensity-duration curves in three different stations of the region having heavy, moderate and comparatively low rainfall respectively.

3. To compare of Intensity-Duration curves during days of different magnitude of rainfall.

4. To development of general equations for Intensity-Duration curves for particular ranges of rainfall magnitude; and

STUDY AREA AND DATA USED

Kigga is a hill town and sringeri isTaluk headquarterslocated in Chikkamagaluru district,Malnadu region. It receives a mean annual rainfall of 3,160 mm. It is located at North latitude 13.250 and East longitude 75.150 and its altitude is 634 m.

DATA USED

The continuous Rainfall data of 15 min duration used in the present study is procured from The Drought Monitoring Cell (DMC) of the Karnataka State Natural Disaster Monitoring Centre (KSNDMC). This data has been obtained from Telemetric rain gauges (Figure 2.3). Karnataka is the first state which is to adopt a telemetric rain gauging system. The unit consists of a Tipping Bucket Rain Gauge mounted on a 2" BSP pipe and a stainless steel enclosure that encloses a data logger, a GSM modem and a 12VDC battery. The original data obtained from this system is in the cumulative form. The data is converted into actual rainfall depths in mm for the sake of this study. In this system, the standard commencing time of recording data for each day is 8.30 am and the accuracy of the rainfall depth obtained is 0.5 mm. The details regarding the data used are provided in the table 1

Table1:-Values of Rainfall Intensity (mm/hr) by considering Maximum Rainfall Depths

Duration(min)	Duration (hr)	Max Depth(mm)	Intensity(mm/hr)
15	0.25	14.5	58.00
30	0.5	20.5	41.00
45	0.75	23.5	31.33

60	1	24.5	24.50
75	1.25	24.5	19.60
90	1.5	24.5	16.33
105	1.75	24.5	14.00
120	2	24.5	12.25
135	2.25	25.5	11.33
150	2.5	25.5	10.20
165	2.75	26.0	09.45
180	3	32.5	10.83

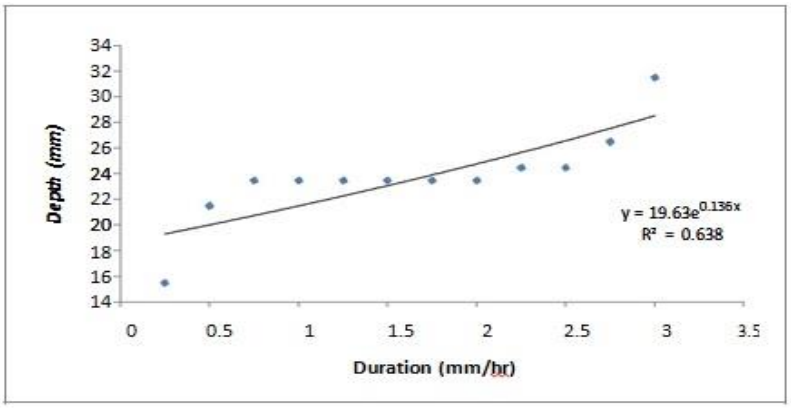

Fig1:Depth-Duration Curve for 131.5 mm Rainfall day in Kigga

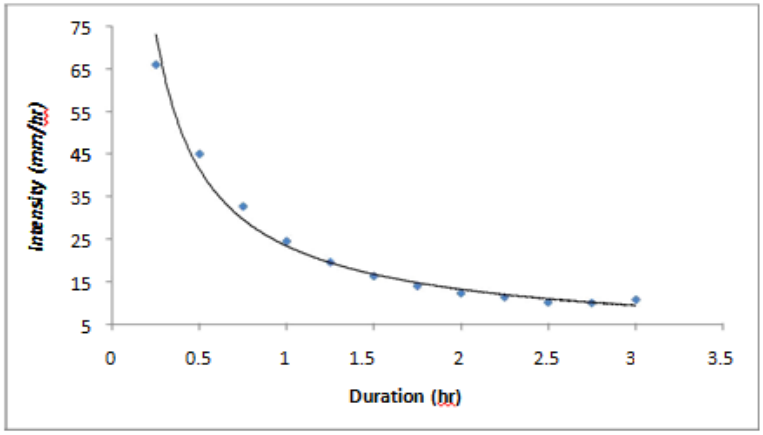

Fig: Intensity-Duration Curve for 131.5 mm Rainfall day in Kigga

RESULTS AND DISCUSSIONS

First, the Intensity - Duration (I - D) curves and Depth - Duration (D - D) curves are plotted for Kigga for the individual days of the years 2009, 2010 and 2011 (around 85 days in each year). Curve fitting is done using EXCEL Spread sheet for both the D-D and I-D data. A few graphs are shown in Figure 4.1 and Figure 4.2 for the two cases respectively. It is seen from the examples shown in Figure 2 to Figure 3that the I-D curves for different days are different and that the range of parameters of the equations is very wide. Further, it is observed from Figure 4 that not even the curves pertaining to different days with nearly the same rainfall are similar. Hence, in the next step, an attempt is made to determine generalised equations by combining all the data pertaining to different particular ranges. The daily rainfall depths were grouped into ranges 20-50 mm, 51-100 mm, 101-150 mm and above 150 mm, and studies were taken up within each group. The lower rainfall ranges were not considered for the analysis since they are not significant in flood estimation and other hydrological design

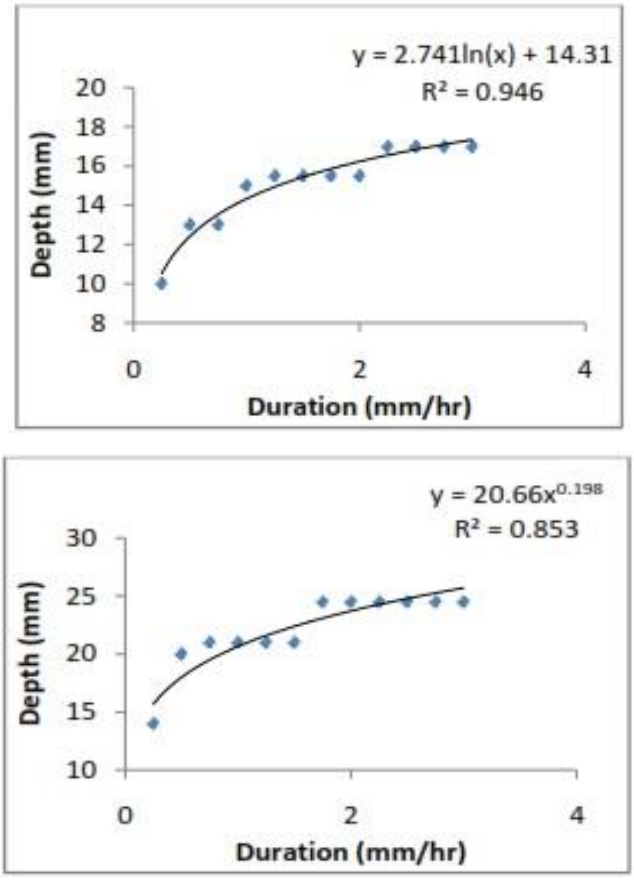

Figure 2:Depth –Duration curves for Kigga - A few examples.

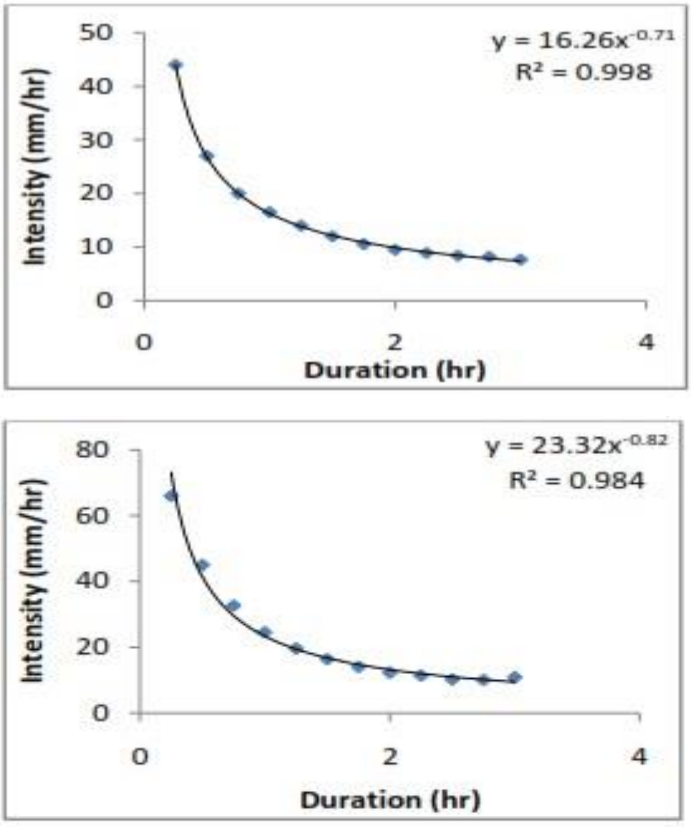

Figure 4: A few Intensity - Duration curves for Kigga.

SUMMARY AND CONCLUSIONS

As flood estimation is an important step in the hydrological designs, intensity studies play a very important role. In the present work, plotting of the Intensity - Duration curves has been done for the Malnadu region located in Western Ghats in Karnataka. This area has some special characteristics - it gets continuous rainfall throughout the day, on many days in monsoon Usually, Intensity - Duration is plotted storm - wise, but in the present study it is plotted day-wise. 15 minute data from three stations in the Malnadu region has been considered for the studies. Three years rainfall data is used to plot Intensity - Duration and Depth - Duration curves.

The conclusion drawn from the study are listed below:

1. ***The Depth*** - Duration curves do not show any regular pattern and reliable relationships cannot be obtained in most cases. But, the Intensity - Duration curves have got best fits and the power equation is found to be the best.

2. Attempts made to generalize the equation for the particular ranges

of rainfall depths, show that even within any given ranges of daily rainfall depth, both the parameters i.e. „C" and „k" vary randomly. Hence, comparison between individual equations is not possible.

3. **Intensity -** Duration curves plotted by clubbing all the data within the various ranges, for each of the three stations show that the R2 value obtained are not good. Hence, such averaged relationships are dependable.

Since the maximum intensity is very important for the hydrological applications envelop curve are developed for the Intensity - Duration curves for different ranges and comparison is made between the stations as well. In Agumbe and Sringeri the maximum intensity obtained for the higher rainfall depths and lower rainfall depths has low rainfall intensity. Whereas in the Shanthalli which is having low rainfall compare to other two stations, get high intensity for the low rainfall depths.

SCOPE FOR FURTHER STUDIES

1. The comparative work has been done only for the three stations in the Malnadu region. But the same work can be continued for more stations having larger rainfall data (for more years).

2. When the more data and regions are compared, the equations can be generalised over larger areas.

3. Same kind of work can be tried for regions which are present in the Western Ghats and comparison can be done with the Western Ghats region.

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