Modeling of Existing Mini Watershed Using Geo informatics

[1]Supriya Patil, [2]Gaurav Borate, [3]Amrutesh Raut,[4] Bhagyashree Pardeshi, [5]Saurabh Sathe
[1]Assistant Professor, [2]Student, [3]Student, [4]Assistant Professor, [5]Saurabh Sathe
[1]Civil Engineering Department
[1]D. Y. Patil College of Engineering, Akurdi, Pune.

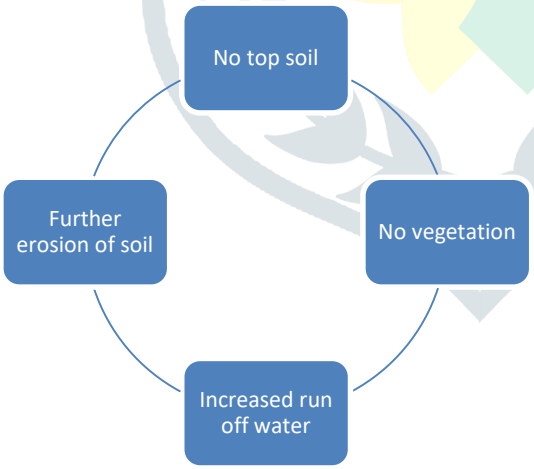
Abstract:
In this project we made an attempt to be familiar with the aspect of 'Watershed Management and Development' using Geographical Information System. As there is continuous increase in population and degradation of environment. Also currently India is facing scarcity of water. So watershed development is only option for development of rural areas. The major objective of this project is that the all these engineering knowledge like GIS we have learn and apply it to another rural areas and raise economy as well as to improve the lifestyle of village people.
We select Ralegaon Siddhi village for case study. We prepared the different layers such as wells, gabian bandhara, cement nala bund, loose boulder, brush wood dam and percolation. We fix the position of these watershed structures according to their suitability. Also we show different contributory areas and we calculate runoff from each of the outlet.
This method we applied can be also used to another watershed. Virtual model of area is done by using topographical data of area which designed by using GIS tool. Fundamental of watershed and amalgamation with GIS technique can be successfully implemental in new watershed. Future scope includes applying same methodology to new area.

Index Terms - Watershed, Sustainable, Integrated watershed management, GIS, Georeferncing, Gambian bund, Loose boulder structure, Cement nala bund, CCT, Check dam.

I. INTRODUCTION

Water is the basic requirements of all life on Earth. The origin of life has been attributed is water along with other basic elements water the source of life is passionate. Too passionate to manage excess of, it leads to flood and lack of its results in drought and famine. It must be remembered that any natural or manmade activity on the surface of the earth will have its for most impact on the quality and quantity of water this will be taken into the biosphere systems and ultimately lead to hydrological extremes.

The increase in population and urbanization and urbanization necessitates growth in the agricultural and industrial sectors which demand for more fresh water. When surface water is the non-available mode the alternative is to depend on ground water.
The dependability on ground water has reached an all-time high in recent decades due to reasons such as unreliable supplies from surface water due to vagaries of monsoon, increase in demand for domestic, agricultural and industrial purposes. This has resulted in over exploitation all over the country and in certain places it has reached critical levels like drying up of aquifers.



Geographic Information System (GIS) is a computer based decision making tool to plan, implement and govern the objects in space. GIS accept large volumes of spatial data derived from different sources, retrieve, manipulate, analyze & display according to user-defined specifications. GIS transforms data into information on spatial locations of entities that occupy space in natural & built Environment.
Now a days water scarcity increases rapidly due to decrease of ground water. The ground water is also polluted due to various artificial man-made activities. Due to this, quality of the water is reduced. This will produce various adverse impacts on human beings, animals and plants. Therefore, it is necessary to monitor the water quality.

II. Study area:-

Ralegan Siddhi is a village situated in Parner Taluka ,Ahmednagar District, Maharashtra state. The study area Ralegaon Siddhi watershed lies between geographic latitudes 18.9156°N and 74.4145°E. Ralegan Siddhi is located 87km from Pune. It is considered a model of environmental conservation. The village has carried out programmes like tree planting, terracing to reduce soil erosion and digging canals to retain rainwater. For energy, the village uses solar power, biogas and a wind mill. The project is Heralded as a sustainable model of a village republic. The area comes under the rain shadow zone. The rainfall ranging between 450 to 650mm. and temperature ranging between 12 to 44°. It has area about 982.31 ha. But about 300ha area is not avaible for cultivation. Geologically the area is represented by Deccan trap basalts of

Malwa group, Vindhyan sandstone and alluvium and groundwater in this group occurs under phreatic conditions. The rocks of the area are hard and compact.In 1975 the village was afflicted by drought, poverty prevailed and trade in illicit liquor was widespread.

The village tank could not hold water as the embankment dam wall leaked. Work began with the percolation tank construction. Anna Hazare encouraged the villagers to donate their labour to repair the embankment. Once this was fixed, the seven wells below filled with water in the summer for the first in memory. Now the village has water year round, as well as a grain bank, a milk bank and a school. There is no longer any poverty.

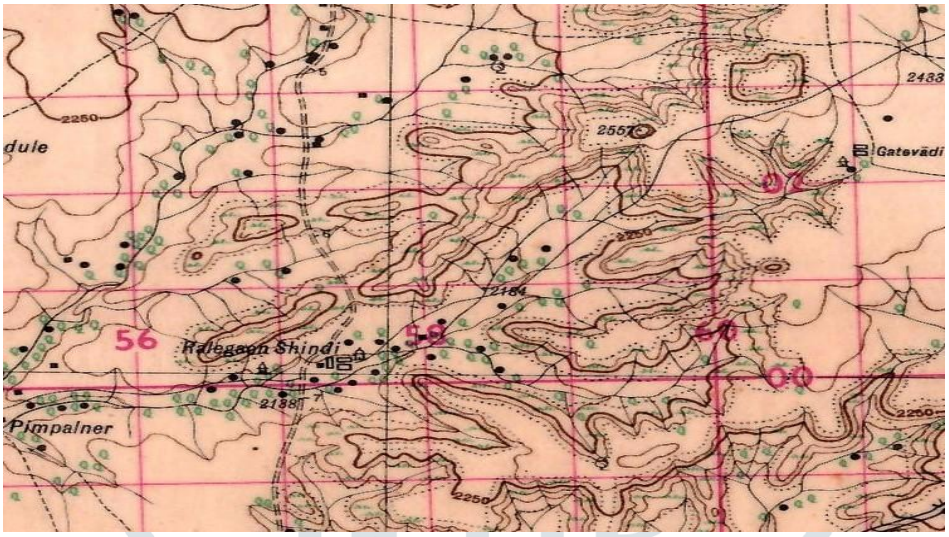


Fig 1: Toposheet image of Ralegaon Sidhhi

III. Methodology:-

1. Site Selection:

Ralegan Siddhi is a village situated in Parner Taluka ,Ahmednagar District, Maharashtra state. The study area Ralegaon Siddhi watershed lies between geographic latitudes 18.9156°N and 74.4145°E. Ralegan Siddhi is located 87km from Pune. The area comes under the rain shadow zone. The rainfall ranging between 450 to 650mm. and temperature ranging between 12 to 44°.

2. Pre field Work:

In pre field work we collected Topographical sheet of Ahmednagar and Pune District of scale 1:63360 from Survey of India and studied previous literature data about Watershed management and development in that area.

3. Field Investigation:

a) Survey of Watershed: In preliminary survey we studied about the selected region considering on various parameters.

b) Data collection from site visit.

4. Watershed Modeling:-

a) Scanning of toposheets and Geo referencing:-

For the modelling work we used QGIS 3.4 Version (Quantum GIS) tool. Scanning results in the conversion of the image into an array of pixels thereby producing an image in raster format. A raster file is an image created by a series of dots called “Pixels” that are arranged in rows and columns. A scanner captures the image by assigning a row in a column and a colour value each dot. The Pune and Ahmednagar district map was scanned. Geo referencing is the process of assigning real world coordinates to each pixel of raster data. Geo referencing in QGIS is by ‘Geo referencer.

b) Digital Elevation Model (DEM):-

It is three-dimensional representation of surface of terrain. Digital elevation model are the data files which contain elevation of terrain over a specific area. The actual location associated with elevation data is calculated by software reading of actual DEM file, knowing the precise location of data value inside the DEM file. We have used DEM ASTGIM2_N19E074 for modelling work.

c) Vector file generation:-

The geo database model represents vector base spatial features points, polylines and polygons. In the vector model, information about point (individual trees, wells, service line post etc.), lines (e.g. boundaries, streams) and polygons (water bodies, forest patches, agricultural fields etc.) is encoded and store as a collection of X, Y coordinate. A single X, Y coordinate can be desire location of the point features.

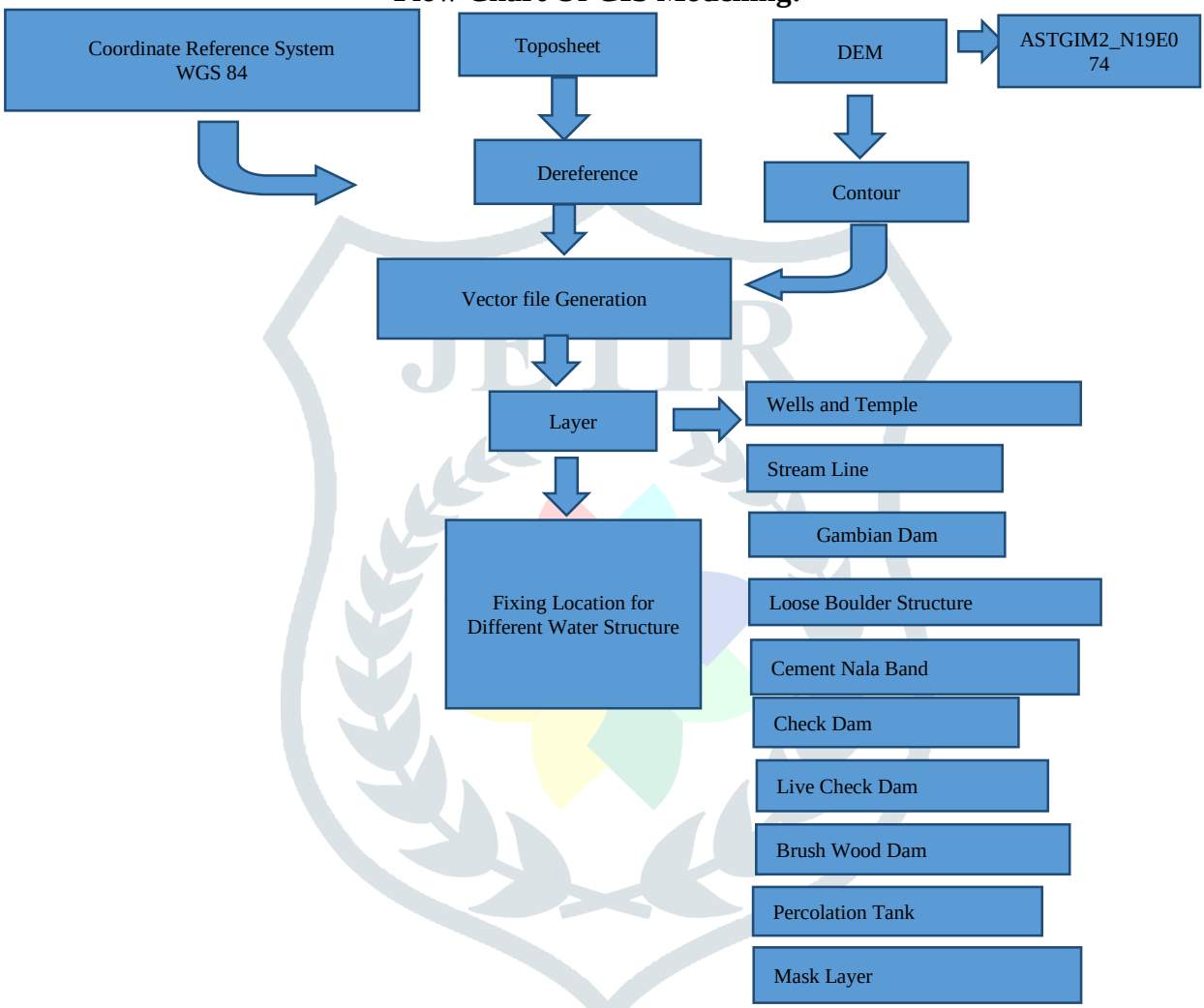
d) Digitizing:-

Digitizing is the process of interpreting and converting paper map or image data to vector digital data. In manual digitizing you trace the lines or points from the source media. Digitization is the process which converts raster to vector format. Most of the GIS technologies are vector formats are more common, so the raster format is converted into a vector format. In the vector format the position of the line is determined by the coordinate which are present at the starting and ending points of the line. In digitization involve line, points and polygons.

e) Layers and fixing location of structures:-

After digitizing, the various layers are constructed such as stream lines, gabion bandhara, check dam, brush wood dam, loose boulder structure, percolation tank, mask layer and mini watershed. According to nature of ground slope, discharge and purpose of the structure we finalize the location of these structures.

Flow Chart Of GIS Modelling:-



IV. Runoff Calculations:-

For the fixation of water structure calculation of runoff is essential. Dimensions of the water structure are decided by runoff of that area. Also it helps in deciding capacity of water structures.

I. Peak discharge-

Q= 0.0028CIA

Where,

Q is the discharge in m^3/sec. C is runoff coefficient, I is the intensity of rainfall mm/hr., A is the area of the catchment.

II. Kirpich Equation for calculating time of concentration-

For calculation of time taken by flowing water from farthest point to outlet point of catchment Kirpich equation is used.

$Tc= 0.0195L^{0.77}X\ S^{-0.385}$ …….. (Since 1940)

Tc is the time of concentration in hours, L is the length of the streamline, S is the slope in m

III. IDF curve equation (For 1 in 2 year rainfall)

$$i = \frac{w}{(\Theta + d^a)^n}$$

Note: - Above formula should be applicable only for Pune region

Values of:-

W=24
θ=0.008
a=1
n=0.669

ID	AREA	COEFFICIENT (C)	TIME OF CONCENTRATION (TC)	INTENSIY (I)	DISCHARGE (Q)
	(hector)		(min.)	(mm/hr.)	(m^3/sec)
1	137.31	0.3	1.52	18.07	2.08
2	85.63	0.9	1.55	17.84	3.85
3	198.5	0.9	1.96	15.25	7.62
4	27.71	0.3	0.94	25.05	0.58
5	135.37	0.7	2.09	14.62	4.98
6	51.24	0.4	1.02	23.56	1.35
7	35.07	0.3	1.54	17.91	0.53
8	77.77	0.8	4.3	9.034	1.57

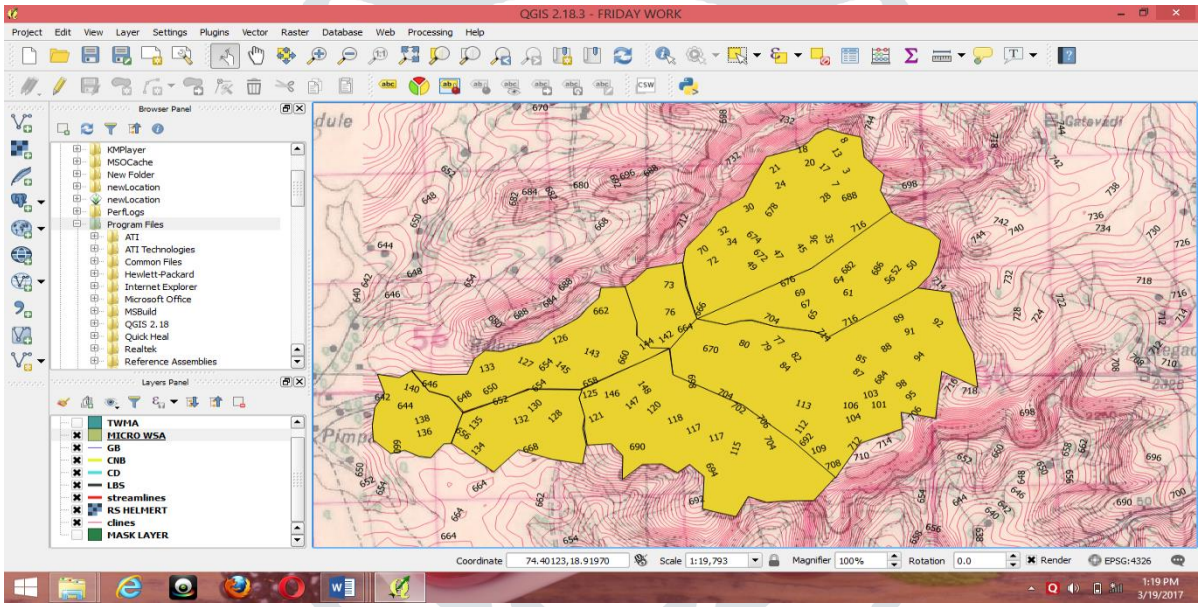


Fig 2: Different contributory areas

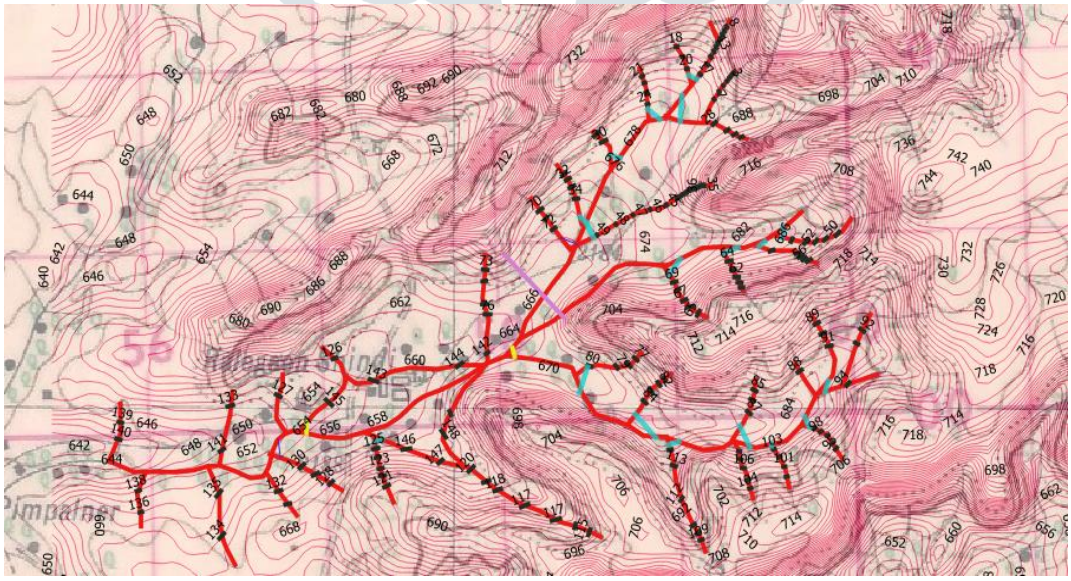


Fig 3: Stream lines

V. Design and estimate of different water structures:-

Gabian bandhara	2
Loose boulder structure	149
Cement nala bund	2
Percolation tank	1
Live check dam	12
Brush wood dam	6

VI. RESULTS:-

Finalizing the location of water structure is easy by using GIS tool. Finalizing the location of water structure is easy and economical by using GIS tool. We calculate area and runoff of catchment. Based on above information we finalize position of structures and also calculate storage capacity of structure.

.

VII. CONCLUSION:-

Watershed development program is very vital for the development of the village as well as country. Method applied can be also used to another watershed. Virtual model of area is done by using topographical data of area is designed by using GIS tool. Fundamentals of watershed and amalgamation with GIS technique can be successfully implemented in new watershed. Future scope includes applying same methodology to new area.

VIII. REFERENCES:-

1. Mr. Chetan Bansode, Mr. Vishal Bhosale, Mr. Akash Dongare, Mr lalit Shirsagar, Mr Aniket Malwadkar, Prof. P.D. Sabale 'Watershed Development by Using GIS and Remote Sensing For Water Budgeting'
2. T. Subramani, S. Krishnan, P.K. Kumar ' Study of ground water quality and GIS application for Coonor taluka in Nilgiri District'
3. Book- Mrudugandh,Ramchandra Zagade, Publication- Hind Swaraj Trust.
4. Arnoff S., 1989 : 'Geographical Information System', WELP Publication, Ottawa, Canada.
5. Krishna Murhy J, Kumar NV, jayaraman V and Manivel M., 1996 : An approach to demarcate ground water potential zones through remote sensing and GIS. International Journal of Remote Sensing, Vol 17(10) : p. 1867-1884.
6. Basavaraj Hutti, and Nijagunappa. R., 2011 : Identification of Groundwater Potential Zone using Geoinformatics in Ghataprabha basin, North Karnataka, India Basavaraj Hutti, Environmental Science Department, Gulbarga University, India. International Journal of Geomatics and Geosciences, Vol 2, No 1. p. 91-109.
7. Ni G, Jia Y, Kinouchi T, Tojima K, Yoshitani J., 2001 : Monitoring and Modeling of Urbanization impacts on Groundwater in the Yata River Watershed, Urban River Division, Public Works Research Institute, Ministry Of Construction, Japan, p. 1-6.
8. Jyoti Sarup et. al., 2008 : Delineate Groundwater prospect zones and identification of artificial recharg sites using Geospatial Technique, International Journal of Advance Technology & Engineering Research (IJATER).