Availability of Water Resources in the Indapur Tahsil, Pune District

Gajanan Dhobale
Assistant Professor, Dept. of Geography, Arts, Science and Commerce College, Indapur, Dist. Pune, Maharashtra, India

Abstract

The average annual rainfall is 550 mm. Owing to lack of rainfall there is a need of restoring and maintaining water. In Indapur tahsil, out of 142 villages, around 73 villages (51% area of the total area) gets the benefit of Ujani Dam, Bhima river, Nira river, Nira Left canal and Khadakwasala right canal. The remaining 71 villages (49 % area of the total area) depend on uneven rainfall. All these villages fall under the drought-prone area. The middle part of Indapur tahsil is the most water scarcity area. The majority of small and marginal farmer and landless depends on agriculture, especially in the dry area. Primary and secondary data are used in this paper and data process through Arc View 9.3, Surfer version 10, Global Mapper version 11 for this paper.

The availability of fresh water for domestic use, agriculture purpose and industrial purpose water conservation and management is necessary. Water resources are available through canal, reservoir, K.T. weirs, farm tanks, tanks and other sources in the study area. From all reservoir types water is made available for Indapur tahsil and around 273.81MCM.

The major amount of availability of water resources is rainfall and existing conservation measures. It is observed that the wells and canals are major source of water supply in the study area.

KEYWORDS: availability, domestic, agriculture, industrial, reservoir, water scarcity.

Introduction

Water is the basic need of life for the human beings and any alteration in its availability is directly going to impact them through various means. Most of the rivers are rain-fed and seasonal and only few are perennial. The present study has been taken up to quantify the area being in monsoon climatic conditions it is subject to high variability conditions, it's likely to affect on the availability of water. Thus the conservation and optimum utilization of water as scare resource is extremely important for national economic development. Verma and Phansalkar (2007) studied the temporal and spatial variation in availability of water and it was observed that 71 percent of India's water resources are available to only 36 percent area while the remaining 64 per cent has 29 percent available. Till the middle of the 20th century, the importance of water on life had not been particularly felt because of its moderate demand. But relentless increase in the demand of fresh water in recent years has lead to the scarcity of this basic resource in country.

In Indapur tahsil, out of 142 villages, around 51% area of the total area gets the benefit of different natural and manmade sources. The remaining 49 % areas of the total area depend on uneven rainfall. Water use includes all individual and collective activities of human society which affect water resources and change their quality and quantity. The method of water use and distribution depends especially on the degree of development and availability of water. It becomes systematic as a consequence of agricultural, social and industrial development. Water is also an

integral part of the natural environment and the habitat for many forms of life; it may be human, animal and plant (Opoku-Agyemang, 2005). The water availability statistics has also been worked out through personal interviews and different government office data.

Objectives

1. To identify the availability of water.
2. To find out the sources of water resources.
3. To make favourable suggestions for water availability.

Study area

Indapur tahsil is one of the tahsils in the Pune district consisting of 142 villages along with one urban centre in the study area. There are eight revenue circles in the tahsil. The area extends from 17° 53´ 42" to 18° 19´ 58" North latitudes and 74° 39´ 16" to 75° 09´ 39" East longitudes **(Fig. 1)**. The area is drained by the river Bhima on north and east both sides. Nira River flows south of Indapur tahsil. Total geographical area of the tahsil is 1575.38km^2 (Census 2011), out of which Nira river catchment area compress about 586.8 km^2 and Bhima river catchment covers an area of 902.43km^2. Nira River joins the Bhima River at famous tourist place i.e. Narsinhapur village after travelling a course of 209 Kms. The slope of region is towards east. There are three soil types, namely, coarse shallow, medium black and deep black soils occupying 30, 40 and 30 percent respectively.

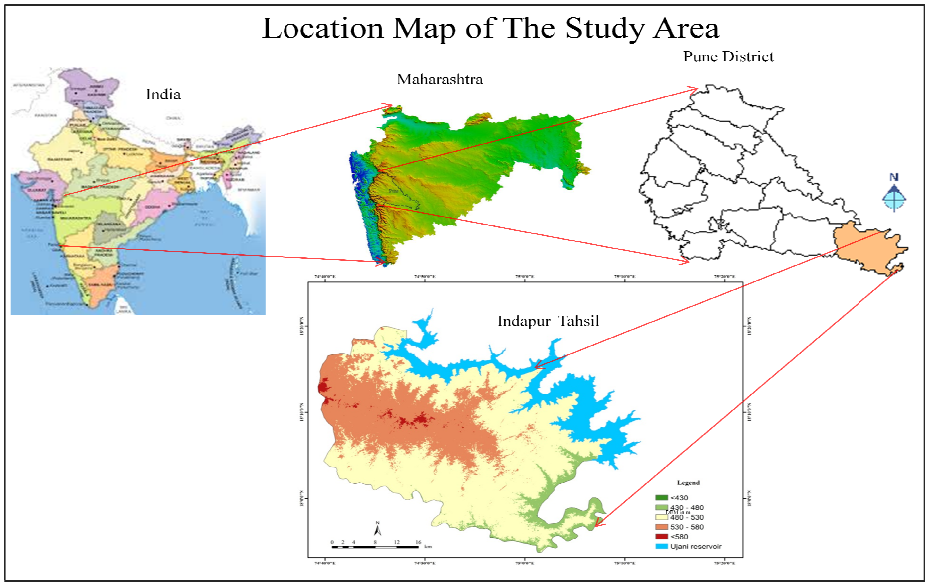


Fig. 1 Location map

Database and methodology

For the present research work primary and secondary data source are used. This work is to develop digital database at large scale using spatial and attribute data. The spatial data comprise of all the thematic and topographic maps and the attribute or non-spatial data is created mainly water details availability information etc. All the supported data is collected from survey of India, Maharashtra State Gazetteer Pune District, Maharashtra Governments department of irrigation, department of agriculture, department of water conservation, These data base converted to Microsoft access format to suit to the link up for processing through Arc View 9.3, Surfer version 10, Global Mapper version 11.

Availability of water resources in the study area

There are around 142 villages and one urban centre which are spread over the Indapur tahsil. The source of water in each village clearly indicates its dependence on

ground water for domestic water requirement. Some of the villages however rest upon two or more resources. The villages can be grouped into two categories: such as ground water dependent i.e. wells, tube wells, hand pumps and springs and surface water dependent it includes river, tank, lake and canal. Considering this scenario of the water supply in the study area it is thought appropriate to conduct sample survey for understanding the pattern of water utilization in the villages.

Rainfall distribution and its variation

The rainfall is varied from season to season. Monsoon is the main rainy season in the study area. The monsoon starts as early in June and continues up to September, sometimes continues till the month of October as noted from the rainfall records during the years (1999-2019). Data recorded at the different rainfall stations of the study area form the main source of information for surface water resources. However, the data are still inadequate for planning and integrated management of the water resources. The monthly records are available for a period of 20 years (1999-2019) from 8 stations in the study area. Mean annual rainfall increases from east to west part of the study area. The average annual rainfall recorded at Bawada, Indapur and Sansar station is more than 550 mm and at Anthurne, Walchandnagar, Nimgaon, Bhigwan and Shetphalgadhe rainfall receives less than 470 mm over a period of 20 years.

The study area receives nearly 75% mean annual rainfall by south –west monsoon, that blows from Arabian Sea and remaining rainfall receives from retreating monsoon. Monthly maximum rainfall occurs in June to September. The highest monthly mean rainfall occurs at Bawada station in the month of September (457 mm).

However, the lowest mean monthly average rainfall occurred in the month of May and November with values reaching between 15mm to 10 mm. It can be concluded that the monsoon season is the only important rainy season in the study area. During the south west monsoon, the study area receives high amount of rainfall. Retreating monsoon contributes around 15% of the mean seasonal totals. Whereas pre monsoon season contributes about 10% of the total mean seasonal rainfall.

Rainfall volume computation

In the study area, the uncertainty of rainfall is a routine picture which has been reflected on total landuse pattern as well. Moreover, the irrigation is provided through canals, wells etc. to support irrigated crops up to some extent. Database on rainfall has been made available from variety of sources i.e. **F**ood and **A**griculture **O**rganization (FAO) grid of climate data, **W**ater **R**esources **I**nformation **S**ystem (WRIS) from river atlas of India (2014). The data obtained is of a longer period around hundred years or more and therefore considered as a final data set for present analysis.

Grid operations

Average rainfall distribution spread over the entire study area thus produced in grid format has been used for volumetric analysis. The area of tahsil segmented into Present paper deals with the assessment of the surface water availability in the study area. In addition to this detail, spread of average annual rainfall which has been analysed for more than 90 years of data has also been considered for interpretation.

Table 2 and Fig. 3b Watershed wise computation of volume of rainfall

Sr. No.	Name of area	Surface area in		Rainfall volume	
		Km^2	%	M^3	in %
1	Bhigwan-BM61	24.72	1.57	16434626513	01.56
2	Loni-BM66	193.87	12.31	130769925147	12.43
3	Palaasdev-BM67	241.88	15.35	161222847818	15.32

4	Akole-BM68	124.42	7.90	83873429156	07.97
5	Sansar-BM76	337.28	21.41	224940004744	21.37
6	Nimgaon-BM77	281.58	17.87	187270276730	17.79
7	Indapur-BM78	371.63	23.59	247957793057	23.56
	Total	1575.38	100.00	1052468903164	100.00

Source: By author

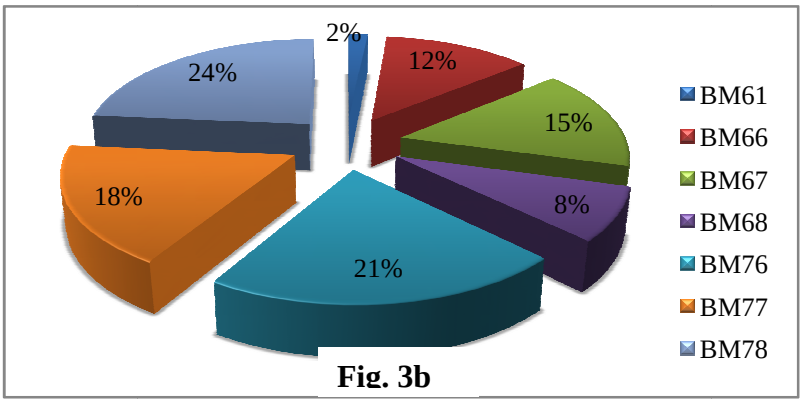
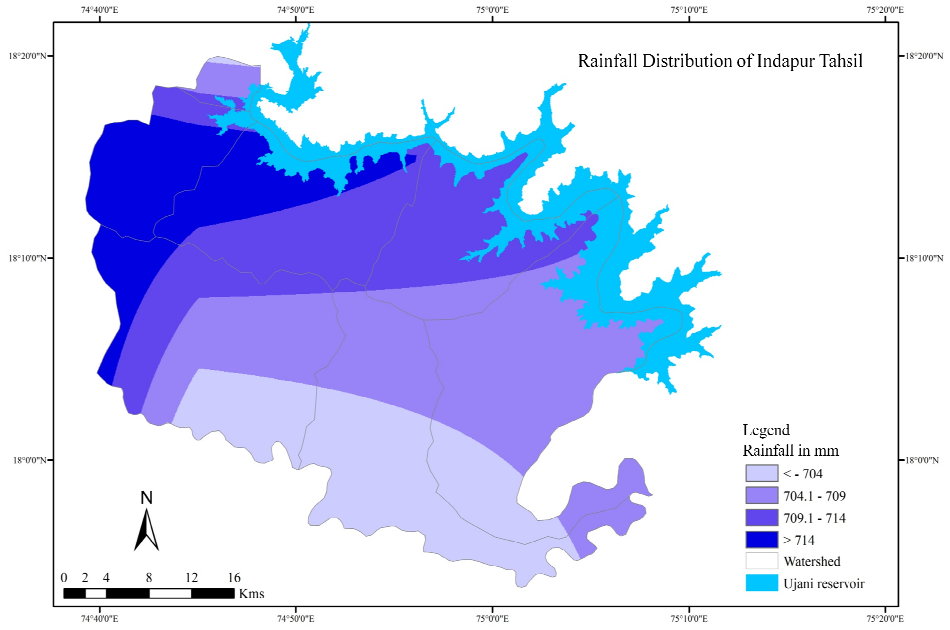


Fig. 3b



Source: www.india.wris.nrsc.gov.in **Fig. 3a**

Soil Moisture

The soils hold water (moisture) due to their colloidal properties and aggregation qualities. The approximate amount of moisture stored in the soil is calculated for the top 150 cm (common rooting zone) of the soil. In the study area soil moisture declined from east to west. It cans clearly distribution of moisture in the area which ranges between 40 - 46 % all over the study area. Except the far eastern area have the moisture variation between 40 - 42 %. From Chakati to Narsingpur village area reduction in the moisture below 42 %. North south strip area of western side found high soil moisture ranges more than 45%. Remaining part of the study area has presented the medium soil moisture i.e. between from 42.1 45%.

Ground water availability

In the study area groundwater recharges from rainfall which is about 85.59 MCM and from other sources it is accounting to 190.05 MCM. There are 275.65 MCM is total groundwater recharge. The natural discharge is to the tune of 13.78 MCM and thus net ground water availability in the study area is 261.86 MCM (GoM Groundwater Survey and Development Agency, GSDA Pune 2014).

Depending on the groundwater occurrence as per Maharashtra Remote Sensing Applications Centre (MRSAC), the study area is divided into three zones, i.e. 'high', 'medium' and 'low'. The 'High' ground water potential areas are those having ground water table less than 5 mbgl, admeasures about 394.79 km^2 (25.06%). The 'Medium' areas are those having water table in the range of 5 to 15 mbgl this groundwater potential zone covers 553.12 km^2 (35.11%) of the total study area and the 'Low' ground water potential areas are those having water table more than 15 mbgl and under these having maximum area i.e. 627.47 km^2 (39.83%) of the total study area (**Table 3 and Fig. no. 4)**. The High groundwater potential covers middle part like a strip from west to east, medium groundwater level is in all villages and low groundwater level appears in small patches and are mainly found in the eastern part of the study area. The average pre monsoon water level is 7.98 mbgl and average post monsoon water level is 3.8 mbgl observed in the study area. The average fluctuation of groundwater level in the study area is 4.19 m.

Table 3 Groundwater potential and covered area

Sr. No.	Zone	GW Potential	Area	
			km^2	%
1	Less than 5.0m below ground level	High	394.79	25.06
2	5 - 15m below ground level	Medium	553.12	35.11
3	More than 15m below ground level	Low	627.47	39.83
	Total		1575.38	100.00

Source: GSDA Pune 2014 – Author

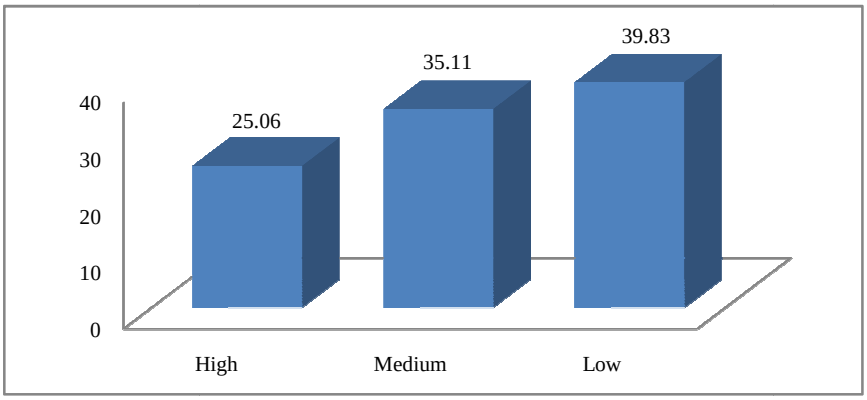


Fig. 4 Groundwater potential

River water volume

Bhima is the main river in the study area and Nira is a tributary of river Bhima. The total length of Bhima and Nira rivers are 103 and 64 kms respectively in the study area. Both rivers bring water during rainy season and shrink during summer. Out of the total 142 villages, 34 villages are lying on the boundary of river Bhima located in the eastern and north eastern parts of the study area; whereas 19 villages are situated on the bank of the river Nira in the study area. Although in the rainy season they vary in water volume, the river system of both the rivers play a significant role in economy of the Indapur tahsil. The large part of surface water is found in the Bhima

and Nira rivers. There are 327.706 MCM volume of water found in the river. About 20% of the total surface water found into two rivers of the study area.

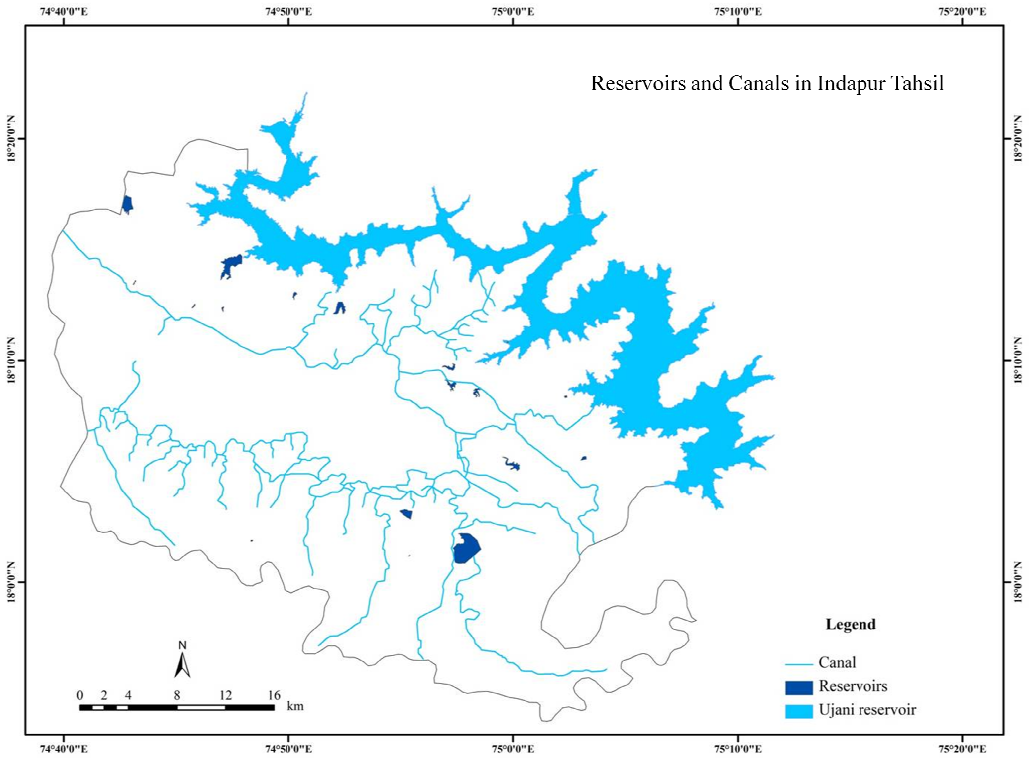
Water resources available through existing conservation measures

Water resources are available through canal, reservoir, K.T. weirs, farm tanks, tanks and other sources in the study area. Nira Left Bank Canal (NLBC) is distributed in the southern and Khadakwasala canal is distributed in the northern part of the study area. Reservoirs and K.T. weirs are located on the main channel network. Different type's reservoirs are available and it's displayed in **table 4 and Fig. 5a and 5b**.

Table 4 and Fig. 5a and 5b Reservoir types and quantity

Sr. No.	Reservoir types	Quantity	Sr. No.	Reservoir types	Quantity
1	Dam	1	8	Percolation Tank	5
2	M.I. Tank	10	9	Underground Band	6
3	K. T. Weir	16	10	Cement Nalabandh	89
4	Valan Bandhara	18	11	Soil Nalabandh	1911
5	L.B. Structure	476	12	Earthen Structure	498
6	Vanraie Band	560	13	Continuous Counter Trench	1020ha.
7	Farm Tank	536	14	Compartment Banding	8957ha.

Source: Agriculture Department, Indapur 2013



Source: Reproduced from mpcb.gov.in/ DEA Pune map **Fig. 5a**.

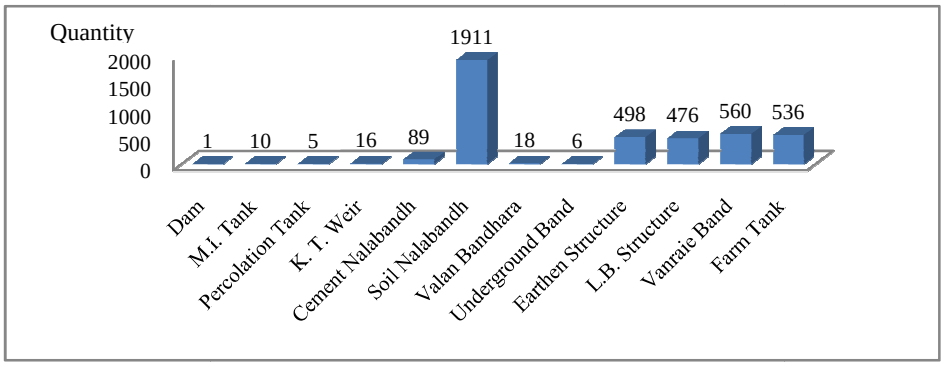


Fig. 5b

Canal

There are two canals in the Indapur tahsil. The canal which flows from southern part is known as Nira Left Bank Canal (NLBC) and that which flows from the northern part is known as Khadakwasala canal. These two canals supply the water for the purpose of domestic, agriculture and industrial use. From the Nira canal total 57.14 MCM water is made available for Indapur tahsil and around 36.823 MCM from Khadakwasala canal total of which 93.963 MCM**.**

Reservoir

The Ujani reservoir is located in the study area, aimed at increasing area under irrigated agriculture in the drought prone areas. The Ujani reservoir is an important source of water for Indapur tahsil. It is the major and reliable water source to meet the water demand. The actual live storage of Ujani reservoir is 117.25 TMC (3283MCM). However, in the last few years, the Ujani reservoir is facing the problems associated with eutrophication and the water quality has undergone significant deterioration. Permitted water for Indapur tahsil for irrigation is 120.624 MCM.

Table 5 Reservoir type and water available for use

Sr. No.	Type of surface reservoir	Water available in MCM	Sr. No.	Type of surface reservoir	Water available in MCM
1	Dam	120.624	11	Varangali tank	0.56
2	Canal	93.963	12	Tarangwadi tank	1.75
3	Shetphal tank	5.85	13	Percolation tank	0.95025
4	Varkute tank	1.43	14	Valan bandhara	2.14735
5	Madanwadi tank	5.64	15	Farm Tank	1.45
6	Pondavadi tank	1.49	16	KT Weir 0-100 ha.	0.08355
7	Bhadalwadi tank	4.57	17	KT Weir 101-250 ha.	0.97963
8	Palasdeo tank	2.7	18	KT Weir >250 ha.	22.1103
9	Gagargaon tank	1.31	19	Other structure	5.48
10	Balpudi tank	0.72		Total	273.80808

Source: *Khadakwasala Patbandhare Sub Division No. 1, Daund, Nira Patbandhare Vibhag, Baramati, Bhima Patbandhare Vibhag, Pandharpur,* Ujani Dam Management Division, Bhimanagar, Irrigation Office, Indapur and Minor Irrigation Department Baramati and Indapur 2013.

K. T. Weir

K. T. weirs are built up where there is flow or depth in the river and where there is strong base rock. Many minor irrigation systems are built on Nira and Bhima

rivers in Indapur tahsil. Bhima is the largest river in the study area which flows in northern and eastern side of Indapur tahsil and which has fully irrigated the eastern part of Indapur tahsil. There are 3 K. T. weirs built on Bhima River, From these K. T. weirs around 9.0286 MCM water resources are made available and 1859 ha area is irrigated in the study area. Owing to the K. T. weirs, 6 villages are under irrigation.

On Nira river around 13 K. T. weirs are built and 13.0816 MCM water resources are made available in the study area. Around 3845 ha area under 17 villages is thus irrigated in the study area, herewith two below 250 ha irrigation capacity K.T. weirs are built in Kurwali and Chavanwadi Villages. These two K. T. weirs storage capacities are 1.06 MCM. The K. T. weirs gross 23.1703 MCM available the water resources in the study area.

Farm tanks

In the study area 340 farm tanks are observed. These farm tanks are constructed the size of 30 X 30 X 3 m. There are 140 farm tanks are built by the grant of Maharashtra Rural Employment Guaranteed Scheme (MREGS), while 200 farm tanks, they are built by the grant of National Agricultural Development Scheme (NADS). These entire farm tanks avail 1.45 (0.449 as per Agri. Office -2012) MCM water resources in the study area.

Tank and other sources

In Indapur tahsil around 5.05% agricultural area is irrigated through tank water. In Indapur tahsil there are 10 Minor Irrigation tanks, 5 percolation tanks and 18 *valan bandhara* are available in the study area. All these tanks gross capacity is 4.16077 MCM and all other types of water conservation i.e. compartment bunding, soil nalabunding, cement nalabunding, earthen structure, underground bund and *Vanraie bund* stores around 5.48 MCM water resources. Totally 9.64077 MCM water resources are available in the study area.

Ground water recharge potential map procured from the primary report clearly indicates that there is very low to low ground water potential in the Indapur tahsil, may be probably due to hard compact basaltic terrain spreaded throughout the tahsil. Therefore in the computation of total water availability for the tahsil only actual evapotranspiration and runoff values have been considered and infiltration has not been considered. It is observed that in the **table 5**.

Conclusions

The entire tahsil is characterised by basement of Deccan trap basaltic lava, which comprises mostly the prophylactic basalts with columnar joints inter trapped beds in the form of red boles at many places. Therefore, ground water recharge potential is very low in the Indapur tahsil. There is only 74.67 km^2 (4.74%) area recommended for groundwater development in the study area. It is observed that the wells and canals are major source of water supply in the study area from the Nira canal total 57.14 MCM water is made available for Indapur tahsil and around 36.823 MCM from Khadakwasala canal total of which 93.963 MCM**.** The K. T. weirs gross 23.1703 MCM available the water resources in the study area. In the study area 340 farm tanks are observed. These entire farm tanks avail 1.45 MCM water resources in the study area. There are totally from all sources 535.66 MCM water available for domestic use, agricultural and industrial purpose in the study area.

REFERENCES

Cara W. Shonsey (2009): Quantifying Available Water at the Village Level: A Case Study Horongo, Mali, West Africa, Unpublished report, Michigan Technological University.

Central Water Commission (2005): General Guidelines for Water Audit and Water

Conservation, Ministry of Water Resources, Government of India.
Chow, Ven Te, Maidment D. R. and Mays L. W. 91988): Applied Hydrology, McGraw-Hill Book Company, New York USA.
Dynamic Ground Water Resources of Maharashtra (2011-12), Prepared By Groundwater Surveys and Development Agency, Pune, Water Supply and Sanitation Dept., GoM and Central Ground Water Board, Central Region, Nagpur, GoI
Government of India (1992): "Gazetteer of the Bombay Presidency, Poona District", 1992, Vol. XVIII, part-III.
Gujar R. K. and Jat B. C. (2008): Geography of Water Resources, Rawat Publi.Jaipur.
Milan K. Jermar (1987): Water Resources and Water Management, Elsevier Science Publishers B.V., Amsterdam, the Netherlands.
Patil A. V. (1994): *Dushkali Jaminisathi Adhik Pani*, Continental Publication, Pune.
Ropelewski, C.F. and Halpert, M.S.(1986). Global and Regional Scale Precipitation Patterns Associated with the ElNino / Southern Oscillation. *Mon. Wea. Rev.*, 115, pp.1606-1626.Sahai V. N.: Fundamentals of Soil, Kalyani Publishers, Ludhiana.
Sharma J. R. (2014): Krishna Basin, Central Water Commission, Ministry of Water Resources, Government of India, New Delhi.
Sodal S. V. (2003): Water Saving Initiatives in Maharashtra State, The Indian Journal of Public Administration, Vol. XLIX No.3 July-September.
Suresh R. (2008): Watershed Hydrology, Standard Publishers Distributers, Delhi.

WEB SITES

www.india.wris.nrsc.gov.in
www.mahaagri.gov.in
www.maha.gov.in
www.pune.gov.in