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STUDY ON SUSTAINABLE PLANNING, DESIGN AND MANAGEMENT OF MICRO-WATERSHED FOR BASAVANA BAGEWADI TALUKA OF VIJAYAPUR DISTRICT

Nagraj S. Patil [1], Basavaraj B. Hosamani[2], Nataraja M.[3], Nagendra[3]

[1](Associate Professor, Dept. of Water & Land Management, VTU, Belagavi, Karnataka, India)

[2, 3](Dept. of Water & Land Management, VTU, Belagavi, Karnataka, India)

Abstract:

The water supply system is very important aspect on a global level, which is used for supply of water for various useful purposes and without which life seems to be very difficult to be sustained. Hence the supply of pure water has been a major concern from years and is still developing. Recent developments involve the use of software's for simulating the hydraulic and water quality. Basavana Bagewadi Taluk of Vijayapur district has number of village tanks that to go dry frequently due to scanty rainfall and on many occasions even drinking water is scarce in summer. In order to take care of this extreme drought situation and to provide drinking water facility to the population of villages and to enable assured irrigation, fishery development it is proposed to pump water from Krishna River during a monsoon month to fill a 10 tanks in this area this will help to recharge ground water table in the region by the use of hydrological model i.e., SWAT. This approach significantly saves time and cost and is able not only to determine the suitable locations, but also to determine the best region for construction of rainwater harvesting structures.

Keywords — **Water Supply System, Hydrological Model, Rainwater Harvesting Structures.**

I. INTRODUCTION

Water is the vital natural resource essential for the survival of mankind. Rainfall is the main source of water which is unevenly distributed spatially and temporally. This makes the management of water resources (assessing, planning and managing of water resources for sustainable use) a complex task. It has become more critical in places where rainfall is very low and uneven. Water and land are the two main resources which need preservation, control and maintenance through improved engineering practices. Management and conservation of water resources require hydrological investigations related to storage capacity of reservoirs, flood magnitude and its frequency of occurrence, peak runoff and seasonal variation in stream discharge. High intensity of runoff is the main cause of soil erosion in humid areas which causes floods and siltation of rivers and reservoirs. Keeping in view that the water and land resources need to be managed in an integrated and comprehensive manner. In this paper we proposed a design and plan to supply a water to the Basvana Bagewadi taluk through a gravity flow to fill 10 tanks in the surrounding villages, to increase the groundwater table in the villages and to propose best suitable site for rainwater harvesting.

II. MATERIALS AND METHODOLOGY

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A. *Study Area*

The Basavana Bagewadi Taluka of Vijayapur district is selected as a study area shown in figure 1. The study area geographically lies between 75̊ 47' 30" and 75̊ 58' 00" E Longitude and 16̊ 20' 30" and 16̊ 34' 30" N latitude, the watershed area geographically covers about 52.59 Sq. km and is covered in Survey of India (SOI) Topo sheet numbers 47 P/15 47 P/14 AND 47 P/5 on 1:50000 scale. The main water source is Krishna River. Krishna river rises at Mahabaleswar near the Jor village in the Wai Taluka, Satara District, Maharashtra in the west and meets the Bay of Bengal at Hamasaladeevi in Andhra Pradesh, on the east coast. The maximum length and width of micro watershed area is about 3.00 km to 5.20 km respectively. The basin is home to some 74.2 million inhabitants. The population density is 287 in h/km² with people concentrated in the irrigated areas and metropolitan urban centers. The lowest densities are recorded in the southwest and center of the basin in Karnataka.

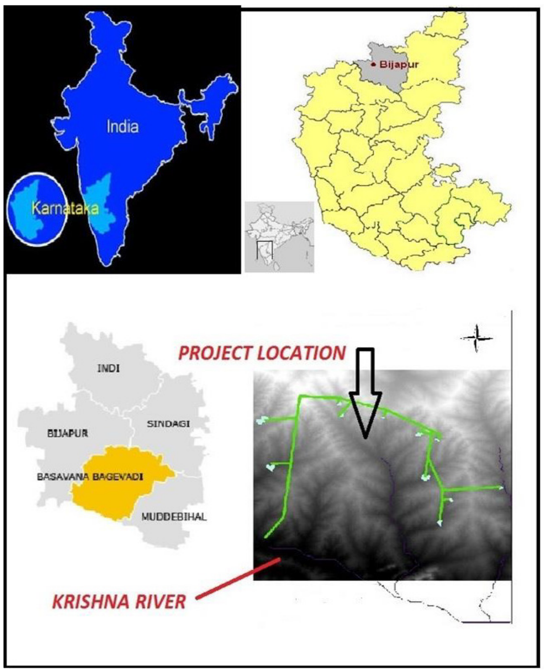

Fig. 1: Location of study area

B. Data and its Sources

The Various data required for the study were collected from different sources which are shown in table 1.

TABLE 1: Data and its Sources

Sl. No.	Data	Sources
1.	Toposheets (1:50000 scale)	Survey of India
2.	Digital Elevation Model	Cartosat - I Ver. 3R1
3.	Land use land cover	Global Land cover facility
4.	Soil map (1:250000)	National Bureau of Soil Survey and land use Planning (NBSS & LUP) 1995, and Karnataka State Remote Sensing Application Centre (KSRAC) of 1:50000
5.	Rainfall	Statistical Department, Belagavi

The following fig. 2 shows the flowchart methodology i) To Prepare thematic maps using SOI Topo maps and remotely sensed data; and ii) Creation of digital database using ArcGIS software.

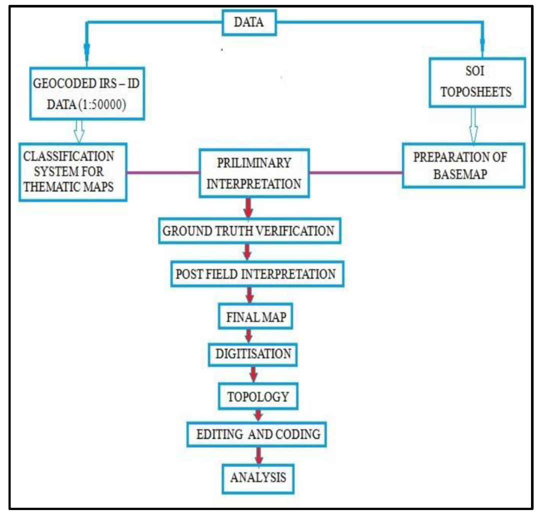

Fig. 2: Methodology for preparation of thematic maps

C. Preparation of Thematic maps

In order to know the different natural resources, terrain conditions, etc. in the study area, different thematic maps are prepared. The preparation of different thematic maps follows the “Integrated Mission for Sustainable Development “(NRSA, 1995) Technical Guidelines, NRSA, Hyderabad. The thematic maps are prepared using Arc GIS 10.1 software,

i) Base map shown in fig. 1 created using SOI Topo sheets, ii) Drainage map using DEM data which is 32m resolution shown in figure 4, iii) Land use/ land cover Map shown in figure 5, iv) Soil map in figure 6, figure 7 shows the proposed tanks for waters supply and recharge of groundwater v) Slope map in figure 8 vi) Micro-Watershed map in fig.9.

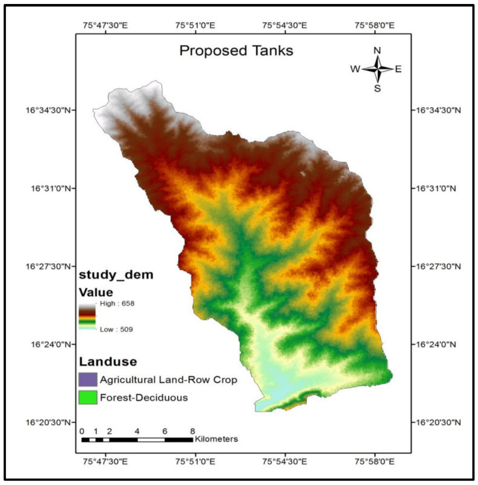

Fig. 3: DEM map of the B. Bagewadi watershed

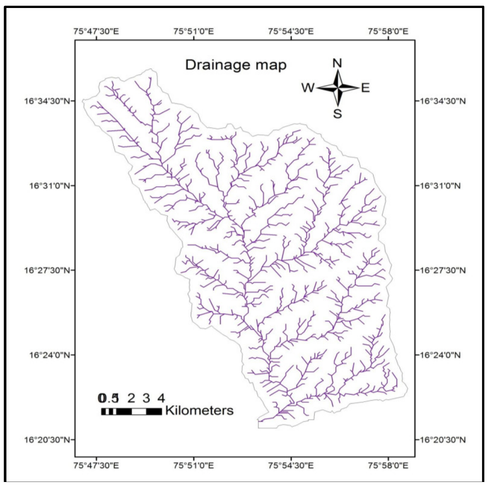

Fig. 4: Drainage map of the B. Bagewadi watershed

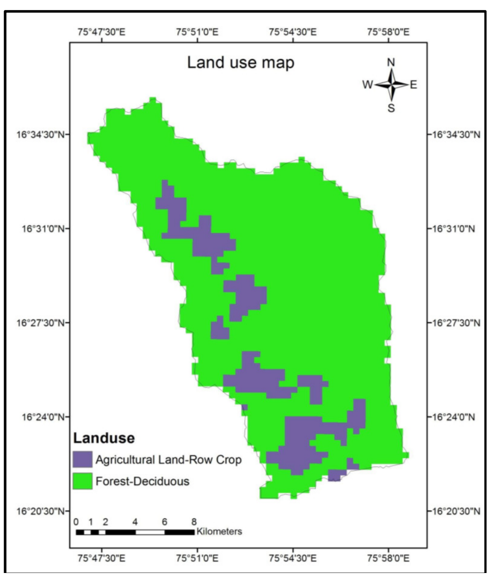

Fig. 5: Land use Land cover map of the B. Bagewadi watershed

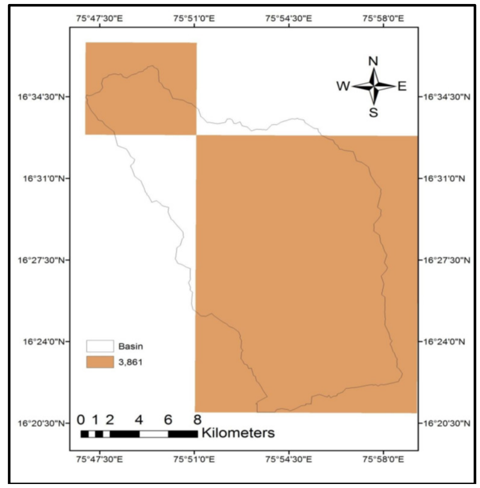

Fig. 6: Soil map of the B. Bagewadi watershed

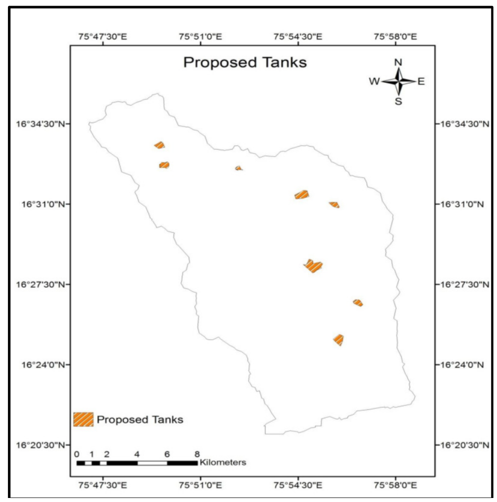

Fig.7: Village Tanks of the B. Bagewadi watershed

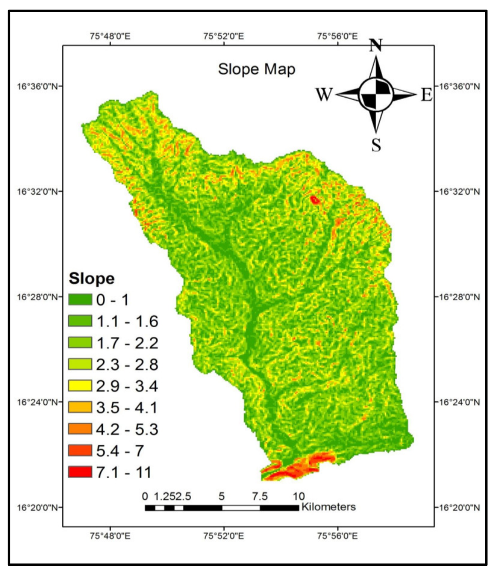

Fig. 8: Slope map of the B. Bagewadi watershed

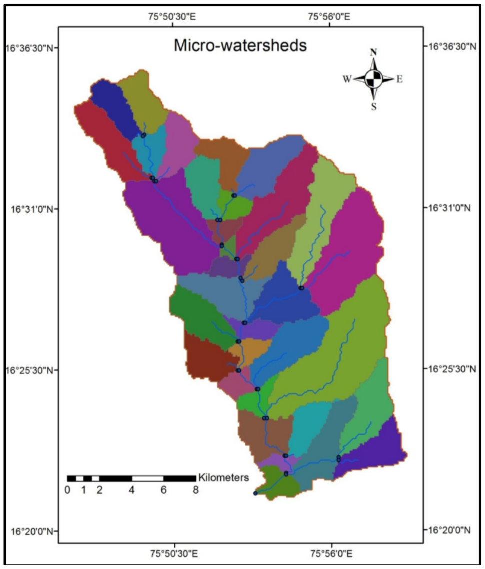

Fig. 9: Micro watershed map of B.Bagewadi catchment

d. ***Results and Discussion***

Design of Water Supply System

The proposed location of head works is on Krishna river left bank shown in figure 12. The rising main, feeder canals to supply water to the tanks from outlets and delivery chamber were marked on the maps by considering the high flood level of the river and the topography of the land and ground levels. Alternate alignment of the rising main of location of lift head works consisting of intake structure jack-well and pump house where also studied on the topo-maps. In order to compute the quantity of water to be lifted for supplying to the tanks 75% of their capacity is considered. To this 20% is added to take care of transmission loss, evaporation loss and requirement for drinking water supply.

TABLE 2: Name of tanks with storage capacity of B. Bagewadi Taluka

SL NO	Name of the tank	Gross storage capacity in Mcft	Capacity at 75% for filling (mcft)	Add 20% for evaporan tion transmission losses &drinking purpose Mcft (#)	Capacity in (mcum) (#*0.0283168)	Discharge in cumec for 1 filling
1	MASUTI	9.00	6.750	8.550	0.242	0.012
2	MALAGHA	20.780	15.585	19.741	0.559	0.027
3	TALEWAD	6.00	4.500	5.700	0.161	0.080
4	KUDAGI	25.050	18.788	23.798	0.674	0.032
5	MUTTAGI	5.470	4.103	5.197	0.147	0.007
6	NAGAWAD	15.200	11.400	14.440	0.409	0.019
7	MUNNAR	14.670	11.003	13.937	0.395	0.019
8	MUKARTIH	51.340	38.505	48.773	1.381	0.066
9	KIRSHAL	57.140	42.855	54.283	1.537	0.073
10	HEBBAL	7.00	5.250	6.650	0.188	0.009

This works out to 201.10 Mcft or 5.649 MCM, considering all the tanks proposed in the scheme. It is proposed to supply this quantity of water over a period of 120 days for one shift or 240 days for two fillings with the pumps working for 24 hours a day. This works out to a discharge 0.549 cum/sec.

Hence 0.549 cumces have to be lifted. For this purpose, one V.T pump of 1577 HP capacity has to be installed. One more pump of the same capacity is proposed as stand by. The raising main for the pumping will be 850mm dia PSC pipe of 35mm thick for length of 12800Km, 800mm dia PSC pipe of 35mm thick for a length of 6400m, length upto DC. The bleeder lines are connected to the feeder line with the control valves. These valves are operated to maintain the required discharge flow in the tanks. At the end of the bleeder one structure is named stilling basins are constructed to control the erosion. The delivery chamber is designed for suitable capacity with detention period of 180 seconds. The gravity pipes connected to DC with control valves. Table 2 shows list of proposed tanks in B. Bagewadi taluka.

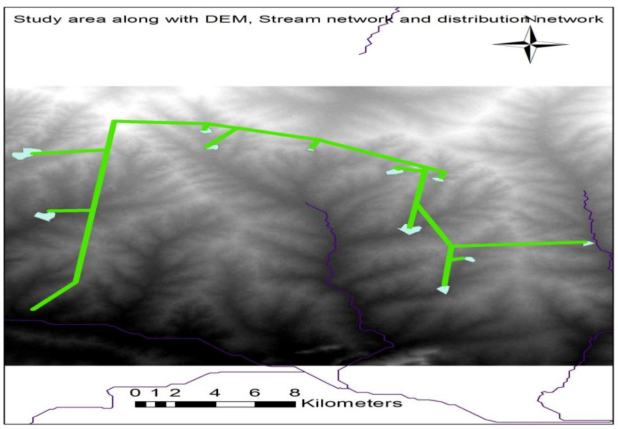

Fig. 10: Location map of tanks

Rain Water Harvesting

In this study rainwater harvesting structures were proposed in the catchment of B. Bagewadi taluka based on the geology and necessity of such structures as explained. Hydro geologically, the area forms the part of the hard rock and most part covers black cotton soil. The topographical conditions lead high runoff. Adopting watershed treatment is good option in augmenting the natural recharge due to the uneven topography, there will be more soil erosion. The villages located in the areas facing drinking water scarcity and the village tanks frequently drying due to uneven rainfall. Such an attempt to recharge the ground water is made in the catchment by applying principles of rain water harvesting. Fig.10 shows the methodology adopted for rain water harvesting.

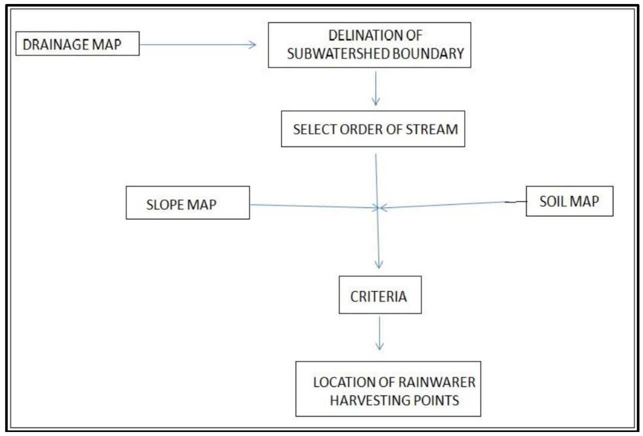

Fig. 11: Methodology for suggesting the RWH structures

TABLE 3: Weights assigned to different soil textures

Soil texture	Weights
Clay	1
Sandy clay loam, clay loam	2
Shallow weathered pediplain	3
Moderately weathered pediplain	4
Sandy clay	5

TABLE 4: Weights assigned to different class of slope

Different class of slopes	Weights
0-1 %	1
1-3 %	2
3-5 %	3
Above 5 %	4

The rainwater has to be captured and made to infiltrate at the place where it falls and should not be allowed to generate runoff. But, this cannot be done at all places due to variation in soil type, geomorphology and slope etc. RS and GIS are very much helpful in identifying areas which are suitable for RWH. Different soil types have different infiltration capacity. Based on their infiltration weights are assigned to different types of soil texture (refer table 3).

Slope is very important for land capability assessment. Slope map is useful for selection of RWH structures and soil erosion treatment for the watershed management. The slope in the watershed is the indicative of intensity of runoff. Runoff increases with increases in slope and vice versa. Hence weights are assigned to different classes of slope (refer table 4). These weights are signifying the suitability of various land forms for RWH structures. Soil type, hydro geomorphology and the slope are the main criteria involved in identifying suitable areas of recharge. Then the suitability indices are calculated for each polygon and regions with higher suitability are identified. The existing water bodies from topo maps are identified and are not considered for constructing RWH structures. The areas identified from the topographic maps are updated with recent satellite data. These are identified as the best suited areas for RWH show in figure 11. Figure 11 shows the location of proposed RWH structures recommended based on the available natural resources within catchment. The RWH structures, such as gully plugs, nala bunds and check dams are suggested for conservation of natural resources and also to arrest the sediment entering in to the Krishna reservoir.

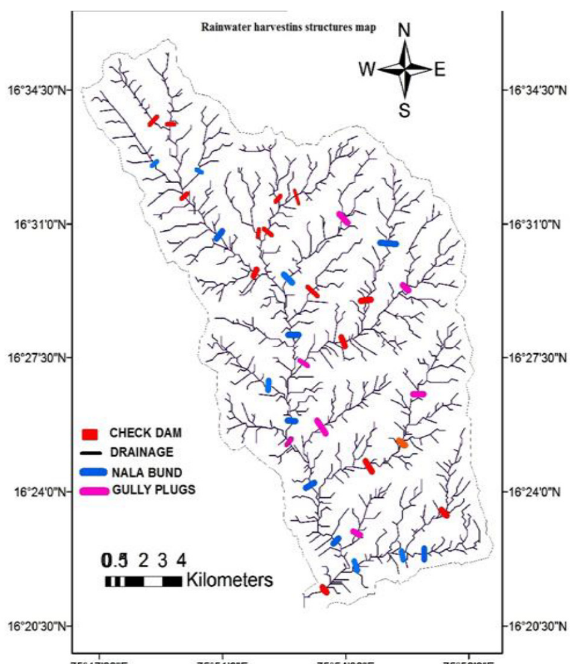

Fig. 12: Location of different rainwater harvesting structures

III. CONCLUSION

The proposed project envisages several irrigation benefits through construction of irrigation and settlement projects for conservation, diversion and distribution of water under gravity and lift irrigation to new and existing lands for cultivation by farmers for food crop production. When the ground water potential is low and is available at greater depths. Hence it is very much essential to explore alternate source of water to fill up the tanks. To stabilize irrigation activity and ensure drinking water supply to the people and cattle of the region. Since the schemes involves drinking water supply it has to be taken up on top priority which is in live with the policy of both central and state governments. Emerging tools like GIS and remote sensing can be successfully utilized for deriving the Existing water bodies and drainage patterns. Such information which is generally not collected and maintained in any organized fashion in the conventional mechanisms is very useful for developing performance indicators of irrigation system. Remote sensing and Geographic Information Systems can help in the determination of areas suitable for rain water harvesting. At the same time, on a much broader geographic scale, remote sensing and GIS technologies are being applied to assess and select suitable areas for large-scale water harvesting applications within selected area.

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