

Comparison of Run-off Computed by Strange's Table and 'Dry Damp Wet' Method

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Abstract

Run-off calculations are essential for designing any storage structure. Run-off can be calculated based on the rainfall data of rain gauge stations influencing the catchment area. In general, empirical methods are being used to compute the runoff. One of the methods of computing run-off is by Strange's table. The Strange's table provides the run-off in terms of percentage of the monsoon rainfall for Good, Average and Bad catchments. One more method is Dry Damp Wet method to compute the run-off. In this method, the condition of the catchment can be considered as Dry, Damp or Wet based on the occurrence of daily rainfall. In the present study, an attempt has been made to compare the runoff obtained by these two methods. The influencing zone of Anantapur rain gauge station, determined by Theissen polygon method has been selected for the present study. Rainfall data of Anantapur rain gauge station for the period from 1982 to 2013 has been used to compute the run-off. Monsoon rainfall of corresponding year has been considered for computation of run-off using Strange's table and daily rainfall data has been used to compute the run-off as per Dry Damp Wet method. Run-off values obtained by Strange's table and by Dry Damp Wet method have been compared and found that the values are varying. The variation is due to occurrence of rainfall at varied frequencies. As the frequency of rainfall is also taken in to account in addition to the magnitude of rainfall in Dry Damp Wet method, the values obtained by this method can be considered more precise.

Keywords: Dry Damp Wet method, Monsoon Rainfall, Rain gauge station, Run-off, Strange's table and Theissen polygon
Abbreviations: mm - Milli meters; S. No - Serial number

I. INTRODUCTION

The 'run-off' of a catchment area in a particular year (or other specified season) is the volume of water discharged by the stream draining the area. The run-off is stated in terms of the equivalent depth of water over the catchment area. Computation of runoff is the most essential requirement in hydrological aspect of any project. For computing runoff, monsoon rainfall data is the basic requirement which is measured at rain gauge stations in terms of depth. Monsoon rainfall is the rainfall received during monsoon period (considered from May to December). General practice to compute the runoff is using Strange's table. Another method to compute the runoff is Dry Damp Wet method. In Strange's table the runoff is given in terms of depth for different catchments like good, average and bad. In Dry Damp Wet method, the catchment is considered as dry, damp and wet based on the occurrence and magnitude of daily rainfall. In the present study, the runoff obtained by these two methods has been compared for a particular rain gauge station.

II. STUDY AREA

Anantapur district is one of the drought affected area in Andhra Pradesh, India which is having an average annual rainfall of 540 mm. There are 63 rain gauge stations in the district located in mandal headquarters. Among these rain gauge stations, Anantapur rain gauge station has been considered. Study area is the influencing zone of Anantapur rain gauge station which is determined by 'Theissen polygon' method. An Index map showing the study area i.e. influencing zone of Anantapur rain gauge station is given in figure 1.

III. DATA

Following data has been collected for the present study

- 1) Daily rain fall data for a period of 32 years from 1982 to 2013 from the Chief Planning Office (CPO) of Anantapur district.
- 2) Strange's run-off table for good, average and bad catchments and also run-off table for 'Dry Damp Wet' method have been extracted from Irrigation manual by W.M. Ellis for estimation of run-off.

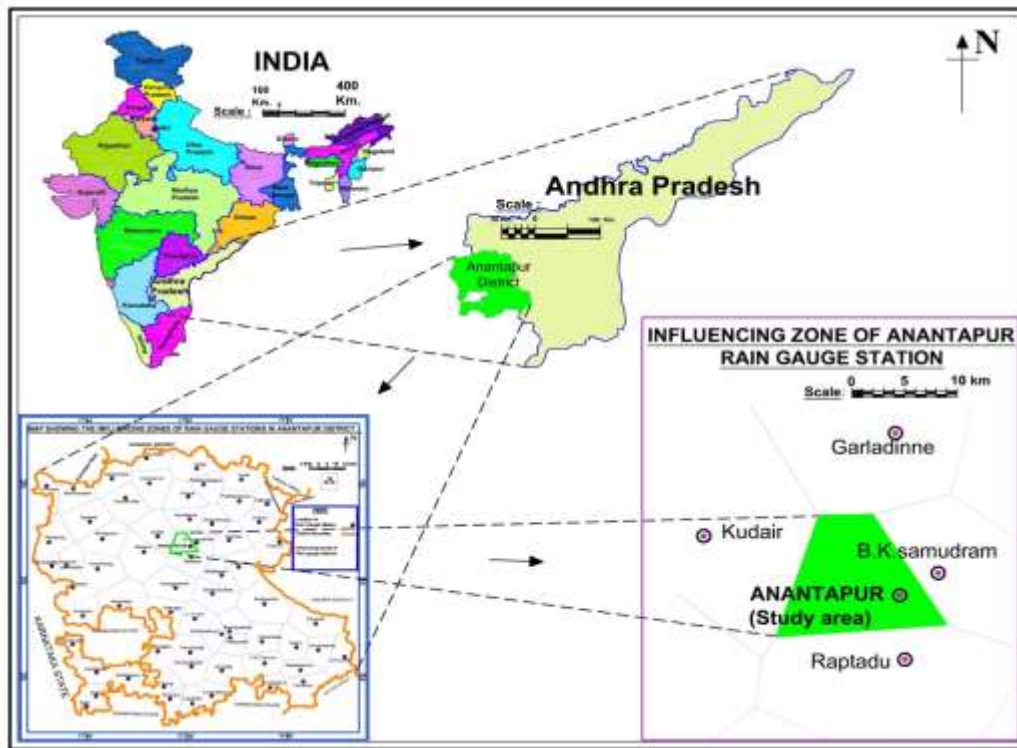


Fig. 1: Index Map showing the influencing zone of Anantapur rain gauge station

IV. METHODOLOGY

A catchment is a basin shaped area of land from which surface and sub-surface water flows into streams and rivers. In general, the catchment can be considered as Good, when it is in hilly terrain with steep slopes and thick vegetative cover. Similarly, the catchment can be considered as Average, if it is in undulated terrain with moderate slopes and little vegetative cover. Where the catchment area consists of flat terrain with no vegetative cover, it can be considered as Bad. Accordingly study area has been considered as 'average catchment' for the purpose of run-off calculations. In general, the run-off will be estimated based on Strange's table for planning storage reservoirs. The details of estimated run-off for the monsoon rainfall considering the catchment as average has been presented in table 1.

Table – 1
Strange's Table of total monsoon rainfall and estimated runoff for average catchment area.

S. No.	Total monsoon rain fall in mm	Percentage run-off to rain fall	Depth of run-off in mm due to rain fall	S. No.	Total monsoon rain fall in mm	Percentage run-off to rain fall	Depth of run-off in mm due to rain fall
1	25.4	0.10	0.025	21	533.4	12.00	64.008
2	50.8	0.15	0.076	22	558.8	12.90	72.085
3	76.2	0.30	0.229	23	584.2	13.80	80.620
4	101.6	0.50	0.508	24	609.6	14.60	89.002
5	127.0	0.70	0.889	25	635.0	15.40	97.790
6	152.4	1.10	1.676	26	660.4	16.30	107.645
7	177.8	1.50	2.667	27	685.8	17.10	117.272
8	203.2	2.10	4.267	28	711.2	18.00	128.016
9	228.6	2.60	5.944	29	736.6	18.80	138.481
10	254.0	3.20	8.128	30	762.0	19.70	150.114
11	279.4	3.90	10.897	31	787.4	20.50	161.417
12	304.8	4.60	14.021	32	812.8	21.30	173.126
13	330.2	5.40	17.831	33	838.2	22.20	186.080
14	355.6	6.20	22.047	34	863.6	23.10	199.492
15	381.0	7.00	26.670	35	889.0	23.90	212.471
16	406.4	7.80	31.699	36	914.4	24.70	225.857
17	431.8	8.70	37.567	37	939.8	25.50	239.649
18	457.2	9.60	43.891	38	965.2	26.40	254.813
19	482.6	10.40	50.190	39	990.6	27.30	270.434
20	508.0	11.25	57.150	40	1016.0	28.10	285.496

The Strange's table has been presented from 25.40 mm to 1016 mm with regular increment of 25.40 mm to cover 1005 mm which is the maximum monsoon rainfall during the study period. Where ever records of daily rainfall covering the entire catchment area are available and the accuracy is important, the daily rainfall can be considered for estimation of run-off using Dry Damp Wet method. The details of run-off estimated from the daily rainfall considering the catchment as average have been presented in table 2.

Table - 2
Estimated run-off from daily rainfall for average catchment as per Dry Damp Wet method

Rain fall in mm	Dry		Damp		Wet	
	Percentage	Run-off in mm	Percentage	Run-off in mm	Percentage	Run-off in mm
0	0	0.00	0	0.00	0	0.00
6.35	0	0.00	0	0.00	8	0.51
12.70	0	0.00	6	0.76	12	1.52
19.05	0	0.00	8	1.52	16	3.05
25.40	3	0.76	11	2.79	18	4.57
31.75	5	1.59	14	4.45	22	6.99
38.10	6	2.29	16	6.10	25	9.53
44.45	8	3.56	19	8.45	30	13.34
50.80	10	5.08	22	11.18	34	17.27
63.50	15	9.53	29	18.42	43	27.31
76.20	20	15.24	37	28.19	55	41.91
101.60	30	30.48	50	50.80	70	71.12

The criteria considered for classifying the catchment area as dry, damp and wet is given in table 3.

Table - 3
Criteria considered for classifying the catchment as dry, damp and wet

Conditions required for transition from 'dry' to 'damp'				Conditions required for transition from 'Wet' to 'damp'			
Rain fall				Rain fall			
In Inches	In mm			In Inches	In mm		
0.25	6.35	In the previous day	1 Day Damp	0.17	4.32	In the previous day	1 Day Wet and then Damp
0.50	12.7	In the previous day	3 Days Damp	0.25	6.35	In the previous day	2 Days Wet and then Damp
1.00	25.4	In the previous day	7 Days Damp	0.50	12.7	In the previous day	4 Days Wet and then Damp
1.50	38.1	In the previous day	10 Days Damp	0.75	19.05	In the previous day	5 Days Wet and then Damp
Conditions required for transition from 'damp' to 'Wet'				Conditions required for transition from 'damp' to 'Dry'			
Rain fall				Rain fall			
In Inches	In mm			In Inches	In mm		
0.33	8.38	In the previous day	1 Day Wet	0.13	3.3	In the previous day	1 Day Damp and then Dry
0.50	12.7	In the previous day	2 Days Wet	0.25	6.35	In the previous day	3 Days Damp and then Dry
1.00	25.4	In the previous day	3 Days Wet	0.50	12.7	In the previous day	7 Days Damp and then Dry
1.50	38.1	In the previous day	5 Days Wet	0.75	19.05	In the previous day	10 Days Damp and then Dry
If more than 2.50 Inches (63.50 mm) is occurred, upto 2.50 Inches (63.50 mm) is to be considered as dry and remaining as Wet on the same day							

Based on the above criteria classification of the catchment (like dry, damp and wet) has been noted against the rainfall occurred in each day as per daily rainfall data. The runoff has been calculated for the rainfall occurred on the day and with respect to the classification of the catchment on the same day as per tables 2 and 3. Sample calculations showing the classification of catchment and runoff for the respective rainfall for the month of August, 2009 is shown in table 4.

Table - 4
Sample calculations of runoff for the month of August, 2009

Date	Rain fall in mm	Classification of Catchment	Run-off in mm	Date	Rain fall in mm	Classification of Catchment	Run-off in mm
1-8-2009	0	Dry	0	17-8-2009	6.0	Wet	0.482
2-8-2009	0	Dry	0	18-8-2009	0.8	Damp	0
3-8-2009	0	Dry	0	19-8-2009	0	Dry	0
4-8-2009	0	Dry	0	20-8-2009	0	Dry	0
5-8-2009	0	Dry	0	21-8-2009	0	Dry	0
6-8-2009	0	Dry	0	22-8-2009	21.6	Dry	0.305
7-8-2009	0	Dry	0	23-8-2009	21.1	Damp	1.93
8-8-2009	0	Dry	0	24-8-2009	20.3	Wet	3.349
9-8-2009	0	Dry	0	25-8-2009	15.2	Wet	2.122
10-8-2009	1.6	Dry	0	26-8-2009	0	Wet	0
11-8-2009	0	Dry	0	27-8-2009	0	Wet	0
12-8-2009	0	Dry	0	28-8-2009	0	Wet	0

The results obtained by the said methods are applicable for the proposals of any storage structure located within the influencing zone of respective rain gauge station.

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