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Identification of Water Conservation Zone By Application Of Electrical Resistivity Method In Parts of Osmanabad District, Maharashtra-India

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ABSTRACT - *Osmanabad district as a whole is facing draught conditions for several decades. The northern region of Osmanabad city has high elevated land, but the villages like Alni, Kumalwadi, Sonegaon, Bhanasgaon, Gad Devdari, and Jahagirdarwadi is facing water scarcity. In the last few decades, the water demand and the availability of resources have been studied in detail for the present study area. The water-retaining structures constructed in the region are also analyzed for their suitability test, and validation of the region or location has been made during the studies. The initially constructed structures in this area are about 7 in number. But the suitability test has shown contradicting results. Knowing the availability and demand ratio of the study area, a detailed analysis is carried out. The geophysical survey found favorable sites for the construction of the check dams to enhance the water management in this studied micro watershed. The conclusions of the present studies stated that the regional watershed needs to be split into mini and micro watersheds to encourage the perfect watershed management.*

Kumalwadi, the Alani region needs to have more percolation tanks, and this will enhance the low-lying regions of Sonegaon, Bhanasgaon to have more irrigated regions.

Keywords: *Water demand, Geomorphology, Geophysical, Water conservation, Watershed, etc.*

I. INTRODUCTION

Over the past 2 decades, water resources are becoming a major issue related to the development and sustainable lifestyle of human life. India has crossed the 100 crore population, and due to which the management of water to be utilized for human life development is becoming the prominent issue. To enhance and overcome these problems, the need for watershed management and to have a sustainable solution for it, a minor project was carried out for the Maharashtra region. Marathwada region faces a strong draught condition for the last 4-5 decades due to which the agriculture development and industrial development in this area has been stoped. Osmanabad region faces a seviour drought condition, the land in this area is quite encouraging for the agriculture purpose.

The northern region of Osmanabad city has high elevated land, but the villages like Alni, Kumalwadi, Sonegaon, Bhanasgaon, Gad Devdari, and Jahagirdarwadi is facing water scarcity (fig.1.1). The area falls in OSM toposheet no. E43J16. The average rainfall in these areas is about 400 mm average in a year. In the last few decades, the water demand and the availability of resources have been studied in detail for the present study area.

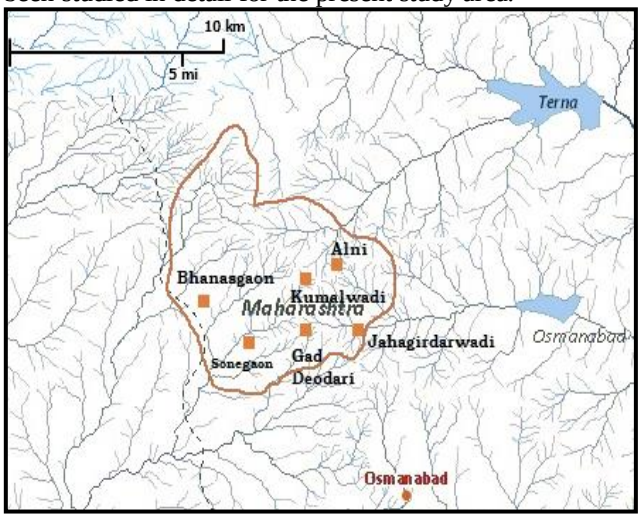

Fig. 1.1: Drainage network map of the catchment with the scale of 10 Km

II. MATERIALS & METHODS

The base of the present project was related to surveying carried by visiting the villages and geophysical field survey. The experimentation carried for the geophysical survey will help in establishing the lithological units in the study area. DDR3 is the geophysical, i.e., electrical resistivity instrument used during this study. This data will help in understanding the actual site for the construction of the hydraulic structures.

A. Geophysical Field Survey:

Water is a natural source that needs to be used appropriately, and its management is required nowadays due to overwhelming population growth, industrial growth, and degrading climatical changes. The presently selected six villages area falls in the northern Osmanabad region. Initially, the area was visited for reconnaissance survey to understand the soil type, rock type, topography, vegetation practices, etc., in the area keenly. Now the detailed geophysical survey has been initiated.

B. Experimental Investigation:

Surface geophysical surveys play a vital role in groundwater exploration. The survey can be used to conduct either shallow subsurface investigation or deeper investigations. The survey can be used to,

- To identify productive aquifers.
- To estimate the thickness of weathered zones.
- Delineate bedrock topography.
- To monitor the direction of groundwater movement.

C. Field Procedure:

When the current is supplied to the earth by two contact electrodes, and the distance between these two electrodes is increased, then the depth of penetration of the current also increases, thus by changing the distance between these electrodes, we can sound the resistivity of the subsurface at varying depths. This consideration defines the field application of the expanding spread method. It is the most important application in the search for water. The presence of water in the pore spaces of rocks and its salinity affect the resistivity of the rock. In the direct current (DC) resistivity method, the external voltage is applied at two points on the ground surface through metallic electrodes; this sets the flow of electric current from one electrode to another, between these two electrodes, the potential is measured at two points, with the help of non-polarizable electrodes. The flow of current and equipotential lines has been shown in fig. The effective depth of penetration of the current increases with the increase of the distance between the current electrodes. There are two popular electrode arrangements known as Wenner (1915) configuration and Schlumberger (1920) configuration electrode arrangements of both these configurations. In Wenner configuration, measurements of the earth's electrical resistivity are done with four equispaced co-linear electrodes.

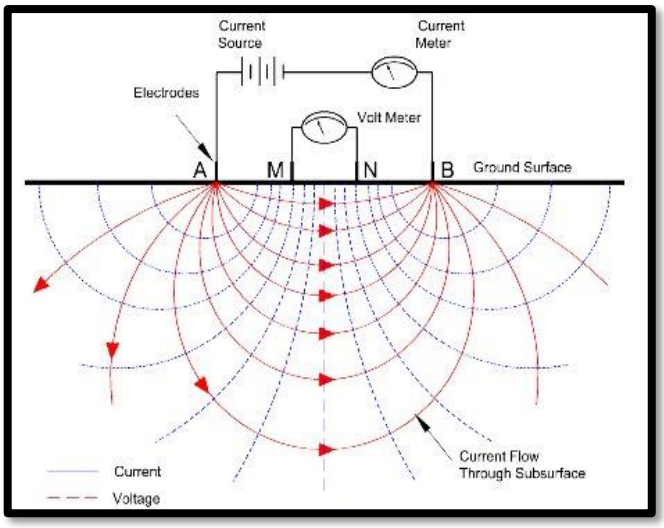

Fig. 1.2: Flow diagram of Electrical Resistivity Method.

Fig. 1.3: DDR3 electrical resistivity instrument used during this study

III. RESULTS

A. Geophysical Studies:

In Wenner configuration, measurements of the earth's electrical resistivity are done with four equispaced co-linear electrodes. Accordingly, the 6 readings are experimentally taken at each of the sites, and a single site is tabulated, and other sites' graphical representation with interpretation is elaborated below.

Table 1.1: Sample Reading of Electrical Resistivity

Name:	Tambat			**Lat.**	18°16'39.60"N		
Village	Alni			**Long.**	76° 0'26.99"E		
District:	Osmanabad			**Alt**			
Sr. No.	**(a)**	**Direct R**	**Reverse R**	**Average R**	**XΩ**	**2πaR**	**1/R**
1	5	0.16	0.15	0.155	1	4.867	6.45
2	10	0.1	0.1	0.1	1	6.28	10.00
3	15	0.09	0.08	0.085	1	8.007	11.76
4	20	0.08	0.08	0.08	1	10.048	12.50
5	25	0.08	0.08	0.08	1	12.56	12.50
6	30	0.07	0.09	0.08	1	15.072	12.50
7	35	0.08	0.08	0.08	1	17.584	12.50
8	40	0.08	0.08	0.08	1	20.096	12.50
9	45	0.08	0.07	0.075	1	21.195	13.33
10	50	0.08	0.07	0.075	1	23.55	13.33
11	55	0.08	0.07	0.075	1	25.905	13.33
12	60	0.08	0.07	0.075	1	28.26	13.33
13	65	0.08	0.07	0.075	1	30.615	13.33
14	70	0.07	0.07	0.07	1	30.772	14.29
15	75	0.07	0.07	0.07	1	32.97	14.29
16	80	0.06	0.07	0.065	1	32.656	15.38
17	85	0.06	0.07	0.065	1	34.697	15.38
18	90	0.06	0.08	0.07	1	39.564	14.29
19	95	0.07	0.06	0.065	1	38.779	15.38
20	100	0.07	0.06	0.065	1	40.82	15.38

Table 1.2: Interpretation of Litholgs

Lithology	**Thickness**
Soil &Weathered Basalt	5 m
Murum	10 m
Massive Jointed	20 m
Jointed Basalt	5 m
Massive	20 m
Fractured / Highly jointed	20 m
Massive	15 m

The varying lithological sequence gives an idea about the difference in the elevation as well as the rock types exposed in the Alni and Kumalwadi region (Graph 1).
The surficial rocks are more or less the massive jointed basaltic terrain which is permeable and due to which the surface runoff in the regions is can be conserved by constructing the CCT or maybe the water storage tanks. The conservation of water can be done till 60 m depth. Deatiled analysis of experimentation gives a lithological sequence of villages, so conservation zone suitability is decided

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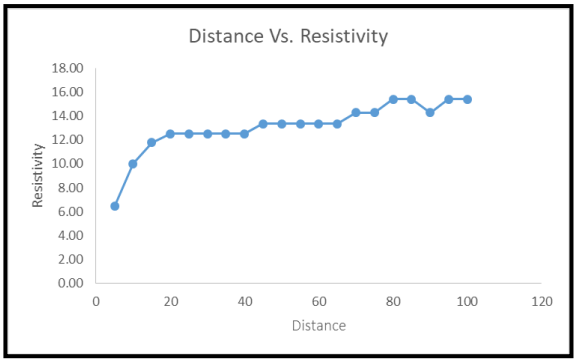
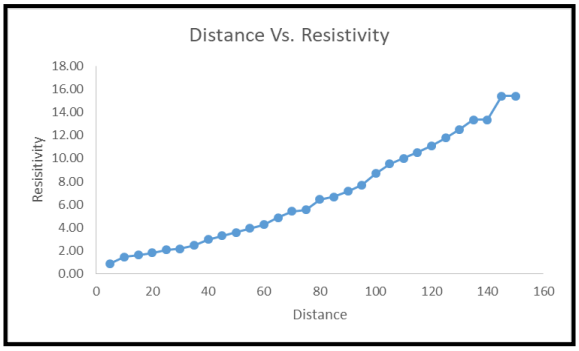
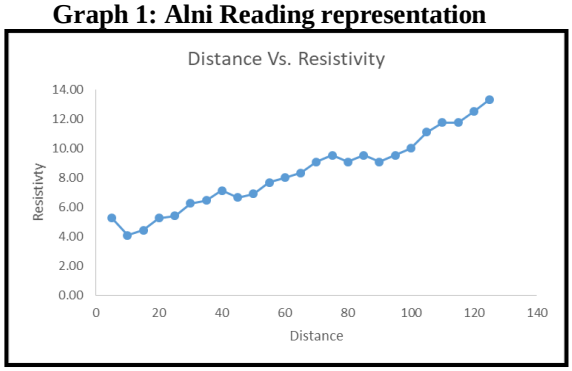


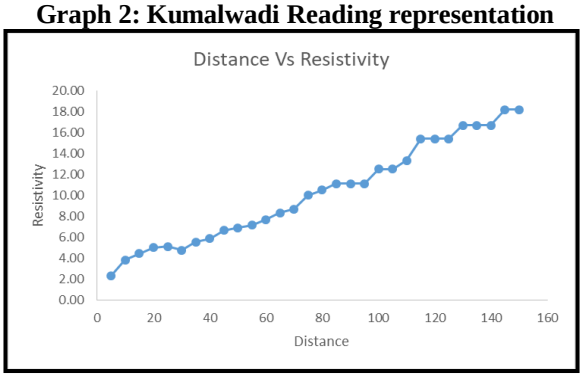
Graph 1: Alni Reading representation



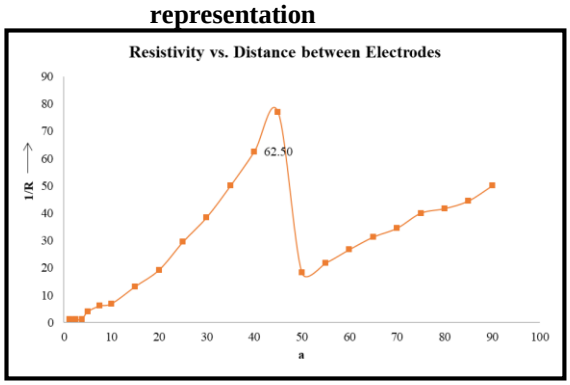
Graph 2: Kumalwadi Reading representation



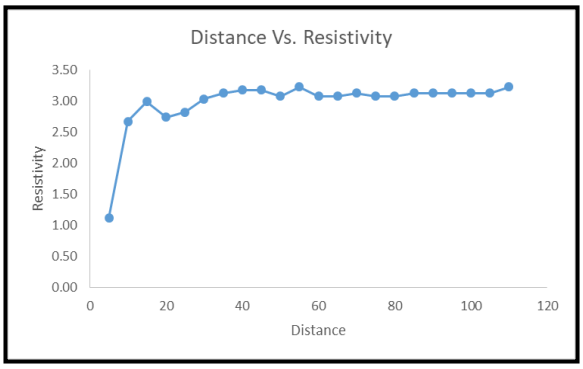
Graph 3: Jahagirdarwadi Reading representation



Graph 4: Sonegaon Reading representation



Graph 5: Gad Deodari Reading representation



Graph 6: Bhanasgaon Reading representation

B. Interpretation of Kumalwadi, Jahagirdarwadi, Sonegaon, Gad Deodari, and Bhanasgaon:

The varying lithological sequence gives an idea about the difference in the elevation as well as the rock types exposed in the Kumalwadi – Sonegaon region (Graph 2). The surficial rocks are more or less the massive jointed basaltic terrain which is non - permeable starta after 5m and due to which the surface runoff in the regions is more which cannot be conserved. The conservation of water can be done till 85 m depth which is non-economic. Hence, the sites are not suitable for water construction of water conservation. The Kumalwadi initial flows are mixed complex having weathered murum with massive strata. The First 25 m depth shows feasibility for constructing CCT, but due to massive rock at 15-17 m depth deep, CCT is expected to be constructed. While the bottom region shows a mixed complex of massive with vesicular matrix, and at a depth of 95 m, redbone occurs (Graph 3).In fissure eruption, the flows which demark are like vesicular forming to the surface, while the massive or jointed or previous strata forming at the basal of the vesicular formation. Distinctive episodes of flows are evident on the Sonegaon field (Graph 4). Due to which the region gives a piece of evidence to have major watershed management in these areas as the region is a plan plateau region. The maximum strength of depth can be achieved herewith for the conservation of water in deep-sighted regions. Occurrence of Compact Basalt and Vesicular Amygdaloidal basalt suggests the distinctive episodes of flow. This is also observed in the periphery of the hilly regions of the Gad Deodari to Sonegaon area (Graph 5). The area shows nonpervious strata after 10 – 13 m depth in the region (Graph 6). At the same time, the bottom region of it shows very mixed complex strata having massively jointed and highly massive basaltic rock, which are non-pervious in nature. Water conservation in the region is highly impossible due to elevation differences in the region the surface water flow is more.

IV. Discussion

The locations in the study area for site selection of electrical resistivity are selected on the basis of the available land surface with reference to its strike and dip directions of the lithologies. Varying lithological sequence gives an idea about the difference in the elevation as well as the rock types exposed in the Kumalwadi – Sonegaon region (Graph 2), the sites are not suitable for water construction of water conservation. The Kumalwadi initial flows are mixed complex having weathered murum with massive strata. In fissure eruption, the flows which demark are like vesicular forming to the surface, while the massive or jointed or previous strata forming at the basal of the vesicular formation. Distinctive episodes of flows are evident on the Sonegaon field (Graph 4). The occurrence of Compact Basalt and Vesicular Amygdaloidal basalt suggests the distinctive episodes of flow. This is also observed in the periphery of the hilly regions of the Gad Deodari to Sonegaon area (Graph 5). The area shows non-pervious strata after 10 – 13 m depth in the region (Graph 6). At the same time, the bottom region of it shows very mixed complex strata having massively jointed and highly massive basaltic rock, which are non-pervious in nature. Water conservation in the region is highly impossible due to elevation differences in the region the surface water flow is more. Individual prioritized maps are compiled with reference to the geomorphological and geophysical studies, and the same has been shown in fig. 1.4. The area has also been studied for the geomorphological analysis for selective area. The six order streams have been identified, and the geomorphological parameters of the study. The geomorphologic studies have revealed that the stream channels from the region have vital information to develop.

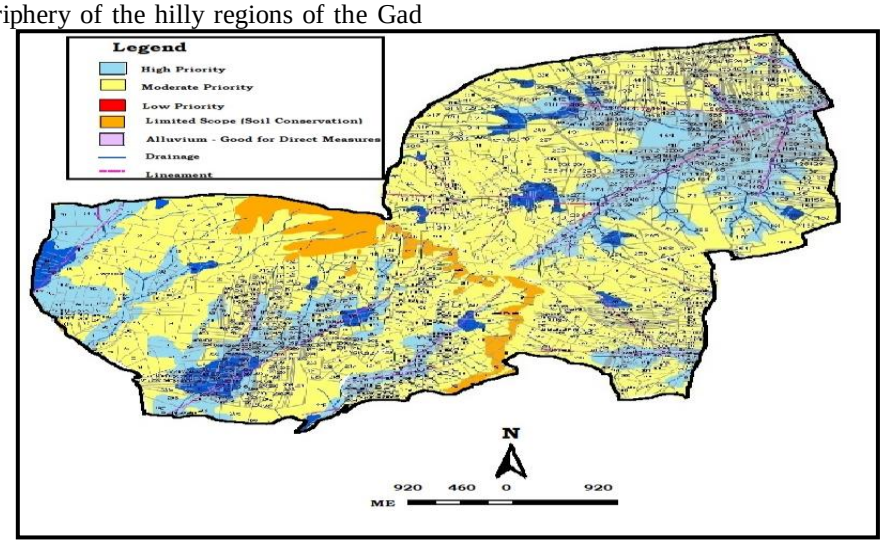


Fig.1.4: Prioritization map of watershed management of the study area.

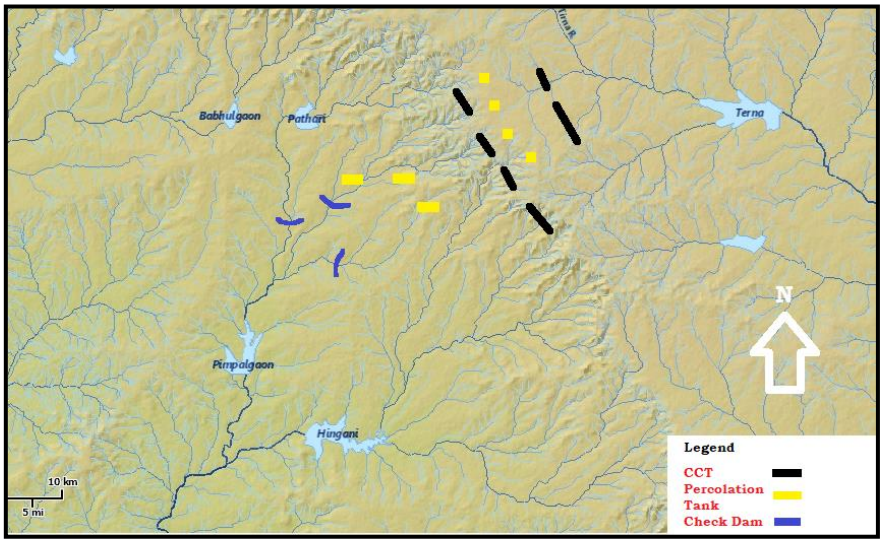


Fig. 1.5: DEM model suggesting the different treatment methods in the study area.

V. Conclusion

Each of the six village base maps has been prepared, and their prioritization of work has been decided. The implementation of the suggested remedies can fully at least 30% of the required lacking water resource in the present study area. The geomorphological studies have revealed that the stream channels from the region have vital information for watershed preservation as well as for soil conservation. Following are the conclusions of the studies:

i. Geologically the area has gone for major deformation, which is reflected by different elevations in the region with structurally disturbed rock strata.
ii. The prioritization maps of the studied area suggest that the alni, gad deodori region needs to have CCT (close contour Trenches) with varying depths for conserving the surface flowing water.
iii. The Kumalwadi and Gad Deodari region need to construct storage tanks to satisfy the requirement of local needs.
iv. Sonegaon and Bhanasgaon region with the southern part of Gad Deodari region are better for constructing the small earther type of check dams for better conservation of the surface flowing water.

Acknowledgment

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