International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-10, August 2019

Watershed Management using Remote Sensing and Gis of Maheshwaram Watershed

Kavita Singh, Naveen Kumar Band, M. Anji Reddy

Abstract*: Conservation of integrated watershed management essential resources plays an active role in reduction of unfavorable effects like soil erosion, production of food determining the exact water potential zones etc. Land potential is the main basis of managing watershed. Watershed management studies demand is increasing in the recent years. The study is not limited to drought prone areas, but also in humid and semi humid areas in order to maintain the survival of the crops in critical stages. The main objective of the current study area is management of Maheshwaram Watershed based on the rainfall data. In the study area the rainfall data is collected for the 10 years span (2006-2015) from ARI (Agricultural Research Institute) from Rajendra Nagar Hyderabad. Topographic maps are collected from Survey of India in order to prepare base map, digital elevation model (DEM), contour map, drainage map. The Second main objective of the study area is approximation on annual and monthly run-off by using rainfall data. Further Base map, DEM(Digital Elevation Model), contour map, drainage map, slope map, land use and Land cover map, TIN(Triangulated Irregular Network) maps were generated by Survey of India toposheet maps to prepare maps by using ArcGIS Software. Analysis of the study helps the decision makers to provide sustainable planning of the environment and economy in the future.

Keywords* : Watershed Management, GIS, Remote Sensing, ArcGIS, DEM, Land use/Land Cover

I. INTRODUCTION

Watershed is not simply the hydrological unit but also socio-political-ecological entity which plays crucial role in determining food, social, and economical security and provides life support services to rural people [1]. For the development of any country best possible utilization of water resource plays a very important role. Therefore it is very important to use the resources judiciously. Watershed management plan has proved to be very beneficial for water conservation. Analysis and assessment tools like GIS along with remote sensing have proved to be very efficient and effective and hence useful for management of such a useful resource [2]. Reliable monitoring and assessment of land and water resources timely and accurately. India is one of the well endowed country with rainfall estimated around 400 million hectare- meters, so far vast regions of the country is drought prone 53.9% areas are arid and semi arid areas. Water resource is a very essential natural resource. Geographical Information Systems (GIS) is extensively used for spatial data production effectively based on spatial planning [3]. Due to population growth the pressure is increasing on the land and water resources. 70% of the Population indirectly or directly depends on agriculture in the developing countries. Watershed management is a holistic approach which aims at optimizing the use of land, water and vegetation in an alleviate drought, moderate floods, prevent soil erosion[4]. A watershed management provides natural environmental unit for planning a developmental initiative [5]. GIS holds great promise with a provision to handle spatial and temporal data and aid as an integrative planning tool for watershed management [6]. Integrated watershed management is emerging as an approach for the sustained development and management of natural resources[7].

Manuscript published on 30 August 2019.
*Correspondence Author(s)
Dr. Kavita Singh, Accociate Professor, Department of Civil Engineering, Malla Reddy Institute of Technology, Maisammaguda, Dhulapally Hyderabad, Email:drkavi14@gmail.com
Naveen Kumar B, Assistant Professor, Department of Civil Engineering, Malla Reddy Institute of Technology, Maisammaguda, Dhulapally Hyderabad. Email: nave8391@gmail.com
Dr. M. Anji Reddy, Professor and Directorate of Research and Development Cell, Jawaharlal Nehru Technological University Hyderabad, Kukatpally Email: drkavi14@gmail.com

II. CLASSIFICATION OF WATERSHED

Watershed is classified into different categories based on the area that it contains as shown in Table1

Table 1 classification of watershed

Classification of watershed S.No	Type of Watershed covered	Area covered in hectares
1	Micro Watershed	0 to 10
2	Small Watershed	10 to 40
3	Mini Watershed	40 to 200
4	Sub Watershed	200 to 400
5	Macro Watershed	400 to 1000
6	River basin	>1000

Characteristics of watershed

1) Size: By Size of the stream watershed is governed or river development management works taken. Size of the watershed helps in computing the parameters like receiving precipitation, retained amout of water and drained off.

2) Shape: Different shapes on the watershed based on the parameters like morphology, geology and structure for example Pear, elongated etc.

3) Physiography: Physiography depends on the altitude and the type of land which speaks about a watershed and climate

4) Slope: A slope controls the movement of rainfall water and distribution of movement of water, utilization of land and watershed behavior. If slope is more then the velocity of the water is more, hence the flood water drains quickly. And it results to higher peak discharge. Slope reduces the infiltration rate an

5) Climate:
Watershed of a region depends on climatic conditions like wet seasons or dry seasons. If climatic condition is dry before the rainfall then loss of runoff will more and infiltration will also be more.

6) Drainage: Drainage pattern and drainage density have influence on watershed for infiltration, land management etc.It is determined by the flow characteristics and erosion behavior.

7) Vegetation: Due to vegetation cover flow of water is influenced, further reducing the peak flow and it protects the soil erosion.

8) Geology and soils: The type of soil and geology influences the runoff of water for example soil such as sand absorbs large amount of run-off water, where the rate of flow is less. If the soil is clayey soil then the flow of water is more and absorption of water is less.Geology of an area controls the formation of watershed because rocks structure and nature determines shape, size, physiography,drainage and ground water conditions.

III. OBJECTIVES OF THE STUDY AREA

1. The main objective of the current study area is management of Maheshwaram watershed based on the rainfall data.
2. Approximation on annual and monthly run-off by using rainfall data for the Span period of 10 years.
3. Development of Base map, drainage map, contour map, slope map, TIN (Triangulated Irregular Network, DEM (Digital Elevation Model) Map, Land Use/Land Cover map of the Study area.
4. To evaluate monthly and annual rainfall and Runoff.
5. Analyze monthly and annual Relative Humidity, Temperature, Wind Speed, Evaporation.

IV. STUDY AREA (MAHESHWARAM WATERSHED)

Maheshwaram watershed is located in Ranga Reddy district 35 Km south from Hyderabad. Location of Maheshwaram 78˚24'30"E to 78˚29'00"E and latitude 17˚06'20"N to 17˚11'00"N. The area is surrounded with hard rock aquifers with semi-arid climate. The area is one of the fastest expanding and growing urban centers, due to which this area is facing problem with regard to groundwater depletion and deterioration of quality of water. The catchment area is ranging from south to north, and the topographic relief is ranging from 90 meters to 590 meters in the North-East direction and 680 meters south-west above the mean sea level. And about 1.79 degrees is the average slope. The drainage pattern is sub-dentritic type with and undulating topography, and a number of gullies are draining into streamlets along with eroded banks. The characterization of the study area is it is hot as well as dry summer and winter is cool as well as dry. The rainy season ranges from June to September, Temperature range is between 220 C to 440 C. In this region most of the rainfall or around 80% of rainfall it receives from south-west monsoon.

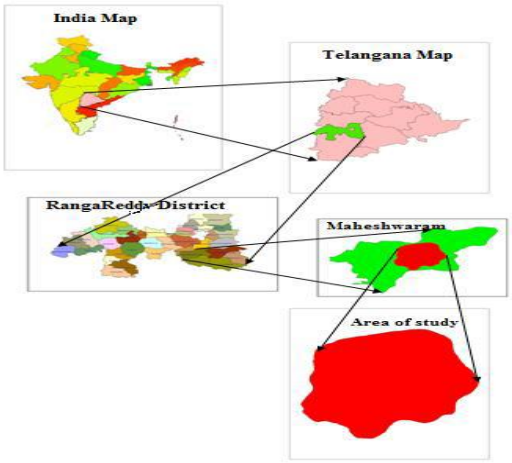

Figure1 Location map of Maheshwaram Watershed

V. RESULTS AND DISCUSSION

A.Base map

Base map of Maheshwaram watershed is prepared using Survey of India, Hyderabad toposheet map at 1:50000 scale. Base Map is the map which depicts the basic fundamental map elements such as transportation network settlements rocky lands, forests, etc.(Figure 2)

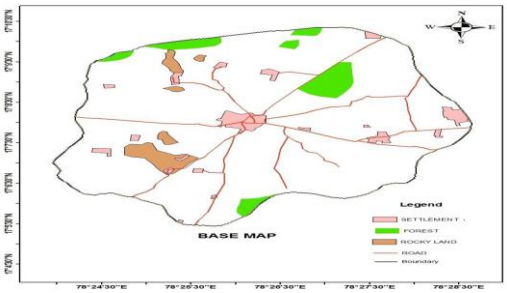

Figure 2 Base Map of the Study area

B.Contour map

Contours are imaginary line which is connected with the points of equal elevation. A contour line is an imaginary line which connects points of equal elevation. Contour lines drawn by keeping difference elevation between two successive lines. Contour map of Maheshwarm watershed is prepared using survey of India, toposheet map on 1:50,000 scale. Toposheet were collected from survey of India; further scanned, rectified and further projected maps were finally merged as a single layer in order to clip the study area Further contours were digitized using ArcGIS 10.2.1. Contour map represents the steep and flat areas. (Figure 3)

Retrieval Number: J98920881019/19©BEIESP
DOI: 10.35940/ijitee.J9892.0881019
Journal Website: www.ijitee.org

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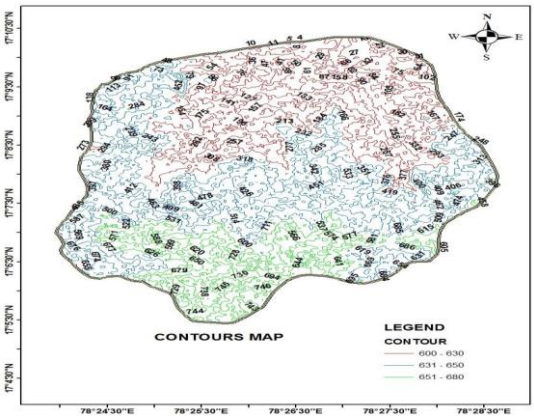

Figure3 Contour map of the study area

C. Slope map

Steepness and degree of inclination is measure of slope. Slope map is prepared by using DEM Map.

D. Drainage map

Rainfall runoff is that water which flows on the surface of the ground. It flows across the slope surface until it joins in a stream. Every waterway has a specific watershed area or drainage basin in which all of the precipitation falls and drain downhill to a stream. Usually drainage basins have distinct boundaries. Larger rivers drainage basin are comprised of many branch networks. First order stream is where the source starts and they are not having other stream attached to that, next to first order stream second order streams are followed by the streams are created where two streams from first order meets, and further when two second order streams meet together the third order stream is generated. The flow of watershed direction is south to north and further it joins into the Musi River. The progression continues until a huge network waterway area is created. The length of the Maheshwaram watershed is 85 km along with 1515 streams, fourth order streams are 78 Nos., fifth order streams 17No., sixth order streams 3 No. and seventh order streams are only 1(**Figure 4**)

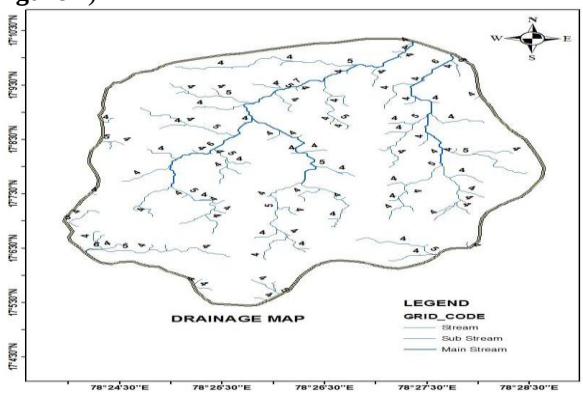

Figure 4. Drainage Map of the Study Area

E. Digital Elevation Model (DEM)

DEM (Digital Elevation Model) and TIN (Triangulated Irregular Network) maps are used for the representation of continuous topographic terrain. The digital representation of continuous topography. (Figure 5)

The Digital Elevation Model of Maheshwaram watershed is developed by contours using Arc GIS Software with spatial analysis tool and surface analysis tool.

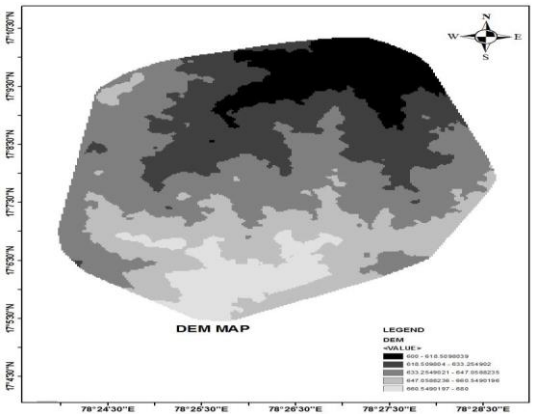

Figure 5 DEM Map of the Study Area

F. Land Use/Land Cover map

Land Use / Land Cover is a result of classifying satellite data into different categories based on satellite data. Landuse/Landcover information important for the estimation of rainfall runoff as well as soil loss. Landuse/Landcover Map is prepared by using Visual Interpretation Techniques and Digital Interpretation Techniques by using IRS LISS data under GIS Environment. Landuse/ Landover gives a very important method for shaping the extent of a variety of landuse /Land cover types viz. shrub land, agriculture etc. The land use/Landcover of Maheswaram watershed is shown in the **Figure 6**

Three main categories of land use and Land cover are identified and mapped. They are,

(i) Vegetation
(ii) Wasteland
(iii) Settlements.

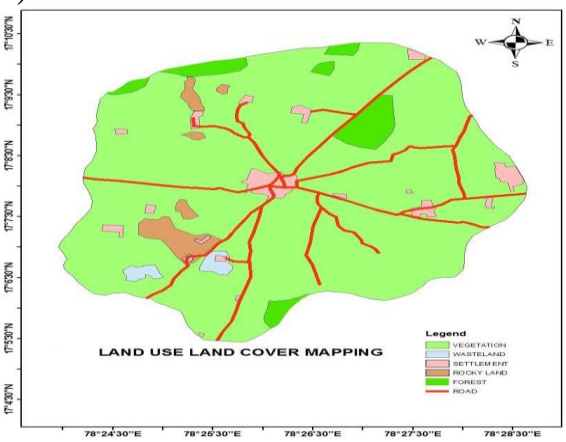

Figure 6 Land use / Land Cover Map of the Study Area

G. Analysis for Temperature

The maximum temperature recorded is 34.1 in the year 2009. And the maximum temperature recorded in minimum Temp is 33.1 in the year 2007. **During June to September (South west mansoon season) temperature goes down in decreasing stage.**

Table 2 Maximum and Minimum temperature from the 2006-2015

S. No.	Year	Max Temp	Min Temp
1	2006	32.7	20.9
2	2007	33.1	33.1
3	2008	32.9	20.8
4	2009	34.1	32.9
5	2010	33.5	21.2
6	2011	33.5	20.6
7	2012	33.3	21.3
8	2013	32.2	21.7
9	2014	33	21.9
10	2015	33.6	21.9
	Average Temperature	33.19	23.63

Table 4 Average Relative Humidity from 2006 to 2015

S.No.	Month	Wind Velocity (km/hr)
1	2006	**7.8**
2	2007	7.5
3	2008	7.1
4	2009	7.1
5	2010	6.3
6	2011	6.9
7	2012	7
8	2013	5.5
9	2014	**5.4**
10	2015	5.6
	Average	**6.62**

H. Analysis for Relative Humidity The relative humidity of the study area in the years 2006-2015 is shown in table 3. It is observed that the relative humidity is measured highest i.e. 70.2 in the year 2010.

Table 3 Average Relative Humidity from 2006 to 2015

S.No.	Month	Relative Humidity (%) at 8:00AM (I)
1	2006	67.9
2	2007	66.8
3	2008	67.4
4	2009	63.3
5	2010	**70.2**
6	2011	65.5
7	2012	65.6
8	2013	69.8
9	2014	68.9
10	2015	68.3
	Average	67.37

I. Analysis of Wind velocity

The wind velocity of the study area in the years 2006-2015 is shown in table4 .It is observed that the maximum wind velocity is in the year 2006 and the minimum wind velocity is in the year 2014.

J. Overall analysis of total rainfall

The rainfall analysis of monthly basis was calculated from the year 2006-2015 The yearly average rainfall of the span of 10 years is **844.57** mm based on the collection of data. The highest rainfall was recorded **1151.6mm, 1081.9mm** and **1035.7mm** in the years **2008, 2010** and **2013** respectively. The highest rainfall was 1151.6 mm for the year 2008 and the lowest rainfall was 603.2 mm for the year 2015.

Table 5 Monthly Overall Rainfall

Year/ Month	2006		2007		2008		2009		2010	
	Rainfall(mm)	Run off (mm)	Rainfall (mm)	Run off(mm	Rainfall (mm)	Run off(mm	Rainfall(mm)	Run off(mm	Rainfal l(mm)	Run off(mm
Jan	0	0	0	0	0	0	0	0	6.3	0
Feb	0	0	0	0	69.2	39.63	0	0	2.7	0
Mar	41.8	19.7	0	0	166	93.64	2.1	0	0	0
Apr	67.9	36.43	23	10.3	13.8	2.4	23	10.3	0.6	0
May	100.3	49,32	11.5	0.38	20.8	9.2	17.3	6.12	17.4	6.17
June	83.8	41.89	113.3	51.4	40.2	19.26	69	36.5	150.8	80.39
July	192.7	97.48	92.8	45.12	96	47.4	55.5	32.45	338.8	254.85
Aug	228.1	129.93	214.6	137.47	464.6	377.08	353.7	269.21	216.7	139.4
Sept	206.1	109.67	266.6	185.97	185	110.54	145.6	75.93	231.1	152.72
Oct	15.1	4.82	18.1	7.11	48	27.4	69.6	36.53	55.5	32.45
Nov	52.2	29.8	21	9.6	48	27.4	28	13.6	46.8	25.8
Dec	0	0	0	0	0	0	4.4	0	15.2	4.83
Total	988.0	519.04	760.9	447.35	1151.6	753.95	768.2	480.64	1081.9	696.61
Average	**82.3**	**43.3**	**63.4**	**37.3**	**96.0**	**62.8**	**64.0**	**40.1**	**90.2**	**58.1**

Table 6 Monthly Overall Rainfall

Year/ Month	2011		2012		2013		2014		2015	
	Rain fall(mm)	Run off(mm	Rainfal l(mm)	Run off(mm	Rain fall(mm)	Run off(mm	Rain fall(mm)	Run off(mm	Rainfal l(mm)	Run off(mm
Jan	0	0	0.3	0	0.3	0	0	0	0.4	0
Feb	25.2	11.7	0	0	17	6.3	0.7	0	0	0
Mar	**1.7**	0	0	0	0	0	47.3	26.2	21.2	9.63
Apr	6.9	0	18.3	7.21	74.5	37.9	13.9	3.41	99.2	48.7
May	1.7	0	4.8	0	10.2	0	34.3	15.54	8.9	0
June	35.6	16.2	132.8	65.8 9	203. 2	128	73.4	37.1	167.6	95.9 3
July	185. 9	112.29	232.4	154. 97	197. 2	122.53	174. 2	101.79	38.4	18.8
Aug	234. 9	157.3	143.5	74.9 5	124. 8	59.25	162. 2	91.79	60.1	34.5 2
Sept	76.9	38.54	114.3	50.7 4	155. 4	85.22	66.9	34.6	141.3	73.0 7
Oct	70	36.59	78.1	39.8	239. 1	161.22	27.3	13.4	65.1	35.3
Nov	8.4	0	39.5	18.7	14	4.1	44.2	24.25	1	0
Dec	0	0	0	0	0	0	0.6	0	0	0
Total	647. 2	372.6	764.0	412. 3	1035 .7	600.4	645. 0	348.1	603.2	316. 0
Avera ge	**53.9**	**31.1**	**63.7**	**34.4**	**86.3**	**54.6**	**53.8**	**29.0**	**50.3**	**26.3**

Table 7 Average Rainfall and Average Runoff

S.No.	Year	Average Rainfall(mm)	Average Runoff(mm)
1	2006	988	461.35
2	2007	760.9	423.42
3	2008	1151.6	673.84
4	2009	768.2	421.07
5	2010	1081.9	663.25
6	2011	647.2	320.42
7	2012	764	378.98
8	2013	1035.7	581.08
9	2014	645	244.79
10	2015	603.2	241.98
	Total	**8445.7**	**4451.76**

VI. CONCLUSIONS

Watershed conceived as geographical unit of the terrain which drains water to a common point. Management of watershed is concept which integrates conservation management. Watershed management is not a Technology it budgets the rainwater by a simple hydrological units.

Conclusions made from the objectives of the study area:

Using ArcGIS software maps are prepared like Base map, Contour Map, Drainage map, slope map, TIN(Triangulated Irregular Network Map), Digital Elevation Model (DEM) map, Land Use/Land Cover map to know the topographical features of the Maheshwaram Watershed.

Development of contour map is to visualize for flat areas and steep areas, ridges and valleys in the study area. The elevation of the study area ranges from 600 to 680m. Drainage map is developed to study the flow direction of water in the area. The flow direction of water is from north to south direction and then joins into Musi River.

Slope map is developed using the contours; and the study area falls under the category of very gentle slope with an average of 2.5. The yearly average rainfall of the study area is 844.57mm. The yearly average runoff of the study area is 445. 17mm. This is approximately 50% of the average yearly rainfall. From the present study we conclude that whenever evaporation and wind velocity decreases the storage capacity of the watershed increases and ground water recharge also increases.

Analysis of the study helps decision makers to provide requirements for the sustainability of the environment and economy in the future.

REFERENCES

1. Suhas P Wani and Kaushal K Garg, Watershed Management Concept and Principles (ICRISAT) January 2009
2. Ingavale R.R., Jadhav V.V. and Raut P.D., Studies on Watershed Management in Shivaji University, Kolhapur, India IRJES ISSN 2319–1414 Vol. 2(7), 35-38, July (2013).
3. Recep nisanci1, Volkan Yildirim, Tahsin Yomralioglu, Nihat Enver Ulger, Ali Erdem Ozcelik, GIS-based drinking water watershed management a case study of the Galyan watershed in Turkey. Environmental Engineering and Management Journal December 2015, Vol.14, No. 12, 2919-2927 November, 2012.
4. Parag R.Thakare, Raj A. Jadhav, Hastmal S. Kumawat, Watershed Management-A case study of Satara Tanda Village International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-3, Issue-3, August 2013.
5. Thorat MM, Watershed Management Int. Res. J. of Science & Engineering, 2017; Vol. 5 (5): 81-83 ISSN: 2322-0015
6. Biplab Das, Aditiya Bandyopadhyay, A Model of Watershed Management Process-A Case Study of Rarh Region in Gangetic Delta IJERD Volume 6, Issue 3 (March 2013), PP. 28-34
7. Molla Mekonnen Alemu, Integrated Watershed Management and Sedimentation Journal of Environmental Protection, 2016, 7, 490-494 , 9 March 2016.

AUTHORS PROFILE

Dr. Kavita Singh is an Associate Professor in the department of Civil Engineering Malla Reddy Institute of Technology. She has 13 years of experience in industry, research and academics. She obtained her Master's degree from Osmania University, Hyderabad and was awarded PhD from Jawaharlal Nehru Technological University, Hyderabad in the year 2012. She has published 12 papers in national and international journals and conferences in India and abroad. She is and Life member of ISTE, Life member of ISRS, life member of IRED, Life member of ISRD Individual member ISPRS (International Society for Photogrammetry and Remote Sensing)

Naveen kumar B Assistant Professor in the department of Civil Engineering, Malla Reddy Institute of Technology. He Obtained his M.Tech from RYMEC, Ballari, Karnataka. He has 5 years of experience in Reasearch and Teaching. He has published 6 papers in international and national Journals. He is the Life member of IRED.

Dr.M. Anji Reddy Directorate of Research and Development Cell, Jawaharlal Nehru Technological University Hyderabad, Kukatpally. is a man with outstanding caliber in guiding many students with their academics and their projects in various applications of remote sensing and GIS in environmental management and planning. His contributions to the field of environmental management, the guest lecturers delivered at esteemed universities are outstanding. JNTU is privileged to have such a scholar with great commitment, dedication and knowledge. He is having Publications – 48(IN) &79(N), books – 09, articles – 04
PhD guided- 22 & ongoing – 12

Retrieval Number: J98920881019/19©BEIESP
DOI: 10.35940/ijitee.J9892.0881019
Journal Website: www.ijitee.org

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