Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 24 (2016) 62 – 69

Procedia Technology

International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015)

A Comparative Study On The Derivation Of Unit Hydrograph For Bharathapuzha River Basin

Abhinanda Roy[a], Reeba Thomas[b]*

[a]*M-Tech student, Civil Engineering Department,Government Engineering College, Thrissur-680009 ,India*
[b]*Associate Professor, Civil Engineering Department,Government Engineering College, Thrissur-680009 ,India*

Abstract

Several techniques are available for the development of the unit hydrograph. But most of these traditional methods require manual fitting of the unit hydrograph through few points, which does not guarantee the area under the unit hydrograph to be unity. More over most of the stations are ungauged, due to which it becomes difficult to develop the unit hydrograph. So in order to overcome these problems, two methods have been considered in this study for the development of the unit hydrograph for Bharathapuzha river basin. They are the "two parameter Gamma distribution" and "three parameter Beta distribution", both of which are based on Probability Distribution Functions (pdfs). The unit hydrograph developed by the two parameter Gamma distribution match well with the one developed by CWC method, but the unit hydrograph developed by the three parameter Beta distribution does not match well with the one developed by the CWC method. From the unit hydrograph, runoff hydrograph is convoluted for the year 2008. For this the hourly rainfall are generated from daily rainfall values by disaggregation. But on plotting, the simulated discharge hydrograph is found to be greater than the observed discharge. This may be due to non incorporation of the inflow outflow processes of many hydraulic structures such as dams, irrigation schemes etc, existing in the basin in the model study. The data related to these structures could not be obtained due to certain restriction in acquiring the data from authorized agencies.

Peer-review under responsibility of the organizing committee of ICETEST – 2015

Keywords: unit hydrograph; Gamma distribution; Beta distribution; CWC method; discharge hydrograph.

* Corresponding author. Tel.: 9809854862; fax: +0-000-000-0000 .
*E-mail address:*abhinandaroy123@gmail.com, reeba@gectcr.ac.in

Peer-review under responsibility of the organizing committee of ICETEST – 2015
doi:10.1016/j.protcy.2016.05.010

1. Introduction

The beginning of rainfall runoff modeling for solving engineering problems dates back to the second half of the nineteenth century. Even today it is very important in activities such as design of hydraulic structures in watershed, flood control and management etc. But in the absence of runoff data, as in case of ungauged stations, it becomes necessary to obtain runoff data with the help of set up models. Historically researchers have relied on conventional techniques; however these techniques do not ensure the area under the graph to be unity. Hence to develop a runoff data for a rainfall event, L. K. Sherman introduced the concept of "unit hydrograph" in 1932. This was the first attempt to predict a unit hydrograph instead of just peak flow rate and time to peak. Later many researchers attempted to improve the unit hydrograph shape by incorporating more complexities in the model. Thus unit hydrograph is the most widely accepted tool for hydrological analysis and synthesis.

However as most of the sites are ungauged, the idea of Synthetic Unit hydrograph (SUH) came into existence. The term 'synthetic' in SUH denotes that the unit hydrograph has been derived from watershed characteristics and not from the rainfall runoff data. Moreover the traditional methods for developing SUH required manual fitting of the points which is subjective and do not assure the area under the graph to be unity. The empirical equations used in the traditional methods also involve certain constants which vary over wide range. Due to the similarity in shape of statistical distribution and a conventional unit hydrograph, several attempts have been made to use pdfs for the development of unit hydrograph. The Gamma distribution and Beta distribution are such pdfs and they not only ensure the area under the graph to be unity but also provide a smooth shape for the unit hydrograph.

Nomenclature

A	area of the watershed in sq km
b	The scale parameter (in hours) in Beta distribution
B(a,b)	The Beta function of a and b, where a and b are parameters
CWC	Central Water Commission
IUH	Instantaneous Unit Hydrograph
K	Equal storage coefficient
n	Number of linear reservoirs
p	Non dimensional shape parameters in Beta distribution
pdf	probability distribution function
q	depth of runoff per unit of time per unit of effective rainfall
q_p	Peak discharge of unit hydrograph per unit area in cumecs per sq km
Q_p	Peak discharge in cumecs
r	Non dimensional shape parameters in Beta distribution
R_i	Rainfall event
SUH	Synthetic unit hydrograph
t	time in hours
T_B	Base width of the unit hydrograph in hours
t_p	Time to peak discharge in hours
W_{50}	Width of the unit hydrograph measured at 50% peak discharge ordinate in hours
W_{75}	Width of the unit hydrograph measured at 75% peak discharge ordinate in hours
W_{R50}	Width of the rising side of the unit hydrograph measured at 50% of peak discharge ordinate in hours
W_{R75}	Width of the rising side of unit hydrograph measured at 75% of peak discharge in hours
α	Dimensionless parameter in Beta distribution
β	Dimensionless parameter in Gamma and Beta distribution
γ	Dimensionless parameter in Beta distribution
Γ	Gamma function