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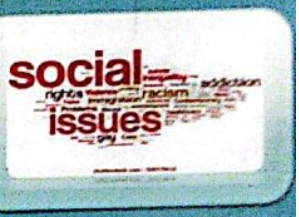

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Rainfall Runoff in the Indapur Tahsil

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Abstract: General hydrological equation to compute runoff has been estimated. The average surface water village wise runoff of the study area is estimated. There is great deal of variations in terms of volume of runoff by different villages. The entire tahsil is drought prone and faces the problem of water scarcity throughout the year. Observing these outcomes in the present context, this paper calculates the rainfall runoff in the Indapur tahsil. The outcomes of these studies are briefly presented in this paper. It has been observed that the very high runoff found in the study area.
Key words: Rainfall, runoff, surface water, groundwater

Introduction

The nature and distribution of rainfall of the study area discussed earlier indicates that about 90 percent rainfall takes place during the short period of four months from June to September. There is a great variation in the number of rainy days. The maximum water holding capacity of soils is the basic controlling elements of runoff. Outputs are the processes that remove water from the system; these include evapotranspiration, the various uses of water by humans, and outflow from surface water and groundwater. In the present study examined the rainfall runoff in the Indapur tahsil.

Objectives

1. To calculate the runoff of the study area.
2. To make favourable suggestions to low runoff and sufficient water available

Study area

The area extends from 17° 53′ 42" to 18° 19′ 58" North latitudes and 74° 39′ 16" to 75° 09′ 39" East longitudes **(Fig. 1)**. The area is drained by the river Bhima on north and east both sides. Nira River flows south of Indapur tahsil. Total geographical area of the tahsil is 1575.38km^2 (Census 2011), out of which Nira river catchment area compress about 586.8 km^2 and Bhima river catchment covers an area of 902.43km^2. Nira River joins the Bhima River at famous tourist place i.e. Narsinhapur village after travelling a course of 209 Kms from origin. The slope of region is towards east. There are three soil types, namely, coarse shallow, medium black and deep black soils occupying 30, 40 and 30 percent respectively.

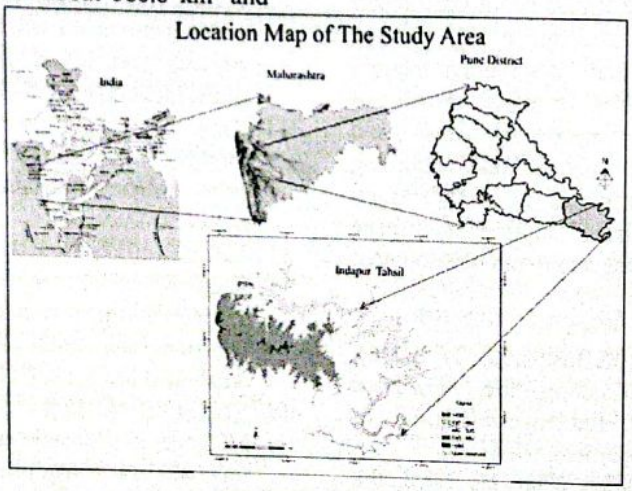


Fig. 1 Location map

Database and methodology

For the present research work secondary data source are used. This work is to develop digital database at large scale using spatial and attribute data All the supported data is collected from survey of India, Maharashtra Governments department of irrigation, department of water conservation. The Dickens, Inglis and Nawab Ali Jung Bahadur formula was used to estimate the runoff. These data base converted to Microsoft access format to suit to the link up for processing through Arc View 9.3, Global Mapper version 11.

Runoff estimation and computation of its volume

There are several rainfall-runoff models available in the study of hydrological field. In this study, the following empirical formulae have been used and runoff has been estimated by the three methods. Design flood for Indapur tahsil has been worked out by empirical formulae are given below;

1. Dickens formula

$Q = CA^{3/4}$

Where Q = flood discharge in cumecs

C = constant depending upon the rainfall depth which may be taken as 13.9 to 19.5 for central India basins

A = catchment area in sq.km.

2. Inglis formula

$Q = 124A/(A+10.4)^{0.5}$

3. Nawab Ali Jung Bahadur formula

$Q = C\,(0.386A)^{\{0.925 - (1/14)\log 0.386A\}}$

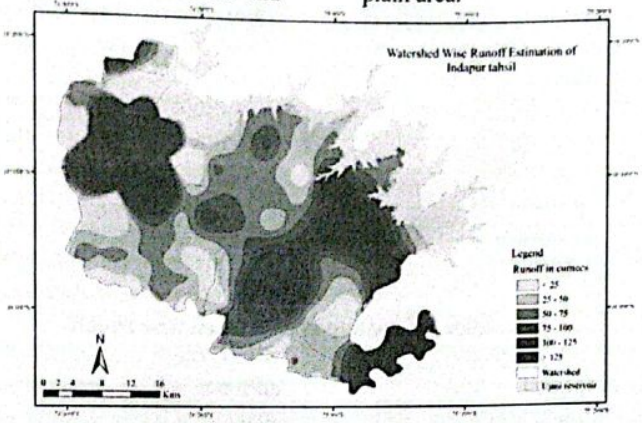
Where Q = flood discharge in cumecs

C = coefficient varies from 49 to 60 with maximum value 86

A = catchment area in sq.km.

Distribution of surface runoff

Runoff is that portion of rainfall, which enters the stream immediately after the rainfall. It occurs when all losses are satisfied and if rain is still continued, with the rate greater than in-filtration rate, at this stage water starts flowing over the land as overland flow. For the design of any soil and water conservation structures and waterways or channels, runoff volume and peak rate of runoff are required to be estimated. Runoff rate is expressed in cubic meter per seconds and runoff volume or water yield from watershed is generally expressed as m^3 **Fig. 2a** The study area is characterised by undulating terrain land in western part and eastern part is a plain area.



Source: Author **Fig. 2a**

In the study area it is observed that the maximum 402.25 km^2 (25.57 %) area under more than 125 cumecs runoff and 235.51 km^2 (14.95%) area under less than 25 cumecs. More than 125 cumecs area found western high altitudinal area, eastern side strip between river Bhima and Nira and two patches are found at around Nimgaon Ketki and Indapur settlement. Low runoff (< 25) has found in the Northern area, besides this it found around in patches in the middle and Eastern part of the study area. Besides this 25-50, 50-75, 75-100 and 100-125 cumecs runoff found in patches all over in the study area **(Fig 2a & Fig 2b).**

Table 1 watershed wise runoff

Sr. No.	Runoff in cumecs	Area		Description
		Km^2	%	
1	< 25	235.51	14.95	Very low
2	25-50	334.86	21.25	Low
3	50-75	357.76	22.71	Medium
4	75-100	149.32	9.48	High
5	100-125	95.08	6.04	Very high
6	> 125	402.25	25.57	
	Total	1575.38	100.00	

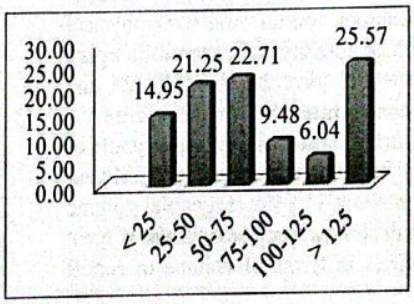


Fig 2b Average surface water runoff (%area)

The average surface water runoff of the catchment is estimated to 327.72 MCM/year **(Table 2 & Fig. 3)**. This is about 31.14% of the total volume of rainfall for the entire study area. There is great deal of variations in terms of volume of runoff by different watersheds. The maximum contribution of runoff in the watershed no. BM67 area that is amounting 46.08% and lowest contribution can obviously be expected from BM61 Bhigwan area which is only 0.37%. From the following table it becomes clear that, due to variation in rainfall and size of considerable amount of rainfall volume does not get converted in to runoff.

Table 2 and Fig. 3 Watershed wise area and runoff of Indapur tahsil

Sr. No.	Name of Watershed Area	Surface Area in		Runoff in	
		Km^2	%	MCM	in %
1	Bhigwan-BM61	24.53	1.56	1.20	0.37
2	Loni-BM66	194.93	12.37	12.07	3.68
3	Palasdev-BM67	238.97	15.17	150.99	46.08
4	Akole-BM68	125.67	7.98	50.57	15.43
5	Sansar-BM76	337.88	21.45	49.33	15.05
6	Nimgaon-BM77	281.63	17.88	29.98	9.15
7	Indapur-BM78	371.77	23.59	33.57	10.24
	Total	1575.38	100.00	327.71	100.00

Source: Author.

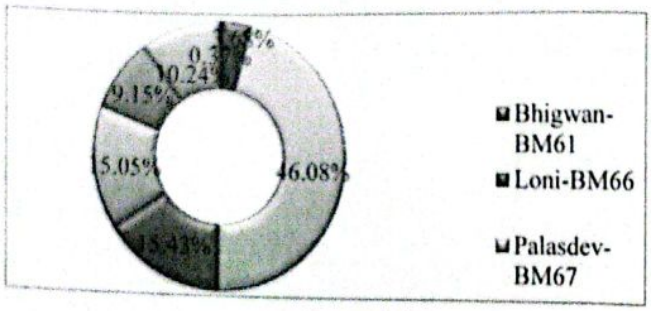


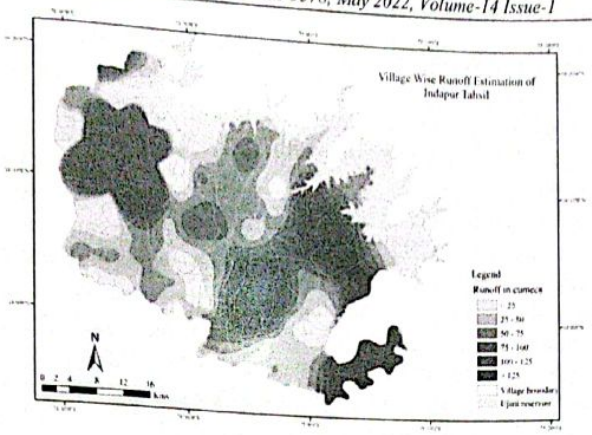
Fig. 3 Variation in watershed wise runoff

Infiltration capacity of the soil

The study area is in the rain shadow and semi-arid climatic condition. In this climatic condition the direct infiltration is relatively ineffective because of the rarity of rainfalls, low mean average precipitation and high potential evaporation. Furthermore, the high potential evaporation compared to precipitation in semi-arid environment results the low deep infiltration of rainwater. The entire tahsil is the basement of Deccan trap basaltic lava. Typically these rocks form the 'Hard rock terrain' and their physical properties such as porosity and permeability play an important role in the movement and accumulation of groundwater.Therefore, in the study area, ground water of acceptable quality and quantity usually lies very low. There are more than 95% area of the study area shows very low ground water recharge, along the Ujani back water and near the confluence of river Bhima and Nira low recharge the ground water. There are only 74.67 km^2 (4.74%) area recommended for groundwater development in the study area. These are found in the patches in SW and NE part of the study area. Another 1500.71 km^2 (95.26%) area is notable for groundwater development.

Village wise computation of runoff volume

The average surface water village wise runoff of the study area is estimated to 327.72 MCM/year **(Fig. 4)**, this is about 31.14% of the total volume of rainfall for the entire study area. There is great deal of variations in terms of volume of runoff by different villages. The maximum contribution of runoff in the Akole area that is amounting 79.889 MCM and lowest contribution can obviously be expected from Lamjewadi village that is amounting 0.007MCM.



Source: Author **Fig.4**

Conclusions

The average annual volume of rainfall is 1052.46 MCM. The very low rainfall volume is observed to the northern side sub basin of the tahsil (BM-61) accounts 16.43 MCM i.e. 1.56% and very high rainfall volume is observed to the eastern side sub basins of Indapur tahsil (BM-78) accounts 247.95 MCM which covers around 23.56% of the total study area. The 'High' ground water potential areas are those having ground water table less than 5 m bgl, admeasures about 394.79 km^2 (25.06%). The 'Medium' areas are those having water table in the range of 5 to 15 m bgl this groundwater potential zone covers 553.12 km^2 (35.11%) of the total study area and the 'Low' ground water potential areas are those having water table more than 15 m bgl and under these having maximum area i.e. 627.47 km^2 (39.83%) of the total study area. In the study area it is observed that, the maximum 402.25 km^2 (25.57 %) area under more than 125 cumecs runoff and 235.51 km^2 (14.95%) area under less than 25 cumecs. More than 125 cumecs area estimated for western high altitudinal area, eastern side strip between river Bhima and Nira and two patches are found at around Nimgaon Ketki and Indapur settlement. Low runoff (< 25) has estimated for Northern area, besides this it found around in patches in the middle and Eastern part. Besides this 25-50, 50-75, 75-100 and 100-125 cumecs runoff found in patches all over. The average surface water runoff of the catchment is estimated to 327.72 MCM/year.

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