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WATER REQUIREMENT IN THE INDAPUR TAHSIL DISTRICT PUNE MAHARASHTRA

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Abstract

The requirement of water is essential for every inhabitant and for a wide range of economic and informal sector activities. India accounts for about 17.5 % of the world's population and roughly 4% of the total available fresh water resources. With increasing population and growing demand from industrial and agricultural sectors the water consumption is set to jump up tremendously in the near future. Present study attempts to highlight the requirement of water resources in the Indapur tahsil Pune district of Maharashtra.

The proportion of water requirement is in three different activities i.e. domestic purpose, agriculture purpose and industrial purpose in Indapur tahsil are also discussed in the paper. The water requirement statistics has also been worked out through secondary data and personal interviews conducted during the field visits. For this purpose a questionnaire was framed. Questions are related to domestic, agriculture, livestock and industrial water requirement has also been incorporated accordingly. 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. The outcomes of these studies are briefly presented in the paper. It has been observed that the requirements of water resources are not uniform over the study area. The total water requirement for domestic, agricultural and Industrial purpose claims to 601.38MCM.

Key words: domestic, agriculture, industrial, requirement of water.

Introduction

A given water requirement is the amount of water which is necessary for the undisturbed course of any natural or technological process. It includes water consumption (consumed flow), i. e. the difference between water withdrawal and the net return flow that consists of consumptive use and losses. The water loss represents that part of the water requirement, water consumption, water withdrawal or water resource which returns into the hydrologic cycle in the form of seepage, leakage, percolation, evaporation etc. losses may be either ways. Water requirements and water consumption in the course of agricultural and industrial processes may be distinguished as

(a) Minimum,

(b) Optimum,

(c) Non-Economic.

Minimum water requirement or minimum water consumption during a specific production process can be achieved under special conditions, e.g. in

laboratories. The water saving technology which achieves the minimum water requirements may differ from the technology which achieves the minimum consumption of water, and both can be unsuitable from the point of view of the total production cost. An optimum water requirement and optimum water consumption are attained when industrial processes may be distinguished as the product of desired quality is produced under the conditions of minimum total social effort, i.e. from the point of view of the national economy, by applying an optimum technology. The non-economic water requirements and water consumption exceed this optimum value. Low losses and optimum water consumption are indispensable preconditions for any efficient industrial technology. Low water requirements depend primarily on the degree of recirculation. An efficient water resources management policy is based on a decrease in water consumption and an improvement in the waste water quality. The requirement of society largely depends on its size, the spectrum of activities the society is engaged in and also the lifestyle of the individuals. It may generally be said that greater the concentration of population the more need for the resources. The amount of water required by a group of persons does not depend on only the size of the group but also the need arising out of concentration such as maintenance of hygienic conditions. Hence, the water requirement of rural areas and urban areas differ significantly. UNESCO estimates that the world demand for water will double between 1964 and 1984, but the natural supply will remain same (Batisse, 1964). By the large, water requirements are grouped as domestic requirements, agricultural requirements and industrial requirements.

Objectives

1. To understand, identify and to compute present domestic water requirement.
2. To understand, identify and to compute present agricultural and livestock water requirement.
3. To understand, identify and to compute present industrial water requirement.
4. To make favourable suggestions to utilise appropriate water resources.

Study area

Indapur tahsil is one of the tehsils 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 1575.38km² (Census 2011), out of which Nira river catchment area comprises about 586.8 km² and Bhima river catchment covers an area about 902.43km². Nira River joins the Bhima River at famous tourist place i.e. Narsinhapur village. The slope of a region is towards east. There are three soil types, observed namely, coarse shallow, medium black and deep black soils occupying 30, 40 and 30 percentage area respectively.

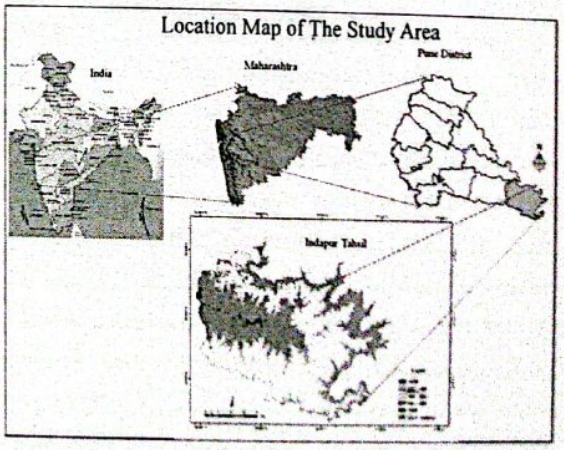


Fig. 1 Location map

Database and methodology

For the present research work secondary data source are used. This work is to develop digital database at large scale using spatial and attribute data. The spatial data comprises of all the thematic and topographic maps and the attribute or non-spatial data is created mainly confined to water resources availability and its utilisation etc. All the supported data has been collected from Survey of India, Maharashtra State Gazetteer Pune District, socio economic reports of Pune district 2011, 2012 and 2013, economic survey of Maharashtra 2012-13, 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 ver.11.

Water requirement

The total quantity of water required for each village was quantified. The amount of water required for a village is the sum of different water uses like domestic water requirements, Livestock water consumption, cultivation and industrial sectors. The water requirement is primarily dependent on the water use of a village domestic, livestock and cultivation. The proportion of water requirement in three different activities in the study area is given in the following **table no 1 and Fig. 2.**

Table 1 Proportion of water requirement in Indapur tahsil

Sr. No.	Water requirement type	Requirement in MCM	In %
1	Domestic requirement	11.00	1.83
2	Agricultural requirement	580.36	96.50
3	Industrial requirement	10.02	1.67
	Total	601.38	100.00

Source: District Socio Economic Report 2012, Census 2011 and data analysis.

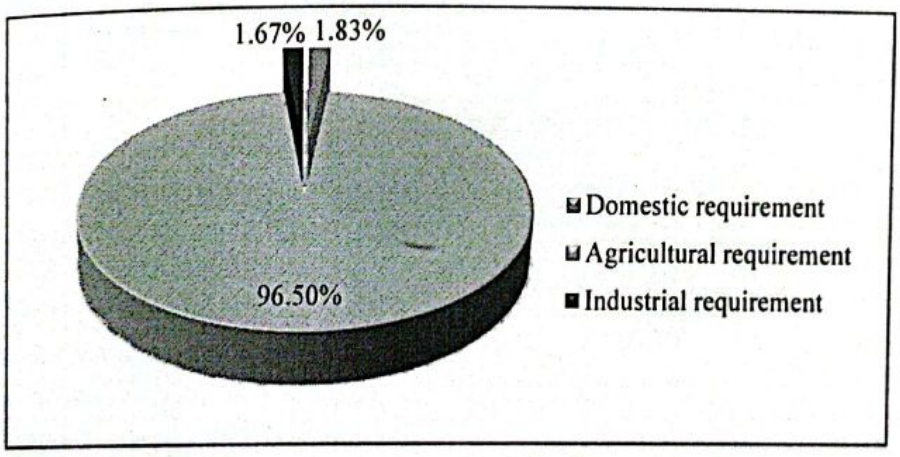


Fig. 2 Proportion of water requirement in the study area

It is clear from the above table and figure that the total water requirement for agricultural claims to 580.36 MCM (96.50%), it is a large proportion. In the industrial sector 10.02 MCM (1.67%) required water, it is considerably low and only 11 MCM (1.83%) water required for domestic purposes. Thus agricultural water required to the only major water consumption sector in the study area.

Domestic requirement

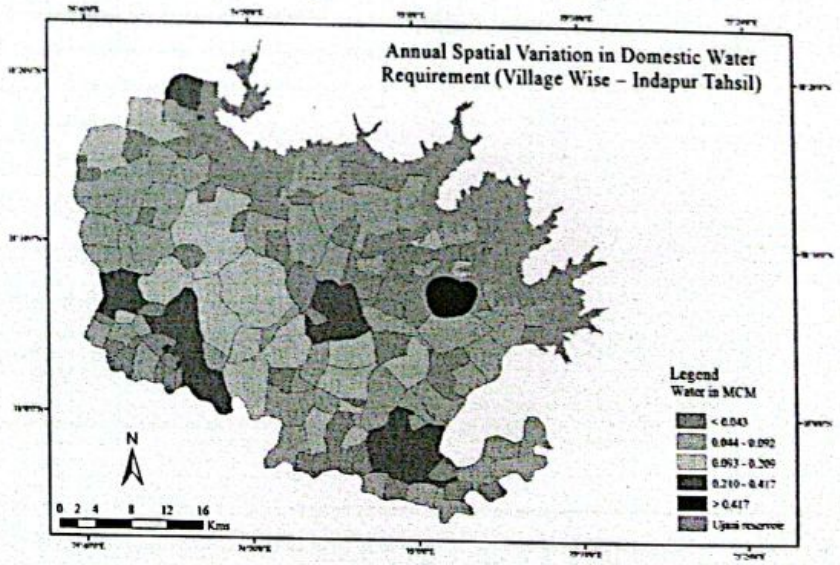
The amount and quality of water used in human settlements influenced the social development of the society concerned and affects the biological development of the individual human beings. The quality and quantity of drinking water supplied to organisms has a direct effect on health. Water demand in households, workshops and public services has different quality requirements for drinking, cooking and other domestic uses for washing, showering, bathing, dish washing, laundry, house cleaning, car washing, yard and park watering, street cleaning, sewer flushing, toilet rinsing, fire extinguishing, heating and air conditioning.

The requirement for drinking and domestic water depends on physical as well as level of socio-economic development. However, World Health Organization (WHO) has estimated that about 200 litres per capita per day (lpcd) water is required for these purposes. It is estimated that 200 lpcd would be sufficient for one person per day living in towns and only 70 lpcd living in villages without flush latrines. The quantity of water required for each village per day, for domestic per annum was estimated as follows.

Quantity of water required per day, QH1= Total population of the village * 70 liter/day

Quantity of water required per annum for each village, QH= 365 * QH1

Taking this average requirement of water for domestic purposes, it has been estimated on the basis of rural and urban population of 2011. It is shown in **fig no. 3**. Total population of the study area is 3, 83,183 persons out of them total rural population is 3, 57,668 and urban population is 25515. Thus, a total requirement of rural people per annum arrives at 9.14 MCM and for urban people, it is 1.86 MCM and thus total 11 MCM water requirements for domestic use in the study area has been estimated.



Source: Author **Fig. 3**

There is a wide regional variation in the requirement, which is the size of the rural and urban population. Rural necessity ranges from 0.007 MCM in Taratgaon village to 0.42 MCM in Kalamb village of study area. It is simply a reflection of the number of people living in these villages. The report of Panchayat Samiti 2010 mentions that the per capita water requirement for rural population is around 50 lpcd. This is on the basis of assumption that the rural water requirement is one third of the urban requirements.

Agricultural requirement

Agricultural water requirements are frequently satisfied by a combination of on-site and external supplies. The regulating function of water has to be achieved by an external water supply for regulating the soil moisture by means of irrigation and drainage, livestock and poultry breeding, fish and water poultry breeding, processing, boiling, cooling, heating, waste disposal, public uses in agricultural settlements.

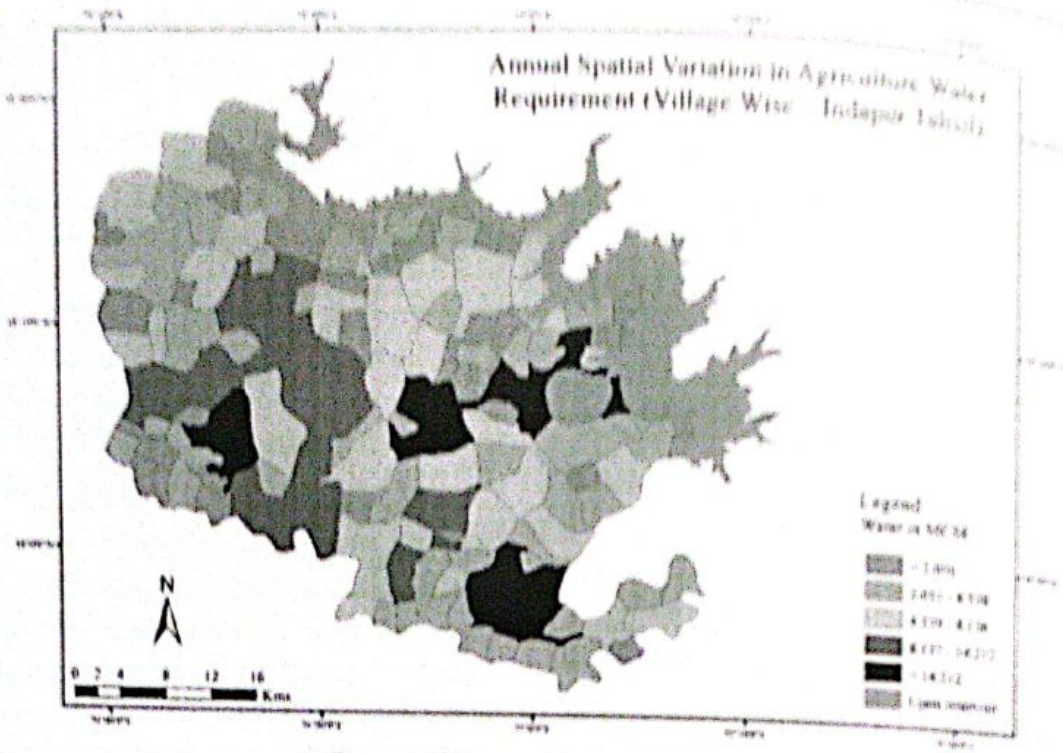
With the modernization of agriculture, irrigation has become imperative. In fact the green revolution has started in areas where reliable sources of irrigation water existed. Total net sown area in the tahsil is 114092 hectors in the year 2012 and more than 83067 hectors (52.72 %) area under irrigation of the total study area. The irrigation department of Maharashtra has taken the data for estimation of water requirement for irrigation in this area. It is proposed to estimate for only half of the net sown area in the first instance. Water requirement for irrigation depends on several factors such as the characteristics of soil, season of cultivation, nature of crops and method of cropping. Agricultural water use of a village was estimated based on the quantity of water required for cultivation of different crops in a village during cropping seasons. The major crops cultivated during kharif (June to October) and rabbi (November to March) and their irrigation water requirements were used in the estimation of village wise agricultural water requirements. In this major crops assumed in agriculture water use estimation were Cereals, Pulses, Oil seeds, vegetables, Fruit's, Sugarcane, cotton, Fodder, Spice, Medicinal and Non-eatable. The total irrigation water requirements of different crops per ha in kharif and rabbi season are shown in **Fig 4.**

Quantity of water requirement for cultivation during Kharif and Rabbi season (QK) = Cereals water demand + Pulses water demand + Oil seeds water demand + vegetables water demand + Fruit's water demand + Sugarcane water demand + cotton water demand + Fodder water demand + Spice water demand + Medicinal water demand + Non-eatable water demand

QK = No of Acers * 450/100000 + No of Acers * 500/100000 + No of Acers * 506/100000 + No of Acers * 450/100000 + No of Acers * 600/100000 + No of Acers * 1200/100000 + No of Acers * 500/100000 + No of Acers * 225/100000 + No of Acers * 625/100000 + No of Acers * 625/100000 + No of Acers * 500/100000

Similarly, Rabbi Season agriculture water requirement was estimated based on the standard water consumption values.

Quantity of water requirement for cultivation during Rabbi season (QR) = water demand for cereals + Pulses water demand + water demand for oil seeds + water demand for vegetables + water demand for fruit's + water demand for sugarcane + water demand for cotton + water demand for fodder + water demand for spice + water demand for medicinal + water demand for non-eatable cultivation.



Source: Computed by author **Fig. 4**

More than 74% population in the study area is directly or indirectly connected to agricultural activity. The major crops of the study area are millets, wheat, maize, sugarcane and fodder etc. The impact of irrigated agriculture on water resources is significant since it uses 96.50% of the total water resources in the study area. There are 68.22% area under cereals and requires about 60.89% of water resources whereas around 7.83% area is under sugarcane and 18.64% water required for this crop. Below 1% area under cotton, spices, medicinal and non-eatable crop and less than 1% water required to cotton and medicinal crop.

Table 2 and Fig. 5a Shows area under crop and **Fig. 5b** shows water requirements

Sr. No.	Crop	Req. water in mm	Area under crop (ha)	Area in %	Water requirement in MCM	Water in %
1	Cereals	450	77832	68.22	350.24	60.89
2	Pulses	500	6326	5.54	31.63	5.50
3	Oil seeds	506	4861	4.26	24.60	4.27
4	Vegetable	450	4218	3.70	18.98	3.30
5	Fruit's	600	3171	2.78	19.03	3.31
6	Sugarcane	1200	8935	7.83	107.22	18.64
7	Cotton	500	173	0.15	0.86	0.15
8	Fodder	225	7549	6.62	16.98	2.95
9	Spice	625	367	0.32	2.29	0.40
10	Medicinal	625	81	0.07	0.51	0.09
11	Non-eatable	500	579	0.51	2.89	0.50
	Total		114092	100.00	575.24	100.00

Source: District Socio Economic Report 2012, Santosh Kumar Garg (2011) Irrigation

Engineering and Hydraulic structures, Khanna publishers, New Delhi, 24th editions and data analysis.

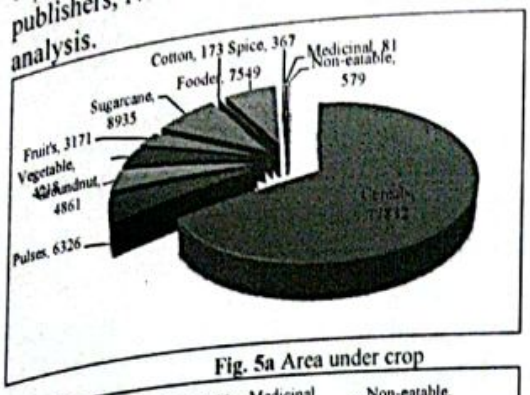


Fig. 5a Area under crop

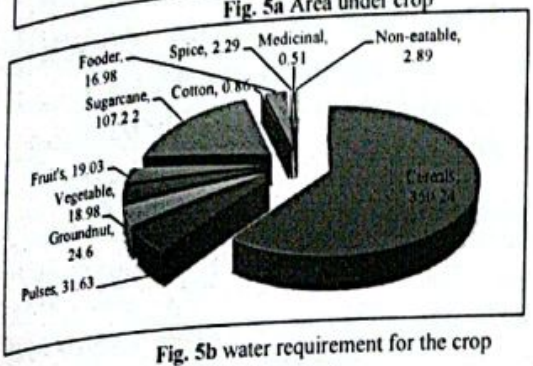
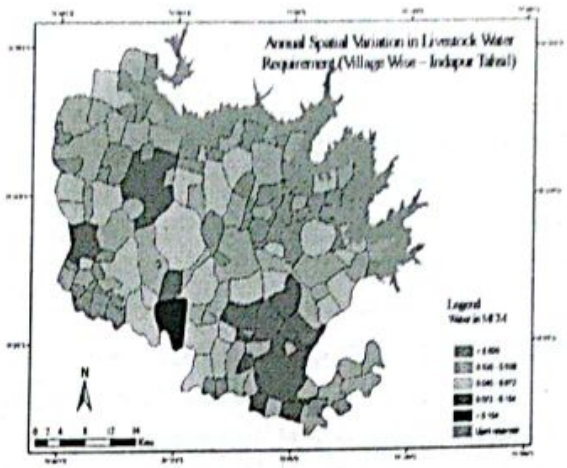


Fig. 5b water requirement for the crop

Livestock Water Requirement

Livestock are an integral part of farming in this area. Hence, it is essential to have an estimation of water required for provision of water for livestock rearing. Water requirement for livestock refers to the quantity of water required for drinking and water in feed to support livestock production (M. Blummel et al. 2009). The water required for livestock rearing depends on the number of animals and consumptive use per head (U.A. Amarsinghe et al. 2004). The total livestock water required for a village was assumed as the sum of water required for domestic animals like cattle, buffaloes, sheep and Goat. Approximate water required considered for different animals as recommended in Frasier and Hyers (1983) in litres per day (lpd) are shown in **fig. 6.** It is presumed that, on an average 85 to 10 litre of water required for one animal per day.

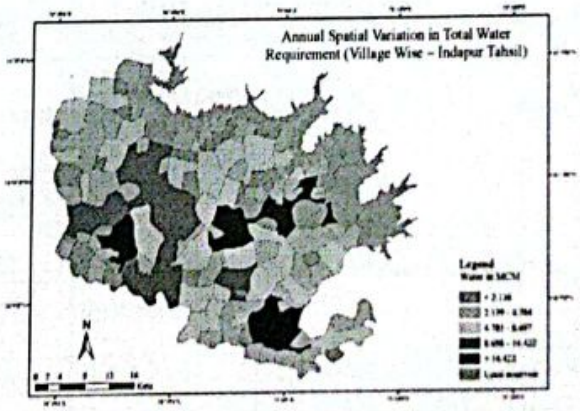


Source: Author **Fig. 6**

Quantity of water requirement for livestock consumption per day, QL1 = No. Of Cattle * 85 + No. of Buffaloes * 85 + No. of Goats * 10 + No. of Sheep * 10

Quantity of water requirement for livestock consumption per annum, QL = 365 * QL1

Total animal population was 259980 (Census 2012) in the year. Thus, total requirement of water for animal rearing arrives at 5118659625 litres (5.12 MCM) water required per annum are shown in **fig no. 6.** Agricultural water requirement is 575.24MCM and animal water requirement is 5.12 MCM totally 580.36 MCM **(Fig. 7)** water required for agriculture purposes in the study area.



Source: Author **Fig. 7**

Industrial requirement

Industrial supply is enable by industrial water supply and disposal systems, i.e. sets of structures, technological equipment such as measuring and controlling devices with associated feedbacks which secure the withdrawal and treatment of water, its distribution and circulation, as well as waste water treatment and recycling, sludge disposal and the harmless discharge of polluted water into appropriate recipients. So supply of water is taken care of before establishing the industrial plants so that the industrial activities are not hampered by the scarcity of water. But there are several problems hindering the estimation of industrial requirement of water. First, distribution of industries by nature is a localized phenomenon. Secondly, requirements vary with size and nature of manufacturing. Therefore, requirements of industrial units cannot be generalized and estimated. There are 4 Sugar factories, 1 paper industry, 1 Jaggery mill, 1 Dairy industry and other small scale industries are located in the study area. Thus, at present about 10.02 MCM of water is required by industries located within this area, out of them paper industry requirement is on high amount i.e. 8.6 MCM (Science and Technology Park, University of Pune) it is 85.83% of the total industrial water requirements **(Table 3 and Fig. 8)**.

Thus, the amount of water use and requirement by different sectors i.e. domestic, agriculture and industrial it is observed that agricultural component in the study area requires a high amount of water.

Table 3 and Fig. 8 Shows industrial water requirements.

Sr. No.	Name of industry	Crushing capacity in MT	Daily intake water (m^3)	Total yearly utilization (m^3)	Water requirement in MCM	Water use in %
1	Ballarpur Industries Ltd. (BILT)	-	23571.0	8603415	8.603	85.89
2	Chhatrapati Sahkari Sakhar Karkhana	3500	1312.5	196875	0.197	1.97
3	Nira-Bhima Sahkari Sakhar Karkhana	3500	1312.5	196875	0.197	1.97
4	Karmyogi Shankarrao Patil Sahkari Sakhar Karkhana	8000	3000.0	450000	0.450	4.48
5	Baramati Agro Sakhar Karkhana	3500	1312.5	196875	0.197	1.97
6	Sonaie Jaggery Industry	500	20.00	3000	0.003	0.03
7	Sonaie dairy	-	600.0	219700	0.220	2.19
8	Other industries	-	410.96	150000	0.150	1.50
	Total	19000	31539.5	10016740	10.017	100.00

Source: Socio-Economic report of Pune district 2012, 2013 and sugar factory reports.

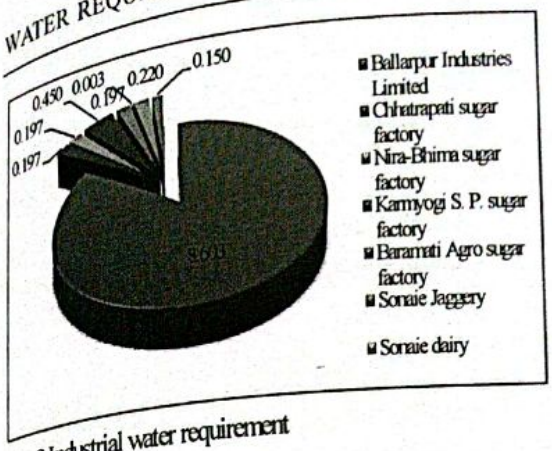


Fig. 8 Industrial water requirement

Conclusions

It has been one of the challenging studies for quantifying the climate change impact where in the water balance simulation modelling approach has been used to maintain the dynamics of hydrology and thereby make assessments of vulnerability which are more authentic and reliable. The average annual volume of rainfall is 1052.46 MCM. . The total water requirement for agricultural claims to 580.36 MCM (96.50%), it is a large proportion. In the industrial sector 10.02 MCM (1.67%) required water, it is considerably low and only 11 MCM (1.83%) water required for domestic purposes. In an attempt to find out the present villages which are dependent on water supply through water tankers for domestic purpose especially in summer months. Thus agricultural water required to the only major water consumption sector in the study area. Central part of the tahsil almost remains same as showing the acute shortage of water, where as marginal areas have more or less fluctuating little bit.

The strategies may range from change in land use, cropping pattern to water conservation etc. and need rigorous integrated analysis before paving way into policy decisions. The research works done on water requirement of the study area. Some of the affects of climate change on water resources. Agriculture cannot sustain without adequate water available for its consumption. With increasing population and demands from various sectors including industry and agriculture the consumption of water is going to jump up in the coming decades.

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