"WATER BALANCE STUDY FROM AKKALKOT AREA, SOLAPUR DISTRICT: A CASE STUDY OF DAHITANE AND CHAPALGAON REGION"

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ABSTRACT

Akkalkot taluka as a whole has faced drought conditions since its establishment. The northern part of the Akkalkot city, villages like Dahitane, Dahitanewadi, Chapalgaon and Chapalgaonwadi are lying towards the downstream of the tributary of Bori River but still the water scarcity in these regions is comparatively more. To understand the availability and demand ratio of the 45 sq.km area the detail analysis is carried out. Human population, livelihood stock population and the agricultural demand calculation are carried out in the study area. Major animals like cattle, buffaloes, sheep's, goats, poultry etc are considered for the present study.

The at actual site calculation are carriedout for the present work which has shown the availability and the demand ratio doesn't match for present study area. This conclusion leads for the further management studies in the study area.

Keywords: *Field visit, water availability, water demand, population, livelihood stock etc.*

1.1 Introduction:

Water usage in rural areas is the challenging task for all human beings as well as livelihood stocks. Solapur the connecting district of South India with Central India as well as Western Maharashtra to Marathwada region. The major streams flowing in this district on Bhima, Seena, Bhogawati, Maan and Bori River. Akkalkot taluka being connected to Karnataka falls in the south eastern part of Solapur district, Bori River flows from this taluka region. Number of check dams are constructed in the Akkalkot taluka, but still the scarcity of rainfall occurring in this region has created a major issue in watershed management. A sample case is studied herewith to understand the water balance for a micro watershed.

1.2 Study Area:

Akkalkot taluka being the South eastern part of Solapur district faces a large scarcity of water in all respect to domestic as well as industrial water requirement. The present study area falls in OSM toposheet no. E43Q2 (Fig.1.1) with scale 1:50000 having rectangular shape with Latitude of North 17°37'25.93"N and South 17°34'36.27"N and Longitude of East 76°11'51.40"E and West 76° 7'33.99"E with an area of approximately 44 sq. km. Dahitane and Chapalgaon region falls towards the north western part of Akkalkot city. The area is about 30 km away from Solapur city towards Akkalkot city.

1.3 Methodology:

The water availability and the water demand in the present study area is calculated to understand its demand and supply ratio. This has shown the water demand for the conservation with surfacial water bodies. To investigate the surfacial water availability the field studies were carriedout and the survey of field has shown a vast demand of water in comparison with the water available in the region.

To understand the surfacial water availability geomorphological studies of the region is carriedout. Also the survey is carried to understand the water demand for both domestic and agricultural usage. Census of 2011 is used as the base data for the population calculation for both human and animal husbandry. The crop pattern cultivated in the region was analyzed and the demand for the same is being calculated.

The conservation techniques were analyzed with the help of proper scientific and technical data derived from the present study. Use of 4 micro watershed was carried out in the present study viz. Chapalgaon, Chapalgaonwadi, Dahitane and Dahitanewadi individual.

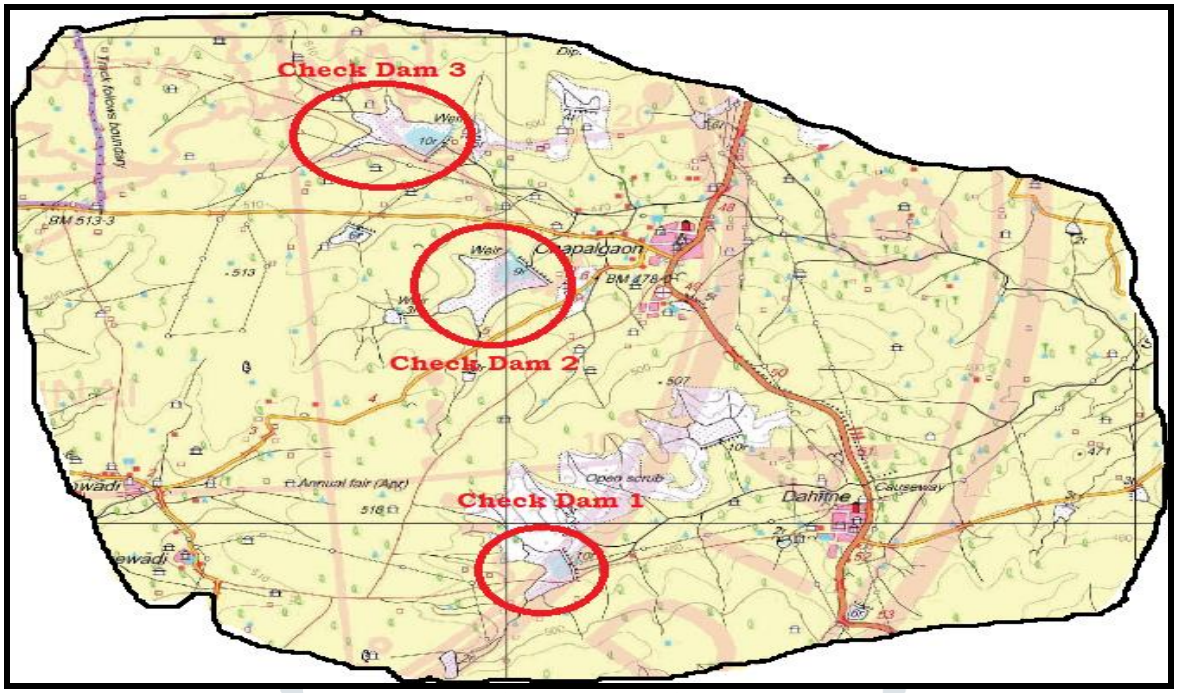

Fig. 1.1: Study area lying near Akkalkot Tehsil of Solapur District.

1.4 Data Analysis:

The average rainfall of the present study area is about 538 mm which is the average of 8 years since 2010 to 2017. The same has been tabulated in the table 1.1.

Table 1.1: Rainfall Data of the Akkalkot Taluka.

Year	Rainfall (in mm)	Year	Rainfall (in mm)
2010	717.2	2014	433.3
2011	618.0	2015	246.86
2012	556.3	2016	456.67
2013	601.4	2017	379.68

(Source: https://Solapur.gov.in/en/rainfall/)

The rainfall trend for last 9 years has shown frequently fall in the rainfall of the study area. The maximum rainfall occurred in 2010 and minimum occurred in 2015. This indicated the falling trend of rainfall in the study area (Fig. 1.2).

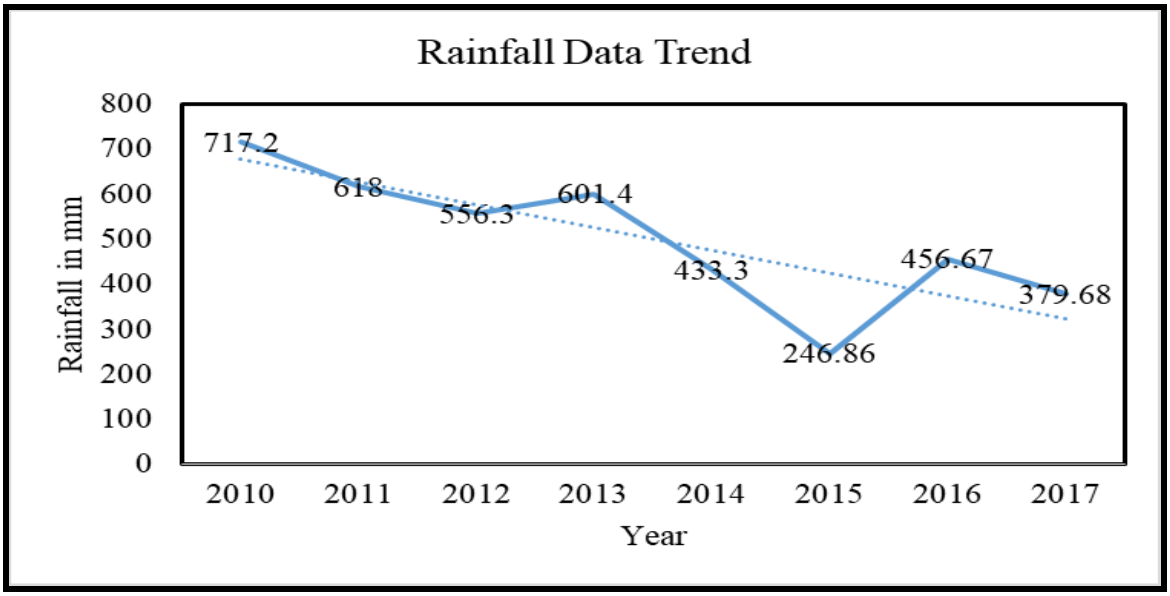

Fig. 1.2: Rainfall Trend in the study area.

1.4.1 Availability of Water:

Government of Maharashtra's Irrigation department has constructed 3 check dams in the study area. Dam 1 is almost in dry conditions for 10 months. Considering the rainfall in the region the dams are never flooded. The water storativity in the check dam no. 2 and 3 is to some extent occurring for 4 months of the rainy season. The details of the dam are calculated with the reference to its perimeter and depth of water level from surface.

Table 1.2: Details of Check Dams in study area.

Check Dam	Dimension (in m^2)	Depth (in m)	Quantity of Water Available (in m^3)
Check Dam 1	37258	1.1	40983.8
Check Dam 2	20371	1	20371
Check Dam 3	65994	1	65994
Total	123623		127248.8

Total surface water available in the study area is 127248.8 m^3.

1.4.2 Demand of Water:

The water demand with respect to surfacial water bodies has been considered for the present study. The details of the basin and the conservation, yield, losses both groundwater as well as evaporation are considered and are tabulated in table 1.3.

Table 1.3: Detailing of the Basin area.

Basin Area	= 43.43 Sq. Km		
Conversion to m^3	= 43.43 x 1000000	43430000	43430000
Yield of water in the basin	= 43430000 x 0.538	23365340	Area has 538 mm of average rainfall
Considering the 40% GW and losses	= 23365340 x 0.6	14019204	As per K Subramanya runoff coefficient is 0.6
Considering the 20% of Evaporation Losses	= 14019204 x 0.80	11215363.2	20% of Evaporation losses considered in Akkalkot region

1.4.3 To understand the water demand in Dahitane and Chapalgaon Basin:

The calculation of water requirement is made on the basis of human population, livelihood stock occurring and also the crop pattern cultivated in the study.

WHO standards were adopted for calculation of the water demand of population as well as the livelihoods stock present in the region. Simple techniques like requirement can be achieved by multiplying the population with per capita requirement similarly it can be adopted for livelihood stock too. Industry is negligible in the present study area so no consideration is given for the calculation of the water requirement through industries. But agricultural demand has been emphasized to understand the actual requirement in the study area with respect to the crops cultivated in the region.

a. Population Water Demand:

As per the Census 2011, the total number of families in Atpadi area is 4267 in number and the population of Study is 20791 of which 10786 are male and 10005 are female. WHO norms states that Indian person consumes 135 lit/day of water for all purposes, they are tabulated in table 1.4.

Table 1.4: Consumption of domestic water
(As per IS 1172: 1963 Normal Consumption of water in India)

Water Usage	Quantity (in lcd)
Drinking	5
Cooking	5
Bathing	55
Cloths Washing	20
Utensil Washing	10
House Washing	10
Total =	**135**

Hence, the required water demand for domestic use is as follows

Per Day Requirement = Total Population x Average Water Consumption
= 9491 x 135= 1281285 litres / day

Per Year Requirement = Per Day Requirement x 365 days
= 1281285 x 365 = 467669025 lit/year
= 467669.025 m^3

b. Livelihood Water Demand:

As per the animal census 2007 the livelihood stock population of Solapur was estimated of which Akkalkot Taluka livelihood stock population and the study area livelihood population is tabulated in the below table 1.5.

Table 1.5: Livelihood detail consumption of water.
(As per IS 1172: 1963 Normal Consumption of water in India)
(**Source:** Akkalkot Taluka Animal Census 2012 and field survey.)

Live Stock	Cattle	Buffaloes	Sheep	Goats	Pigs	Horses	Ponies	Mules	Donkeys	Dog	Rabbit	Fowls
Akkalkot	1732	24969	6629	40938	2865	17	21	1	60	5637	5	23873
Study Area	101	4231	544	1254	109	2	4	0	6	289	0	4555
Per Day/Per Animal Water	40	40	8	8	4	6	5	0	6	2	0	0.5

Requirement												
Total Water Requirement per day per animal (in litres)	4040	169240	4352	10032	436	12	20	0	36	578	0	2277.5
Total Water Requirement per Year (in litres)	= 69723578											
Water requirement (in m^3)	**= 697235.78**											

c. Agricultural Water Demand:

In agriculture use the water demand is calculated considering the data acquired through the agro department as well as the gram panchayats through survey. Based on which an average requirement is calculate for the region. This water demand is calculated based on the crop pattern adopted in the field. Most of the farmers adopted the crops like Bajara, Wheat, Jowar, Maize, Sugarcane, Groundnut, Sunflower etc. The agriculture department has provided the water demand for each crop based on which the below calculation are made for water demand and the same is tabulated in table 1.6.

Table 1.6: Crop Pattern Ranking.

Ranking	Crop	Hectares under Cultivation	Hectares Forest	Total Land
1	Jowar	792	104	4239 + 104
2	Bajara	648		
3	Maize	713		
4	Wheat	721		
5	Gram	575		
6	Sugarcane	435		
7	Groundnut	345		
8	Sunflower	10		
Total (in Hectares)		4239	104	4343

The requirement of agriculture is also based on the IS standards. The general crop pattern adopted in the Chapalgaon and Dahitane region is Rabi Crops, Maize and Pulse pattern. Through the agriculture department the standard requirement of water per year per crop is tabulated below in table 1.7.

Table 1.7: Crop Pattern distribution and water requirement. (Source: Gatade, 2012)

Crop Pattern	Per Acre water requirement (in Litres)	Per Hectare Water Requirement (in Litres)	Total Hectares of Cultivation in Study area	Total water requirement (in Litres)
Jowar, Bajara & Wheat	6000	15000	2161	82875000
Gram	2000	5000	575	2295000
Maize	4000	10000	713	8240000
Sugarcane	2000	30000	435	13050000
Groundnut & Sunflower	1000	8000	355	2840000
Total Water Requirement in Litres =				109240000
Total Water Requirement in m^3 =				109240

1.5 Actual Water Requirement in Study Area

Summation of a) Population Water Demand + b) Livelihood Water Demand + c) Agricultural Water Demand. This will give the actual pin pointed water requirement in the Chapalgaon-Dahitane Basin.

Table 1.8: Water Requirement in Chapalgaon-Dahitane basin.

Symbols	Description	Quantity (in m^3)
X	**Available Water from Rainfall =**	127248.8
A	**Domestic Requirement =**	467669.025
B	**Livelihood Requirement =**	697235.78
C	**Agricultural Requirement =**	109240
Y	**Total (A+B+C) =**	1274144.78
Requirement of Water in Chapalgaon and Dahitane basin (Y - X)=		**1146896**

The water requirement is 1146896 m^3 for Chapalgaon Dahitane Basin. This is the primary requirement for this basin which needs to be made available for the further cultivation of agricultural land and domestic requirements of the study area.

1.6 Result and Discussion:

The present study was an attempt to understand the micro requirements for the watershed management of the Akkalkot as whole but of which a small part of 43.43 sq. km area has been considered as a representative. The surface available water resources is just 127248.8 m^3 (Table 1.2) which is not sufficient for the present scenario of the study area as the requirement is about 1274144.78 m^3 (Table 1.8), while the demand of domestic water is about 467669.025 m^3 (Table 1.4), the livelihood water demand from farm is 697235.78 m^3 (Table 1.5) and agricultural demand is 109240 m^3 (Table 1.7) purpose is very high. This is almost 10 times the available resources.

1.7 Conclusion:

Following are the findings of this micro research work:

- Calculation of on site can be possible after precise field investigation.
- Data collection should be validated for population and livelihood stock.
- Indian standards for rural domestic water usage needs to be improved as the consumption in other modes is never considered during the calculation.

Hence, it's suggested to have an appropriate watershed management as well as conservation in the present study area with the help of scientific and technical structure design.

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