International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 02 | Feb 2022 www.irjet.net p-ISSN: 2395-0072

Estimation of Average Rainfall Depth using "SSV's Depth Leveling Method"

Suraj Sukhadev Vankamble[1], Maheshkumar D. Inamdar[2]

[1]Assistant Professor, Civil Engineering Department, SBGI Miraj.
[2]Lab Assistant, Civil Engineering Department, SBGI Miraj.

Abstract – Rainfall is the main source of water and used for various purposes. A knowledge of the amount of rainfall and the distribution of rainfall is extremely useful for irrigation engineers and all other involved in the development of water resources. The amount of rainfall is expressed as the depth of water in centimeters which would accumulate on a level surface if the rainfall were retained where it fell.

The rainfall recorded by a rain gauge represents the rainfall at that station. It is also called the point rainfall. In many hydrological studies, the average depth of rainfall over a specified area due to storm, or due to number of storm, is required. For determination of average precipitation over an area, a large number of rain gauges are installed. The average rainfall over an area is found from number of methods such as Arithmetic mean method, Thiessen polygon method and isohyetal map method. In this study by using "SSV's Depth Leveling Method" the average rainfall depth is find out. The resulting depths are found by combination of rain gauge as well as ranging rod readings.

Key Words: Average rainfall Depth, rain gauge station, ranging rod, specified area.

1.Introduction :

The Average rainfall depth is necessary to maintain the record of rainfall amount of that particular area. The rain gauge are implant in specific area on the basis of terrain properties and the average rainfall. There are various methods used in the field to calculate the average rainfall depth such as Arithmetic mean method, Thiessen polygon method and Isohyetal method.

If the country is flat and the gauges are uniformly distributed over the area, the rainfall of the, the rainfall of the indivisual station does not show much variation from the mean precipitation of the area. In the arithmetic mean method, the average depth of rainfall over an area is taken as the arithmetic mean of the rainfall depths of all stations. It is obtained by the dividing the sum of the depths of rainfall recorded at all rain gauge stations by the number of stations.

$$P = \frac{P1 + P2 + \ldots + Pn}{N}$$

Here, P1, P2 … Pn are the depth of rainfall recorded at the rain gauge 1,2,….n.

In the Thiessen polygon method, the rainfall recorded at each rain gauge station is given weightage on the basis of the area which it represent. This method is better than the arithmetic mean method which gives equal weightage to all stations. The average precipitation of the area is given by :

$$P = \frac{P1A1 + P2A2 + \ldots\ldots\ldots + PnAn}{A1 + A2 + \ldots An}$$

Here A1, A2, …An are the area of the Thiessen Polygon representing the station 1,2, …. , n and P1, P2, … Pn are the corresponding precipitation and A is the total area.

Isohyets are the contours of equal rainfall depth. For plotting of an isohyetal map, rain gauge stations are marked on the plan of the catchment. The rainfall recorded at these stations is also marked on the plan of the catchment. The rainfall recorded at these station is also marked on the plan. The rain gauge stations located outside the catchment but in its neighborhood are also marked. The isohyets of various rainfall depth are then drawn by interpolating the values of the rainfall.

In this study we use the SSV's Depth Leveling method to found the average rainfall depth by using rain gauge station and ranging rods.

2. SSV's Depth Levelling Method :

In this method the terrain with ups and downs are allowable. The procedure required to complete the results using this method is are as follows:

a) The total area for which rainfall depth is measured is going to be distributed into equal area having name as A1, A2 …. And so on.

b) The positions of the rain gauge stations are marked on the plan of the catchment area over which the average rainfall depth is required.

c) The care should be taken that the rain gauge station should be at center position of the each equally separated area. As shown in figure.1 :

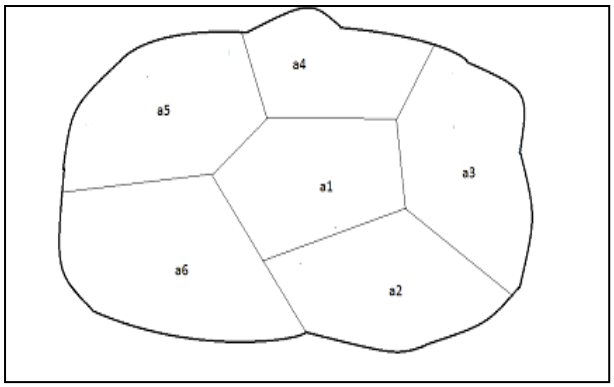

Fig.1 Catchment area divided into equal area.

Here a1, a2, and ..an are the area of divided parts of catchment area.

d) The sub divisions which are equally distributes by area wise are set up with the rain gauge stations placed centrally of that sub division. Then the ranging rods are placed on the four corners of the sub divided area around the rain gauge station.

e) There is lots of chances of presence of uneven terrain in the divided area. So there is chances of incorrect rainfall data collection. So to avoid this the ranging rods are setup to take the RL of that position and match with rain gauge stations position RL.

f) The care should be taken that the ranging rod should be on equal distance from the central rain gauge station.

g) After the complete set up the readings should be taken. The rainfall depth at all rain gauge station and the respective ranging rods are taken into observation table and the calculation should be done to obtain the average rainfall depth by using formula as discussed further.

3. Average Rainfall Depth Formula:

The average Precipitation of the area is calculated by taking the all the rainfall depth at the rain gauge station of that area and the respective ranging rod of that sub divide area, as given in below figure. 2:

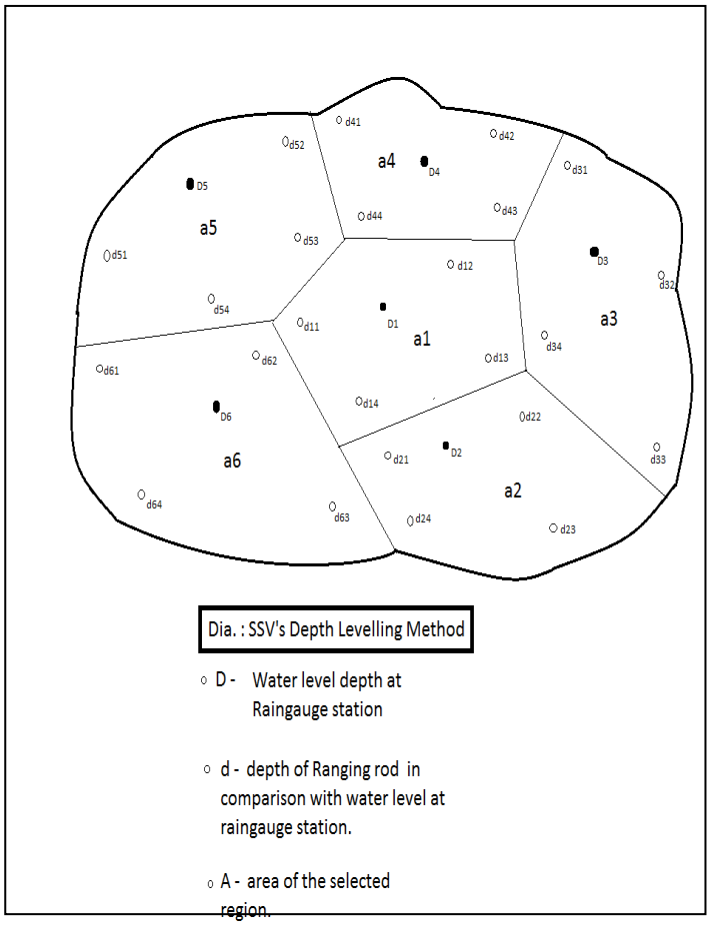

Fig.2 SSV's Depth Leveling Method.

The average precipitation of the area is given by using the formula :

$$d = \frac{A_1\left((d_{11} + d_{12} + D_1 + d_{13} + d_{14}) / n_d\right) + A_2\left((d_{21} + d_{22} + D_2 + d_{23} + d_{24}) / n_d\right) + \ldots\ldots + A_n\left(d_n / n_d\right).}{A_1 + A_2 + A_3 + A_4 + A_5 + A_6 + A_n.}$$

Here,

D = Water level depth at raingauge station.

d = depth of ranging rod in comparison with water level at raingauge station.

A = area of the selected region.

4. Observations :

Table no. 1 given below shows the value of water depth in cm observed at rain gauge station and ranging rod present at divided area.

Table.1 Depth of water level observation.

Sr. No.	Area (A)	Rain gauge Rainfall Depth (D)	Ranging Rod Rainfall Depth (d)
1.	A1= 2 square km	15 cm	16 cm
			18 cm
			D-15 cm
			15.5 cm
			16.5 cm
2.	A2 = 2.52 square km	18 cm	17 cm
			17.5 cm
			D-18 cm
			19 cm
			14 cm
3.	A3 = 1.98 square km	21 cm	19 cm
			21 cm
			D-21 cm
			20 cm
			21 cm
4.	A4 = 2.225 square km	13 cm	11 cm
			13 cm
			D-13 cm
			15 cm
			16 cm
5.	A5 = 1.985 square km	20 cm	22 cm
			28 cm
			D-20 cm
			15 cm
			18 cm

- Average Depth of rainfall in 24 hours =

$$d = A_1 ((d_{11} + d_{12} + D_1 + d_{13} + d_{14}) / n_d) + A_2 ((d_{21} + d_{22} + D_2 + d_{23} + d_{24}) / n_d) + \ldots\ldots + A_n (d_n / n_d) .$$

$$A_1 + A_2 + A_3 + A_4 + A_5 + A_6 + A_n.$$

After the calculation we get the value of average rainfall depth is : 17.463 cm.

5. CONCLUSIONS :

- This SSV's Depth Leveling method is effectively applicable to measure the rain fall depth in case large catchment area having uneven terrain area.
- The combination of readings of water depth at rain gauge station and ranging rods will reduce the error occurring during the rainfall depth measurement.
- The accuracy of average rainfall depth is increased due to taking ranging rod depth into consideration.
- In this study after taking the observation and calculation get the resulted average rainfall depth of 17.463 cm.
- This SSV's Levelling Depth method also gives the accurate average rainfall depth , that means this method is applicable in field.
- The SSV's Rainfall Levelling Depth formula is applicable to measure the average rainfall depth effectively.

6. REFERENCES

- Allen, R. J., and A. T. DeGaetano (2005), Considerations for the use of radar-derived precipitation estimates in determining return intervals for extreme areal precipitation amounts, J. Hydrol., **315**, 203.
- Barnes, S. L. (1964), A technique for maximizing details in numerical weather map analysis, J. Appl. Meteorol., **3**, 396– 409.
- Buishand, T. A. (1991), Extreme rainfall estimation by combining data from several sites, Hydrol. Sci. J., **36**, 345– 365.
- Buishand, T. A., and J. B. Wijngaard (2007), Statistiek van extreme neerslag voor korte neerslagduren (in Dutch), Tech. Rep. TR-295, KNMI, De Bilt. (Available)
- Buishand, T. A., R. Jilderda, and J. B. Wijngaard (2009), Regionale verschillen in extreme neerslag (in Dutch), Sci. Rep. WR-2009-01, KNMI, De Bilt.
- Carbone, R., and J. D. Tuttle (2008), Rainfall occurrence in the U.S. warm season: The diurnal cycle, J. Clim., **21**, 4132.
- Bhowmik SKR, Das AK (2007) Rainfall analysis for Indian monsoon region using

- the merged rain gauge observations and satellite estimates: Evaluation of monsoon rainfall features. J Earth Syst Sci 116(3):187–198
- Mishra A, Gairola RM, Varma AK, Agarwal VK (2010) Remote sensing of Precipitation over Indian land and oceanic regions by synergistic use of multi-satellite sensors. J Geophys Res 115, D08106, doi no. 10.1029/ 2009JD012157
- Mishra A, Gairola RM
- Bhowmik SKR, Das AK (2007) Rainfall analysis for Indian monsoon region using the merged rain gauge observations and satellite estimates: Evaluation of monsoon rainfall features. J Earth Syst Sci 116(3):187–198
- Mishra A, Gairola RM, Varma AK, Agarwal VK (2010) Remote sensing of Precipitation over Indian land and oceanic regions by synergistic use of multi-satellite sensors. J Geophys Res 115, D08106, doi no. 10.1029/ 2009JD012157
- Mishra A, Gairola RM

BIOGRAPHIES

MR. SURAJ SUKHADEV VANKAMBLE.
- ASSISTANT PROFESSOR, CIVIL ENGINEERING DEPARTMENT, SBGI,MIRAJ, (2021-22)
- M-TECH (GEOTECHNICAL ENGINEERING), COLLEGE OF ENGINEERING PUNE, COEP, (2019-21).
- B.E. (CIVIL ENGINEERING), DR. JJMCOE, JAYSINGPUR, (SHIVAJI UNIVERSITY), (2014-18).

MR. MAHESHKUMAR DAMODAR INAMDAR.
- LAB ASSISTANT, CIVIL ENGINEERING DEPARTMENT, SBGI, MIRAJ.
- DIPLOMA (CIVIL ENGINEERING), LATTHE POLYTECHNIC, SANGLI.