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Watershed Management in Rural Area –A Case Study

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Abstract: ***Watershed management plays a vital role in reducing soil erosion and water conservation. Several districts in coastal Maharashtra face the perennial problem of water shortage despite of getting heavy rains during the monsoons. Lack of water is a particularly acute problem during the months after the monsoon season. Raigad is one such district, where a number of villages and hamlets inhabited by adivasis or tribal's face acute water shortage leads to many health and socio-economic problems. Also because of lack of knowledge at village level causes the water scarcity. This study aim to cater the water scarcity by implementing watershed management practices.***

Keywords: watershed, water scarcity, perennial, soil erosion.

1. Introduction

Watershed is the hydro-geological unit of area from which the rain water drains through a single outlet. When rain falls on the mountains, it flows down through small streams. Many such streams join to form bigger streams, which in turn join to form rivulets, which join to form rivers and so on. The entire area which supplies water to a stream or rivulet or a river at a particular point in its flow is called the watershed or catchment area or drainage basin of that particular point. The top of the watershed is called hill or ridge portion. The ridge-line partitions one watershed from another, or can be said to be the boundary of the watershed. All the droplets of rain within the watershed will flow from ridge portion through different drainage lines to the valley portion of the watershed and will be drained out of the watershed through a common exit point [11].

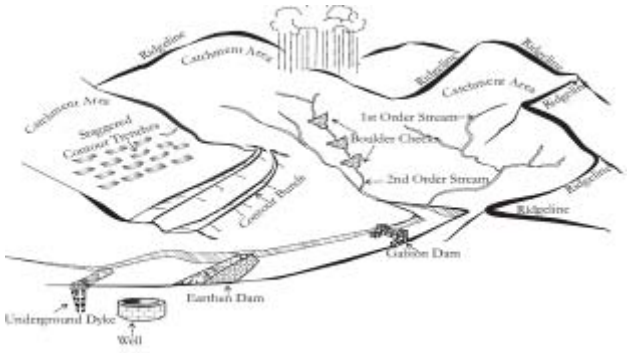

Figure 1: Watershed Network [11]

About 32 000 ha of land in parts of Uran, Alibagh, Pen, Panvel, Murud, Roha, Mangaon, Mahad, Mhasala, Shrivardhan talukas along the coast and creek have been rendered saline due to breach in age old bunds. In affected Areas, ground water quality has also become saline therefore rendering it unsuitable for irrigation. The prominent hill ranges, isolated hillocks, undulation etc., in the district give rise to higher runoff, rather than natural recharge. The formations due to poor storage and transmission characteristics get fully saturated during the monsoon and a situation of rejected recharge is resulted. These aquifers then are drained naturally due to sloping and undulation topography. As a result, the dug wells become dry by the month of February onwards.

2. Literature Review

Maharashtra has a large drought prone area (52%) and has faced recurrent droughts and famines (1907, 1911, 1918, 1920, 1972 etc.), which generated attention on the improvement of agriculture in non-irrigated areas. The Bombay Land Improvement Schemes Act (1942) became the precursor for the Government of India's Model Bill on Soil Conservation for enactment by all states in the post-independence period.

Following the 1972 drought, the Employment Guarantee Scheme (EGS) was initiated in the state and subsequently Comprehensive Watershed Development Programmed (COWDEP), in 1982, which saw the first steps in the direction of a systematic watershed development approach within government programmers.

Ralegan Siddhi and Adgaon in Maharashtra were the initial NGO successes that popularized these model- villages. With watershed development as the central theme and they shot to fame even internationally. Today there are a large number of programmed being implemented in the state through central financial assistance such as Drought Prone Areas Programmed (DPAP), National Watershed Programmed for Rain fed Areas (NWDPRA), River Valley Projects (RVP), Integrated Wasteland Development Programmed (IWDP),

Western Ghats De velopment Pr ogrammed (WGDP), st ate supported pr ogrammers su ch as I ntegrated Watershed Development Projects (IWDP) Adarsh Gaon Yojana (AGY) and bilateral programmers such as Indo-German Watershed Development Pro grammed (IG WDP) besides a num ber of projects bei ng i mplemented by Non Go vernmental Organizations (NGOs) with financial support from local and foreign s ources. Almost al l t hese programmers ha ve institutionalized th e watershed approach t o treating land s and water harvesting in asso ciation with p eople's participation to enhance the production potential of rain fed farming. With Mah arashtra's esti mated p otential o f surface irrigation not expected to cross 30% of the cropped area (in conventional sense), t he im portance o f watershed development as a bulwark for rain fed agriculture is obvious in these large tracts of drought prone lands. [8]

3. Methodology

Following steps were followed for implementing techniques:
1. Selection of Site for implementing watershed techniques.
2. By personal interviews of the local people, we analyze the problems faced by the villagers regarding water shortage.
3. Collection of th e data of site con dition and surrou nding area.
4. Preparation of contour map of selected site.
5. Profile leveling is used to select the water outlets.
6. Constructing the suitable structures on water outlet points.
7. Preparation of the estimates of structures proposed.

4. Techniques for Water and Soil Conservation[12]

4.1 Earthen bunds: Reduction in soil erosion

The g round water t able o f wel ls wi thin 1 t o 2 km on downstream side of bund increases. The submerged material that has been flown off ca tchment area can be used as fertilizer.

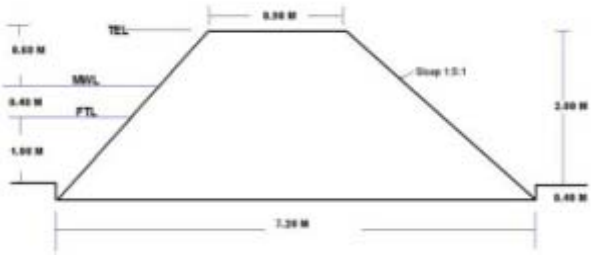

Figure 2: Typical Cross section of earthen bund

4.2 Continuous Contour Trenches

Figure 3: Continuous Contour Trenches

Reduces surface water flow v elocity, promotes in filtration, and prevents pollutants from draining into water bodies.

4.3 Farm Ponds

Ponds co nstructed o n t he upper si de of t he farm s t o bl ock and st ore t he ru noff rai n wa ter whi ch ca n be used during emergencies a re cal led fa rm po nds. T he main ob jective of farm pond is to store the water from the surface runoff in the ponds and use for the irrigation purpose. The water stored in the farm pon ds i s general ly use d w hen i rregular rai ns a re received. Places where construction of wells are not possible in such areas, the farm ponds are constructed.

Figure 4: Farm ponds

4.4 Gabion Bunds

They are sim ilar to lose bould er checks, but are construct ed across bigger streams and ha ve their own catchment area at least 5 ha. Also, these st ructures a re constructed on flatter regions as a gainst loose boulder c hecks. The flatter t he upstream slo pe, th e m ore will b e th e sto rage. Al ong with slowing down t he ru noff t hese structure s also help i n temporary water stor age i f the b ed is im permeable en ough. These structures are generally reinforced with wire mesh for Stable embankments and oppose strong currents. The bunds made by co vering t he l oose st ones by mesh are cal led "Gabion Bandhara" The areas where the slope of the nala is greater than 3% and the rainfall is h eavy in su ch conditions the loose boulder structures cannot sustain, so in suc h cases the Ga bion B andhara are p referred. The boulders l ocally available are s tored in a steel mesh and are tied up in the form of rect angular bl ocks. This is put across the stream to make it as a s mall dam by anchoring it to the stream banks. The h eight of su ch stru ctures is ar ound 0 .5 m an d is normally used streams with width of about 10 to 15 m. The excess water overflows this structure storing some water to serve as source of recharge. The silt content of stream water in due course is deposited in the interstices of the boulders to make it m ore impermeable. These st ructures are c ommon in Maharashtra, Madhya Pradesh, and Andhra Pradesh etc.[11]

Figure 5: Gabion bund

In case of overflow of water where the construction of earthen bunds is not possible or in areas where construction of strong foundation is not possible and so cement bunds cannot be constructed these types of bunds are used.

4.5 Loose Boulder structure

Figure 6: Loose Boulder structure

To reduce the erosion of soil on the upper side of the catchment area loose boulder structure is more effective. By constructing the bunds made up of rocks across the nala the velocity of flowing rainwater can be reduced, to reduce erosion of soil. Blocking the way of water and allowing it to percolate in the soil. As the silt gets accumulated between two bunds, this area can be used under agriculture. By doing plantation on the downstream side of bunds afforestation can be done.

5. Case Study

The area taken for case study is located in Kashele, Taluka-Karjat. Total area taken under mini water shed project was 6Ha. This watershed area comes under heavy rainfall zone even then during summer season water scarcity is noticed. The entire area is absorbs water, but does not retain the water, because of the slope and ground condition. As a result this village faces water scarcity in rest of the season, and people cultivate only one season crop in rainy season and hence vegetation cover is not so good in this area along with agriculture people also face water shortage for drinking purpose. Due to water scarcity agriculture is not the source of living for people in that village and hence we have taken this area under consideration for the water shed management project to solve the water problems faced by the villagers.

Figure 7: Kashele Village

A. Population: 2480 souls
B. Male: 1269
C. Female: 1211
D. Total livestock: 273

5.1 Land use

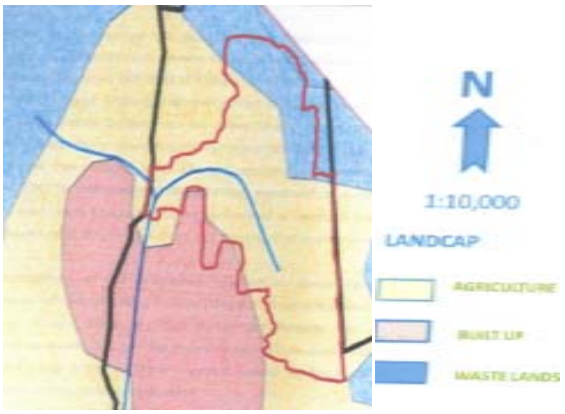

Figure 8: Land Use Map

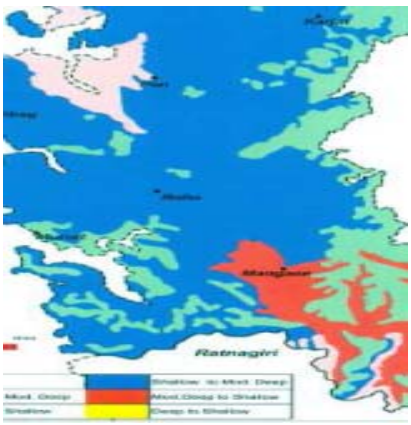

Figure 9: Soil map of Raigad
[Source: - NBSS & LUP, Nagpur]

5.2 Problems existing in the District

a. High rainfall above 3000 mm season causes severe soil erosion.
b. Low income levels hence low living standard
c. Lack of water supplies in summer season
d. Very low irrigation
e. High percentage of barren, uncultivable waste land.
f. Agricultural production in only one.

5.3 Problem analysis in the area

After having a meeting with Gram Panchayat we came to know the water problems faced by the people in that area. The water level in 3 wells coming under our watershed area had reduced from 6-7m during rainy season to 0.8 to 1m. Even if the soil condition was good due to water shortage people cultivated only one season crop during the rainy season. On the hill top due to heavy rains erosion of the soil that is taking place is too high thus reducing the soil cover on the hill surface.

5.4 Average Rainfall [Meteorological dept]

Rainfall was high with average rainfall of 3642.36 mm for past 12 years. The highest rainfall in last 10 years was 4808 mm in 2005-2006 and lowest rainfall was 2931.70 mm in 2001-2002.
2001:02: 2931.70 mm 2002 -03: 3117.50 mm
2003 -04: 3243.00 mm 2004 -05: 3293.50 mm
2005 -06: 4808.00 mm 2006 -07: 4800.60 mm
2007 -08: 3465.80 mm 2008 -09: 3489.90 mm
2009 -10: 2749.70 mm 2010 -11: 4400.10 mm
2011 -12: 4260.00 mm 2012-2013:3148.60 mm
(01-01-13: 24-09-2013: 4012.3 mm)

5.5 Ground Water Depth

	2007-08	*2008-09*	*2009-10*
Pre Monsoon	1.5 -8.6 m bgl	1.5-10 m bgl	2-8m bgl
Post Monsoon	0.8-2.8 m bgl	1-2.7 m bgl	1- 3.5 m bgl

5.6 Geology of the area

Deccan Trap Basalt of upper Cretaceous to lower Eocene is the major rock formation and intruded by a number of dykes. The western part of the district Consisting Basalt flows is altered to Laterite. Recent deposits comprising Beach Sand and Alluvium occur along the coast and in the river mouth; however they do not form potential aquifer. Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 10 – 15 m bgl under unconfined condition. The water bearing strata at deeper depth exists under semi confined to confined conditions. The dug wells in these areas show rapid decline in water level during post monsoon period and practically go dry in peak summer. In foothill zones the water table is relatively shallower near water course. The yield of dug wells tapping upper phreatic aquifer ranges between 45 to 60 m3/day, whereas that of bore wells varies from 0.50 to > 20 m3/hr. depending upon the local hydrogeological conditions, however in most of the bore wells it is up to 5 m3/hr. [G.W.I]

5.7 Structures constructed in the area [IWMP]

Stone Bunds
Loose boulder structures
Earthen Bunds
Farm Pond
Continuous Contour trenches
Terraced Bunds

5.8 Proposed Works in the Area

5.8.1 Engineering Measures:
1. Treatment proposed on hilly areas.
On the hilly surface "Area Treatment" is proposed as soil erosion in large amount has taken place. In area treatment stone bunding is proposed in that area as soil layer required for CCT is not enough for excavating. The aim of providing stone bunding is to cultivate horticulture plants and prevent soil erosion.

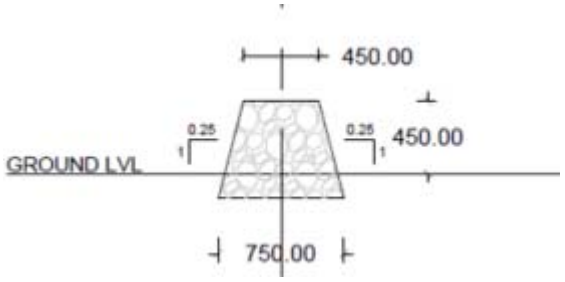

Figure 10: Stone Bund

2. Treatment proposed along the Drainage Line.
Along the drainage line treatment "3 Gabiyan Structure" and "7 Loose Boulder Structure" are proposed. Gabiyan structure is provided to store the water as well as to change the alignment from road to the original line. Loose boulder structures are proposed to store as well as to recharge the ground water table. Nala bank stabilization is proposed as people have artificially changed the originally alignment of nala and hence would face the erosion problem of nala.

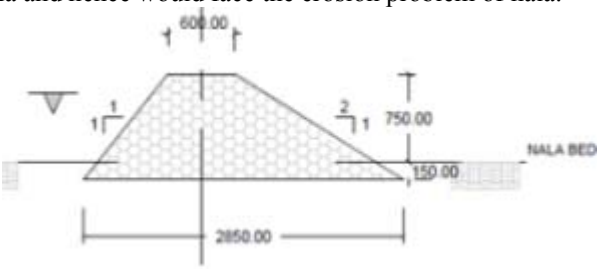

Figure 11: Loose Boulder structure

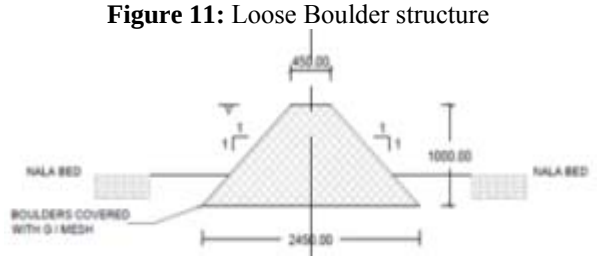

Figure 12: Gabion Structure

6. Conclusion

Plenty of water is available during rainy season, Particularly in Konkan region where more than 3000 mm rainfall is available. But in this region slope of river bed is so steep and all the rain water flows toward s the outlet very fast and results in scouring land, it is major problem. After the rainy season around month of December the water scarcity starts in most of the hamlets comprising of adivasis or tribals, and water demand increases. As large amount of ground water is drawn out from underground, reduction of ground water table which in turn reduces water level in wells.

To cater this problem of water storage in rural areas, the technique of water shed management is best suited. By implementing this method the ground water table is increased thus providing sufficient water to the farmers during summer season and reducing the call of tankers on which crores of rupees were spent by the government. This method is cheap and also provides employment to villagers. It also reduces soil erosion and also facilities plantation of

trees or f odder w hich is b eneficial to th e farmers. By implementing wat er s hed m anagement t echniques farm ers can also cultivate all season crop s thu s in creasing t he revenue an d also l iving st andard o f t he pe ople. Hence watershed m anagement i s a go od t echnique t o s olve t he problem o f water in rural areas an d also to i ncrease the revenue of rural population.

7. Acknowledgement

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