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IMPACT ASSESSMENT OF WATER CONSERVATION ACTIVITIES ON GROUNDWATER LEVEL USING RS AND GIS IN PARTS OF PUNE DISTRICT

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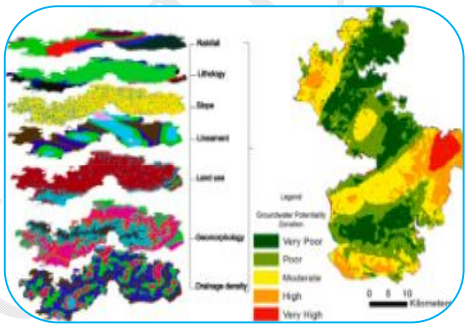
ABSTRACT:



The Maharashtra government started the water conservation scheme Jalyukt Shivar Abhiyan to reduce water scarcity problem and to make Maharashtra a drought free state by 2019. The aim of this programme is to make 5000 villages free of water scarcity every year. The study of impact assessment of water conservation activities on groundwater level carried out for some parts of Pune district. Totally ten parameters where considered such as stream, slope, geology, geomorphology, landuse and land cover, lineaments, slopeand soil texture, soil erosion, soil depth, groundwater prospect. Reclassification of the thematic layers was done byranking the various classes contained in each map. The reclassified thematic maps were assigned ranking based on cross parameter relationship on the importanceof each parameter with reference to other parameters. The reclassified layers are combined by using the overlay tool to accomplish at a suitability map which demarcated the suitable zones for water conservation activities based on the total weights for this area. water level datawere processed for 33 wells for both pre-monsoon andpost-monsoon period to get the water level fluctuation. Finally, we get the comparison table for suitable area for water conservation and water level fluctuation for year 2014, 2015, 2016 and 2017. The result shows maximum villages falls under moderate suitable zone and not suitable zone. The result helps to find out suitable sites for implement water conservation activity, which is helps to improve soil moisture as well as groundwater.

KEYWORDS: *Water Conservation Activities, GIS, Reclassification, Ranking method, water level fluctuation.*

INTRODUCTION

Almost 70% geographical area of the Maharashtra state's lies in semi-arid region showing its vulnerability to water scarcity. Every year, some part of the state is affected by drought conditions affecting availability of water for domestic use and irrigation. Forecasting of the droughts is linked with the forecasting of monsoon which is influenced by several global and regional factors such as the El Nino and Southern Oscillation (ENSO) events (Ropelewski and Halpert, 1986, Nicholls, 1993).

For the solving water scarcity problem Maharashtra government started "Jalyukta Shivar Abhiyan" from year 2014-15. In this research soil and water conservation having an ideographic importance. That is also affect on watershed development and the implementing water conservation activity should be technically improved. The purpose of this study is to determine the impact of water conservation activities on groundwater in Baramati,

Indapur, Daund and Purandar by using ranking method in ArcGIS. To assess the impact of water conservation activities on groundwater level, its necessary to understand the suitability for water conservation structures.

This research concentrate on the impact of water conservation structures on groundwater and by understanding suitability sites for this structures e.g. Farm pond (FP), MatiNala Bund (MNB), Cement Nala Bund (CNB), NalaDeepning (ND), and Continuous Contour Trenches (CCT). Totally ten parameters have been considering for the study suchas stream, slope, geology, geomorphology, landuse and land cover, lineaments, slopeand soil texture, soil erosion, soil depth, groundwater prospect. The selected parameters have been prepared and classified inGIS environment, then weightage for each parameters and itsclasses have been assigned using weighted overlay analysis in ArcGIS used tofind out the result.

STUDY AREA

The study area is a part of Deccan plateau region; it consists four tehsils e.g. Baramati,Daund, Purandar and Indapur (Figure 1). The latitudinal and longitudinal extent of the area is 73°53'13" E to 75°9'44" E and 17°53'41" N to 18°40'15" N with areal extent 5249.28 sq.km.Deccan trap basalt is the rock structure of Pune district, its divided into hard rock (Deccan trap basalt) and soft rock (alluvium)(Kale and Kulkarni, 1992). This area divided into plain and hilly area. The highest elevation is 1364 m. and the lowest being 440 m. from msl., the gradation elevation is from east to the west. The area experiences the sub-tropical to tropical temperate monsoon climate with a hot summer and general dryness throughout the year except during the south-west monsoon season. The normal annual rainfall over the area varies from 468 mm to 4659 mm. and temperature ranging from 30° C to 40° C. The entire study area is occupied by the basaltic lava flow.Geologically the western Maharashtra is covered by basaltic lava flows commonly known as Deccan trap of Cretaceous-Eocene age (Gaikwad, 1977).

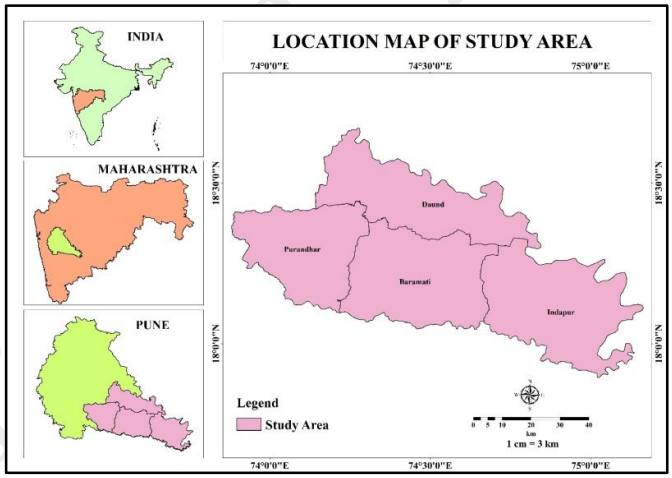


Figure 1 Location Map of Study Area

METHODOLOGY

The methodology adopted in the present study is summarized in Figure 2. There are three major components in the study viz.

a) Data collection includes geological mapping

b) Well (Groundwater level) data collection from Groundwater Survey and Development Agency (GSDA). From the water level data graphs were prepared.

c) Ancillary data collected from Vasundhara Watershed Development Agency (VWDA).

The other analysis outputs used to interpret streams, lineament, slope, soil depth, geology, soil texture, geomorphology, land use/ land cover, groundwater prospect soil erosion. All these studies are

integrated in GIS environment to delineate for find out the suitability zones water conservation activities.

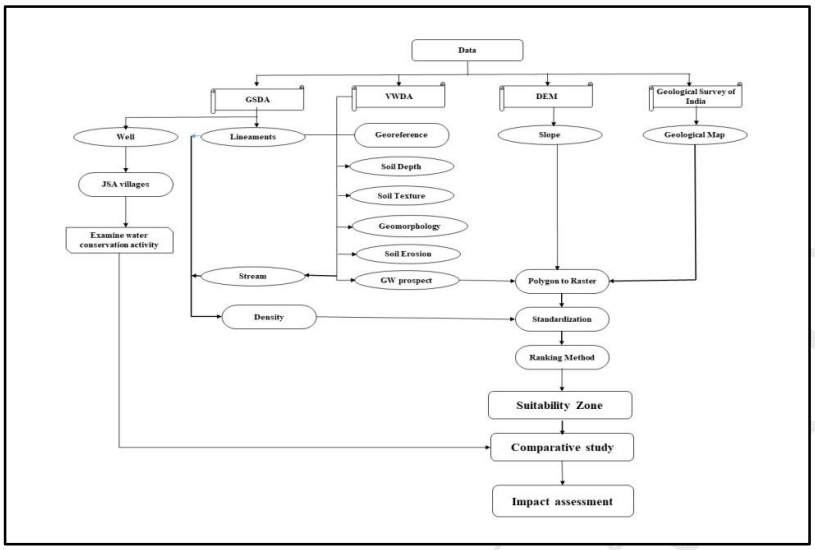


Figure 2 Methodology Chart

IMPACT ASSESSMENT OF WATER CONSERVATION ACTIVITIES ON GW

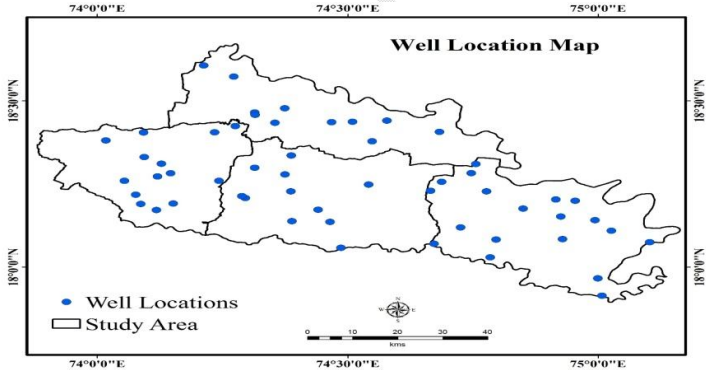


Figure 3 Well Location Map

Considering a wide variation in groundwater, the need to incorporate the fluctuation of groundwater level, which could furnish tentative information about impact of water conservation activities. Thirty-three (33) representative water samples of wells were collected from GSDA. The location of sample wells of Baramati, Daund, Indapur and Purandar administrative divisions of Pune district shown in Figure 3.

WATER LEVEL ASSESSMENT

During monsoon season usually recharge increase and discharge decrease the difference goes into storage. Thus the water level rises because of increase in soil moisture. During non-monsoon seasons the recharge usually decrease. As a result, the water table goes down due to the increase discharge. In case of annual recharge equal to annual discharge the change in storage over the year will be negligible and water table may not show any notable change on an annual basis. However, during a dry year, the annual discharge may exceed the annual recharge resulting in the decrease in storage and

lowering of the water level. In wet year annual recharge may exceed annual discharge resulting in an increase in storage and rise in the water level.

Water level datawere processed for 33 wells of both pre-monsoon andpost-monsoon period for the year 2014, 2015, 2016 and 2017. Wells are unevenly distributedthroughout the study area. Water level conditions in preand post monsoon period are studied.

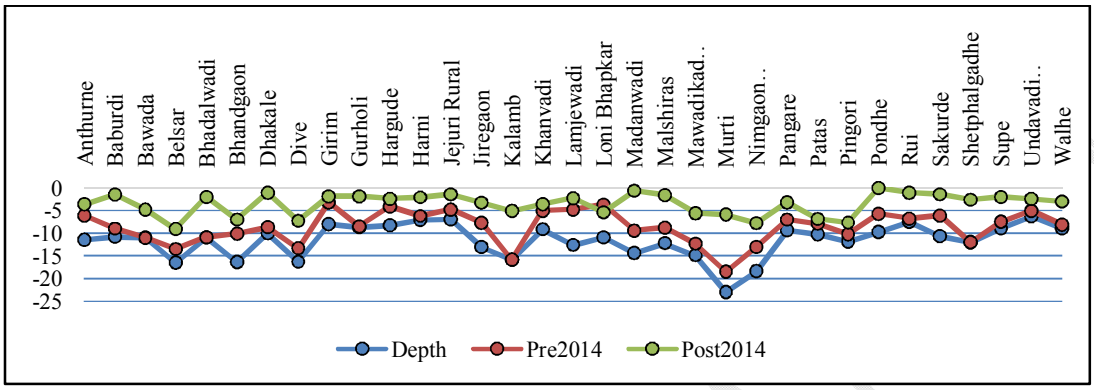


Figure 4 GSDA GW level 2014

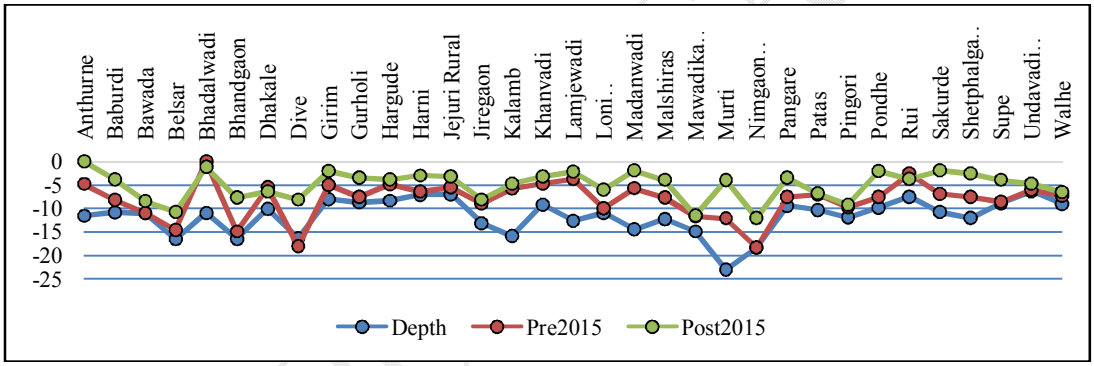


Figure 5 GSDA GW level 2015

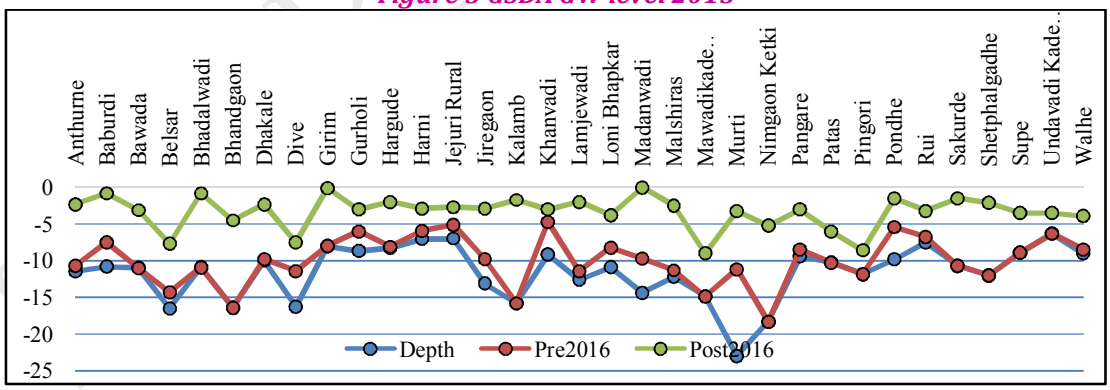


Figure 6 GSDA GW level 2016

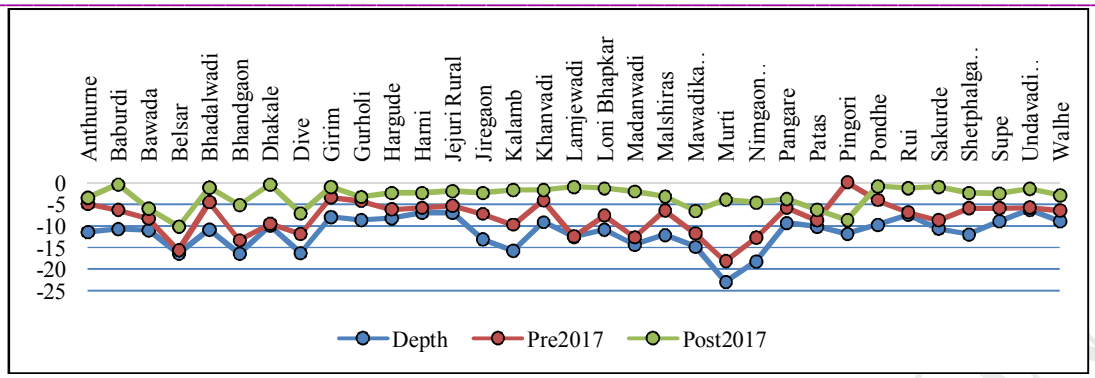


Figure 7 GSDA GW level 2017

WATER LEVEL FLUCTUATION

Where, groundwater level fluctuation high means the water level increase and low means decrease. The average groundwater level fluctuation year of 2014 to 2017 is 5.01 bgl. In the 2014 fluctuation were less and from the 2015 fluctuation increase (Figure 4 to 7).

STANDARDIZATION OF LAYERS, RANKING METHOD AND WEIGHT ASSIGNMENT

Standardization of the all ten thematic layer were done using ranking the various classes. All the vector layers were rasterizing and then reclassify,thisgives an output which is far easier and accurate toanalyses the suitability for water conservation activities. All the ten thematic maps used for the analysishas to be reclassified based on knowledge based ranking.The scale for ranking is of descending nature and is from10 to 1. This means that ranking of 10 for a class within atheme will be having a higher suitability for water conservation activities compared to a rank of 9. After determining the relative importance, values of the entities from the highest to the lowest priorities, the score range of the entire entities is set by considering the relative importance difference between the highest priority entity and the lowest priority entity (Song and Kong, 2016).The weight for all sub classes given according to experience, expert's opinions and information from various sources. Knowledge acquisition has been accomplished through discussions with experts of related fields of study and previous related literatures. Those weight were selected according to the professional expert's opinions.

Overall classified by overall ranking into weightage. These total weight assign to the thematic layers and generate the maps.

SPATIAL INTEGRATION USING GIS

The reclassified layers are combined by using the overlay tool of the ArcGIS 10.3 to accomplish at a final map which demarcated the suitable zones for water conservation activities based on the total weights. Were assigned to each layer based on the influence each layer parameters for this project. Based on the output of weighted overlay analysis, the region with low stream density, high lineament density and moderate slope and suitable geomorphology were categorized as high suitable zone for water conservation activities and JSA assessment villagesshown in Figure 8.

RESULT AND DISCUSSION

The result shows, out of 33 villages most of the villages are falls under moderate suitable zone and not suitable zone. Thisoutput helps to find out suitable sites for implement water conservation activity, which is helps to increase groundwater level. Out of 33 villages, Dive,Khanvadi, NimgaonKetki and UndavadiKadePathar having more than 50% high suitable area, 18 villages area falls under the moderate suitable area and rest of the villages falls under low to very low suitable area for water

conservation activities. High suitable area having high groundwater level fluctuation.Its indicate close relationship between suitable zones and water conservation activity, which is done in JSA villages.

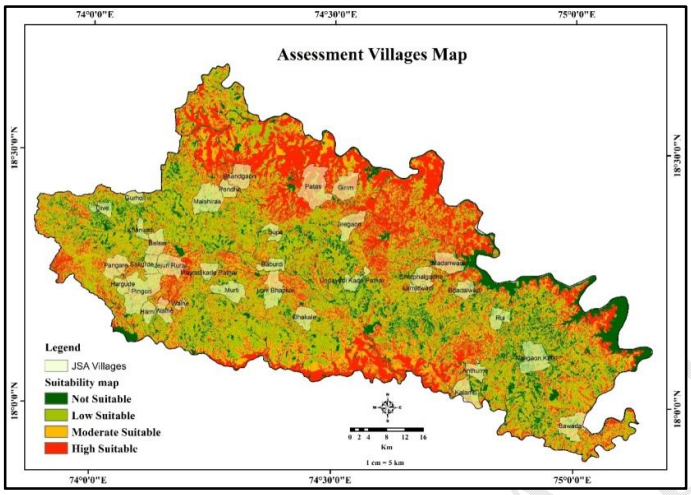


Figure 8 Suitability Map with Assessment Villages

Table 1 Comparison Table

Village name	Suitability area in %				JSA Project year	Activities	Fluctuation
	High	Moderate	Low	Very low			
Anthurne	23.88	28.66	28.01	19.45	2016	FP and CNB	8.4
Baburdi	26.52	41.37	22.07	10.04	2015	CNB and MNB	4.4
Bawada	23.9	25.53	32.64	17.93	2016	CNB, FP and MNB	6.7
Belsar	25.41	29.96	21.02	23.6	2014	FP, MNB and CCT	4.4
Bhadalwadi	28.7	19.71	32.59	19	2016	FP, MNB, ND, and CCT	10.1
Bhandgaon	4.22	19.58	29.82	46.38	2014	FP, MNB and CCT	3.1
Dhakale	17.6	40.4	24.95	17.04	2017	FP, MNB and CNB	9.1
Dive	69.85	20.69	6.43	3.03	2014	FP, MNB,CNB and CCT	6.05
Girim	2.13	18.63	26.08	53.15	2016	FP, MNB, ND and CCT	7.9
Gurholi	32.86	30.85	26.69	9.6	2017	FP, MNB, LBS and CCT	1
Hargude	23.4	32.12	28.61	15.86	2017	FP, MNB, CNB and CCT	3.7
Harni	25.96	33.91	27.44	12.7	2016	FP, MNB, CNB and CCT	3
Jejuri Rural	12.31	13.42	32.8	41.47	2014	FP, MNB, CNB and CCT	3.4
Jiregaon	15.23	28.59	22.29	33.89	2014	FP, MNB, ND and CCT	4.4
Kalamb	25.15	25.02	25.33	24.49	2015	FP and ND	1.1
Khanvadi	47.73	25.73	22.7	3.84	2016	FP, MNB, CNB and CCT	1.7
Lamjewadi	16.29	38.21	24.48	21.02	2015	FP, MNB, CNB and CCT	1.5
LoniBhapkar	25.72	26.62	30.2	17.46	2016	MNB	4.4
Madanwadi	14.45	15.44	21.65	48.46	2016	FP, MNB, ND and CCT	9.69
Malshiras	41.66	26.81	23.09	8.44	2016	FP and CCT	8.8
MawadikadePathar	23.18	37.1	23.21	16.5	2017	FP, ND and CCT	5.15
Murti	44.83	29.57	19.12	6.49	2015	FP, MNB, ND and CCT	8.1
NimgaonKetki	55.45	27.43	11.47	5.66	2015	FP, MNB, ND and CCT	6.3
Pangare	7	23.71	43.14	26.16	2016	FP, MNB and CCT	5.5
Patas	1.31	10.63	20.4	67.66	2016	FP, MNB, ND and CCT	4.25
Pingori	22.14	35.71	26.44	15.71	2015	FP, MNB, CNB and CCT	0.5
Pondhe	16.49	28.65	34.71	20.15	2016	FP, MNB, CNB and CCT	3.9
Rui	49.49	28.45	17.68	4.39	2016	FP, MNB and CCT	3.55
Sakurde	24.74	39.97	21.17	14.12	2014	LBS, MNB and CCT	4.7
Shetphalgadhe	19.6	25.49	28.77	26.13	2016	FP, MNB and CCT	9.9
Supe	38.39	27.84	21.98	11.79	2016	FP, MNB, CNB and CCT	5.4
UndavadiKadePathar	50.45	29.22	15.18	5.16	2017	FP, MNB and CCT	4.3
Walhe	14.89	22.1	32.71	30.3	2015	LBS, MNB and CCT	0.8

Villages which are falls under high suitability zone. It's also have max number of water conservation activities like FP, MNB, CNB, ND and CCT, its showing improvement in groundwater fluctuation and low suitable zones also have water conservation activities but improvement in groundwater fluctuation is negligible.

CONCLUSION

The overall assessment is showing the positive results and negative too.This study will help to save money and time which is required to implement government policy or water conservation programs in that region.

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