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Watershed Management-a case study of Satara Tanda Village

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***Abstract*— Water is the most critical component of life support system. India shares about 16% of the global population but it has only 4% of the water resources. The national water policy gives priority to drinking water followed by agriculture, industry and power. The single most important task before the country in the field of India's water resource management is to pay special attention to rainwater conservation, especially which falls on our vast rain-fed lands but most of which flows away from it.**

The Marathwada region is declared the drought for this year by state government, to overcome the water scarcity watershed management is decided to do near the Sataratanda it is the outskirt region of Aurangabad city. The proposed site of watershed management structure bandhara is located on stream flowing near the Sataratanda village. The proposed bandhara is design for the conservation of water and recharging into the ground to raise the water table of this particular area for the benefits to villagers, fields & farmers. Since last few decades the demand for water had rapidly grown and with the increasing population would continue to rise in future. In Maharashtra, the assessment of ground water potential and scope for artificial recharge in the overdeveloped watershed is very crucial. The total cost of cement bandhara works about 9 lakhs thus the scheme is found economically feasible. The quantity of water store in the bandhara basin is 0.74 TCM.

***Index Terms*—Bandhara, Water Conservation, Watershed Management**

I. INTRODUCTION

Watershed is defined as a geo-hydrological unit draining to a common point by a system of drains. All lands on earth are part of one watershed or other. Watershed is thus the land and water area, which contributes runoff to a common point.

A watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a lager river or lake.

A. Watershed Management

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, improve water availability and agriculture production on a sustained basis [1].

The thrust of Indian Agriculture in the post Green Revolution period was on enhancing agricultural productivity through sustainable practices. In order to achieve this, the Government of India implemented a national level program for the development of rain fed areas through the watershed approach.

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The Watershed approach aimed at augmentation and stabilization of production and productivity, minimizing ecological degradation, reducing regional disparity, and opening up opportunities for employment of rural poor in the rain fed areas.

Watershed management has immersed has a new pattern for planning, development and management of land, water resources with the focus on social and environmental aspects following a participatory approach.

Watershed management involves the judicious use of natural resource with active participation of institutions, organization, peoples, in harmony with the ecosystem [2].

There is an increase on concern about watershed problems and interest in methods of meeting them, around the world. Concern over repeated floods, excessive siltation, accelerated erosion with loss of soil and capacities have resulted have in an interest in measures to correct these situations and prevent their occurrences [3, 4].

B. Types of Watershed

Watershed could be classified into a number of groups depending upon the mode of classification. The common modes of categorization are the size, drainage, shape and land use pattern. The categorization could also based on the size of the stream or river the point of interception of the stream or the river and the drainage density and its distribution. The all India Soil and Land Use Surveys (AIS and LUS) of the ministry of Agriculture, Government of India, have developed a system for watershed dilation like water resource region, basin, catchments, sub-catchments, and watershed.
The usually accepted five levels of watershed dilation based on geological area of the watershed are the following:

1. Macro Watershed (>50,000 Hect.)
2. Sub-watershed (10,000 to 50,000 Hect.)
3. Mili-watershed (1000 to 10,000 Hect.)
4. Micro watershed (100 to 1000 Hect.)
5. Mini watershed (1-1000 Hect.)

A watershed could be described as fan shaped (near circular) or fern shaped (elongated) [5].

Hydrological the shape of the watershed is important because it controls the time taken for the runoff to concentrate at the outlet. Watersheds may also categorized as hill or flat watersheds, humid or arid watersheds, red soil watershed or black soil watershed based on criteria like soil, slope, climate etc. depending on the land use pattern watershed could again be classified as highland watersheds, tribal settlements and watershed in areas of settled cultivation.

It controls the rainfall distribution and movements, land utilization and watershed behavior.

Metrological parameters like precipitation, Temperature variation, wind velocity, humanity and evaporation decide a quantities approach for arriving at water availability in a watershed.

Climate is a determining factor for the management of all aspects of watershed.

The order, pattern and density of drainage have a profound influence on watershed as to runoff, lend management etc. it determines the flow characteristics and thus erosion behaviour.

Land use pattern is vital for planning, programming and implementing a management project on a watershed. It is an important statistics for ascertaining the background, appreciating the status and planning the programs in managements [6]. It portrays man's impact on the specific watershed and forms a basic for categorizing the land for the formulation of pragmatically action plan.

The demand for groundwater is every on the increase. As such the appreciation of groundwater resources for determining their further availability in the context of conjunctive use of water resources for greening the specific watershed is a logical prelude. The information should not only include nature, thickness and characteristics of aquifers but also contain quantity available for additional exploitation through specific number of wells [7].

C. Objectives of watershed management

The different objectives of watershed management programmes are:

1. To control damaging runoff and degradation and thereby conservation of soil and water.
2. To manage and utilize the runoff water for useful purpose.
3. To protect, conserve and improve the land of watershed for more efficient and sustained production.
4. To check soil erosion and to reduce the effect of sediment yield on the watershed.
5. To moderate the floods peaks at downstream areas.
6. To increase infiltration of rainwater.
7. To enhance the ground water recharge, wherever applicable.

D. Study Area

This Bandhara is on stream flowing near village Satara Tanda Taluka Aurangabad District Aurangabad. The village is situated on d/s of bandhara. The location of selected site is according to its latitude and longitude, based on Topo Sheet No. M47/11 received from survey sub-division Godavari minor and medium irrigation Department Aurangabad is Longitude 19.82 N, Latitude 75.32 E.

II. SYSTEM DEVELOPMENT

Catchment area of proposed site is 0.52 Sq. km the catchment area is hilly and some flat terrain is available. Hence it is classified as good average.

The nearest rain gauge station as influencing the Catchment area is at Aurangabad it is 1.0 km from site. Average monsoon rainfall is 68.17 cm the scheme is designed at 50% dependability as per directions Contained in Government circular NO. PLN- 1067 / 39481- Part – II – Ml (1) dated 24-2-1962 monsoon rainfall at 50% confidence limit.

Yield from the catchment area at the proposed site is calculated from stranger's table at 50% dependable monsoon rainfall total yields works out to 0.74 TCM.

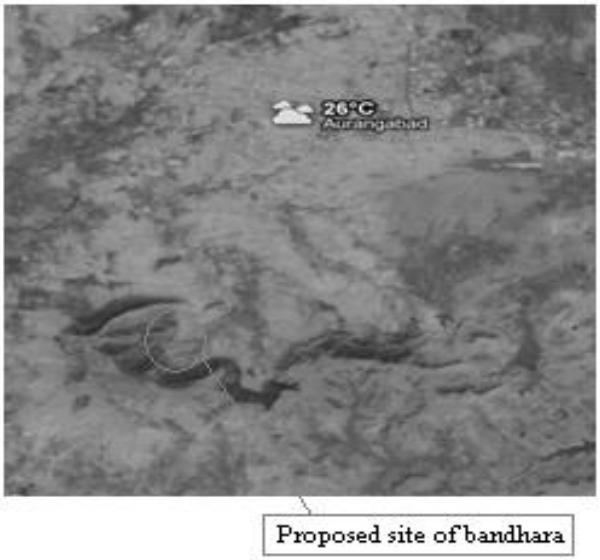


Fig. 1 (a) Proposed site of bandhara

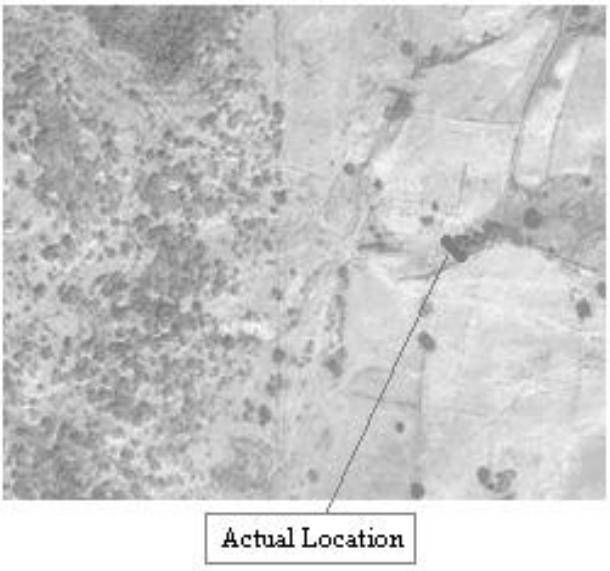


Fig.1 (b) Enlarged view of proposed site of bandhara

Survey is carried out to plot contour at 2m interval for the purpose of working out capacity of the tank at the proposed site. They are further interpolated at 0.5m interval to enable fixation of standard levels of the bandhara.

Being Bandhara yield available at site proposed to be stored, thus F.T.L. is fixed at RL 583.50m having a capacity of 0.74 TCM. A flood lift of 1.00 m as found adequate to pass design flood of cumecs over the waste weir. Thus the M.W.L. gets fixed at R.L. 584.00m.

Waste Weir of 16.00 m. long is proposed to be located on left/right flank of the stream between meter age m. to meter age m. foundation of the waste weir is rested 1.20 m. minimum in soft rock and steps as suitable face of body wall is kept vertical and is bear better of work foundation u/s stability calculations for the various condition of the weir are appended with the estimate. The site conditions results show that rock available at d/s of the weir is good enough and hence d/s protection work are not considered necessary.

Unemployment problem in the vicinity of the scheme will be solved during construction of the scheme water table of the wells about 5 Nos. in the d/s of the scheme will increase and thus more land scan be brought under irrigation.

III. RESULT AND DISCUSSION

Table I. Summary of site features and other parameters

Site Features	Longitude 19.82 N Latitude 75.32 E Toposheet No.M-47/11
Average monsoon rainfall	68.17 cm
Dependable rainfall at 50% C.L. of monsoon rainfall	66.70 cm
Catchment area at site	0.52 sq. km
Nature of catchment	Good
Flood lift over weir	1.00 m
Length of waste weir	16.00 m
Width of water cushion	6.00 m
C.B.L. of stream at	581.00m
F.T.L.	583.50m
M.W.L	584.00m
T.B.L.	585.00m
H.F.L. assumed	583.00m
Total cost of the project	Rs.9.00 Lacks

Table II. Components of bandhara and its design parameters

Components of Bandhara	Top width	Max Height	Bottom width
Stability calculation of abutment	0.60 m	3.54 m	2.46 m
Stability calculation of weir body wall	1.00 m	2.79 m	3.23 m
Design of water cushion Thickness of water cushion U.C.R masonry = 0.30 m Thickness of water cushion concrete = 0.10 m Width of water cushion = 6 m Length of water cushion = 16.35m Water cushion tank depth = 0.72 m			
Excavation width of water cushion Excavation without water cushion = 5.68 m Top width of water cushion = 6.00 m Top width of water cushions U.C.R. = 6.44 m Bottom width of water cushion U.C.R= 6.12 m Average width of U.C.R. = 6.28 m			
u/s Wing Wall (L/S & R/S) Max. height= 4.04m Top width=0.6m Bottom width= 2.82m Length= 4m Slant length= 4.15m Rear length= 3.25m Average length= 3.7m			
d/s Wing Wall (L/S & R/S) Length= 7.91m Top width=0.6m Max. height= 4.04m Min. height= 0.75m Bottom width= 1.01m Average height= 2.4m			

The stability calculation of abutment are top width is 0.60 m, max height 3.54 m and bottom width 2.46 m. When there is abutment only the distance of resultant is 0.85 m within the middle third hence safe & when the earth on back the distance of resultant is 0.95 m within middle third hence safe.

The stability calculation of weir body wall are Top width 1.00 m, maximum height 2.79 m & bottom width 3.23 m. Distance of resultant when there is body wall only 1.12 m.

Table III. Quantity and amount for Excavation

Sr. No.	Particulars	Quantity
1	L/S Abutment	11.33
2	u/s Wing wall	39.89
3	d/s Wing wall	51.62
4	Key Wall	8.89
5	R/S Abutment	11.81
6	u/s Wing wall	41.55
7	d/s Wing wall	53.77
8	Key wall	9.27
9	Water Cushion 0-2	6.53
10	Water Cushion 2-4	18.96
11	Water Cushion 4-8	49.72
12	Body Wall 0-2	6
13	Body Wall 2-4	18.4
14	Body Wall 4-8	46.4
	Total	370.14cu.m
	Amount in Rs.	51079.00

Table IV. Quantity and amount for providing U.C.R Masonry

Sr. No.	Particulars	Quantity
1	L/S Abutment	6.09
2	u/s Wing Wall	25.56
3	d/s Wing Wall	10.45
4	Key Wall	7.39
5	R/S Abutment51	6.90
6	u/s Wing Wall	25.56
7	d/s Wing Wall	10.45
8	Key Wall	7.39
9	Water Cushion	19.63
10	Water Cushion Wall	6.54
	Total	125.96cu. m
	Amount in Rs.	271821.00

Table V. Quantity and amount for providing M_{10} concrete

Sr.No.	Particulars	Quantity
1	Abutment	0.18
2	u/s Wing Wall	0.747
3	d/s Wing Wall	1.27
4	Body Wall	0
5	Water Cushion	19.63
6	Water Cushion Wall	1.47
7	Body Wall	147.43
	Total	170.7cu. m
	Amount in Rs.	463873.00

Table VI. Quantity and amount providing M_{15} concrete

Sr. No.	Particulars	Quantity
1	Abutment	0.56
2	u/s Wing Wall	2.34
3	d/s Wing Wall	2.70
4	Key Wall	0.4
5	Body Wall	5.28
	Total	11.28 cu. m
	Amount in Rs.	24274.00

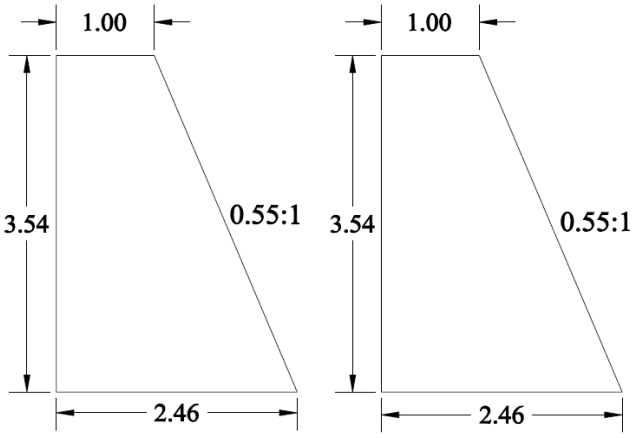
Table VII. Quantity and amount providing staggering and shuttering

Sr. No.	Particulars	Quantity
1	Body Wall	45.64
2	Body Wall	98.16
	Total	143.8 sq. m
	Amount in Rs.	24446.00

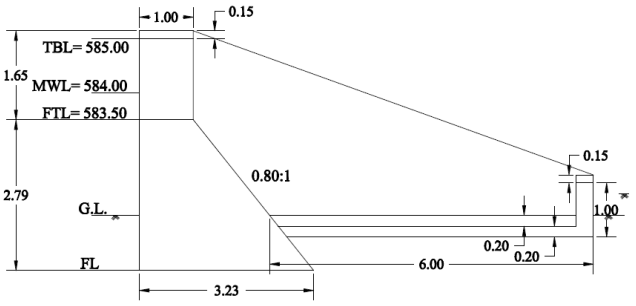
Table VIII. Quantity and amount providing cement pointing & filling trenches

Sr. No.	Particulars	Quantity
1	Pointing	300 sq. m
2	Filling trenches	170.43 cu. m
	Amount in Rs.	36134.00

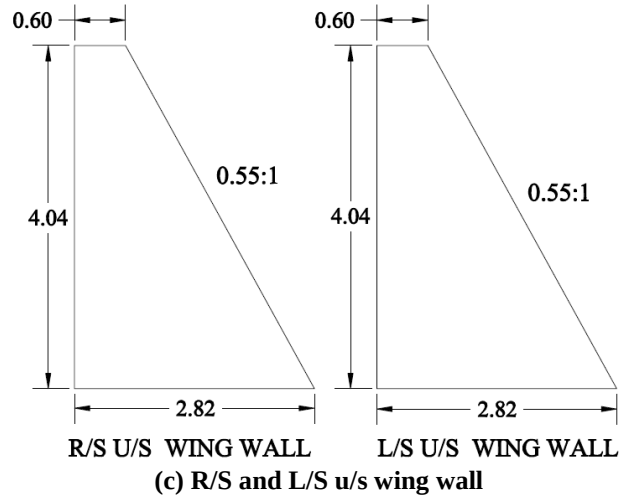
Note: Rate according to latest DSR of PWD Aurangabad.



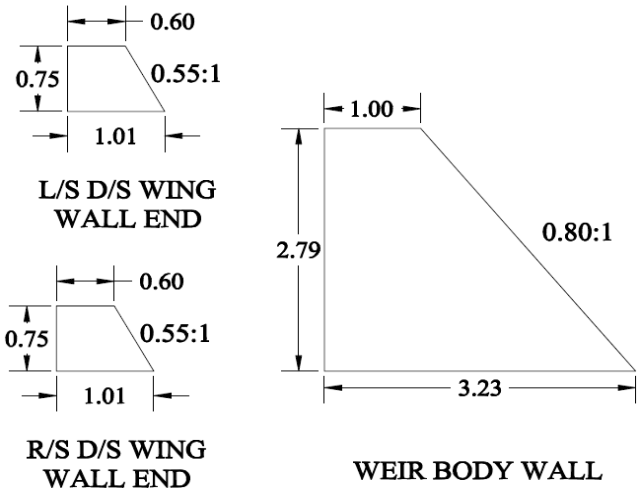
(a) R/S and L/S abutment



(b) c/s of body wall



(c) R/S and L/S u/s wing wall



(d) R/S and L/S d/s wing wall end & weir body wall

Fig. 2 Components of bandhara

IV. CONCLUSION

The aim of this project is to emphasize the importance of the water conservation to overcome from shortage of water. The activities undertaken in this project include soil and water conservation measures like construction of Bandhara. We estimate the quantity of water about 0.74 TCM and work out the cost of construction about 9 lacks. By construction of Bandhara the stored water is use for agriculture purpose and to increase infiltration and to prevent soil erosion. Maharashtra has a large drought prone area (52%) and has faced recurrent drought and famines (1907, 1911, 1918, 1920, 1972, 2013 etc.) which generated attention on the improvement of agriculture in non-irrigated areas.

This study period was too short to confirm effects of watershed management. However this study can be used as a baseline study for future evaluation.

1. The control of damaging runoff and degradation and thereby conservation of soil and water may achieve.
2. The infiltration of water may achieve.
3. The downstream area is protected by moderate floods can be possible.
4. Enhance the ground water recharge wherever applicable is to be possible.

5. Runoff water is managed and utilize for useful propose is to be possible.
6. Check for soil erosion and to reduce the effect of sediment yield on the watershed may possible.

APPENDIX

sq.km	Square kilometer
sq. m	Square meter
cu. m	Cubic meter
cm	Centimeter
m	Meter
km	Kilo Meter
d/s	Down stream
u/s	Up stream
TCM	Thousand cubic meter
cumec	Cubic meter per second
cusec	Cubic feet per second
R.L.	Reduced level
R/S	Right side
L/S	Left side
U.C.R.	Uncoursed rubble
C.B.L.	Channel bed level
F.T.L.	Full tank level
T.B.L.	Top bund level
M.W.L.	Maximum water level
C.L.	Carapace length
H.F.L.	Highest flood level
Hect.	Hectare
DSR	District Schedule Rates
PWD	Public Works Department

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