Vol. 4, Issue. 8, 2017, ISSN 2349-0780

Self Sustainablity Of Tamadalge Village Through Watershed Management

S. S. Gondode[1] , K. M. Kangle.[2]
Research Student[1], Assistant Professor[2]
KIT's college of Engineering, Kolhapur, India

ABSTRACT- Efficient watershed can help in mitigating various problems like soil erosion, water scarcity, flooding. Present drought conditions in Maharashtra are far worse than they were in 1972. For effective study of watershed management Tamadalge village having the area of 7.8km^2(square kilometer), situated at 16°(degree)46'(minutes)03.89"(seconds) North latitude and 74°(degree)28'(minutes)07.26"(seconds) East longitude is a village situated in Kolhapur district of Maharashtra is selected. Since last decade severe case of drought is observed here, the reason mainly for water scarcity is the hard strata, which does not permit the water to percolate and as a result ground water undergoes subsurface runoff. This is the purpose behind choosing Tamadalge village as the study area. Solutions like contour trenching, check dams, construction of earthen dams, etc. are suggested for preventing runoff and providing catchment area for water conservation, depending upon the physical features of the proposed project. By sampling the water quality of soil and water can be determined for further improving the vegetative cover of the village and its surrounding areas.

Keywords: Watershed , Water scarcity, Check dams, Contour trenching

I. INTRODUCTION

Watershed is defined as a natural unit draining runoff water to a common point of outlet. While Watershed management is defined as a process of guiding and organizing land use of other resources in a watershed to provide desired goods and services without adversely affecting soil and water resources[1].
Watershed management is a proper planning and its implementation of available water for improving the given watershed area. Efficient watershed can help in mitigating various problems like soil erosion, water scarcity, flooding. Present drought conditions in Maharashtra are far worse than they were in 1972. [2] By estimating runoff and silt at the end of a watershed, different treatments for conserving soil, water vegetation can be carried out.[1] Studying a large watershed is a lengthy process, which can be made easier with the help of remote sensing data. GIS is a tool which enables us to extract data which otherwise is difficult to process.[3] Different programmes are launched by Government of India for watershed development project. All programmes have their own separate guidelines, norms, funding patterns, etc. depending upon its type. The focus of these programmes maybe different, but their objectives are same.[4] The common guidelines on Watershed Development

projects is the first set of guidelines applying to all projects across three Government of India ministries, Ministry of Rural Development (MORD), Ministry of Environment and Forest (MOEF), Ministry of Agriculture (MOA).These guidelines emphasizes on the area adopted, help of various

departments, scientific planning and monitoring using GIS, conserving resources along with livelihood, etc.[9]

II. LITERATURE REVIEW

Two types of watershed management approaches namely integrated approach and consortium approach. Integrated approach suggests the integration of technologies within the natural boundaries of a drainage area for optimum development of land, water and plant resources to meet the basic needs of people and animals in a sustainable manner. Consortium approach emphasizes on collective action and community participation including primary stakeholders, government and non-government organizations and other institutions. [6]
GIS has a wide range of applications and comes with GRASS interface and user support. GIS is a continuous time model. The ability to incorporate spatial data, manage it, analyze it and answer spatial questions is the distinctive characteristics of GIS. Forecasting hydrological variables can be accomplished in two ways, the first approach deals with the use of various tools such as GIS to obtain map sets of watersheds at macro level and the second approach is to use physical models, which require forecasted weather data i.e. temperature and precipitation in order to predict future values of the hydrological variables such as stream flow and sediment yield in a particular watershed domain.

Using QGIS 2.2.2. various parameters have been developed and discussed in relation to the watershed modeling. The application of GIS 2.2.2. is explained with DEM model of Aurangabad District. [7]

A case study of Madgyal village using QGIS. Data collection including socio-economic survey to determine problems faced in the village and using other GIS based softwares like ILWIS and Bhuvan. By conducting proper study and analysis providing solutions for the proposed area. [1]
Hydrological studies and water resources planning for Varahandi basin in Tamilnadu using QGIS 2.6 open source technology. By this project importance of geo informatics and its application in civil engineering can be understood. [3]
Here integrated watershed management approach is considered. Issues for considering watershed management for the development and protection of countries like Ethiopia where soil erosion and sedimentation are major issues. [8]

III. PROBLEMS FACED IN TAMADALGE VILLAGE

1. Low rainfall every year i.e. average rainfall (between 2007-2016) is 527.575mm.
2. Common drought conditions every year, but severe drought faced during summer season in 2005, 2007, 2012. Water was supplied for drinking by tankers during these years every alternate day.
3. Mainly small marginal farmers, shifting from fulltime farming to other alternatives, like “Ropvatika”.
4. The depth for groundwater is 300-400ft, so while digging a new well, a the well have to be excavated upto a

great depth and still the chances of getting water are quite low.

5. No large water bodies like rivers or lakes are located nearby the village.
6. Undulating topography- hilly regions in northern direction and flat surfaces on southern regions which makes farming difficult.
7. The topography encourages soil erosion as it is uneven therefore the land is degraded.

IV. DATA COLLECTION

Table no:1 Population Data:

Sr.No.	Particulars	Population
1.	Families	396
2.	Population	2002
3.	Male	829
4.	Female	750
5.	Children	423
6.	SC/ST	187 (9.34%)
7.	NT	061 (3.04%)

Table no:2 Cattle Data:

Sr.No.	Animals	Population
1.	Cow	191
2.	Buffaloes	443
3.	Goats	147
4.	Sheep	059
5.	Hens	186

Table no:3 Crop Data:

Sr. No.	Crops	Area (in ha)
1.	Cereals	05
2.	Pulses	20
3.	Oil seeds	65
4.	Sugarcane	81
5.	Spices	08
6.	Vegetables	23
7.	Flowers	02
8.	Fruits	09
9.	Cattle feed	92

Area details of the village:

Geographical area = 892 ha
Cultivated area = 304 ha
Green cover area =1.5 ha
Other area = 14 ha

Table no:4 Food Situation (Tons/Annum):

Sr. No.	Items	R	P	Surplus\ Deficit
1.	Cereals	238	130	-108
2.	Fruits	73	45	- 28
3.	Milk	146	463	+317
4.	Sugar	22	40	-18
5.	Pulses and Nuts	73	51	-22
6.	Leafy Vegetables	73	25	-48
7.	Vegetables	73	20	-53
8.	Meat	73	47	-26
9.	Eggs (lakhs in no.)	0.7	0.2	-0.5

R= Requirements, P=Production
All essential items except Milk are in short supply.

Sample Calculation for Food Situation

Food requirement (surplus/ deficit)
= (population * consumption * days)

tons

$$\text{Cereals} = \frac{(2002 * 325 * 365)}{10,00,000}$$

Sampling :

Water:

For determining the quality of water available in Tamadalge village, water samples are collected from different water bodies. The water samples are collected from four different wells and a lake (Pazar Talav), then the quality of water samples collected is determined. The parameters tested for water are as follows

Table no:5 For Water-Drinking

Sr. No.	Parameter	W1	W2	W3	W4	Limit
1.	pH	7.70	7.90	7.70	7.85	6.5-8.5
2.	TDS (ppm)	268	275	240	260	Max.500
3.	Total Hardness (ppm as $CaCO_3$)	240	223	198	210	Max.200
4.	Ca Hardness (ppm as $CaCO_3$)	136	104	112	115	Max.75
5.	Mg Hardness (ppm as $CaCO_3$)	104	111	86	95	Max.30
6.	Total Alkalinity (ppm as $CaCO_3$)	228	163	172	210	Max.200
7.	Chloride (ppm as Cl)	17	15	22	6	Max.250

The analysis result shows that Hardness and total alkalinity parameters are exceeding the limits.

W1:WELL 1, W2: WELL 2, W3: WELL 3, W4: WELL 4

Table no:6 For Water- Irrigation

Sr. No.	Parameters	Unit	Result	Limit
1.	pH	-	8.18	6.5-7.5
2.	EC	dS/m	0.60	0.2-1.0
3.	Calcium as Ca	ppm	56	100
4.	Magnesium as Mg	ppm	18	30
5.	Sodium as Na	ppm	44	35
6.	Bicarbonates as HCO_3	ppm	210	305
7.	Carbonates as CO_3	ppm	nil	Nil
8.	Chlorides as Cl	ppm	55	178
9.	SAR	meq/lit	1.24	<10
10.	RSC	meq/lit	nil	<1.25

The analysis result shows that pH and Sodium parameters are exceeding the limits.

Soil analysis:
Sampling of two types of soil is carried out. Non fertile soil (barren land) and fertile soil (farm soil)

Table no:7 Soil analysis

Sr. No.	Parameter	Unit	Non Fertile	Fertile	Limit
1.	pH	-	8.30	8.35	6.5-7.5
2.	EC	dS/m	0.33	0.43	<1
3.	Organic carbon	%	0.88	1.33	1.1-3.0
4.	Nitrogen	ppm	98	1.33	181-200
5.	Phosphorus	ppm	41	39	51-75
6.	Potassium	ppm	297	195	450-600
7.	Calcium	ppm	7680	7920	1000-1500
8.	Magnesium	ppm	1264	1410	500-750
9.	Sulphur	ppm	6	14	21-50
10.	Ferrous	ppm	7	10	3.1-5.0
11.	Manganese	ppm	25	18	0.6-1.0
12.	Zinc	ppm	8	9	1.0-1.5
13.	Copper	ppm	6	6	0.3-0.5
14.	Boron	ppm	0.11	0.21	0-0.5
15.	Molybdenum	ppm	0.012	0.01	0-0.5
16.	Sodium	ppm	151	184	0-350
17	Chloride	pp	142	142	<35
.		m			0

The analysis result shows that
1. pH, Calcium, Magnesium, Ferrous, Manganese, Zinc, Copper are exceeding the limits in fertile soil.
2. pH, Calcium, Magnesium, Ferrous, Zink, Copper are exceeding the limits in non fertile soil.

V. METHODOLOGY

A.EXTRACTION OF VARIOUS MAPS USING GIS

1.Toposheet :
Toposheet referred for the study area is "NE 43-14, Series U502". This Toposheet series U502, Edition 1-AMS was prepared by the Army Map Service (GURC), Corps of Engineers, U.S. Army, Washington D.C. which was compiled in 1954 from-: One-inch series, 1:63360, Survey of India, 1983-1947 ; One-inch series, 1:63360, Directorate of Military Survey, 1886-1940.

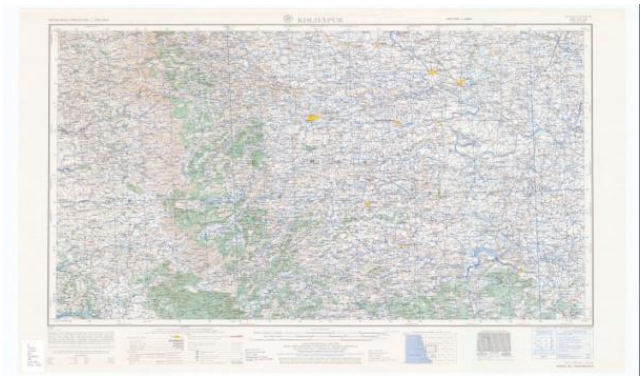

Figure 1: Toposheet

2.DIGITAL ELEVATION MODEL (DEM) :
20 Meter DEM contains elevation values at approximately 20 Meters of intervals.

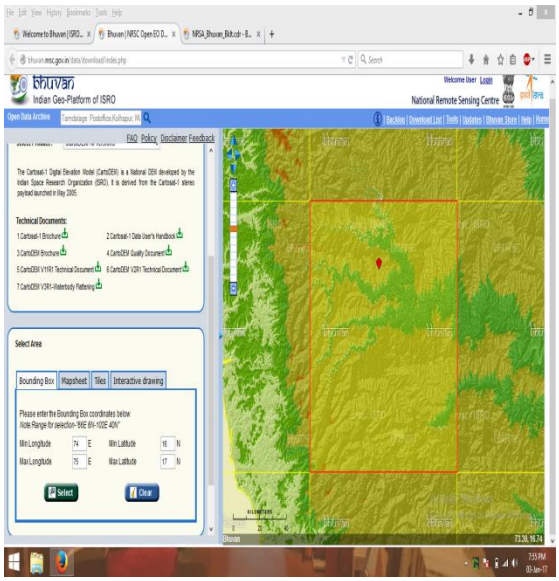

Figure 2: DEM

3. VILLAGE BOUNDARY:

Step 1.1-: Drawing polygon as shown in figure below and saving shape file of village boundary in ".shp" and ".kml" (Keyhole Markup Language) formats.

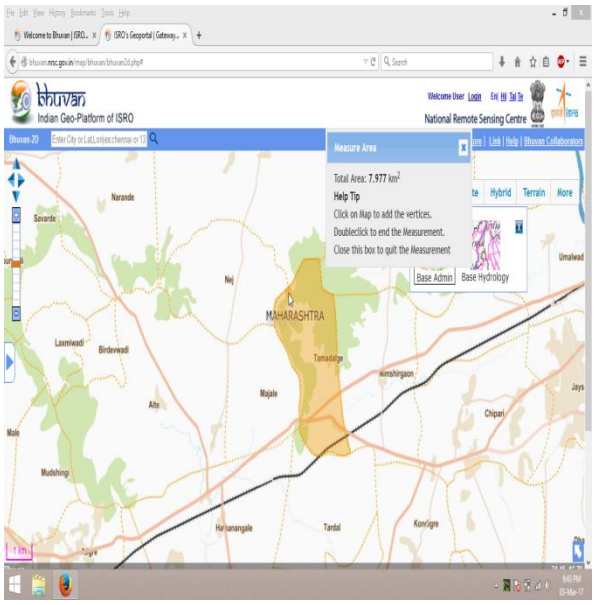

Figure 3: Village Boundary

Step 2,2-: Importing the village boundary into Google Earth by opening the ".kml" format file.

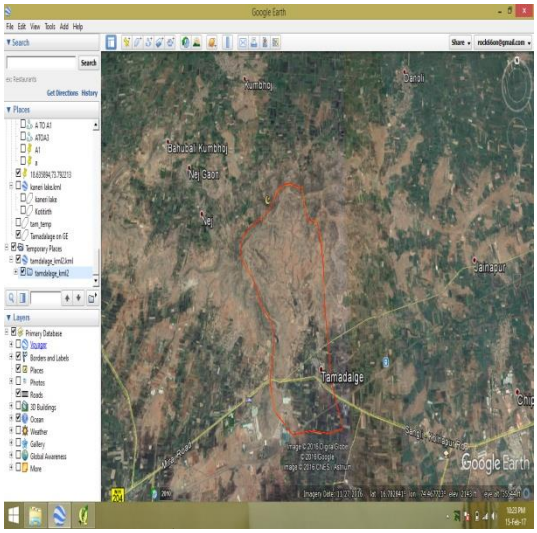

Figure 4: Village Boundary**(**".kml" format)

4.CONTOUR (20 METER AND 1 METER INTERVAL):

a) Contour having 20 Meter interval

From 20 Meter DEM imagery, the most accurate contours that can be derived are of 20 Meter Interval. This contour has been derived in QGIS 2.2.0 by clipping Village boundary and DEM raster.

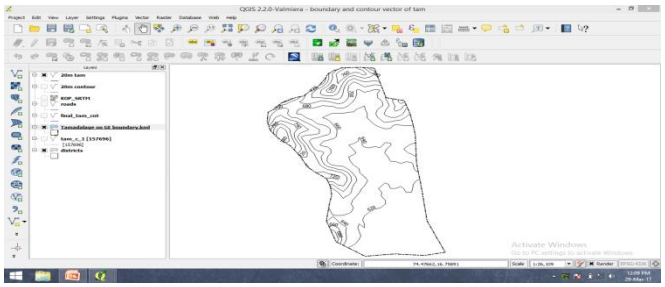

Figure 5:Contour **(**with 20 Meter interval)

b) Contour with 1 Meter interval
Using QGIS 2.2.0, contour of 1 meter interval was derived from 20 meter DEM by reducing contour interval from 20 to 1 meter during clipping of raster layer.

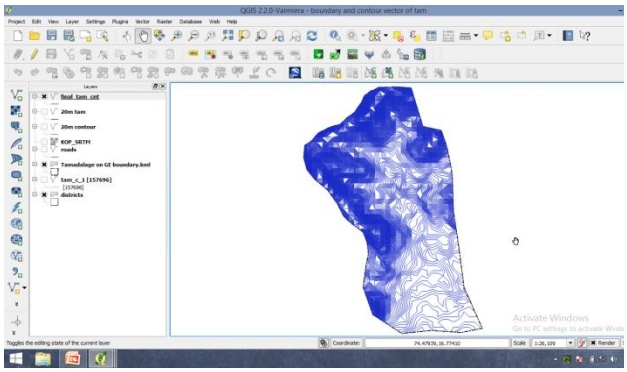

Figure 6:Contour**(**with 1 Meter interval)

5. DELINEATED WATERSHED :
Location of the catchment in the village is shown in the following figures for 2011 and 2016. On the left side, entire village terrain image is given; while on the right side, the watershed catchment is denoted. These images have been taken from Digital Globe Imagery which are available on the Google Earth.

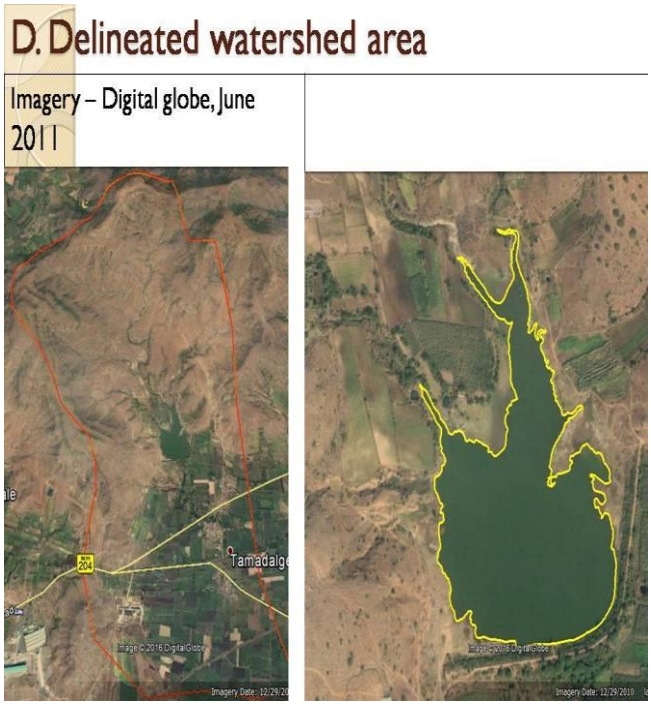

Figure 7: Delineated watershed

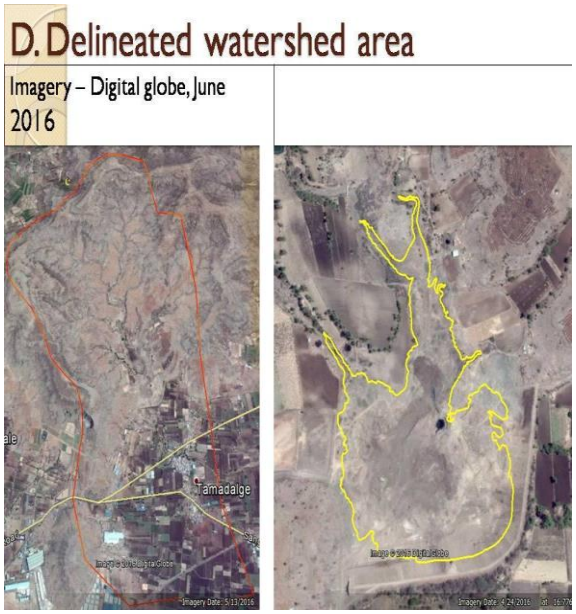

Figure 8: Delineated watershed

6.GEOMORPHOLOGICAL MAP:

It is important to study geological features of proposed area as it gives better understanding of topography of given terrain. From the map given below it can be analysed that the village Tamadalge falls under Denulation origin-Pediment Pedi Plain Complex i.e. typically slopes down from the base enscrapment, but may continue to exist after the mountain is eroded.

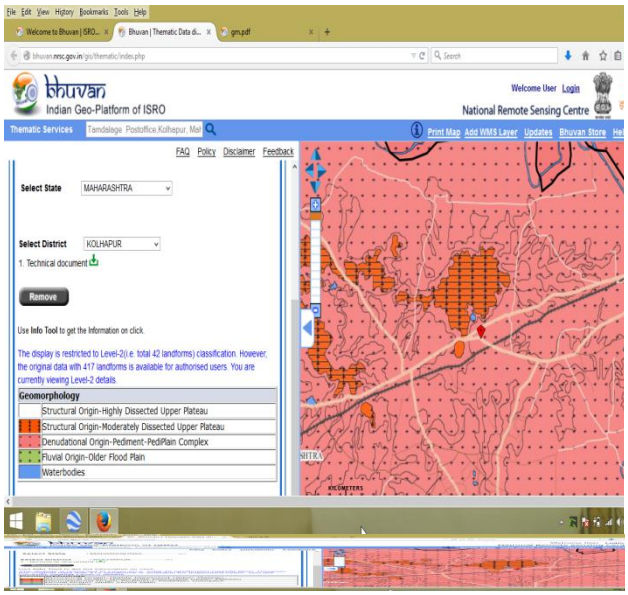

Figure 9: Geomorphological map

B. CATCHMENT AREA FOR CONSTRUCTION OF RESERVOIR

The catchment area that is decided is taken by selecting contour with Reduced Level (R.L.) of 631 meters as shown in figure. This area is chosen by considering the accumulation of various stream flows coming from higher altitudes towards the catchment basin.

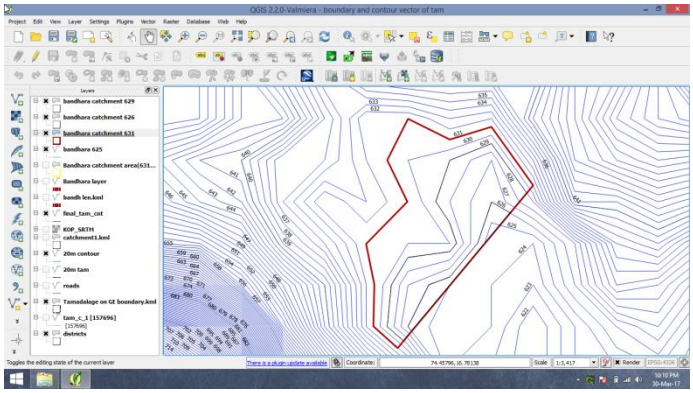

Figure 10: Geomorphological map

Calculating area and volume of selected catchment:-

Method 1:

Sr. No.	Sub catchment name	Area Sq. meters
1.	Catchment with R.L. 631	101000
2.	Catchment with R.L. 629	7326.91
3.	Catchment with R.L. 626	4972

Avg. of sub-catchment areas x Height of reservoir

Average of Areas of Sub Catchments
= (101000+7326.91+4972)/3
= 37766.30 Square Meter

Thus, Volume of Catchment
= 37766.30 X Height Of Dam (5 Meter)
=188831.5 Cubic Meter
=188.8315 Million Liters

Method 2:

Considering volume of sub-catchment having R.L. equal to avg. of highest and lowest R.L.

Average of Highest and Lowest R.L
= (631+625)/2
= 628 Meter

Thus, sub catchment with R.L. 628 m is taken.

Area of this sub catchment = 34800 sq. m.

Thus, volume of catchment
= 34800 x 5
= 17400 Cubic meter = 174 Million liters

C. CONSTRUCTION OF EARTHEN DAM WITH SPILLWAYS

Once the catchment area is decided, it is necessary to propose a construction suitable type of reservoir for storing rain water in the area. Thus, considering the socio-economical factors, it would be appropriate to construct a simple earthen dam with spillways (in case of overflows in monsoon). Dams having height above foundation lesser than 30 meters are considered as 'Very Low Dams'-(Irrigation and Water Power Engineering, B. C. Punmia)

Table no 8 Specifications for proposed work of dam:

1.	Upstream and downstream side slopes	1.5:1
2.	Crest width	3 meters
3.	Base	20 meters
4.	Height of dam	5 meters
5.	Total length of dam	615 meters

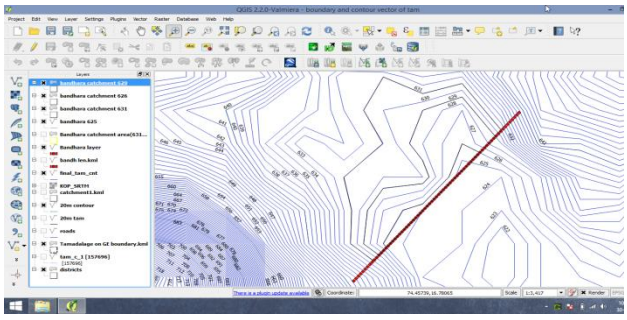

Figure 11: Location for earthen dams:

Costing of Earthen Dam with Spillways

Cost of earthen dam per meter is "12500/-"(approximately)
Thus, for total length of 615 meters,
= 615 x 12500= 7687500/- Rs (approximately)

D. CONSTRUCTION OF CHECK DAMS

A rock fill wire mesh type dam is an embankment which uses variable sizes of rocks to provide stability and an impervious membrane to provide water tightnessIt is necessary to provide such check dams in order to resist the sediments that are carried by streams from higher elevations to lower elevation.

1. Costing of Check Dams

Material requirements:
Stone= 850 Rs./ Brass
Steel (for wire mesh) = 50 Rs./Kg
For 10ft x 3ft x2.5ft check dam, cost is 7000 Rupees per unit.
Thus, total cost of check dams= 13x 7000 =Rs. 91000

2. Locations of check dams provided in study area

In figure, it can be seen that there are checks provided for 4 major streams (or say, branches) of watershed.

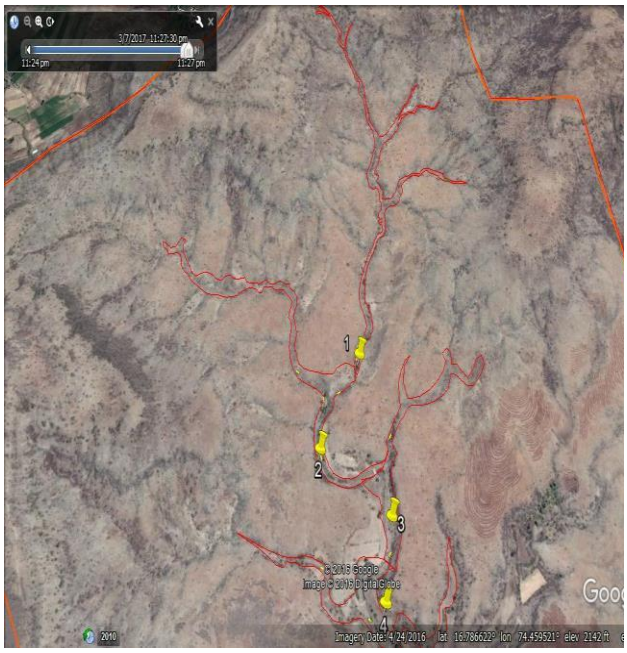

Figure 12: Locations of check dams

VI. CONCLUSION

A. Moisture Control-

The average annual rainfall is low for village Tamadalge =527.575mm.
Therefore, stream water diversion is an economical means of improving moisture.
By construction of Bandhara at suitable height and location the rainwater can be harvested.
The cost for construction of Bandhara =76,87,500/-

B. Water checks-

The chief means of checking the rainwater velocity is by water checks. They are known as check dams. But the suffixing word is confusing. Consequently, complicated and costly structures are designed. Hence the term water checks which check the velocity of rainwater in streams, and sometimes stores water incidentally.

The cost of construction of Check dams =91,000/-

C. Food requirement-

From the surplus/deficit estimation, it can be said that only milk production is in surplus whereas all other components fall short to fulfill the requirement of the population, i.e. cereals, pulses, vegetables, etc.

D. Land Use-

By conserving water at Bandhara and check dams, ground water will recharge and green cover will increase therefore the water scarcity is reduced.

E. Vegetation cover-

The vegetation cover is increased as the soil erosion is reduced thereby improving the nutrient quality of soil and therefore increasing the fertility of soil.

F. Sampling results-

It is clear from the sampling results that no unusual properties are found in either water or soil, so by proper maintenance the fertility of soil and water quality can be enhanced.

G. Economic Elevation-

The economic condition of the farmers will increase and improve as a result of increased vegetation cover.

ACKNOWLEDGEMENT

This research was supported by [KIT's College of Engineering, Kolhapur]. We thank our colleagues [Shruti Patil, Riddhi Sanane, Shweta Nair,Prachi Pradnyawant]who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations or conclusions of this paper.

We would also like to show our gratitude to the (Pramod Jadhav,Assistant Professor,KIT's college of engineering, Kolhapur and Sandeep Patil, Assistant Professor, KIT's college of engineering) for sharing their pearls of wisdom with us during the course of this research, although any errors are our own and should not tarnish the reputations of these esteemed persons.

REFERENCES

[1] S.P. Suryawanshi, Abhijeet Kamble (2012)" Watershed Management In India", Proceeding of International Conference SWRDM

[2] Pandurang D. Jankar, Dr.Mrs Sushma S . Kulkarni (2013) "A Case Study Of Watershed Management For Madgyal Village" International Journal Of Advanced Engineering research and Studies E-ISSN2249-8974 Pp 69-72

[3] Viswanathan K E, Manikandan M, Bharanitharan S (2015) "Watershed Delineation For Varahanadhi Basin Using Opensource Geospatial Technology", IJRSI Volume II, Issue VI, ISSN 2321-2705

[4]Guidelines For watershed Development Programme (IWDP)

[5]Government Of India (2008) "Common Guidelines For Watershed Development Projects"

[6] Dr. (Mrs.) Hansa Shukla (2015) "Watershed Management: Its Role In Environmental Planning And Management" IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399. Volume. 1 Issue 5, PP 08-11

[7]Abhishek P Sinh, D.G. Regulwar (2015) "Watershed Technologies In Civil Engineering" International Journal Of Pure And Applied Research In Engineering And Technology, Volume 3 (8): 287-295

[8] Yericho Berhanu Meshesha, Belay Simane Birhanu (2015) "Assessment of the Effectiveness of Watershed Management Intervention in Chena Woreda, Kaffa Zone, Southwestern Ethiopia" Journal of Water Resource and Protection, 7, 1257-1269

[9](2008) "Common Guidelines For Watershed Development: Some Reflection", Economic And Political Weekly, Volume 43, No. 23, pp. 18-20

[10]A.K. Gosain, Sandhya Rao (2004), "GIS- Based Technologies For Watershed Management", Current Science, Vol. 87, No. 7

[11]J.V.S. Murty, Watershed Management, edition 2007

[12] B.C. Punmia ,Irrigation and Water Power Engineering, , edition 2007