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Analysis of Hydrological Data of Talaji Tributary Catchment in Shetrunji River Basin

KEYWORDS: Tributary, Shetrunji river basin, Runoff, Rainfall-runoff Coefficient of correlation (r), Trend, Variations

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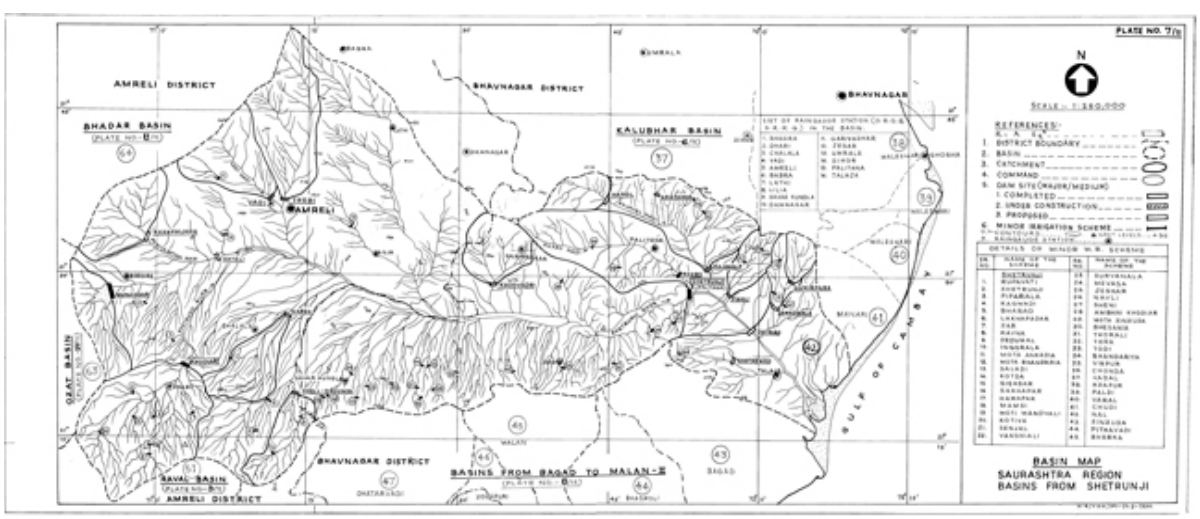
ABSTRACT *Water is the elixir of life. By design it is perfect - The most essential element of life. As water is becoming scarce commodity, its preservation and conservation has become the most important aspect in relation to the water resources development planning. Rainfall is basic input to the hydrologic cycle. Its variation and distribution plays important role in hydrological response of the area and keeps special importance in study of hydrology of a river basin. Rainfall studies are of utmost utility for understanding nature & hence the behaviour of climate changes. In the present paper rainfall-runoff is analysed variation pattern at Sanaliya and Talaji rain gauge stations in Shetrunji River Basin. A co-relation is established and conclusions are derived.*

INTRODUCTION:

Shetrunji is a major river basin among 71 river basins of Saurastra region of Gujarat encompassing districts of Bhavnagar, Amreli and Junagadh with 53.44, 45.21 and 1.35% of total area, respectively. Shetrunji River originates from Gir Jungle and flows towards East and confluence with Gulf of Khambhat near Santhrampur port and meets in bay of Khambhat. Its length is 227 km. & 5636 sq.km Catchment area. Talaji, Khari, Shel are right bank tributaries & Gagario, Rajaval, Satali & Kharoare left bank tributaries of Shetrunji river.

The Shetrunji basin is located between 21°00′ to 21°47′ North latitude and 70°50′ to 72°10′ East longitude. Gagadio and Talaji are two tributaries in downstream end of it on the right bank of Shetrunji. Sanaliya and Talaja are two rain gauge station sites where rainfall is measured runoff is measured at three gauging sites namely Dhari, Sanaliya and Talaji. Gauging site at Talaji at downstream of other two gauging site so runoff value measured at this site is taken for analysis. As the catchment of Talaji tributary is very small rainfall values of Sanaliya and Talaji rainfall station can be considered as rainfall of the catchment.



Geographical Map of Shetrunji Basin
Source link of Graphical Map: http://guj-nwrws.gujarat.gov.in/showpage.aspx?contentid=1594&lang=English

Station	District	Tahsil / Taluka	Latitude	Longitude	River	Tributary	Stream
Talaji	Bhavnagar	Talaja	21°20′47″	72°01′44″	Shetrunji	Talaji	Shetrunji
Sanaliya	Amreli	Liliya	21°30′52″	71°26′39″	Shetrunji	Gagadio	Gagadio

TABLE: Details of Rain gauge Stations for Analysis of Hydrological Data

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RELATED THEORETICAL BACKGROUND:

Runoff means draining or flowing off of precipitation/Rainfall from a catchment area through a surface channel. It thus represents the output from the catchment in a given unit of time. Hydrology is a complex science. Range of hydrologic information is too large; hydrologic cycle largely represents movement of water in which various processes like evaporation, infiltration, runoff etc are involved. For a given precipitation, the evapotranspiration, initial loss, infiltration, and detention storage requirements will have to be first satisfied before the commencement of Runoff. Rainfall-runoff analysis is one of the basic steps in design of hydraulic structures and to carry out various hydrological studies. As the parameters involved are natural and may have great degree of heterogeneous behaviour statistics is many times used to evaluate these parameters. The variation and trend depicts many behavioural characteristics of rainfall and runoff. Here pattern and characteristics of rainfall is analysed graphically and also it is checked how it is correlated with runoff.

RESEARCH SCOPE OF ANALYSIS:

In most of the hydrologic studies, the analysis of rainfall and runoff is basic initial step; scope of this kind of analysis is quite large. This analysis not only gives an idea about hydrological characteristic of the Catchment area but it also serves as guideline to carry out further analysis. This kind of Analysis is influenced by Catchment characteristics and Climatic condition. In addition, Following are two Major Scopes of Research:

Reviewing and searching literature on rainfall-runoff modelling and characteristics to establish a reliable rainfall-runoff relationship for the catchment of Talaji Tributary of Shetrunji River Basin.

Producing land use map and identifying the land characteristics to assess the impervious surface and depression storage of the catchment area.

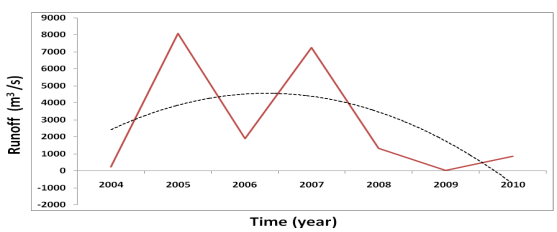
[Note: One of the most common methods of analysis, for getting correlation between Runoff and Rainfall, is to fit liner regression line between Runoff and Rainfall and to accept the results if the correlation – coefficient (r) is near to unity.]

PROPOSED ANALYSIS:

(Hydrological data and its Graphical Representation)

(I). Average Annual Runoff at Talaja for years 2004 to 2010:

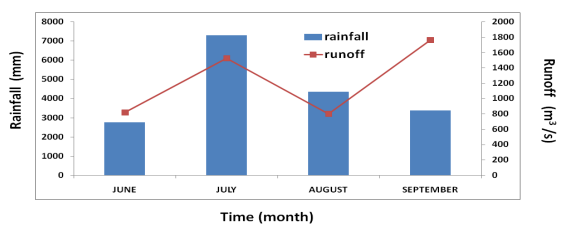
YEAR	2004	2005	2006	2007	2008	2009	2010
RUNOFF	234.764	8085.529	1885.016	7243.61	1312.579	18.29	840



GRAPH-(I) Average Annual Runoff at Talaja for years 2004 to 2010

(II). Average Monthly Rainfall and Runoff for years 2004 to 2010 for Talaja:

MONTH	JUNE	JULY	AUGUST	SEPTEMBER
RAINFALL	691	1827	1092	844
RUNOFF	3276.023	6094.883	3203.671	7045.211



GRAPH-(II) Average Monthly Rainfall and Runoff for years 2004 to 2010 for Talaja

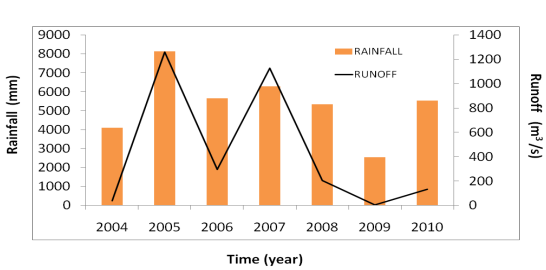
Here the Graphical representation shows how the Runoff and Rainfall are correlated with each other for particular Year.

In the month of July, Average Rainfall (in mm) is maximum.

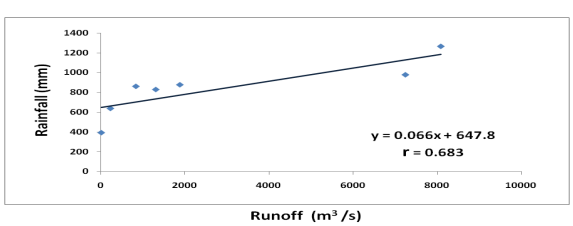
In the month of September, Average Runoff (in m^3/sec) is comparatively higher.

(III). Average Annual Rainfall and Runoff from 2004 to 2010 at Talaja:

YEAR	2004	2005	2006	2007	2008	2009	2010
RAINFALL	637	1264	876	977	828	392	860
RUNOFF	234.764	8085.529	1885.016	7243.61	1312.579	18.29	840



GRAPH-(III.A) Average Annual Rainfall and Runoff from 2004 to 2010 at Talaja



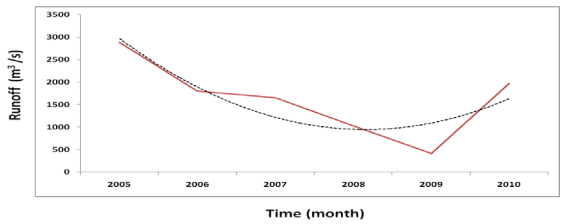
GRAPH-(III.B) Plot of Rainfall V/S Runoff for years 2004 to 2010

Here the Graphical Representation of Relationship between Runoff and Rainfall shows a good correlation as Coefficient

of Correlation (r) comes out to be 0.683 and Average annual Rainfall is increasing largely from 2008 to 2009.

(IV). Average Annual Runoff for Sanaliya for years 2005-2010:

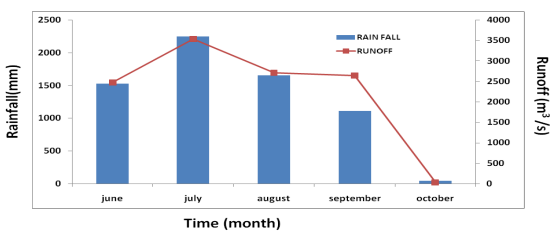
MONTH	JUNE	JULY	AUGUST	SEPTEM-BER	OCTO-BER
RUN-OFF	2476.4	3539.263	2711.322	2642.538	26.06



GRAPH-(IV) Average Annual Runoff for Sanaliya for years 2005-2010

(V). Average Monthly Rainfall and Runoff for years 2004 to 2010:

MONTH	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
RAIN FALL	1528	2253	1656	1115	44
RUNOFF	2476.4	3539.263	2711.322	2642.538	26.06



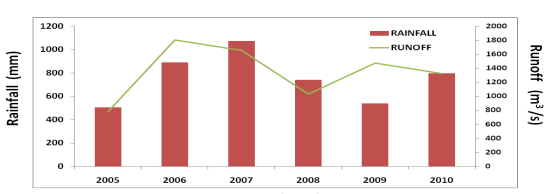
GRAPH-(V) Average Monthly Rainfall and Runoff for years 2004 to 2010

Here the Graphical representation shows how the Runoff and Rainfall are correlated with each other for particular Year.

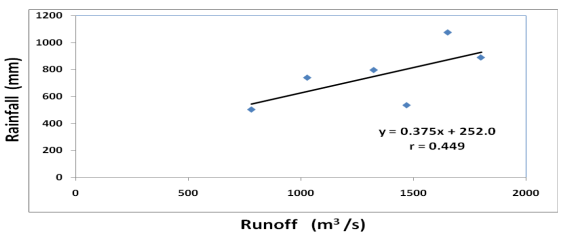
In the month of July, Average Rainfall (in mm) is maximum and Average Runoff (in m^3/sec) is comparatively higher.

(VI). Average Annual Rainfall and Runoff from 2005 to 2010 at Sanaliya:

YEAR	2005	2006	2007	2008	2009	2010
RAIN-FALL	504.5	889	1074	740	536.5	796.5
RUN-OFF	780.5	1801.115	1653.71	1028.8	1471	1324.5



GRAPH-(VI.A) Average Annual Rainfall and Runoff from 2005 to 2010 at Sanaliya



GRAPH-(VI.B) Plot of Rainfall v/s Runoff for years 2004 to 2010

Here the Graphical Representation of Relationship between Runoff and Rainfall shows a comparatively poor (not so as good as at Talaja Station) correlation as Coefficient of Correlation (r) comes out to be 0.449 and Average annual Rainfall is increasing more from year 2008 to 2009.

CONCLUSION AND DISCUSION:

The maximum Runoff in the region of study area is 2883.944 m3/sec to and along with that. The maximum Rainfall in that region of study area is 1264 mm annually. Average annual runoff at Talaja shows major uneven variation compared to runoff at Sanaliya. Average monthly runoff increases from July to September. Minor amount of rainfall is received in July, August and September with maximum rainfall in July. The coefficient of co-relation (r) comes out to be 0.683 for Talaja station and 0.449 for Sanaliya station which represents a relatively good co-relationship between Runoff and Rainfall for the Analysed Shetrunji basin. So Analysis of Hydrological Data of Catchment of Talaji Tributary of Shetrunji River Basin has a good correlated Runoff and Rainfall Pattern. Thus, this co-relation serves as guideline to carry out further analysis and helps in anticipated water-resource studies.

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