Ms.M.P.Kulkarni, et. al. International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 13, Issue 5, May 2023, pp. 180-189

RESEARCH ARTICLE OPEN ACCESS

Water supply in Marathwada Region: ANOVERVIEW

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ABSTRACT
Water is an indispensable part of human existence. Despite the continuousefforts by various governments more than 12 billion people do not have proper accessto pure drinking water and hygienic sanitation is unavailable for more than 3.1billionpeople across the globe, especially the developing nations such as India, China, SouthAfrica, Venezuela, Cuba, etc. are being affected at an alarmingrate. In developing country like India, There are many arid regions like Marathwada region in state of Maharashtra. This is semi-urban and mostly rural area of Maharashtra, Which is having main catchment of Godavari River. Still many districts from the region are facing scarcity of water during hot weather especially. Ruralwatersupplysystemsplayavitalroleintheevaluationoftheprevailing systems as the major share of the population in the developing countriesdwell in rural areas. Life expectancy and mortality rate of a country are majorlydependent on its water supply and sanitation system. This paper gives an over view ofthe existing water supply and in Marathwada highlighting the burning issues andmajorchallengesfacedbytheregion today.
Keywords: Drinking water, Water Demand, Water supply, Population.

Date of Submission: 14-05-2023 Date of acceptance: 26-05-2023

I. Introduction

Water covers over 70% of the surface of the globe. Inferring that just 2% of this water is fresh, the seas make up 98%of it. Due to the presence of polar ice caps and glaciers, 1.6% of this fresh water is rendered inaccessible. Furthermore, only 0.36% of the total is made up of groundwater. Therefore, only 0.036% of the water is usable for direct consumption in lakes and rivers. The human race uses this meager amount of water for a variety of uses, including domestic, industrial, commercial, agricultural, public, etc.[Wikipedia2022].Water supply is the process of moving water efficiently from the point of production to the point of consumption. A water delivery system that ensures a consistent, reliable, safe, and regular supply of water is effective. The Water that is given must maintain the required level and quality. Consequently, a good water supply system should be able to do the following: it should be able to meet all necessary demands, including those for domestic, industrial, and commercial use, public use, etc.; it should maintain an adequate pressure under continuous consumption; it should convey treated water up to consumers with a prescribed degree of purity; it should also be able to supply the necessary amount of water for emergencies, such as firefighting; and it should be dependable and secure. Poor water resource management is the other side. Well-managed water resource is essential because of its complexity and connections to other natural elements. To meet these competing needs, water resources management tries to maximize the available natural water flows, including surface water and groundwater.

The groundwater level in the Marathwada region had dramatically dropped during four decades of unrelenting "water mining" due to poor management of water resources, making its rejuvenation challenging. The water table had alarmingly fallen in 70 of the 76 talukas of Marathwada, according to statistics from the Groundwater Surveys and Development Agency, with more than 25 reporting a decrease of more than two meters. The shift in crop patterns to one that is not compatible with the agro-climatic features of this region is one of the maincauses of the water issue. Cereal and oilseeds were once the primary crops grown here. These plants not only thrived in the dry environment of Marathwada, but also facilitated moisture harvesting and drought resistance. But today, soybean and Bt cotton are the main crops grown here, occupying more than 80% of Marathwada's arable land. These crops, together with the promise of quick money from sugarcane, have brought farmers and city dweller dangerously close to the current hydrological catastrophe. The situation is also caused by the water being diverted to the industries and sugar factories. Marathwada's sugar mills were despite the growing water issue, functioning. A little more than 2,000 gallons of water are needed to manufacture 1 kilograms of sugar. Additionally, the State made no notable efforts to cut off half of the water supply to the industries. Additionally, there hasn't been a significant effort made to collect water or top off the groundwater table. ThemajorityofpopulationinIndia,dwellinruralareas, hencethedevelopmentof the water supply and sanitation facilitiesin these areas had to begivenmaximumconsideration.Accordingtothe1990census,only55.54%population had access to an improved water source. This further improved to 74.39%of fully covered and 14.64% partially covered rural habitation. [Government of IndiaplanningCommission2007].

MarathwadaisaregionintheIndianstateofMaharashtra. The region coincides with the Aurangabad Division of Maharashtra. Itborders the states of Karnataka and Telangana, and it lies to the west of the Vidarbharegion and east of the Khandesh region of Maharashtra. Aurangabad is the largest cityof Marathwada.The Marathwada region straddles 64,500 km2 and has eight main sub-districts. It hasapopulationof19.26million,ofwhom5.39million areinurbanareas,subdividedintocorporations(COs)andmunicipalcouncils(MCs).Inall,thereare4municipalcorporations,51municipalcouncilsand20panchayatsinMarathwada.Itsruralpopulationisorganisedintopanchayats(villagecouncils)andsome12,920villagesarerecordedinthetaluka-wisedatareceivedbyMJP.Thetotalruralpopulationat present(2018) is13.89million. The population projection for Marathwada for 2050 is about 35.5 million, of whichsome 12 million will be located in urban areas. This rural-urban shift is common notonlytoMarathwada,buttoallofIndiaaswell.Astressedagriculturesectorandrisingunemployment in the rural areas are encouraging more and more migration to theurbancentres.The major cities are Aurangabad, Nanded, LaturandParbhani.Marathwadasuffersfromahighlyerraticrainfallduringthemonsoonseason,thoughthisrainfallaccountsforalmost80 % oftheannual rainfall

1.CASE STUDY

In the current research, we have examined Marathwada's urban and rural population projections. And consequently, how much will be needed in terms of quantity for various requests in the following year. Additionally, we are talking about the Godavari River, a perennial river that Flows through Marathwada. Despite this, Marathwada is rapidly turning arid

We have collected forecasted population data.with required water demand for upcoming yeas in Marathwada and also considered various demand in the same

Table1.Decadal urbanandruralpopulationincreases1981-2011

Year	1981	1991	2001	2011
UrbanPop	1,978,281	3,042,564	4,140,433	5,072,074
RuralPop	7,750,501	9,919,559	11,488,815	13,659,798
Urban/rural(%)	26%	31%	36%	37%
Urban/total(%)	20%	23%	26%	27%
Rural/total(%)	80%	77%	74%	73%
Total Pop	9,728,782	12,962,123	15,629,248	18,731,872

Table2.Urbanandruralpopulationprojectionsfordecades2020-2050

	2020	2030	2040	2050
UrbanPop	6,235,933	7,787,787	9,712,180	12,062,224
RuralPop	15,310,988	17,548,418	20,250,393	23,485,454
Urban/rural(%)	41%	44%	48%	51%
Urban/total(%)	29 %	31%	32%	34%
Rural/total(%)	71%	69 %	68 %	66 %
Total Pop	21,546,921	25,336,205	29,962,573	35,547,678

Table3.Industrialwaterdemandfor2018andprojectionsfor2050(MLD)

	2018	2050
MLD	203	305

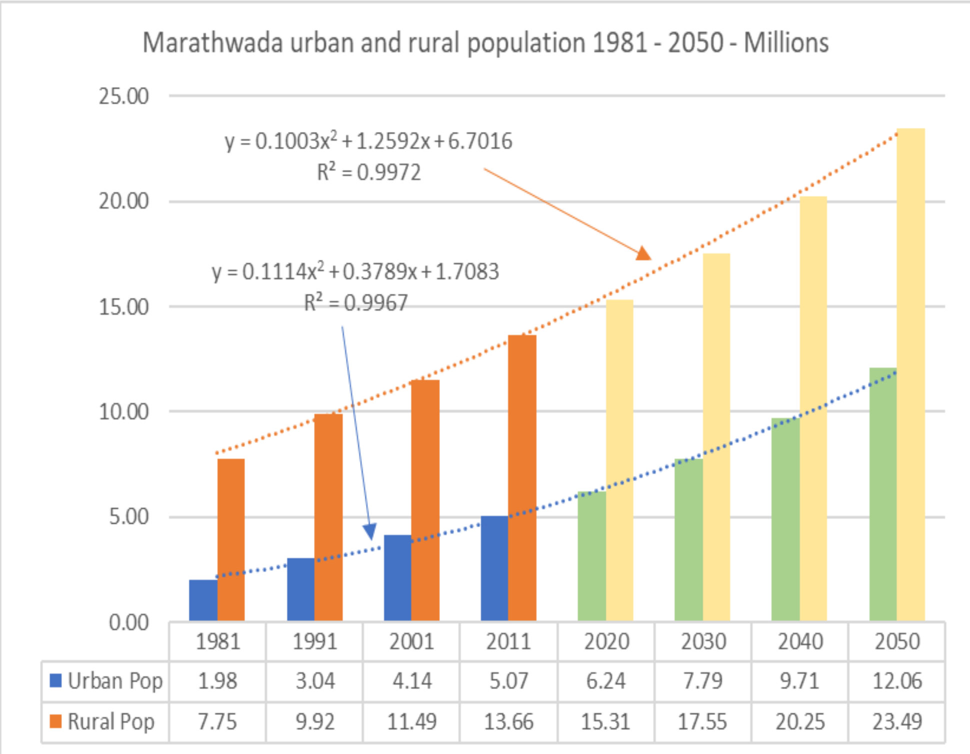
Source:MarathwadaIndustrialDevelopmentCorporation(MIDC)

Table4.Marathwadaindustrialwaterdemandprojections

Year	2020	2030	2040	2050
Mm3	62	68	76	91

Source:datafor2018and2050receivedfromMarathwadaIndustrialDevelopmentCorporation(MIDC)

Graph1.Marathwada Urban and Rural Population



1.1Agriculturesectorwaterdemandprojections

The agriculture sector is the biggest water consumer in the Marathwada region. Datareceivedfromtheagriculturedepartmenthelpedc alculatethesector'swaterrequirements (Appendices 8-13). The irrigation department estimates that due to theprevailingwaterscarcity,only15%-25%ofthepotentiallyirrigableareainMarathwada is being irrigated through irrigation canal systems. From the integratedstate water plan for the Godavari Basin in Maharashtra Volume 1 - November 2017report(table8)-thetotalwatersuppliedfromSWtoirrigationwasestim atedat3,270Mm3 (assumed average yield of SW). From report number 1 – revised (MekorotMarathwada WSMP), it was estimated that annual irrigation from GW origin is 6,780Mm3 - hence: 3,270 Mm3 +6,780 Mm3 = 10,050 Mm3 = estimate of total irrigationsupply.

Table5.Marathwada regionabstractirrigationwaterusefromSWresourcesper projectsize -MM^3,2018

	Major+Medium	minor	Total
completedprojects	1,624	1,646	3,270

Source:integratedstatewaterplanforGodavariBasininMaharashtra

Table6.Annual SWwaterforirrigationsupplypersub-basin–MM^3

	Year			
SubBasin	2006	2008	2009	2010
Godavari	2,213	2,146	588	1,762
Krishna	49	77	49	65
LowerTerna	-	37	14	-
Others	324	355	199	671
Tapi	-	2	2	5
GrandTotal	2,586	2,616	851	2,504

Table 7.Projectedincreaseinmonsoonrainfallperdistrictfortheyears2030, 2040and2050.

			Projected increase inmonsoon rainfall (%increasefrom baseline)			Projected monsoonrainfall(mm)		
#	District	Normalmonsoon rainfall forMarathwada(mm)*	2030	2040*	2050	2030	2040*	2050
1	Hingoli	708.8	22.9	24.6	26.3	871	883	895
2	Beed		22.65	24.425	26.2	869	882	895
3	Nanded		19.22	21.26	23.3	845	859	874
4	Latur		17.93	19.765	21.6	836	849	862
5	Jalna		23.4	23.75	24.1	875	877	880
6	Parbhani		22.64	23.07	23.5	869	872	875
7	Osmanabad		19.8	19.98	20.16	849	850	852
8	Aurangabad		24.95	25	25.05	886	886	886

In order to estimate irrigation water supply at plot level, the following losses wereassumed:

- 40%%lossesfromGWsystemonplot level
- 60%lossesfromSWsystemsonconvey systems+plot levels

Hence, 6,780*0.6 + 3,270*0.4 = 5,376 MM^3 = average net water available to plotirrigatedarea. Upon analyzing the WALMI institute water audit data for past years ,it isfound that SW supplied for irrigation was calculated per project and per sub-basin(calculatingleftandrightbankreleaseandaddingliftforirrigationforeveryproject).

Table6.clearlymarksthefluctuationinwatersupply toirrigationfromSWsourcesdueto annual rainfall. Report number 1 calculates 3,036 Mm^3 for irrigation water use forthe whole of Marathwada in the year 2014 (from Walmi data department) and thisbearssimilaritytotheGodavarireport (3,270).

Today, the demand for irrigation water is much higher than the water available. Thisreport analyses and projects irrigation water requirement (IWR) in Marathwada.

TheanalysisoftheseasonalIrrigationWaterRequirement(IWR)perDistrictandperTaluka,consideredthedataintheclimatechangereportregardingtheeffectsofCConwateruse inagriculture (AssessingClimate Change Vulnerability and AdaptationStrategies for Maharashtra (MSAAPC) provides projections for 2030 and 2050) aswell. The MSAAPC report projected around 20 %. % increase in the monsoon rainintensities over the years 2030 – 2050. Report analysesthe annual rainfalldataforMarathwadacoveringaperiodof36 years,1981-2017,anddrawnfromdifferent data sources like the Indian Meteorological Department (IMD) and localauthorities.Thedatapresentadecreasingtrend intheannualrainfall,withamagnitudenearing10%fortheperiodforthepast30years.Theannualaverage wascalculatedas677*mm*to707*mm*,withastandard deviationof 184*mm.*

In order to obtain a more conservative approach, this report assumes no increase inrainfallin future and uses the current average annual rainfall as the bottom scenarioof677*mm.*Thisistoignorethefutureprojectionregardingincreaseinrainfallinthisareaduetoclimatechangeeffects.

Here we canassumenoincreaseinrainfallovertheyears;itassumesariseintemperatureaspredictedintheMSAAPCreportand,asaresult,anincreaseinaverageevapotranspiration by up to 14.8 %above the current average by 2050. A 5 % decadal increase in average evapotranspiration of crops from 2030 to 2050 wasassumed,rising to15% abovethecurrent baselinein2050.

The IWR projection also includes the improvement in efficiency that will take place inthe agriculture sector over time, and assumes efficiency to increase by 11% withcomparisontothecurrentstate.Thewaterrequirement projections are summarized for the irrigation sector season wise and total. It is importantto note that the figures are represented so as to understand the load of the agriculturesectoronthewater resourcesoftheregion.

1.2 Water Demand Projections

Projectionsfordecadaltaluka wisewaterdemandweremadefor2020–2050asregardsthefollowing sectors:

1.2.1 Averagedailywaterdemand[L/D]=LPCD*Population:

This is the average daily water demand in a year and calculated based on the forecastLPCD values (liters per capita per day) received. LPCD values for planning purposesdifferaccording tolegislationand existingmanuals.

1.2.2 YearlyDemand[M^3/Year]=

Averagedailydemand[L/D]*365/1000.

1.2.3 MaximumdailyDemand[M^3/Day]

=Averagedailywaterdemand*1.2-1.12

This is the maximum daily demand for water and the maximum hourly demand can bedrawn from this. To design a water transmission system, it is important to know themaximumper-day demandforwaterandthedurationofthedailysupply.

There are seasonal and even daily variations in the demand for water,the maximumdemand being calculated by adding 10-30 % to the average daily demand. A muchgreatervariationtakesplaceintwopeaksduringthesameday(hourlyvariation),oneinthe morning and one in the evening. The peak factor by which the average hourlydemandmustbemultiplieddependsonthesizeandcharacterofthecommunityserved.Ittendstobehighforsmallvillagesandlowerforsmalltowns.Thisreporthastaken20%abovetheaveragedailywaterdemand. WaterdemandprojectionsforIndustryandfortherural,urbanandbovinepopulationsrepresentthemaximum daily supplyforeverytaluka.

Sufficientwater must be available tomeetthe peak demandsand the pumps anddistribution system must be suitably designed for this. Hourly variations can influencethedesign of pipediameters, pumpsandservicereservoirs.

1.2.3 WaterLossCoefficient

TheCentralPublicHealthandEnvironmentalEngeeringOrganization(CPHEEO)determines the Non-Revenue Water (NRW)coefficient-typically measuredas thevolume of water "lost" as a share of the net water produced –to be no more than 15 %within residential areas. The same coefficient was used for the industrial, urban, ruraland bovine water demand calculations. A one % decline in NRW coefficient is assumedfor each preceding decade, on considerations of expected improvement in water supplysystems both in performance and in maintenance. We assumed that every 10 years thelosscoefficient willbereducedbat least1 %

1.2.4 Yearly water Supply [M^3/Year]= Average Yearly Demand [M^3/Year]x (1+Waterlosscoefficient).

1.2.4 Maximum daily Supply [M^3/day]= Max daily Demand [M^3/Day]* (1+Water losscoefficient).

II. Methodology

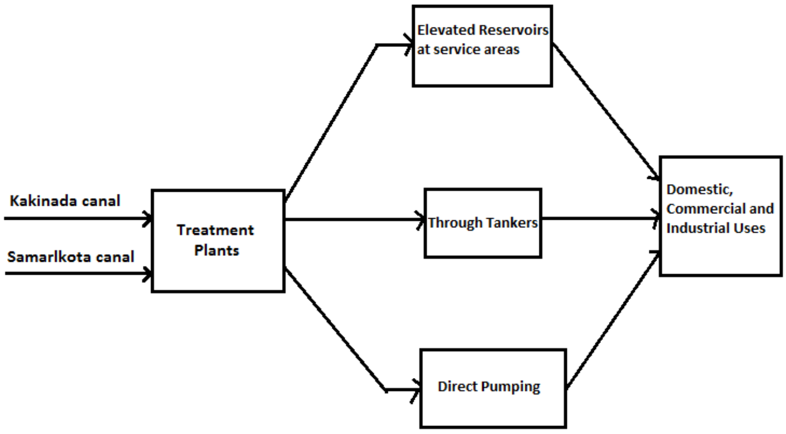
Toestimatewaterdemandprojectionsfortherural andurbansectors,thefollowingparameters needtobedefined:

- LPCD-isthewaterdemandin litresper capitaperday.
- Populationprojections
- Averagedailywaterdemand[L/D].
- YearlyDemand [M^3/Year].
- MaximumdailyDemand[M^3/Day].
- WaterLosscoefficient

Estimationofwaterdemandandsupplyisnecessary tocalculate:

- Pipecapacity
- Reservoircapacity
- Designflow
- waterpumpingstations

Fig.1 Schematicflowdiagramof watersupply inMajor areas in Marathwada



Source:MWRRA'sorderno9/2017dt22.9.2017

Table8.Applicablepercapitanormsfor entitlementtoDBWU –MWRRA

Sr. No.	Category	Norm (lpcd)
(1)	(2)	(3)
1	Rural Water Supply Schemes	55
2	Peri-urban Area	70*
3	Municipal Councils 3a) C - Class 3b) B - Class 3c) A – Class	 70* 100* 125*
4	Municipal corporations (having population less than 50 lakh)	135*
5	Metropolitan centers (having population equal to or more than 50 lakh)	150*

III. Discussion

One major factor responsible for the water crisis is the change in crop pattern to one which is not congruent with the agro-climatic characteristics of this region. Earlier, the main crops cultivated here used to be cereal and oilseeds. These crops were not only conducive to Marathwada's arid climate but were drought-resistant and led to moisture harvesting. But now, the predominant crops here are soybean and Bt Cotton, which dominate more than 80% of Marathwada's cultivable land. These crops, coupled with the lure of easy profits from sugarcane, have led the farmers and the citizens to the edge of the current hydrological disaster. Another factor responsible for the crisis is the diversion of water to the industries and sugar factories. Sugar factories in Marathwada were operational despite the mounting water crisis. To produce 1 kg of sugar, about 2,000 litres of water are required. There was also no significant effort was made by the State to curtail the water supply½ to the industries. Moreover, there has been no significant effort at harvesting water or replenishing the groundwater table.

IV. Conclusion

There are provisions within the Maharashtra Irrigation Act of 1976 wherein the government can notify people in the command area not to go in for water-intensive crops like sugarcane in the case of acute water scarcity. Cultivation of drought-resistant crops like oilseeds and pulses should been encouraged. People should be encouraged to adopt water harvesting practices and watershed should be developed under the MGNREGA programme to replenish the groundwater table.Finally, to tackle this situation, several political measures should be undertaken. Scientific dry farming with introduction of less water intensive crops like oilseeds and pulses to be taken as one of the main task. Marathwada region has tremendous potential for horticulture development such as sweet lime, pomegranate, etc. Sugarcane crushing is to be stopped and finally to be shifted from this area to the nearby area. Industries like beer, distilled water need to be shifted in peripheral area. Steps should be taken to introduce integrated marketing system to avoid exploitation by intermediary. With judicious water management, the area can be turned into a successful grassland farming area.

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