State of India's Rivers

For

India Rivers Week, 2016

MAHARASHTRA

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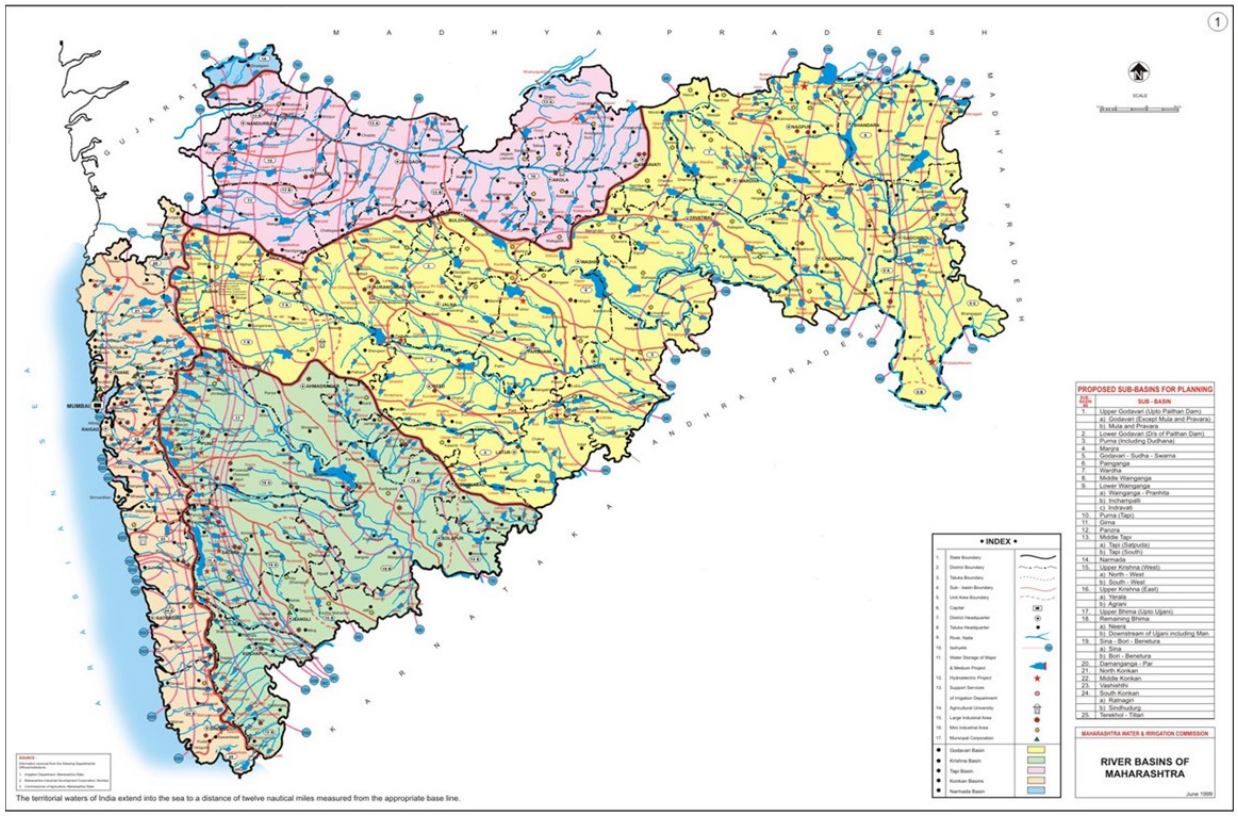


Map 1: Major River Basins of Maharashtra Source: MWRRA

1.1 Introduction

State of Maharashtra is bordered by the states of Madhya Pradesh to the north, Chhattisgarh to the east, Andhra Pradesh to the southeast, Karnataka to the south, and Goa to the southwest. The state of Gujarat lies to the northwest, with the Union territory of Dadra and Nagar Haveli sandwiched in between. The Arabian Sea makes up Maharashtra's west coast.

The Western Ghats or Sahyadri ranges run parallel to the coastline of Maharashtra, at an average elevation of 1,200 metres (4,000 ft).

To the west of these hills lie the Konkan coastal plains, 50–80 kilometers in width and to the east of the Ghats lies the flat Deccan Plateau.

The Western Ghats form one of the three important watersheds of India, from which many South Indian rivers originate, like Godavari, Bhima, Koyna and Krishna

Population of the State: 11,23,72,972. (2011 Census) 35 districts.

- Growth rate: 14.23%
- Per capita income: 74, 027 as against national average of 46492
- Literacy rate 76.88% as against National average of 64.84%
- Contribute to about 14.7% of National GDP, highest in country
- It is the second most populous after Uttar Pradesh and third largest state by area in India.
- Percentage gross irrigated area (4037 thousand ha)as compared to gross cropped area 22655 thousand ha): 17.7% (against National av. Of 44.6% (Mah. Economic Survey 2010-11, GOM)
- Percentage urban population 42.43 % (most urbanized state in India) as against national average of 27.82%, though this is extremely concentrated
- Maharashtra is the third largest state in India with an area of 308 lakh hectares

1.2 Rivers of Maharashtra

The geographical area of Maharashtra state is 308 lakh ha and its cultivable area is 225 lakh ha. Out of this, 40% of the area is drought prone. About 7% of the area is flood prone. The highly variable rainfall in Maharashtra ranges from 400 to 6000mm and occurs in a four months period between June - Sept with the number of rainy days varying between 40 and 100.

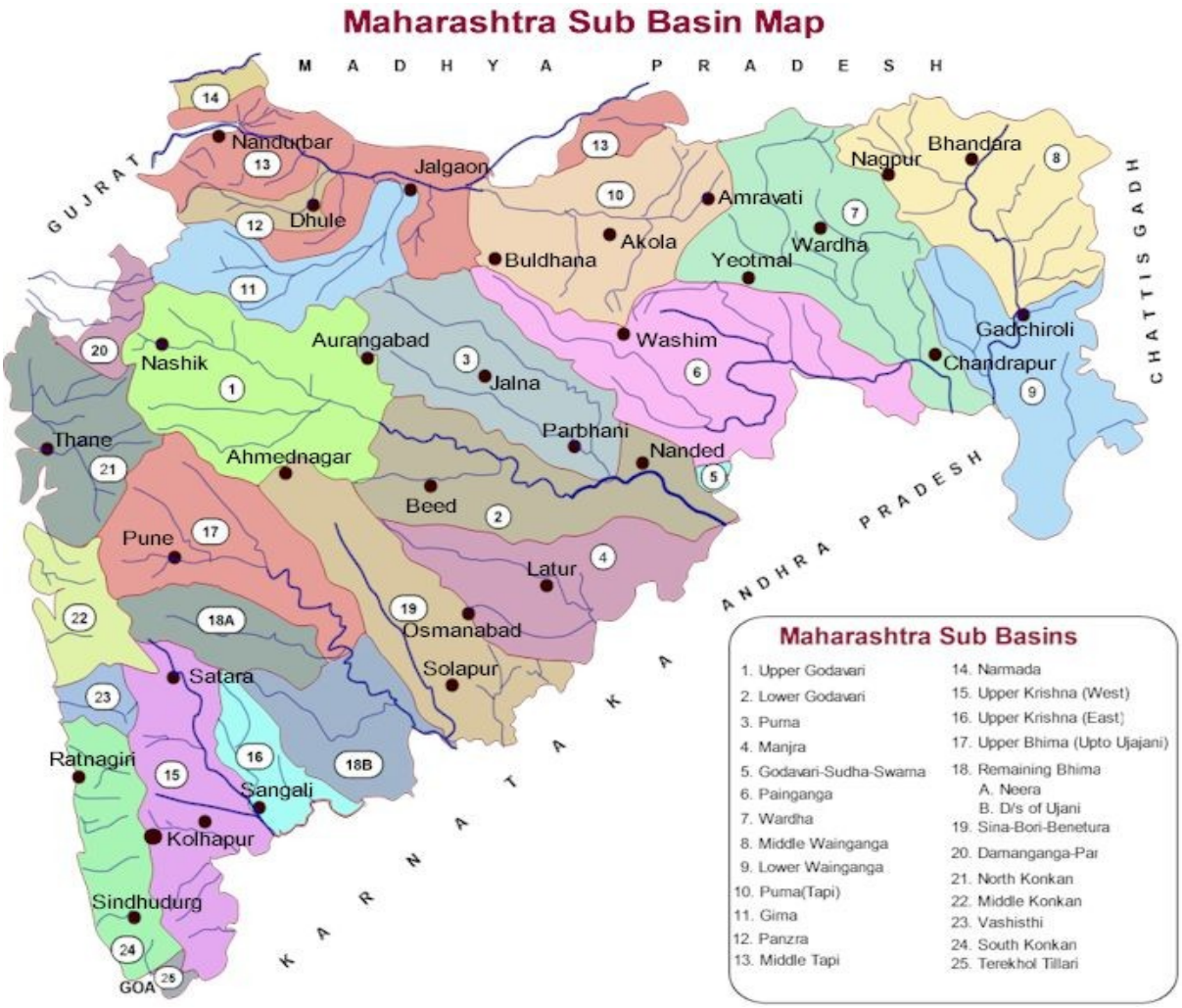
The estimated average-annual availability of water resources consists of 164 km3 of surface water and 20.5 km3 of subsurface water.

In Maharashtra, of the 5 river basin systems, 55% of the dependable yield is available in the four river basins (Krishna, Godavari, Tapi and Narmada) east of the Western Ghats. These four river basins comprise 92% of the cultivable land and more than 60% of the population in rural areas.

* 45% of state's water resources are from West Flowing Rivers emanating from the Ghats and draining into the Arabian Sea.

Sr. no	Name of the Basin	Geog Area (Mha)/ Percentage of Maharashtra	Culturable Area (Mha)	Average Annual availability	75% dependable yield (MCM)/ percentage wrt Mah.	Permissible use as per Tribunals/ Committees (MCM)
1	Godavari	15.43 / 49.5%	11.25%	50880	37300 (28.35%)	34185
2	Tapi	5.12 /16.7%	3.73%	9118	6977 / (5.30%)	5415
3	Narmada	0.16 / 0.5 %	0.03%	580	315 (0.24%)	308
4	Krishna	7.01 / 22.6%	5.63%	34032	28371 / (21.56%	16818
5	West Flowing Rivers	3.16 / 10.7%	1.86	69210	58599 (44.54%)	69210
6	Maharashtra	30.80 / 100.0%	22.53	163820	131562 / (100%)	125936

Figure 1: River Basins of Maharashtra: Area and yield Source: MWRRA, Govt of Maharashtra



Map 2: Sub Basin Map of Maharashtra Source: The Hydrology Project, WRD, Govt of Maharashtra

The geographical area of Maharashtra has been divided into **35 districts & 358 Talukas (blocks)** for administrative purposes. Nearly 148 Talukas are drought prone. The Water and Irrigation Commission appointed by GoM has estimated the water resources of the State and has assessed the ultimate irrigation potential through flow irrigation at 8.5 M ha which can be increased to **12.6M ha** by using advanced irrigation techniques, watershed development and improving water distribution system. The State has corporatised the irrigation sector and construction of irrigation projects is being carried out through five irrigation development Corporations set up in the State. Apart from this, 1.00 Mha of Irrigation Potential is created on projects below Irrigation Potential of 250 Ha which are with Rural Development and Water

Conservation Department[i]. The status and performance of this imporatant sector remains unassessed.

Dam Scam: Maharashtra's Irrigation sector was in the eye of the storm since 2012 following the unearthing of a massive scam surrounding major and medium projects of the state. The scam highlighted not only corruption and links between political class, contractors and bureaucrats, but also the inherent redundancy of several dams in the state, lack of water availability studies, poor quality of construction work, etc. Several activists, NGOs including SANDRP and very few officials, like Retd. Engineer Vijay Pandhare were responsible for exposing his scam simultaneously in the state. This was followed by a White Paper on Irrigation Projects in Maharashtra, which white washed most of the contentious issues. This was further followed by a Special Investigation Team Report headed by Dr. Madhav Chitale, a renowned water expert and past Secretary, Ministry of Water Resources. However, the SIT Report too did not take any tough stand, nor did it suggest a paradigm shift in managing water resources.[ii] This was then followed by an enquiry constituted by Anti-Corruption Bureau (ACB). This inquiry is still ongoing and hardly any firm actions have been taken so far. The new government, although it was elected on the irrigation plank, praised small scale initiatives and initiated a novel "Jalyukt Shivar Abhiyan" (Water rich farm initiative), however, it is also carrying forward the same large dam bias of the past government and has not cancelled or radically rethought of any major ongoing project.

1.3 River Pollution

Maharashtra has most number of polluted river stretches in the country, as per definition and monitoring of the Central Pollution Control Board (CPCB). The State has 49 Polluted stretches of the 302 such identified by the CPCB.

As per the Report dated February 2015, polluted stretches are from the following rivers:

- Wena, Wainganga, Godavari, Bhima, Krishna, Ulhas, Kundalika, Tapi, Girna, Panchganga, Nira, Bhatsa, Rangavali, Chandrabhaga, Vashishti, Mithi, Kanhan, Koyna, Amba, Amravati, Bindusara, Darna, Ghod, Gomai, Hiwara, Indrayani, Kan, Manjra, Mor, Morna, Mula, Mula-Mutha, Mutha, Panzara, Patalganga, Pawna, Pedhi, Pehlar, Penganga, Purna, Savitri, Sina,

Surya, Urmodi, Vel, Vaitrana, Venna, Waghur and Wardha. These rivers are classified in priority class I, II, III, IV and V based on the level of BOD[iii]

1.4 Cultural Importance of Rivers in Maharashtra

Rivers from several parts of the state hold special cultural, spiritual and religious significance to the population. Most of the important rivers have a dedicated text called "Mahatmya" which is either a part of some Purana or a stand-alone text. These include Godavari, Krishna, Bhima, Tapi and Narmada. They are also written in Marathi. Oldest Mahatmya is in Sanskrit Godavari Mahatmya or Gautami Mahatmya, which forms a part of the Brahma Purana. This is translated into Marathi by Dasguru in 1921.

One of the oldest Mahatmya is Tapi Mahatmya written in 1702 by Lukhanath Solanki. Interestingly, all authors note that the Mahatmyas were written on the banks of these specific rivers.

Origins (or approximate origins) of almost all rivers in Maharashtra are marked by Shiva Temples. This includes Trymbakeshwar in Nashik: Origin of Godavari, Mahabaleshwar in Satara: Origin of Krishna, Koyna, Savitri, Gayatri and Venna, Bhimashanker in Pune which marks the origin of Bhima, Budheshwar in Buldhana marking the origin of Painganga, etc.

There are some region-specific rituals surrounding rivers in Maharashtra which include *Saati Asara:* these are not entirely benevolent spirits which reside in deep river pools. They are worshipped by married women on the banks of rivers. Maharashtra also has temple fish sanctuaries in places like Walen Kondh on Kal River, Tilase on Vaitarna River and on Ambi River in Pune.[iv] In addition, in Vidarbha region, in basins like Wainganga, Kathani, Adan, etc, there are scared pools called "Dev Dohs" where fishing is banned. [v]

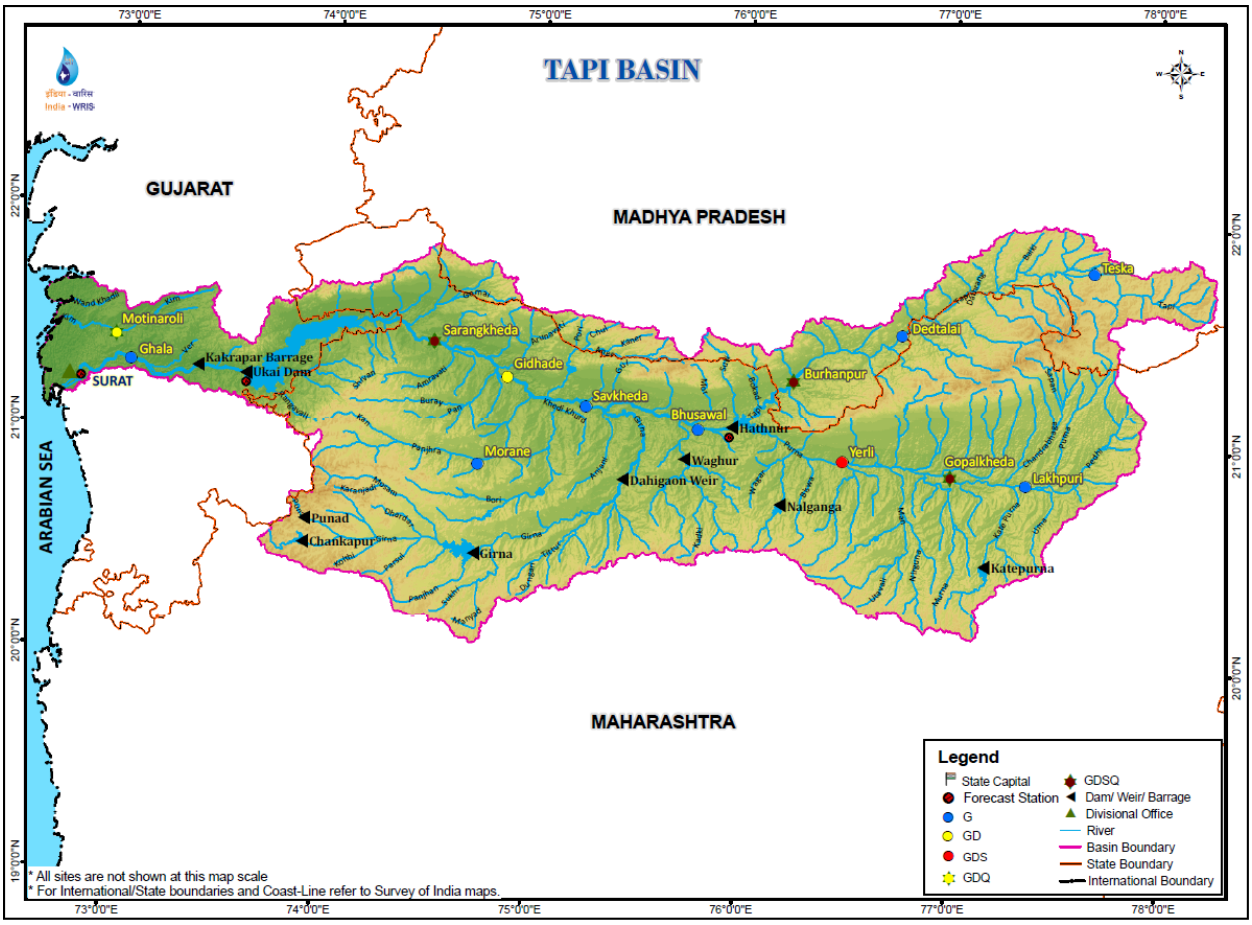
Figure 2: Walen Kondh River Fish Sanctuary on Kal River in Maharashtra Photo: SANDRP

In addition, there are several water-carrying rituals, where waters from a particular river are brought to a deity to ward off issues like drought.

In addition, one of the most important river related festival is Simhasta Kumbh on the banks of Godavari in Nashik every 12 years. There is an active group of citizens who is trying to protect the Godavari during this period.[vi] ***A similar Simhast also takes place on the banks of Rivers Gomai and Tapi, although it is much neglected by the administration.***

Several Rivers have **permanent River shrines** dedicated to them. Some have multiple such shrines like Godavari and Krishna.

2. TAPI RIVER BASIN



Map 3: Tapi Basin Source: India-Water Resources Information System

2.1 Physical features

Tapi is the second longest west flowing river in the Indian Peninsula after Narmada with a length of 724 kms. The basin includes states of Madhya Pradesh, Maharashtra and Gujarat and has an area of 65,145 Sq.km. It lies between 72°33’ to 78°17’ east longitudes and 20°9’ to 21°50’ north latitudes. Situated in the Deccan plateau, the basin is bounded by the Satpura range on the north, by the Mahadev hills on the east, by the Ajanta Range and the Satmala hills on the south and by the Arabian Sea on the west.

Origin: Tapi originates near Multai reserve forest in Betul district of Madhya Pradesh at an elevation of 752 m. This is also called as Mool Tapi. Its important tributaries are the Suki, the Gomai, the Arunavati and the Aner which joins it from right, and the Vaghur, the Amravati, the Buray, the Panjhra, the Bori, the Girna, the Purna, the Mona and the Sipna from the left.

The major part of basin is covered with agriculture accounting to 66.19% of the total area. 2.99% of the basin is covered by water bodies. The basin spreads over 18 parliamentary constituencies (2009) comprising 12 of Maharashtra, 3 of Gujarat and 3 of Madhya Pradesh. Nearly 80% of the basin lies in the State of Maharashtra.

2.2 Physiography[vii]

The Tapi River along with its tributaries flows over the plains of Vidharbha, Khandesh and Gujarat and over large areas in the state of Maharashtra and a small area in Madhya Pradesh and Gujarat.

The State wise distribution of the drainage area is given in the table:

State	Drainage area (sq. km.)
Maharashtra	51504
Madhya Pradesh	9804
Gujarat	3837
Total	65145

Figure 3: Basin Area of Tapi in various states Source: India-WRIS

The basin consists of black soils. The culturable area of the basin is about 4.29 Mha which is 2.2% of the total culturable area of the country. The forest cover is about 25% of the area in the basin.

Tapi basin can be divided in three sub basins:

- Upper Tapi Basin up to Hathnur (confluence of Purna with the main Tapi (29,430 sq km),
- Middle Tapi Basin from Hathnur up to the Sarangkheda gauging site (28,970 sqkm), and the
- Lower Tapi Basin from Sarangkheda up to Sea (6,745 sq km).

The annual rainfall for the upper, middle and lower Tapi basins for an average year is 931.90 mm, 713.05 mm and 1407.9 mm respectively.

2.3 Rainfall

The south west monsoon sets in the Tapi basin in the middle of June and withdraws by mid October. About 90 percent of total rainfall is received during the monsoon months, of which 50% is received during July and August. The average rainfall in the Tapi basin is 888.0 mm.

Sr. No.	Name of Sub Basin	Bank	Length in Km	Catchment Area (sqkm)	% with reference to total area.	10 years average of Monsoon rainfall (mm) from 2003-2012
1.	Upper Tapi up to Hathnur	Main	290	10471	16.1	961.5
2.	Purna	Left	274	18929	29.1	667.6
3.	Middle Tapi, Hathnur to Ukai excluding Girna.	Main	305	22734	34.9	784.4
4.	Girna	Left	260	10061	15.4	618.5
5.	Lower Tapi-from Ukai to confluence to sea near Surat	Main	129	2920	4.5	1394.8

Figure 4: 10 Years average rainfall in various sub basins of Tapi Basin Source: Central Water Commission

Figure 5: Sipna River near Melghat Tiger Reserve Photo: SANDRP

2.4 Forests

Tapi basin exhibits two distinct geographical regions, viz., the plain regions in the east and south-east and the hilly regions of the Satpura ranges in north and northwest. The plain region is extensively cultivated and forests appear only in scattered patches. The hilly region is an extensive block of compact forests and contains an abundance of rich teak trees. **The percentage of the forest area to total area in the Tapi basin is approximately 25% of the total area, and is unevenly distributed**.

2.5 Biodiversity

The basin holds the Melghat Tiger Reserve in Maharashtra and the Purna Wildlife Sanctuary in Gujarat. While the faunal diversity of these parks is documented to certain extent, there is no checklist of fish of the Tapi Basin. A survey done in 1967 reported 52 species belonging 14 families[viii]. A recent report noted only 15 species, however, a robust scientific study is not available to draw conclusions.

2.6 River Course

For the first 282 Km., the river flows in Madhya Pradesh, out of which 54 Km form the common boundary with Maharashtra State. It rises in the eastern Satpura Range of southern Madhya Pradesh state, and flows westward, draining Madhya Pradesh's historic Nimar region.

- It flows for 228 Km in Maharashtra draining historic Khandesh and east Vidarbha regions in the northwest corner of the Deccan Plateau before entering Gujarat.
- Traversing a length of 214 Km in Gujarat, the Tapi joins Arabian sea in Gulf of Cambay after flowing past the Surat city. The river receives tidal influence for a length of about 20 Km upstream from mouth i.e. up to Singanapore weir.

2.7 Tributaries

- There are 14 major tributaries having a length more than 50 Km.
- On the **right bank** 4 tributaries namely, Vaki, Gomai, Arunavati and Aner join the Tapi.
- On the **left bank**, 10 important tributaries namely Purna, Nesu, Buray, Panjhra, Bori, Girna, Vaghur, Purna, Mona and Sipna drain into the main channel. The drainage system on the left bank of the Tapi is therefore, more extensive as compared to the right bank area.

The Purna and the Girna, the two important left bank tributaries together account for nearly 45 percent of the total catchment area of the Tapi.[ix] The Purna is one of the principal tributaries of the Tapi, starts in Betul district in Gawilgar hills of the Satpura range and mostly drains through three districts of Vidharbh namely Amravati, Akola and Buldhana. The Girna another Major tributary rises in the Western Ghats and drains Nasik and Jalgaon districts of Maharashtra

2.8 Major Tributaries of the Tapi River System

a) Purna River:

- Purna, the biggest tributaries of Tapi, joins from the left. It is the main artery of a network of rivers and streams draining Akola, Amravati and Buldana districts of Maharashtra and Betul district of Madhya Pradesh.

- Rising in the Gawilgarh hills at an elevation of 900 m., North latitude 210 38' 00" and East longitude 770 36' 00", the Purna flows first in a South westerly direction for about 60 km through hills and forests before it enters the Purna plains.
- Flowing for a length of 274 Km, the Purna joins the Tapi north west of Edalabad/ Muktainagar.
- The Man is the main left bank tributaries of Purna, and Chandrabhaga and Wan are the principal right bank tributaries.
- Purna drains a total area of 18, 929 Sq.km.

Figure 6: Purna River in Amravati Photo: SANDRP

b) Girna River:

- The Girna River originates at Kem peak in the Western Ghats range of Nashik District, and flows east across Nashik and Jalgaon districts, swinging north in Jalgaon District to join the Tapti River.

- The dams on the river are **Chanakapur and Girna Dam.**
- The name Girna derives from the name of Goddess Giraja (Parvati).
- A 100 sq km area around Girna River has an approximate population of 979337. The basin of the Girna lies on the Deccan Plateau, and its valley has fertile soils which are intensively farmed.

Sl. No.	Name of River / tributary	Bank	Elevation of source above m.s.l. [m]	Length [km]	Catchment area [km^2]	% of total area
1.	2.	3.	4.	5.	6.	7.
1	Tapi		752	724	22522	34.57
2	Gomai	Right	600	58	1148	1.76
3	Arunavati	Right	450	53	935	1.44
4	Buray	Left	600	64	1419	2.18
5	Panjhra	Left	600	138	3257	5.00
6	Bori	Left	600	130	2580	3.96
7	Aner	Right	600	94	1702	2.61
8	Girna	Left	900	260	10061	15.44
9	Waghur	Left	751	96	2592	3.98
10	Purna	Left	900	274	18929	29.06
				TOTAL	65145	100

Figure 7: Main tributaries of the Tapi Basin Source: Central water Commission

c) Gomai River:

It originates in Satpura Mountain Range and merge in Tapi River around 2 km east of Prakasha. Gomai river has many small tributary rivers like Susri river (passing by Sultanpur), Tipria river (passing by Mandane), Umri river, Sukhi river. Confluence of Gomai and Tapi is a place of great religious significance.

d) Panzara River

The Panzara-Kan or Panjhra is a river in Khandesh region of Maharashtra. Panzara River originates just few kilometers from a small town Pimpalner, Tal-Sakri in Dhule District. One small reservoir named Latipada dam is constructed near its origin.

e) Pedhi River:

The only important left bank tributary of the Purna is the Pedhi. It rises in the low hills near Rithpur and receives a number of small affluent both from the east and the west, the chief on the west being the Naghira river.

f) Arna River

The first of the principal right bank affluent of the Purna is the Arna which emerges from the Satpuda hills in Betul district and flows in a south and south-easterly direction passing by Sirasgaon to join the Purna just below Deurwada.

2.9 Districts and regions covered in Tapi Basin:

The Tapi River Basin lies mostly in northern and eastern districts Maharashtra state viz, Amravati, Akola, Buldhana, Washim, Jalgaon, Dhule, Nandurbar, Malegaon, Nashik districts but also covers Betul, Burhanpur districts of Madhya Pradesh and Surat district in Gujarat as well.

2.10 Water sharing and Projects:

During the plan period Kakrapar, Ukai, Upper Tapi and Girna projects were completed. Important projects under construction in the basin are Waghur & Punad.

As per inter-state agreements between MP & Maharashtra out of the water available upto Ukai dam site (Gujarat) will be shared as Madhya Pradesh: 70.0 TMC and Maharashtra: 191.40 TMC

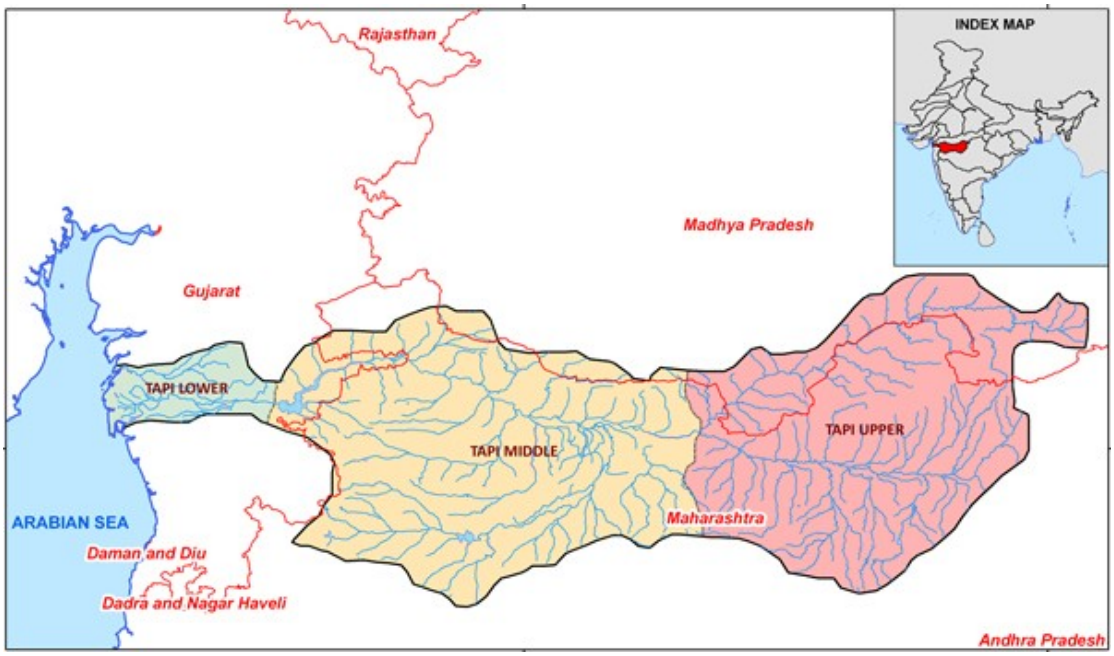


Figure 8: Tapi Basin Source: Centre for Coastal Zone Management and Coastal Shelter Belt

2.11 Major Projects on Tapi Basin:

There are 28 major and Medium Irrigation schemes completed and 2 projects under construction in Tapi Basin. List of the projects is given below:

Sl.No	Name of project	River	Status	Capacity (MCM)	
				Gross	Live
1.	Girna Project	Girna	Medium	608.450	523.55
2.	Dahigaon	Girna			
3.	Manyad Project	Manyad	Medium	53.95	40.27
4.	Bori Project	Bori	Medium	40.31	25.15
5.	Hathnur	Tapi	Medium	388.000	255.00
6.	Suki	Suki	Medium	50.16	39.85
7.	Abhora	Boked Nalla	Medium	7.440	6.020
8.	Boker Bari	Boker Bari Nala	Medium	7.090	6.54
9.	Agnawati	Agnawati	Medium	3.740	2.76
10.	Titur	Titur			Pick up bandhara.
11.	Tondapur	Khadki Nalla	Medium	6.304	4.636
12.	Aner Project	Aner	Medium	103.230	56.38

13.	Karwand Proj.	Arunawati	Medium	33.840	31.15
14.	Panjhra Project	Panjhra	Medium	43.410	35.63
15.	Malangaon	Kan	Medium	13.020	11.35
16.	Kanholi	Khanholi	Medium	11.79	8.450
17.	Burai	Burai	Medium	21.330	14.21
18.	Arunawati	Arunawati	Mediu	27.780	14.97
19.	Rangawali	Rangawali	Medium	15.020	12.89
20.	Nagasakya	Panzar	Medium	15.620	11.240
21.	Haran Bari	Mousam	Medium	34.780	--
22.	Ukai	Tapi	Major	8510	7092
23.	Kakrapar	Tapi	Major	51.51	36.57
24.	Lakhigav	Dhakani	Medium	38.80	37.41
25.	Ver	Ver	Medium	4.90	4.61
26.	Sulwada Barrage	Tapi	Medium	65.06	64.642
27.	Sarangkheda Barrage	Tapi	Medium	92.20	91.82
28.	Prakasha Barrage	Tapi	Medium	63.64	62.11
29.	Kate Purna	Kate Purna	Major	97.670	86.350
30.	Nal ganga	Nal ganga	Major	76.200	69.320
31.	Uma	Uma	Medium	14.000	11.680
32.	Nirguna	Nirguna	Medium	32.290	28.850
33.	Morna	Morna	Medium	44.740	41.460
34.	Gyan ganga	Gyan ganga	Medium	36.260	33.930
35.	Mos	Mos	Medium	17.504	15.140
36.	Paltag	Vishvganga	Medium	9.090	7.510
37.	Man	Man	Medium	39.760	36.830
38.	Thoran	Tributary of Purna	Medium	8.480	7.900

Figure 9: Major Projects on Tapi Basin

Major/ Medium Projects under construction in Tapi Basin:

Under Construction projects					
Sl No	Name of Project	River	Classification	Gross Capacity (MCM)	Live storage (MCM)
1	Shelgaon Barrage	Tapi	Medium	116.37	110.35
2	Padelsa Dam	Tapi	Medium	420.56	407.59

Figure 10: Projects under construction in Tapi Basin

Ongoing Projects in Purna Basin:

Sl. No	Name of Project	River	Classification	Gross Capacity (MCM)	Live storage (MCM)
1	Ghungshi Project	Purna	Medium	17.444	17.269
2	Purna Barrage II (Ner Dhamna)	Purna	Medium	8.1743	8.1126
3	Jigaon Project	Purna	Medium	736.579	296.726

Figure 11: Projects in Purna Basin

2.12 Salient Features of some Projects in Tapi Basin

Hathnur Dam (Maharashtra)

This is the first stage of Upper Tapi Project. It consists of 717 m long Ogee shaped gated overflow weir in the centre with 1863 m long earthen embankment on either side constructed across the river Tapi near Hathnur village in Jalgaon district of Maharashtra State. It is having a live storage capacity of 255 MCM and is supposed to irrigate 3,78,384 hectares of land in Raver, Yawal and Chopda talukas of Jalgaon district by a right bank canal of 95 km length.

The project faces severe issues due to siltation and it is reported that it is silted upto 70%. Even with limited rain in the basin, backwater of Hathnur Dam gets flooded.

Kakrapar Weir (Gujarat)

The project comprises of a pick up weir constructed across the Tapi River near Kakrapar in Surat district of Gujarat.. The weir is 621 m long and 14m high. This project was commissioned in the year 1954 as stage -- I of the Ukai project.

Ukai Dam (Gujarat)

This is stage - II of the multipurpose Ukai Project. It consists of 4928 m long and 68.6 m high composite earth - cum - masonry dam across the Tapi River near Ukai village in Surat district of Gujarat State. It includes a spillway with power dam constructed on the left bank.

Girna Dam (Maharashtra)

It is constructed across river Girna, a tributary of river Tapi near Panzan village in Nandgaon taluka of Nasik district. This is a multipurpose scheme, main purpose being irrigation and subsidiary power generation (power generation yet to be started). This is a composite dam having total length of 963.17 m, masonry dam with gated spillway for a length of 426.72 m and earthen dam of length of 536.45 m respectively.

Dahigaon Weir (Maharashtra)

It is constructed across river Girna near Dahigaon village in Pachora Taluka of Jalgaon district of Maharashtra. It consists of a Ogee shaped Weir having a length of 422.76m and a maximum height of 8.82m.

2.13 Cultural Aspects

Tapti or Tapi is supposed to be the daughter of the Sungod and his wife Chhaya and is also known as Suryaputri. Tapi Mahatmya states that Sungod Surya created her to save himself from his own intense heat. The Sanskrit word *taap*, means heat. According to Mahabharata, a Gandharva narrates the story of Tapi or Tapti to Arjuna. Tapi, daughter of Sun God was half nymph and was married to King Samavarna[x]. She is the mother of Kuru, from where the ancestry of the great Epic Mahabharata began.

Tapi Mahatmya lists 21 names of River Tapi and 21 names for her “vahanas” or Vehicles. Tapi Mahatmya forms a part of the *Skandh Puran,* but while *Skandh Puran* can be dated back to 5th or 6th Century, Tapi Mahatmya is comparatively recent and is supposed to be post-10th Century.

21 names of Tapi or Arkaja as give in the Tapi Mahatmya are:

Satya, Satyodbhava, Shyama, Kapila, Kapilambika, Tapini, Tapanhruda, Naastya, Naasikodbhava, Saavitri, Sahasrakara, Sanakanmrutsanyandini, Sukshma, Sookshmatarmani, Sarpaa, Sarpavishaapahaa, Tigmaa, Tigmaraya, Tara, Tamraa and Tapiti.

There is also a relatively newer version of *Tapi Stotra* written by Tembe Swami.

The seventh day of Ashadh (*Ashadh Shuddha Saptami*) month of Hindu calendar is considered as a time of origin of Tapi River, as per the Tapi Mahatmya. This is supposed to be the river's birthday!

Figure 12: Tapi Janmadivas celebrated in Surat Source: Times of India

Surat Municipal Corporation has been celebrating this for past 35 years. This period is called as Padmak.

The village of **Prakasha** situated on the bank of Tapi River in taluka Shahada in Nandurbar district, Maharashtra is popularly known as *Dakshin Kashi.* Prakasha is marked by the confluence of Tapi and Gomai Rivers. A version of ***Kumbh Mela*** is also held here every 12

years. There are over 108 Shiv temples on the banks of Tapi and Gomai rivers. The main Pooja occurs in Gautameshwar Temple, but there are other temples which too are thronged by devotees like संगमेश्वर, केदारेश्वर, पुष्पदंतेश्वर, सिद्धेश्वर, मुक्तेश्वर, भीमेश्वर and कपिलेश्वर. In 2003 Kumbh Mela on Tapi Gomai Sangam, more than 7 lakh devotees had come to the rivers.

However, Prakasha Barrage has submerged Gomai River Ghats and this causes great inconvenience as well as danger to the devotees. [xi]

Excavation works undertaken at Prakasha village reveals tools like blades and microliths dating back to 1700 BC.

Muktainagar (formerly Edalabad) in Jalgaon District of Maharashtra has the Tapi-Purna Sangam and Temple of Changdev Maharaj who played an important role in the life of Saint Dnyaneshwar, a popular and much-loved child saint of Maharahsra. Muktai, younger sister of Dnyaneshwar took Samadhi on the banks of Tapi in Mehun here and the place is famed as Muktai Nagar.

Just as Gomai River Ghats have been submerged by Prakasha Barrage, Hathnur Dam submerged the old Muktai Devi Temple too.

2.14 Projects and related Issues

Hathnur Dam in Tapi Basin is facing severe issues of siltation. According to Remote Sensing Studies done by the Water Resources Department, more than 50% of the live storage capacity of Hatnur Dam[xii]is silted up**.**

Serious questions about the structural integrity and quality of **Lower Tapi Project** were raised by Rtd. Chief Engineer Vijay Pandhare. However, no answers were issued to these questions. [xiii]

Similarly, huge cost escalations in Lift Irrigation Schemes in Tapi basin are also questioned by Pandhare. The projects include:

A. Sulwade Lift Irrigation Scheme (Cost 2100 Cr)

B. Bodwad Lift Irrigation Scheme (Cost 2200 Cr)

C. Prakasha-Burai Lift Irrigation Scheme (Cost 700 Cr)

D. Varangaon-talwel Lift Irrigation Scheme

E. Padmalay Lift Irrigation Scheme

F. Kurha-vadoda Lift Irrigation Scheme[xiv]

Projects have been initiated without Environmental Clearance. For example, when the Tapi Irrigation Development Corporation applied for Environmental Clearance for the Lower Tapi Lift Irrigation Scheme (which included one than one dams) which would displace more than 20,000 people, work was already underway on the project since 1999. SANDRP pointed this out to the Ministry of Environment, Forests and Climate Change (MoEF and CC). Although EC was not granted, no *suo motto* action was taken by the MoEF and CC to curtail this violation of environmental laws.

Maharashtra Government aims to undertake a **mega groundwater recharge program** in the Tapi basin, supposedly as an alternate to large dams. Reports say that about 80TMC water will be recharged in the ground to raise the groundwater levels. However, there is no clarity about the project in open domain.[xv]

Par Tapi Narmada Link [xvi]as a part of the River Interlinking Project proposed by the National Water Development Agency (NWDA) is strongly opposed by Tribals in Maharashtra, Gujrat as well as the Maharashtra Government.

If the Par Tapi Narmada Link Project (PTN Link Project) one of the priority links in the ILR scheme is materialized, then 75 tribal villages, 3592 hectares of forests in Western Ghats and a minimum of 7559 hectares of land will be submerged. As per 1991 Census, it will displace 15,000 tribals, now the number is likely to be more than 35,000. [xvii]

As per the NWDA Feasibility Report, PTN Link involves seven reservoirs proposed in north Maharashtra and south Gujarat, to enable transfer of 1350 MM3 (Million Cubic Meters) water from the west flowing rivers like Nar, Par, Auranga, Ambica, Purna into Tapi and Narmada. Initially the project was also supposed to utilise surplus waters of Tapi from Ukai dam, but later it dropped Ukai from the calculations. The infrastructure of the links consists of "seven dams, three diversion weirs, two tunnels (5.0 km & 0.5 km of length), 395 km long canal (205 km in Par-Tapi portion including the length of feeder canals and 190 km in Tapi-Narmada portion), 6 power houses and a number of cross-drainage works."

The seven dams proposed in the scheme are Jheri (Jhari), Mohankavchali, Paikhed, Chasmandva, Chikkar, Dabdar and Kelwan. The Jhari and Mohankavchali dams are to be constructed across Par river, one below the other while the Paikhed dam is proposed across Nar river, a tributary of the Par. Chasmandva dam is proposed across Tan River which is a tributary of Auranga, Chikkar dam is proposed across river Ambica, Dabdar is proposed across Kapri which is Ambica's tributary and Kelwan dam is proposed across river Purna. In addition, three diversion weirs are proposed downstream of Paikhed, Chasmandva and Chikkar dams.

2.15 Water Quality

While Upstream of Tapi Basin is relatively unpolluted, agricultural runoff and untreated sewage forms major pollution load of the middle reaches. The major pollution to the river comes from Surat, where more than 7000 illegal drains empty in the river. [xviii]

It is estimated that more than 300 Million Liters a Day (MLD) untreated effluents come to Tapi from Surat.

The Hazira – Kawas industrial belt which houses petrochemical, fertilizer, steel, engineering and power industries is estimated to release 60,000 m3 /day of effluents in the Tapi estuary[xix]

3. GODAVARI RIVER BASIN

3.1 Salient Features

The river Godavari, the largest of the peninsular rivers rises at an elevation of 1,067 m in the Western Ghats near Trimbak Hills in the Nashik district of Maharashtra. After flowing for about 1,465 km., generally in south-east direction, it falls into the Bay of Bengal.

Godavari is the second largest river draining in India. Godavari basin drains about 9.5% of India's total geographical area. catchment area of the basin is 3,12,812 sqkm, extending over the states of Maharashtra (48.6%), Telangana (20% approx.), Madhya Pradesh (10.0%), Andhra Pradesh (3.4% approx.), Chattisgarh (10.9%), Orissa (5.7%) and Karnataka (1.4%).

Figure 13: Godavari Ghats at Nashik Photo: SANDRP

Basin Boundaries: The Godavari basin falls in Deccan plateau. Around 32% of Godavari basin area lies in the elevation zone of 500-750 m. The basin is bounded on the north by the Mahadeo Hills, the Satmala Hills comprising a series of table lands varying from 600-1200 m in elevation. The western edge of the basin is formed by an almost unbroken line of the North Sahyadri range of the Western Ghats, from 600-2100 m height. The eastern area of the basin is majorly covered by the Dandakaranya Range with the Eastern Ghats rising from the plains of East Godavari and Vishakhapatnam. Eastern Ghats are not as prominent as Western Ghats. The

basin's southern boundary of the basin follows the Harishchandra Range in west, Balaghat Range in the center and the Telangana Plateau in east.

Basin is broadly divided into Maharashtra Plateau, Vidarbha Plains &Dandakaranya Region. Except for the hills forming the watershed around the basin, the entire drainage basin of the river Godavari comprises of undulating country, a series of ridges and valleys interspersed with low hill ranges. Large flat areas which are characteristic of the Indo-Gangetic plains are scarce except in the delta.

3.2 Principal Tributaries

The largest tributary of the Godavari is the Pranhita with about 34.87% coverage of drainage area.[xx] The Pravara, Manjira and Maner are right bank tributaries covering about 16.14%, the Purna, Pranhita, Indravathi and Sabari are important left bank tributaries, covering nearly 59.7% of the total catchment area of the basin. The Godavari in the upper, middle, and lower reaches make up for the balance 24.16%.

At about 64 km. from its source, the Godavari receives the waters from Darna, on its right bank and a short distance downstream the Kadana joins it from the left. Pravara known for 'Randha Falls' rises on the eastern slopes of Sahyadris and travels a length of 208 km before joining Godavari. The combined waters of the Pravara and Mula which rise in the hills of Akola join the river from left about 217 km. from its source. About 338 km. from its source, the river receives the combined waters from the Purna and Dudhna rivers.

After about 476 km from the source waters of Manjra join Godavari from South at the border of Maharashtra & Telangana. The Manjara River is one of the major tributaries of Godavari, which originates in the Balaghat Range of hills in the Beed district of Maharashtra an altitude of about 823 m. The river flows in a general east and south easterly direction for 512 km through the states of Maharashtra, Telangana it forms the boundary between Maharashtra and Telangana. The total length of the river from the source to its confluence with the Godavari is about 724 km. The principal tributaries of the Manjara River are the Terna, the Karanga, the Halai, the Lendi and the Maner. The catchment area of the Manjra River including its tributaries is 30,844 km^2.

The river Pranahita, largest of tributaries of Godavari, conveying the combined waters of Penganga, the Wardha and Wainganga, which drain Nagpur and southern slopes of the Satpura ranges, falls into Godavari about 306 km from its origin below its confluence with the Manjra. Pranhita River flows on the edge of Gadchiroli district in Maharashtra and Adilabad district in Telangana and finally empties into the Godavari River, near Sironcha(GadachiroliDist) in Maharashtra. Wardha River is a distributary of Godavari, which later merges with Wainganga River to form Pranahita River. The Wardha& Wainganga Rivers originating in southern slopes of Satpura ranges in Madhya Pradesh together cover the Vidarbha Region of Maharashtra. Total length of Wardha River is 483 km and the main tributaries are Bor, Dham, Pothra, Asoda and Wunna. Wainganga travels a length of 580 km before merging with Wardha to form Pranahita. The chief tributaries of the Wainganga are Garhavi, Khobragadi, Kathani and Potphondi on the left bank and Andhari on the Right Bank.

Figure 14: Wainganga River Photo: SANDRP

Although a mighty river, Godavari loses its glory while flowing through Marathwada and is surrounded by constant drought, several dams, unquenching groundwater withdrawals. It is when Godavari crosses the boundary of Marathwada and enters Vidarbha that it is infused with water from Rivers like Penganga and Pranhita, which arise from a luxuriously forested catchment and assured rainfall region.

The waters of the Indravati join the river Godavari 48 Km downstream of Pranahita. Indravati flowing through central India rises in the jungles of Kalahandi in the Eastern Ghats in Orissa and flows westwards to join the Godavari, thus forming the boundary between Maharashtra and Chhatisgarh states at some places. Most of the River Course of Indravati is through dense

forests of Bastar. Indravati river flowing through distance of 535 km is an important tributary of river Godavari and contributes to about 20% of the waters of Godavari.

Table below summarises lengths and catchment of major tributaries

Length of River & its major tributaries *(Source: Krishna Basin Profile by CWC)*			
S.No	**Name of River**	**Length (km)**	**Catchment Area (sq km)**
1	Godavari	1465	312812
2	Upper Godavari (Source to Confluence)	675	33502
3	Pravara	208	6537
4	Purna	373	15579
5	Manjira	724	30844
6	Middle Godavari (Between confluence of Manjira and Pranahita)	328	17205
7	Maner	225	13106
8	Penganga	676	23898
9	Wardha	483	24087
10	Wainganga	580	49695
11	Pranhita	721	61093
12	Lower Godavari (Pranhita Confluence to Sea)	462	24869
13	Indravati	535	41655
14	Sabari	418	20427

Figure 15: Length of River & its major tributaries

Ref:

http://www.kgbo-cwc.ap.nic.in/About%20Basins/About%20Godavari%20Basin.pdf

http://www.indianetzone.com/31/tributaries_river_godavari_indian_river.htm

http://www.sakti.in/godavaribasin/tributaries.htm

3.3 Climate

The Godavari basin has a tropical climate characterized by Cold weather, hot weather, Southwest monsoon and Post monsoon.

The mean annual surface temperature in the Western Ghat area is about 24° C, and it increases gradually towards the east and attains a maximum of 29.4° C on the East Coast. During January, the mean daily minimum temperature increases from West to East from 15° C on the Western Ghats to about 18° C on the East Coast. The mean maximum daily temperature generally exceeds 30° C in the western part of the Godavari basin and it is only slightly less than 30°C in the Eastern part.

Basin receives 85% of its annual rainfall during south-west monsoon. The rainfall, fairly heavy though irregular and unevenly distributed varies temporally and spatially across the basin. South-west monsoon sets in by July and ends by September entering through the west and south-west coast meets the Sahyadri Range sweeps across the interior of the peninsula. Upper reaches of Godavari Basin lie in the 25 Km wide crest zone of Sahyadri which is the belt of heaviest rainfall region in Maharashtra. Annual rainfall varies from 1000 to 3000 mm in this reach. River further enters in the region falling in the rain shadow area of the Sahyadri which receives less than 600 mm annual rainfall. Rainfall gradually increases to about 900 mm towards the East coast that changes the landscape and the cropping pattern in the eastern Maharashtra, the Wardha-Wainganga sub-basins. Annual rainfall varies from 755 mm to 1531 mm and the average annual rainfall in the basin is 1096.92 mm.

3.4 Principle Sub-Basins

Manjra: Manjra is a 724 kms long tributary of Godavari which originates from the Balaghat ranges of Maharashtra and meets Godavari in Telangana. It is also a unique river which originates in low rainfall region of Balaghat and flows onwards to higher rainfall regions of Telangana before joining Godavari. The principal tributaries of the Manjara River are Terna, Karanga, Halai, Lendi and Maner. Manjara River flows through Latur District of Maharashtra and Bidar District of Karnataka before entering Medak District in Telangana. It flows for about 96 km in Medak District and ultimately drains into Godavari River at Basara near Nizamabad. The catchment area of the Manjra River including its tributaries is 30,844 km2 lying in a zone which gets about 635 mm of rain annually.

There are total 128 dams in the basin. Some of the important dams include Nizam Sagar Dam constructed across the Manjra River in Nizamabad district of Telangana in 1923 by the rulers of the erstwhile Hyderabad State, Mir Osman Ali Khan.[xxi] The huge stonework dam for a length of 3km across the river with a motorable road of 14 feet breadth submerged over 40 villages. Singur Reservoir is another dam built by erstwhile Andhra Pradesh which is situated on Manjara River in Medak District, now a part of Telangana. It serves as the main drinking water source for the Medak district as well as the adjacent twin cities of Hyderabad and Secunderabad. Manjara Dam built in 1983, is an earthfill dam on the Manjara River near Kaij and Kalamb, Osmanabad district in state of Maharashtra.[xxii] By the summer of 2016, the reservoirs completely dried up, after 4 years of no rainfall.

A large portion of Maharashtra (Marathwada) falling in Manjra basin is drought prone. It is the rain shadow area of the Sahyadri (Western Ghats) which receives less than 600 mm annual rainfall. The region is one of the worst drought-affected regions of India during 2012-15. All the major dams including Manjra, Majalgaon, Lower Terna, Manar, Siddheshwar and Sina-Kolegaon dried up in 2015. The state government had roped in a train to provide drinking water to Latur city, all the way from Miraj, about 342 km away.

Figure 16: Unscientific deepedning and widening of Manjara River in name of rejuvenation Photo: Indian Express

Union Government recently announced that it plans interlinking of Bhima and Manjra rivers to tackle the drought of Marathwada.[xxiii] The two rivers will be linked through Ujani dam on Bhima river and Manjara Dam on Manjara river. Water experts are already raising alarms over

this proposition. Manjra flows from Latur district while Bhima originates in Pune and flows to Solapur. Latur is 636 metres above mean sea level while Bhima is situated about 500 metres above mean sea level. This means that the water will have to be lifted to a height of about 150 meters. Locals are of opinion that the Ministry seems to have announced the project without studying the terrain, feasibility and ignoring the past experience of lifting water at a height which had not been successful. A decade ago a project was implemented to lift Terna dam water to a height of 150 meters for Osmanabad. But the project came to a halt soon without benefitting any land.

3.5 River Narratives

Nashik, at the origin of Godavari is important religiously not only as the birth place of this DakshinVahini Ganga, where she refused to fall into the Arabian Sea, but also because of the deep association of the city with Ramayana. Nashik was believed to be a part of Dandakaranya where Lord Ram resided for nearly 14 years in Vanavasa. All along the river in places like Tapovan, one can find glimpses of this ancient myth worshipped today. On the banks of Godavari in Nashik also stands the KalaRamMandir where, in 1930, Babasaheb Ambedkar launched the KalaRam Mandir Entry Satyagraha, storming the temple which was thus far restricted for the depressed classes. Indeed, Godavari has borne witness to several remarkable happenings at her origin itself.

In her middle reaches in Nanded, Takth Sri Hazur Sahib graces the banks of the river where Guru Gobind Singh breathed his last. The place is one of the five holy places in Sikkhism. In Telangana and Andhra too the banks have numerous mosques, temples and ghats of historical significance like Koti lingala in Karimnagar, Telangana, at the confluence of Peddavagu and Godavari. This was the first capital of the Satavahanas circa 230 BC. Most of the important towns in Satavahana era are along the Godavari. Sadly today the Koti Lingala is facing threat of submergence from Sripada Yellampalli Irrigation project. At Dhawaleswaram the river divides into two branches, the Gautami and Vasishta. Between the two lies the Godavari Central Delta. The two arms split into branches as they approach the sea dividing the Central Delta into a number of islands.

Anne Feldhaus sums up the historical legacy of many cultures and religions of this upper Godavari Valley and Marathwada eloquently. She says: *"This is the area that Cakradhar, the*

*founder of the Mahanubhav sect (circa 12-13th Century), referred to as the "Ganga valley" that is, the (upper) valley of the Godavari, the northernmost of the great rivers that flow from northwest to southeast across the Deccan Plateau. In Cakradhar's time, what is now Marathwada was the core of the Yadava kingdom, with its capital at Devgiri (subsequently called Daulatabad). Paithan, the capital of the much earlier kingdom of the Satavahanas (first century B.C.E. to third century C.E.) is also found in Marathwada, on the Godavari river, as is Nanded, the site of the grave of the seventeenth-century Sikh leader Govind Singh. The Mughal emperor Aurangzeb's city, Aurangabad, is now the principal city of Marathwada in Godavari basin, which is also home to the Buddhist (and Jain and Hindu) caves at Ajanta and Ellora (called Verul in Marathi) and to the major Sufi shrines at Khuldabad." (*From: Feldhaus, Anne, in *History of Sacred places in India as reflected in traditional literature,* Edited by Hans Bakker, 1990*)*

3.6 Biodiversity of the basin

Godavari basin supports significant forest are in the Central India much of this is in the belt of eastern Maharashtra, Chhattisgarh and Telangana states. Wainganga, one of the most important tributary of the Godavari is the stage of Kipling's Jungle Book. Wainganga River Basin is home to two oldest tiger reserves viz. Tadoba Andhari National Park in Maharashtra and Pench National Park in Madhya Pradesh[xxiv] and several other wildlife parks which harbor presence of flagship species such as Royal Bengal Tiger & elephant[xxv] along with various other species of endangered fauna. The basin is virtually a nexus for critically important tiger corridors of Kanha, Pench, Satpuda, Melghat, Navegaon-Nagzira, Bor and Tadoba tiger reserves. It provides for 16,000 sq km of undisturbed landscape connecting Kanha and Pench tiger reserves which according to National Tiger Conservation Authority (NTCA) and Wildlife Institute of India (WII) is one of the four most viable tiger habitats in the country.[xxvi]

Table below lists these areas-

Wildlife sanctuaries/ Protected areas/ National Parks in the basin:			
Sr. No.	**State**	**Wildlife sanctuaries/ Protected areas/ National Parks**	**District**
1.	Maharashtra	Tadoba National Park (Tiger Reserve)	Chandrapur

		Bor Wildlife Sactuary	Wardha
		Navegaon Wildlife Sanctuary	Gondiya
		Nagzira Wildlife Sanctuary	Gondiya
		Pench National Park (Tiger Reserve)	Seoni
2	Chhattisgarh	Bhairamgarh Wildlife Sanctuary	Dantewada
		Kanger Ghati National Park	Bastar
		Indravati National Park (Tiger Reserve)	Dantewada
		Pamed Wildlife Sanctuary	Dantewada
3	Andhra Pradesh	Coringa Wildlife Sanctuary	East Godavari
		Papikonda Wildlife Sanctuary	West Godavari
4	Telangana	Kinnerasani Wildlife Sanctuary	Khammam
		Pocharam Wildlife Santuary	Medak
		Manjira Bird Sanctuary	Nizamabad
		Eturnagaram Wildlife Sanctuary	Warangal
		Kawal Wildlife Sanctuary	Adilabad
		Siwaram Wildlife Sanctuary	Karimnagar
		Pranahita Wildlife Sanctuary	Adilabad
		Siwaram Wildlife Sanctuary	Karimnagar

Figure 17: Wildlife sanctuaries/ Protected areas/ National Parks in the basin

Fish and Fisheries in the Basin: Godavari Basin is rich in fish species. The estuarine zone itself is habitat for nearly 228 species, some of which are marine. While the upper stretch of the river is nearly completely dependent on reservoir water releases for fisheries the middle zone has species like Carps, Mahseer, and prawns. Delta, in times of floods and monsoon has rich fisheries of prawns, large sized carps, catfishes, Puntius species, etc. According to CIFRI reports (Selvaraj, 2000, *River Godavari: Environment and Fishery,* CIFRI), dams like Polavaram will affect a number of species like prawns, which would get severely restricted, Hilsa and carps. The impacts of Polavaram on the lives of thousands of migrating fisherfolk has been documented. Hilsa, or the Pulasa, as it is called in the local language is famed in the estuary.

3.7 Dams & Barrages

Dams are a primary challenge faced by a river due to the profound ways in which they affect the hydrology, ecology, sociology, continuum of the river. The number of dams constructed in Godavari basin is the highest among all the river basins in India.

According to MoWR (Ministry of Water Resources), so far nearly 921 Dams, 28 Barrages, 18 Weirs, 1 Anicut, 62 Lifts and 16 Powerhouses have been constructed in Godavari basin for irrigation, diversion or, storage purpose. The basin has 70 Major Irrigation Projects and 216 Minor Irrigation Projects.

One of the oldest barrage in the basin as well as the country is the Dowleshwaram Barrage also known as Arthur Cotton Barrage, situated on the Godavari Delta near Rajamundry, Andhra Pradesh. Godavari barrage has come up by remodeling the Dowleshwaram barrage and irrigates the Godavari Delta. The barrage does not have a fish lift or a pass and does not releases eflows in the downstream, starving the delta of sediment and water and blocking migration of the fames *Pulasa*, Hilsa fish.

Other important projects include Sri Ram Sagar Project or the Pochampadu project in Nizamabad, Telnagana and the Jayakwadi Project in Paithan, Maharahstra. **Jayakwadi** project boasts of the one of the longest dam walls in the country, running more than 10 kms, which has resulted in massive evaporation losses from the reservoir. The project was built displacing 70 villages and is now in the eye of the storm as intra state water disputes heat up in Maharashtra. In the upstream of Jayakawadi are more than 11 large dams in the districts of Nashik and Ahmednagar, which is a cane and grape growing region. Downstream Jayakawadi too are several projects on the Godavari and tributaries in Maharashtra like 11 barrages on Godavari, Vishnupuri, Upper Penganga, etc. The massive GosiKhurd Dam coming up on Wainganga River, one of the biggest tributary of Godavari, is mired is corruption charges. The project will submerge more than 100 villages and is witnessing stiff resistance from the region.

The **Nizamsagar** multipurpose project is constructed in Nizamabad district in Telengana on Manjira River in 1931. **Kaddam** Reservoir is constructed on the Kaddam River in Adilabad district of Andhra Pradesh. The dam broke in a year after construction in 1958, by 4.6 cms water flowing over the crest.[xxvii] **Upper Indravati** multipurpose project on the Indravati in Odisha diverts waters of the Indravati into the Mahanadi for power generation. **Upper Kolab**

dam was completed in 1990 on Kolab River, **Orissa,**it has a live storage capacity of 935 MCM. At FRL, the reservoir water spread covers 114 sq. km. The dam displaced more than 50,000 people in the Koraput district of Odisha, who were already distressed by a number projects in Odisha. Hydro projects in the Sileruriver, a tributary of Godavari in Odishna has displaced thousands of tribals till date. These projects include Machkund (120 MW), Balimela (510 MW), Upper Sileru (240 MW), Donkarayi (25 MW) and Lower Sileru hydro (460 MW) power project.

According to disturbing report[xxviii], about 20,000 people from 6 gram panchayats, predominantly tribal are cut off from the main land for several years, first by the Machkund Hydro electric project and then by Balimela Project. They hire a ferry to get to mainland and in 2010, this ferry was targeted and attacked by the maoists.

Important dams in Godavari Basin ***(Source: Godavari Basin Profile by Central Water Commission)***

Sr. No.	**Name of dam**	**River/ Tributary**	**Name of the project**	**Location**	**Storage Capacity MCM**	**Year of Completion**
1	Gangapur Dam	Godavari	Gangapur Major Irrigation Project	Nashik Dist Maharashtra	215.88	1965
2	Darna Dam	Darna	Godavari (Darna) Irrigation Project	Nashik Dist Maharashtra	215.9	1916
3	Karanjwan dam	Kadwa	Upper Godavari Irrigation Project	Nashik Dist Maharashtra	175.6	1974
4	Bhandardara Dam	Pravara	Pravara Irrigation Project	Ahmadnagar Dist Maharashtra	312.6	1926
5	Totladoh Dam	Pench	Pench Irrigation Project	Nagpur Dist Maharashtra	1241	1989
6	Kamtikhairi Dam					
7	Jaikwadi Dam	Godavari	Jaikwadi Stage-I, Stage-II	Aurangabad Dist Maharashtra	2909.04	1976
8	Yeldari Dam	Purna	Purna Irrigation Project	Parbhani Dist Maharashtra	934.3	1958
9	Siddheshwar Dam	Manjra	Singur Irrigation Project	Hingoli Dist Maharashtra	250.85	1968
10	Singur Dam			Medak Dist	850.7	1989

				Telangana		
11	Nizamsagar Dam	Manjra	Nizamsagar Project	Nizamabad Dist Telangana	504.4	1931
12	ShriramSagar	Manjra	ShriramSagar Project Stage-I & Stage-II	Nizamabad Dist Telangana	3172	1977
13	Bawanthadi Dam	Bawanthadi	Bawanthadi Irrigation Project	Balaghat Dist Madhya Pradesh	280.24	-
14	Gosikhurd Dam	Wainganga	Gosikhurd Irrigation Project	Bhandara Dist Maharashtra	1146.07	-
15	Isapur Dam	Penganga	Upper Penganga Irrigation Project	Washim Dist Maharashtra	1.79	1979
16	Upper Wardha Dam	Wardha	Upper Wardha Irrigation Project	Amravati Dist Maharashtra	802.98	1993
17	Upper Wainganga	Wainganga	Upper Wainganga Irrigation Project	Seoni Dist Madhya Pradesh	507	2005
18	Indravati Dam	Indravati	Upper Indravati Irrigation Project	Nabarangpur Dist Odhisha	2308	1996
19	Upper Kolab Dam	Kolab	Upper Kolab Irrigation Project	Koraput	1215	1993

Figure 18: Important dams in Godavari Basin

3.8 Intra state water disputes

Intra-state water conflicts in Maharashtra are unfortunately becoming a routine. Maharashtra has been trying to address the recurrent conflicts though some of its institutional mechanisms. The institutional mechanism trying to address water sharing issues is the Maharashtra Water Resources Regulatory Authority (MWRRA). MWRRA itself is riddled with several serious flaws, but for now functions as an appellate authority in adjudicating water releases from upstream projects to the downstream in times of scarcity.

Godavari basin has been the stage of such conflicts consistently for past few years. This conflict is concentrated around Jayakwadi Dam in Aurangabad, which is the gateway of Marathwada. In 2015 the decision of Godavari Marathwada Irrigation Development Corporation (GMIDC) to release 12.85 TMC (Thousand Million Cubic Feet) of water from upstream dams in Nashik and Nagar District in October for Jayakwadi dam which had barely 5% of its live storage then based

on an order issued by MWRRA in September 2014 was met with dissatisfaction, uproar and sharp protests from the upstream (because any release of water from upstream dams is seen as their loss) as well as the downstream (because they think water released is too meager than rightful share of downstream area dams).

The decision came only after a long drawn petition filed by parties like Marathwada Janata Vikas Parishad and Aurangbad-based MLA (Member of Legislative Assembly) in Bombay HC for releasing water from upstream dam to Jayakwadi. MWRRA which was dysfunctional till 2013 came in the ring only after several orders of the High Court, facilitating mode and purpose of water release. MWRRA's decision to release water was again challenged in HC and SC and was upheld by both the courts.

The water release was pushed due to huge resentment and protests in Marathwada. As was expected, this was strongly contested by upstream regions of basin Nagar and Nashik largely fueled by politicians, sugar industries. Marches, protest meetings were organised in these cities. Farmers protested at Dams like Gangapur.

Ref: *https://sandrp.wordpress.com/2015/11/26/hydro-hegemony-dams-and-equitable-water-distribution-learnings-from-maharashtra/*

3.9 Surplus basin or Deficit Basin?

Surprisingly although there is a severe water scarcity in many parts of the basin, leading to increasing conflicts, the National Water Development Agency, responsible for works related to Interlinking of Rivers, classifies Godavari as a Surplus Basin and plans diversions from Godavari into other basins like Krishna and Pennar. Ironically, in Maharashtra, there are projects underway to transfer water from Krishna to Godavari!(Krishna Marathwada Lift Irrigation Project).

The situation only highlights the fallacies of labeling river basins "Surplus" or "Deficit". Maharashtra is in fact already transferring water from west flowing basins into Godavari, in a very unscientific manner.

3.10 Inter State River Linking Proposals on Godavari

While the dispute over whether Godavari is a surplus or deficit basin, NWDA has identified 4 inter-state links in the basin under Peninsular Component.

1. The Inchampalli-Nagarjunasagar Link will transfer 16426 Mcum of water from Godavari Basin to Krishna Basin to irrigate 2.87 lakh Ha in Andhra Pradesh. Total length of Link Canal is about 299 km that includes 9 km long tunnel.

2. The Inchampalli–Pulichintala Link envisages diversion of 4370 Mcum water from Mahanadi and Godavari Basins to Krishna Basin to irrigate 613442 ha in Andhra Pradesh. The Length of link canal is about 312 km including 12.50 km long tunnel.

3. Polavaram-Vijaywada Link proposes to transfer 5325 Mcum of water from the Right Bank of Godavari at the proposed Polavaram reservoir up to existing Prakasam Barrage on Krishna river at Vijayawada to irrigate about 5.82 lakh Ha in Andhra Pradesh. Total length of link canal is about 174 km.

4. A quantum of 12165 Mcum is proposed for diversion through the Mahanadi Godavari Link taking off at Manibhadra reservoir on Mahanadi to Dowlaiswaram Barrage on Godavari to irrigate 4.43 lakh Ha (0.91 lakh Ha in Andhra Pradesh and 3.52 lakh Ha in Orissa). The total length of the link canal is about 828 km including 6.15 km long tunnel.

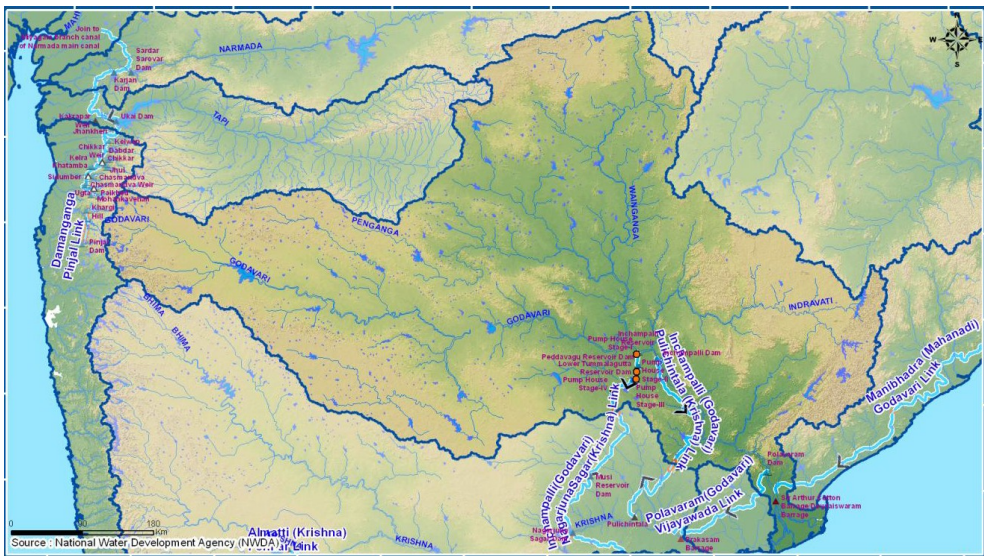


Figure 19: Interstate Links proposed in Godavari Basin Source: NWDA

Intra State River Linking

Godavari basin is also a major focus of intra-state river links in Maharashtra. Apart from Bhima-Manjara link announced recently of the total 20 links proposed originally by the GoM 8 links involve Godavari Basin. Status of these linking proposals is as follows[xxix] -

Sr. No.	Name of the Intra-State Link	Rivers	Status of DPR
1	Wainganga (Gosikhurd) – Nalganga (Purna Tapi)	Wainganga & Nalganga	Completed
2	Wainganga – Manjara Valley	Wainganga & Manjara	Completed, not found feasible
3	Upper Ghat – Godavari Valley (Damanganga (Ekdare) – Godavari Valley)	Damanganga & Godavari	Completed
4	Upper Waitarna – Godavari Valley	Waitarna & Godavari	Completed
5	North Konkan – Godavari Valley	Patalganga & Godavari	Completed
6	Sriramsagar Project-Purna-Manjira	Godavari, Purna & Manjira	Completed
7	Wainganga (Gosikhurd) – Godavari (SRSP)	Wainganga & Godavari	Withdrawn by Gov of Maharashtra
8	Jigaon – Tapi – Godavari Valley	Tapi & Godavari	Completed

Figure 20: Intra-State Link

3.11 Godavari Water Disputes

In April 1969, the Central Government constituted the Godavari Water Disputes Tribunal (GWDT) to address water sharing disputes between Maharashtra and Andhra Pradesh. While the disputes were before the Tribunal, the party States themselves, after negotiations entered into agreements from time to time on the utilisation of the waters of the Godavari and its tributaries. Incorporating these agreements in the final adjudication GWDT gave the final verdict in the year 1980 and ordered that the agreements should be observed and carried out by all concerned. Different sub-basins from the catchments intercepted by major/medium projects proposed on various tributaries by the States have been generally allocated

among the respective States. However GWDT verdict lacks actual water use monitoring mechanism to implement the agreements in true spirit.

In case of Godavari Tribunal decision, the Polavaram dam (also known as Indirasagar) Dam in Andhra Pradesh that was one of the key aspect of the decision, continues to be under construction and large number of disputes and litigations are still pending. The Dam in Andhra Pradesh has led to a dispute with Odisha and Chhattisgarh as it is going to submerge large parts of tribal areas of these states. There has not even been an environment and social impact assessment, nor public consultation process. The Ministry of Environment and Forests have given a stop work order, which keeps getting suspended and also several petitions remain pending in the apex court against the project Union Government has declared the project as a National Project and offered to fund it fully, though the project will be implemented by Andhra Pradesh.

Another point of dispute has been the Bhabali barrage on Godavari River. According to the MoWR website "The State of Andhra Pradesh in May, 2005 brought to the notice of the Central Government that Government of Maharashtra was constructing Babhali barrage in the submergence area of Pochampad Project (Sriramsagar Project) in violation of the Godavari Water Dispute Tribunal (GWDT) award dated 7.07.1980. Babhali barrage is located on the main Godavari River in Nanded district; 7.0 km upstream of Maharashtra – Andhra Pradesh border. The Pochampad dam on Godavari River is 81 km downstream of Babhali barrage. Pochampad storage stretches to a distance of 32 km within Maharashtra territory and its submergence is contained within river banks in its territory under static conditions." Following the creation of Telangana state on March 1, 2014, the dispute now is between Maharashtra and Telangana, but with signing of an agreement between these two states recently, this dispute may now be a history.

Pact between Telangana and Maharashtra over waters of Godavari

In August 2016 Maharashtra &Telangana governments signed pact for three irrigation projects to be constructed on River Godavari. Under the agreement, the two states would take up Tummidihatti, Medigadda (Kaleswaram) and Chanaka–Korata projects. Chief Minister of Telangana K Chandrasekhar Rao reportedly said that "this would herald a new era in the

relations between the two states and would be a standing example of how the states can resolve inter-state disputes without the Centre's intervention."[xxx]

This pact which has been looked at as 'historical victory' for Telangana for convincing the neighboring states is in fact in violation of our country's environmental law framework. Tummidihetti Project & Medigadda Project featured in the agreement have long history of gross irregularities and violations exposed by several apex agencies as well as media.

Tummidihetti Project is in fact an altered version of much controversial "Dr. B.R Ambedkar Pranahitha Chevella Sujala Sravanthi Project" popularly known as 'Pranahita chevella project'. This project originally planned to divert 160 TMC water from river Pranahita (a major tributary of Godavari River) by constructing a barrage at TummidiHetti village in Adilabad District of Telangana has already been **under construction illegally for last more than two years.**[xxxi] Construction of the canals for PranahitaChevella project was started hastily without obtaining EC, forest clearance (FC), wildlife clearance (WC), without sorting out interstate aspects or without even finalizing the height of the dam or assessing any feasibility.

Medigadda barrage is a part of Kaleswaram LIS comprising of three barrages to come up at Medigadda, Annaram and Sundilla. The Medigadda barrage is being proposed with a 100-metre FRL to store 16.17 TMC of water, the Annaram with 120-metre FRL to store 3.52 TMC and Sundilla barrage with 130-metre FRL to store 1.62 TMC of water.[xxxii]

Government of Telangana has taken up six other projects in the region along with the three projects forming a part of the pact including Lower Penganga & Lendi. Construction of total 10 dams & barrages is involved. (list given at the end)

List of projects taken up by Telangana around Pranahita Chevella Project

(Source: Pre-Feasibility Report of Chanaka Korata Project)

Name of the project	River basin	Status	Location (District)	Storage (TMC)
ChanakaKorata (Rudha)	Penganga	Proposed	Yavatmal (Maharashtra)	1.5
Rajapeth		Future	Not finalised	0.7
Pimprad		Future		1.5
Lower Penganga	Penganga	Future	Yavatmal (Maharashtra)	5.12
Mahadivagu		Ongoing	Adilabad	0.905

			(Telangana)	
Satnala		Existing		2.048
Pranahita	Pranahita	Ongoing	Chandrapur (Maharashtra)	160
Medigadda	Godavari	Future	Karimnagar (Telangana)	26.77
Annaram		Future		2.27
Sandilla		Future		1.08

Figure 21: Projects taken up by Telangana around Pranahita Chevella Project

3.12 THREAT and HEALTH ASSESSMENT

Water Quality and Pollution:

Like all rivers across India, Godavari too faces severe pollution from urban and rural sewage, agricultural runoff, and industrial effluents. In Maharashtra upper stretch of Godavari from Nashik District to Paithan has been declared as priority I critically polluted stretch by CPCB with BOD ranging from 6 mg/l to 36 mg/l[ii]. A petition has been filed in the high court by few activists from the city against Nashik Municipal Corporation (NMC), Municipal Commissioner, Government of India (GoI), Government of Maharashtra (GoM), and Maharashtra Industrial Development Corporation (MIDC) for failure on their part to clean the pollution of the river [iii].

In Andhra Pradesh stretch flowing from District of Rajamundry has been declared as priority-IV critically polluted stretch with BOD 6 mg/l.

Water quality of Manjara from Latur city in Maharashtra to Karnataka border and also at Sangareddy, at Wardha's confluence with river Pangangato downstream of Sirpur in Maharashtra and of Indravati at Bodhghat in Madhya Pradesh has been deteriorated. In Vidarbha, the several thermal power plant, including the ones run by the state discharge fly ash and highly contaminated wastes right into the tributaries of the basin.

Subsiding Delta due to upstream dams:

The Godavari and Krishna rivers, which are the second and third largest river systems in India after the Ganga, have built their deltas adjacent to each other almost merging into one large delta complex in the central part of the east coast of India. This delta is one of the most fertile and is a densely populated zone of intense economic activity. Delta plain of the river Godavari

occupies an area of 1700 sq.km. River Godavari gets divided into two main distributaries, viz. Gautami and Vasishta.

Coringa Wildlife Sanctuary is situated on the deltaic branches of Gouthami and Godavari rivers at Kakinada Bay. It has extensive marshes and mangroves extending in an area of about 235.Sq.Kms

There has been almost a three-fold reduction in suspended sediment loads entering the delta due to trapping from upstream dams. This is leading into coatsla erosion, Effective Sea Level Rise, more flood risks, fisheries reduction, etc. Sediment load at the delat has reduced from 150·2 million tons during 1970–1979 to 57·2 million tons by 2000–2006. Experts like Syvistki et al classify Godavari delta as *"Deltas in greater risk: reduction in aggradation where rates no longer exceed relative sea-level rise"*. Decline in historic sediments of Godavari post damming has been as high as 74%!

Winding up

From the origin in Western Ghats to its mouth at the Eastern coast, Godavari traverses a major part of Peninsular India and nourishes several rich cultures and social milieus: from Marathi in Deccan plateau to ancient tribal culture in central India to a vibrant delta system near Rajamundhry. The River is fettered in many dams all along its length and across its basin which have been responsible for human sufferings, ecological impacts, livelihood struggles and conflicts.

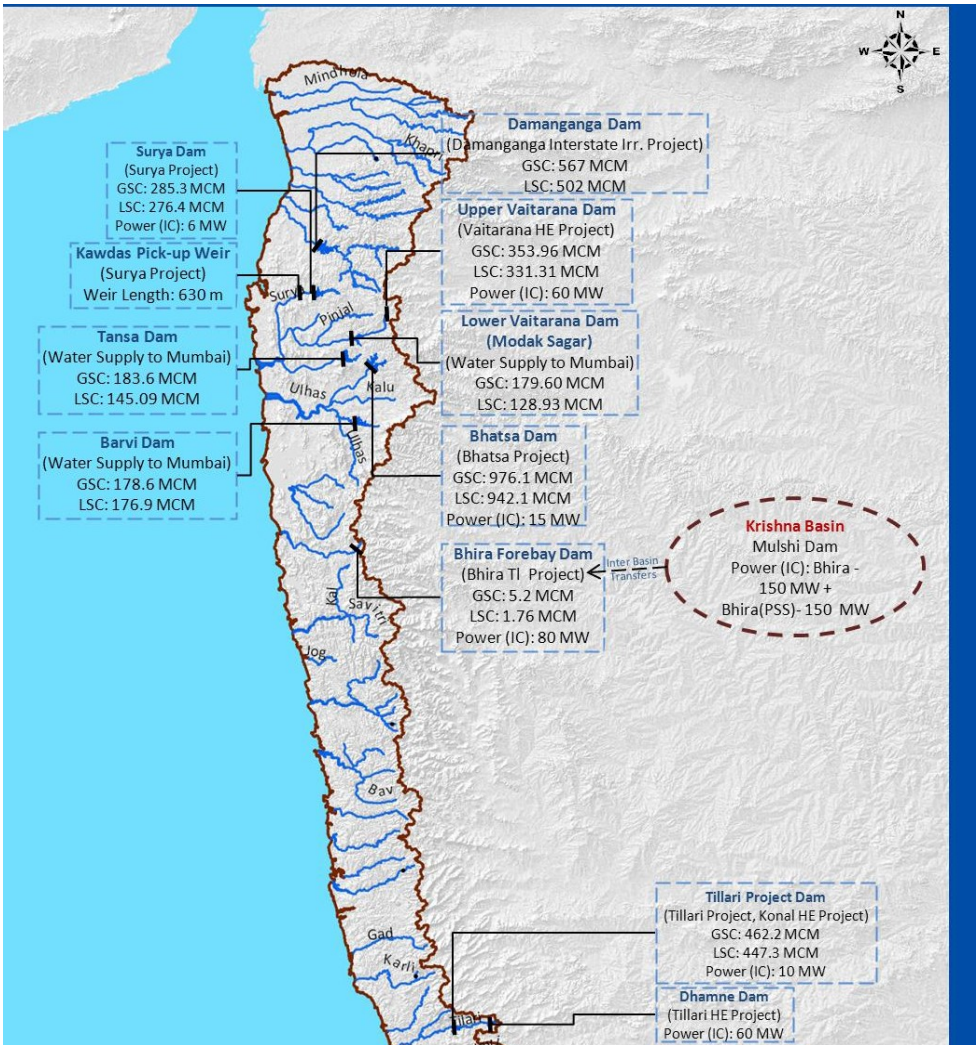
The basin is facing several major issues, but the river is also resilient. Let us hope that inhabitants of the Godavari basin are empowered to solve the problems of their river.

4. WEST FLOWING RIVERS OF MAHARASHTRA

4.1 Introduction:

West Flowing rivers in Maharashtra are spread across the districts of Nashik, Thane, Raigad, Pune, Ratnagiri and Sindhudurg. All of the West Flowing rivers in Maharashtra originate in the Western Ghats or the Sahyadri mountain ranges and flow a short and swift path to the Arabian sea. This region, bounded by Sahyadri Mountain Ranges (Western Ghats) on the east and Arabian Sea on the West is called as ***Konkan***. Hence, basins of all West Flowing rivers fall in Western Ghats or Konkan. Major west flowing rivers of Maharashtra from North to south include Par, Nar, Damanganga, Vaitarna, Ulhas, Kalendri, Patalganga, Kundalika, Amba, Savitri, Kal, Gandhari, Vashishti, Shastri, Kaajvi, Muchkundi, Konvali, Vaghotan, Gad, Karli, Tillari and their tributaries.

Traditional water systems in the Konkan region revolve around groundwater from lateritic plateaus, hills streams and rivers. Due to quick runoff, swift, overflowing rivers of the monsoon dry up in the summer; range of groundwater fluctuation is also high. The region has several evolved traditional practices to utilize rainwater for irrigation and domestic use. The system of making “Paats” or irrigation channels off-taking from rivers, hills streams and groundwater zones exists till date. SANDRP has documented some traditional water systems in Konkan.[xxxiii]

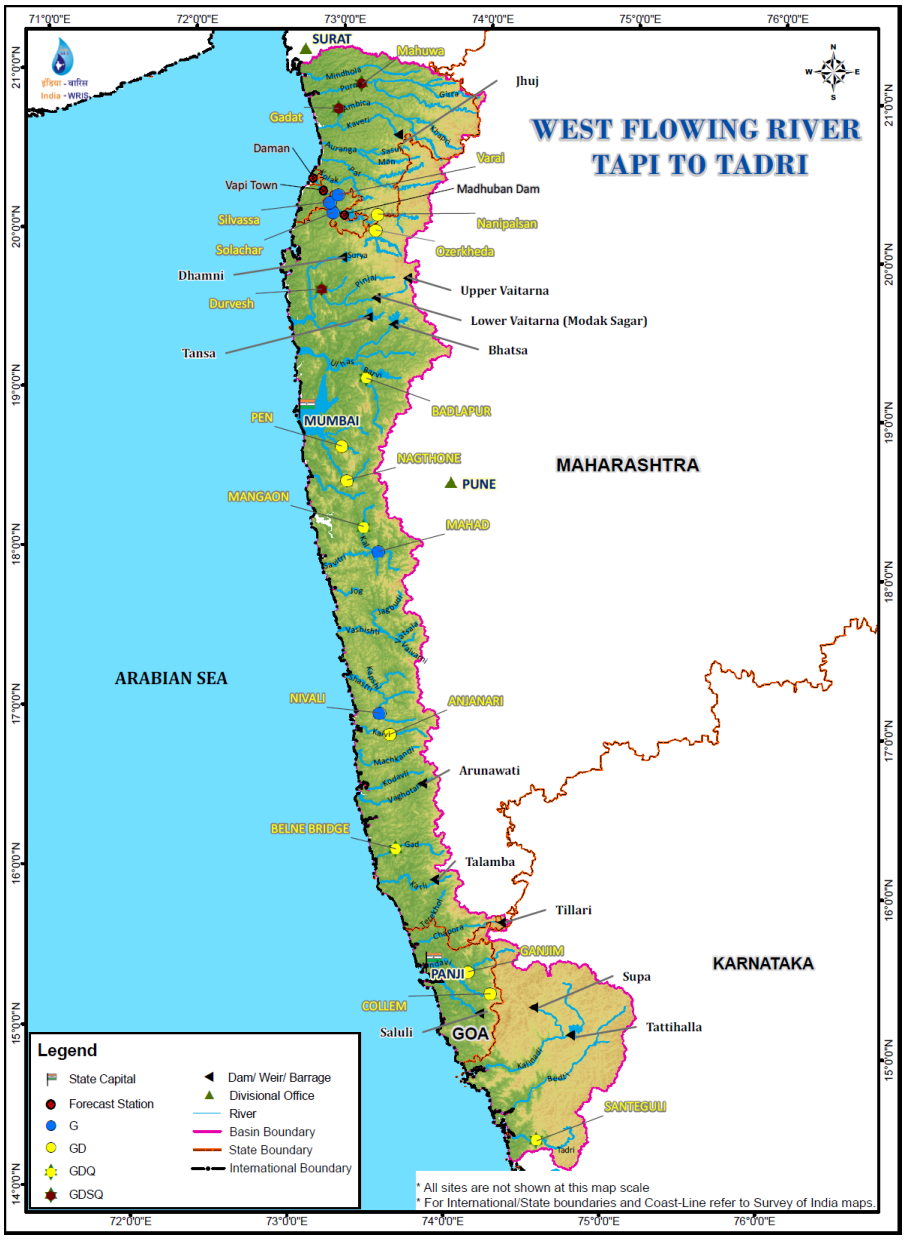


Map 4: Hydropower stations on West Flowing Rivers Source: INDIA-WRIS

As a result of its singular soil-rainfall-topography, agriculture in Konkan is different from the rest of Maharashtra. Traditional crops include paddy cultivated on terraces and millets like Ragi cultivated on slopes. Mainstay of agricultural economy is horticulture of Mango, Cashewnuts and kokam (Garcinia fruit). These have no specific irrigation needs and grow on slopes. Coconut and Arecanut plantations on the precious strips of plain land require water. In Rabi, region-specific pulses are grown on soil moisture and dew. Due to poor soils and hot weather, the region is not a leader in spices, coffee, tea or rubber. Migration from Konkan to Mumbai and other parts of the state has always been high and farm labour is difficult to find. Due to several factors like a rugged undulating terrain, lateritic porous strata, poor soil, traditional crops which do not need irrigation, etc. **Major Irrigation Projects and dams are rare in**

Konkan. This is despite the fact that Konkan gets 45% of the average annual yield of all rivers in the state!

It is here that you find one of the oldest earthen dams in the state: the Dhamapur Dam in Sindhudurg, which still stands proud, not only irrigating plantations but providing drinking water to the entire Malvan city. Temple Tanks in Sindhudurg provide drinking water, irrigation and recharge groundwater.



Map 5: West Flowing River Basins in Maharashtra and Goa Source: India-WRIS

As per the ***Irrigation Status Report 1999***, the West Flowing Rivers are classified as follows:

Name of the Basin	**Rivers**	**Districts (Percentage area in Districts)**	**Geographical Area (sq. kms)**	**Total Area (sq kms)**
Damanganga Par Basin	Damanganga and Par	Thane 24.32%	610	2508
		Nashik 75.68%	1898	
North Konkan Basin	Vaitarna, Ulhas and Patalganga	Mumbai and Suburbs: 5%	603	12063
		Thane: 74.18%	8948	
		Pune:0.92%	111	
		Raigad:18.40%	2219	
		Nashik: 1.51%	182	
Middle Konkan Basin	Amba, Kundalika, Savitri, Bharja and Mhasala	Raigad:83.2%	4933	5929
		Pune: 2.16%	128	
		Ratnagiri: 14.64%	868	
Vashisthi Basin	Vashisthi River	Ratnagiri 100%		2233
South Konkan Basin (Ratnagiri):	Shastri, Kajvi and Muchkundi	Ratnagiri 100%		4735
South Konkan Basin (Sindudurga)	Karli, Gad, Achra, Devgad, Vaghotan, Kodavali and rives which meet near Vengurla	Ratnagiri 8.68%	372	4285
		Sindhudurga 91.32%	3913	
Terekhol Tillari Basin:	Terekhol and TIllari rivers.	Sindhudurga 87.73%	1294	1475
		Kolhapur 12.27%	181	

Figure 22: West Flowing Rivers

Although covering a smaller catchment area, these rivers basins receive 45% of Maharashtra's average annual yield [xxxiv].West Flowing rivers are characterized by a flashy hydrograph. They swell in summer monsoons and empty soon due to higher slopes. The rivers are differentiated from other rivers basins in the state by the steep slope, dense forests at the origin, a saline zone, sand bars, mangroves and estuaries.

Many of the rivers in the region had prosperous ports, but sedimentation and formation of Sandbars have affected the use of these rivers as ports. Estuaries of all West Flowing rivers are important fish nurseries and breeding grounds.

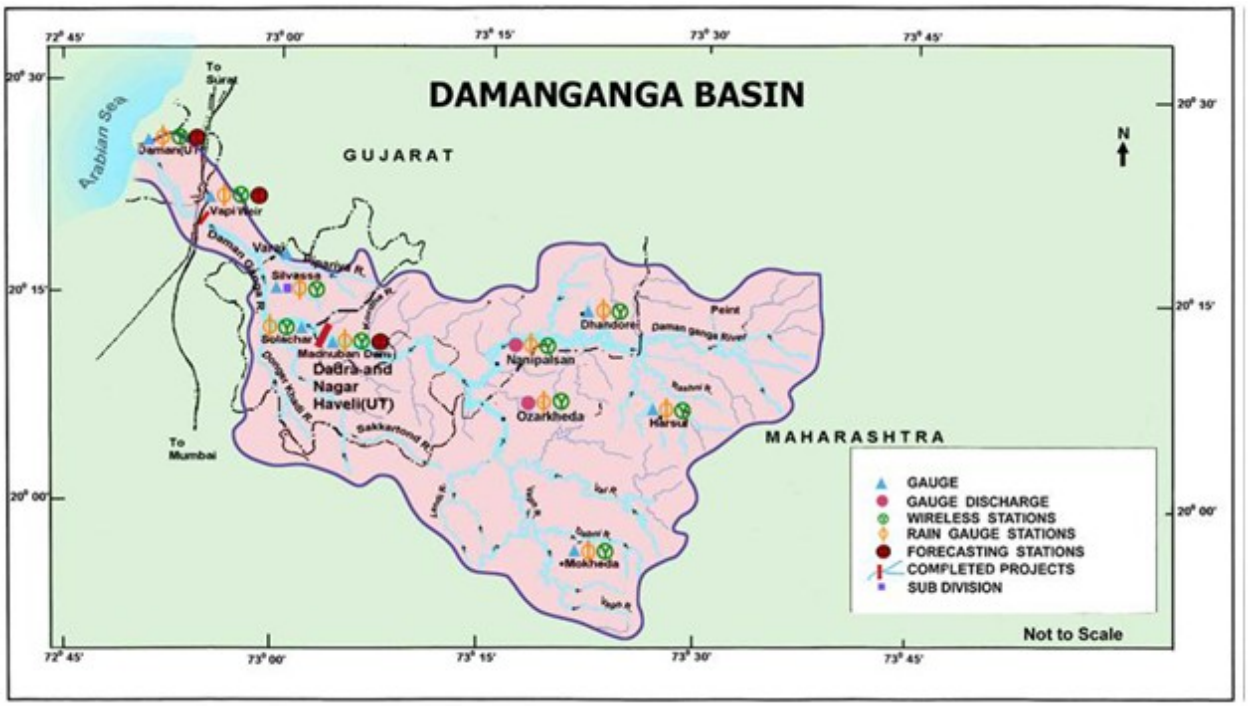
4.2 Climate[xxxv]:

The climate of the basin is mainly of the coastal type where the seasonal variation is small and the atmosphere is moist and humid. The summer and the winter climate are controlled by the south-west and north-east monsoons and the autumn and the springs are practically indistinguishable. By the December, the winter sets in. (Source: Water Year Book, CWC, and 2008-1010. Central Water Commission, New Delhi). Average rainfall of this region is around 2000-3000 mm and it increases from North to South.

4.3 Description of some of the major West Flowing Rivers in Maharashtra

1. Damanganga River Basin:

The Damanganga river rises in the Sahyadri hill ranges near village Ambegaon in Dindori taluka of Nasik district of Maharashtra State at an elevation of 950 m and flows a total distance of about 131.30 km before it drains into the Arabian Sea at Daman. Damanganga along with its tributaries mainly flows through the hilly areas of Maharashtra, Gujarat and Union Territory Dadra and Nagar Haveli and Daman. It drains total area of 2318 sq km in Maharashtra State, Gujarat State and the Union Territories of Dadra, Nagar Haveli (DNH) and Daman & Diu before it drains into the Arabian Sea. The catchment of the river is fan shaped and the river is prone to severe flashy floods. The important tributaries of the Damanganga river are Dawan, Shrimant, Val, Rayte, Lendi, Vagh, Sakartond, Dongarkhadi, Roshni and Dudhni.[xxxvi]



Map 6: Damanganga Basin Source: WRIS, India

Name of District	Drainage area (sq km)	% of total area
Nashik (Maharashtra)	1408	60.74
Valsad (Gujarat)	495	21.36
Dadra, Nagar,Havali& Daman/U.T.	415	17.90
Total	2318	100

Figure 23: Distribution of the Basin Area Source: WRIS-India

Existing Projects: Madhuban Dam: Madhuban Irrigation Dam composite dam constructed across the river near village Madhuban of Dharampur Taluka, Valsad district of Gujarat state. It also supplies water for domestic and industrial use and for generation of 2.0 MW of power. The project has a network of canal system on either bank of the river to provide irrigation to an area of 56630-ha of land. The dam has height of 50 m above the deepest foundation to store 567 Mm3 of water. The capacity of the dam remains woefully underutilized.

Damanganga-Pinjal Link: National Water Development Agency (NWDA) has envisaged Damanganga Pinjal Link to supply approximately 909 MCM (Million Cubic Meters) water to

Mumbai, mainly for drinking water supply . The project entails three major dams called Bhugad, Khargihill and Pinjal all in tribal parts of the Western Ghats. It also involves massive tunnels through forest area running for 42.15 kms. The total submergence of the project is more than 3500 hectares. All of these dams are strongly opposed by the Local Tribals.

Figure 24: Damanganga Basin in Nashik Photo: SANDRP

In addition, there is a possibility that there will be no Environment Impact Assessment, no public hearing and no Environment Management Plan for this massive project. This is due to the fact that the EIA Notification (2006) excludes Drinking Water Supply Dams from its purview. This is entirely unacceptable, especially as it was declared by none other than Minister for Water Resources, River Development and Gaga Rejuvenation Ms. Bharti (at the valedictory function of India Rivers Week) that "If environmental impacts of ILR projects are foreseen to be high, projects will not be taken up." But if there is not even an EIA, how can we even grasp what the environmental (and social) impacts are? Especially for a project that can submerge more than 3500 hectares' forest land in Western Ghats.[xxxvii]

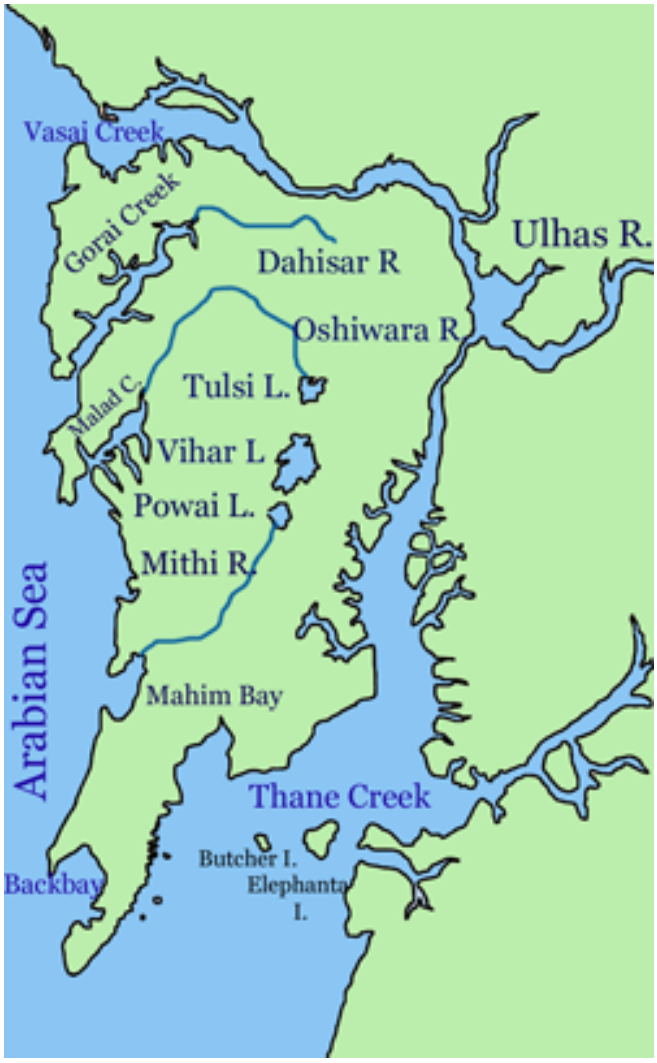
2. Rivers of Mumbai:

Mumbai is the most populated city of this basin and is also the biggest Metropolis of India. The city has India largest deep water harbor and a large well equipped modern port. The main rivers that flow through Mumbai are ***Mithi, Dahisar, Poisar, Oshiwara and Chandansar.*** Most of these rivers originate in the thick forests of the Sanjay Gandhi National Park and flow for around 15 to 20 kilometers to the Arabian Sea.

All of these rivers are severely polluted and encroached. The July 2005 Floods in Mumbai which resulted in over 100 people losing their lives, highlighted the plight of these rivers, but little has been done so far to restore them except some widening and deepening.

A strong people-led struggle to revive some of these rivers is however taking roots recently.

The National Green Tribunal in May 2016, ordered the Central Pollution Control Board and the Ministry of Environment, Forests and Climate change to take strong action against the Maharashtra Pollution Control Board for its inability to control pollution of Ulhas and Waldhuni Rivers. It also ordered a record fine of Rs. 100 Crores jointly to Common Effluent Treatment Plants of Kalyan Dombivali Municipal Corporation and Ulhasnagar Municipal Corporation as well as the MPCB.

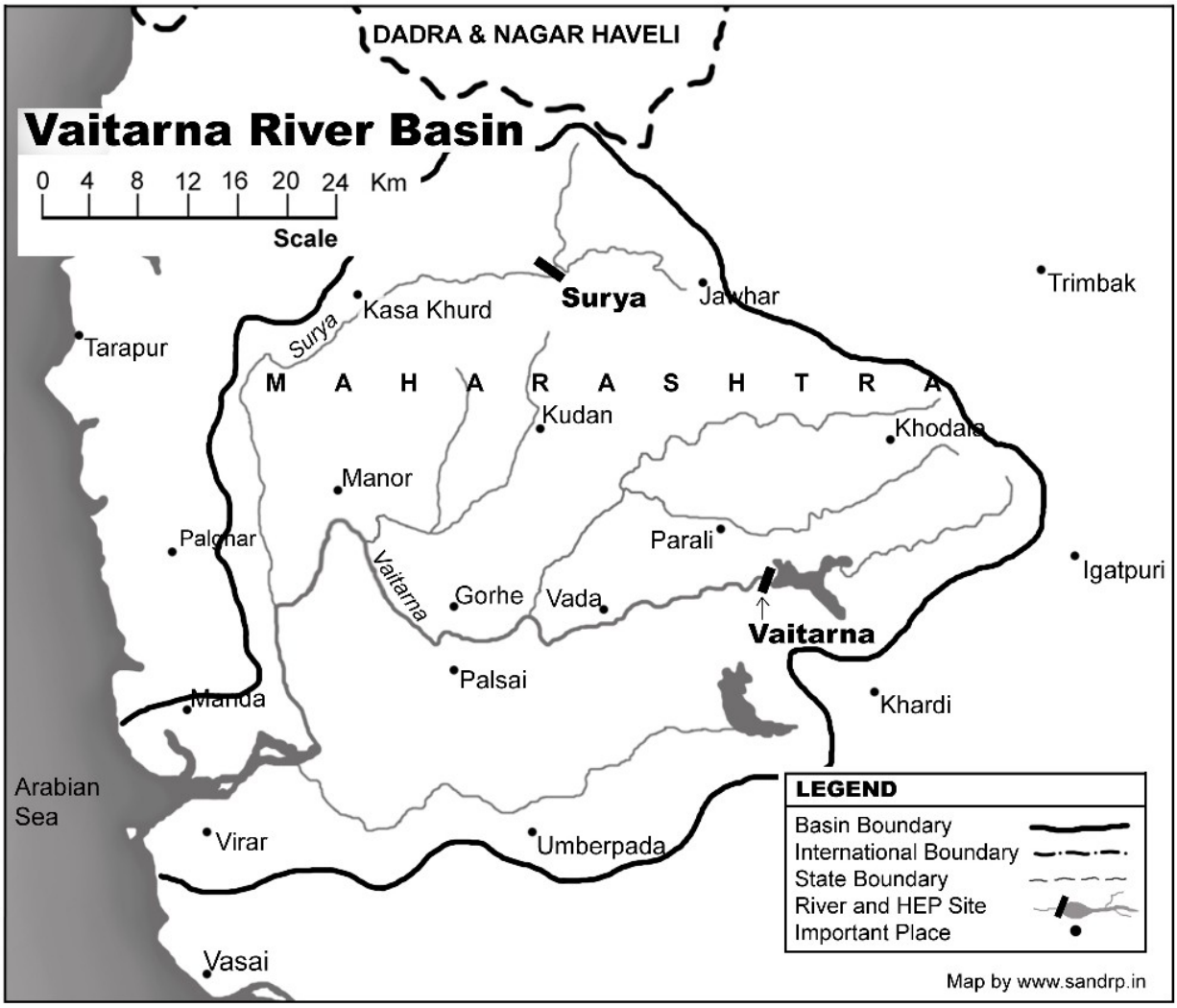


Map 7: Rivers and creeks of Mumbai Source: Wikimedia Commons

3. Vaitarna[xxxviii]

The river rises in the Sahyadri hill range at Trimbak in the Nasik district of Maharashtra State north of the village of

Jawhar in Nasik district of Maharashtra State at an elevation of 800m and after traversing a distance of about 120 km in Maharashtra towards west, it joins the Arabian Sea. The Vaitarna basin lies between East longitude of 72° 45' to 73° 35' and North latitude of 19° 25'to 20° 20'.



Map 8: Vaitarna River Basin

The headstreams of the Vaitarna rise on the southern slopes of the Trimbak-Anjaneri range and combine into three southward flowing streams which unite to form the Vaitarna a little north of Dapure.

The main tributaries of Vaitarna river are Pinjal, Gargai, Surya, Daharji, Tansa. The catchment area of Vaitarna basin completely lies in Thane and Nasik districts of Maharashtra. The Vaitarna drains an area of 2019 sq km before it falls in Gulf of Khambhat.

Sl. No.	Name of Project	River	Status	Gross Capacity(MCM)	Live Capacity(MCM)	Utilization
1	Vaitarn Hydro Electric Project(Upper Vaitarna)	Vaitarna	Major	301.60	295.80	Multipurpose
2	Surya Project.	Surya	Major	285.31	276.35	Multipurpose
3	Modak Sagar (Lower Vaitarna)	Vaitarna	Medium	N.A.	N.A.	Irrigation
4	Wandra Project	Wandria	Medium	37.11	35.938	Irrigation
5	Deharji River Project	Deharji	Medium	93.120	89.840	Irrigation
6	Tansa Dam	Tansa	Medium	N.A.	N.A.	Multipurpose

Figure 25: Major and medium projects completed / ongoing on Vaitarna river basin are as shown in table. Source: CWC

In addition to this, Municipal Corporation of Greater Mumbai (MCGM) has constructed and commissioned the **Middle Vaitrana Dam** to supply 445 Million Liters Water per Day to Mumbai. The dam submerged 760 hectares of land, predominantly forest land and tribal padas (settlements).

Rehabilitation of displaced people is still grossly inadequate. SANDRP had visited the site and has reported about it.[xxxix]

Figure 26: Submergence of Middle Vaitarna Dam Photo: SANDRP

Ecology: The Basin includes Tansa Wildlife Sanctuary, which is surrounded by Tansa Dam. It is also in Important Bird Area (IBA). Recently, critically endangered Forest Owlet was spotted in the sanctuary.[xl]

Pinjal and Gargai Rivers which are tributaries of Vaitarna also flow through Tansa. This part of Northern Western Ghats is lesser studied for its biodiversity. Pinjal and Gargai Dams, also planned for supplying water to the Mumbai Metropolitan Region threaten to submerge 750 hectares of the Tansa Sanctuary itself. SANDRP has reported on the impacts of these dams on Western Ghats and the Tribal population.[xli]

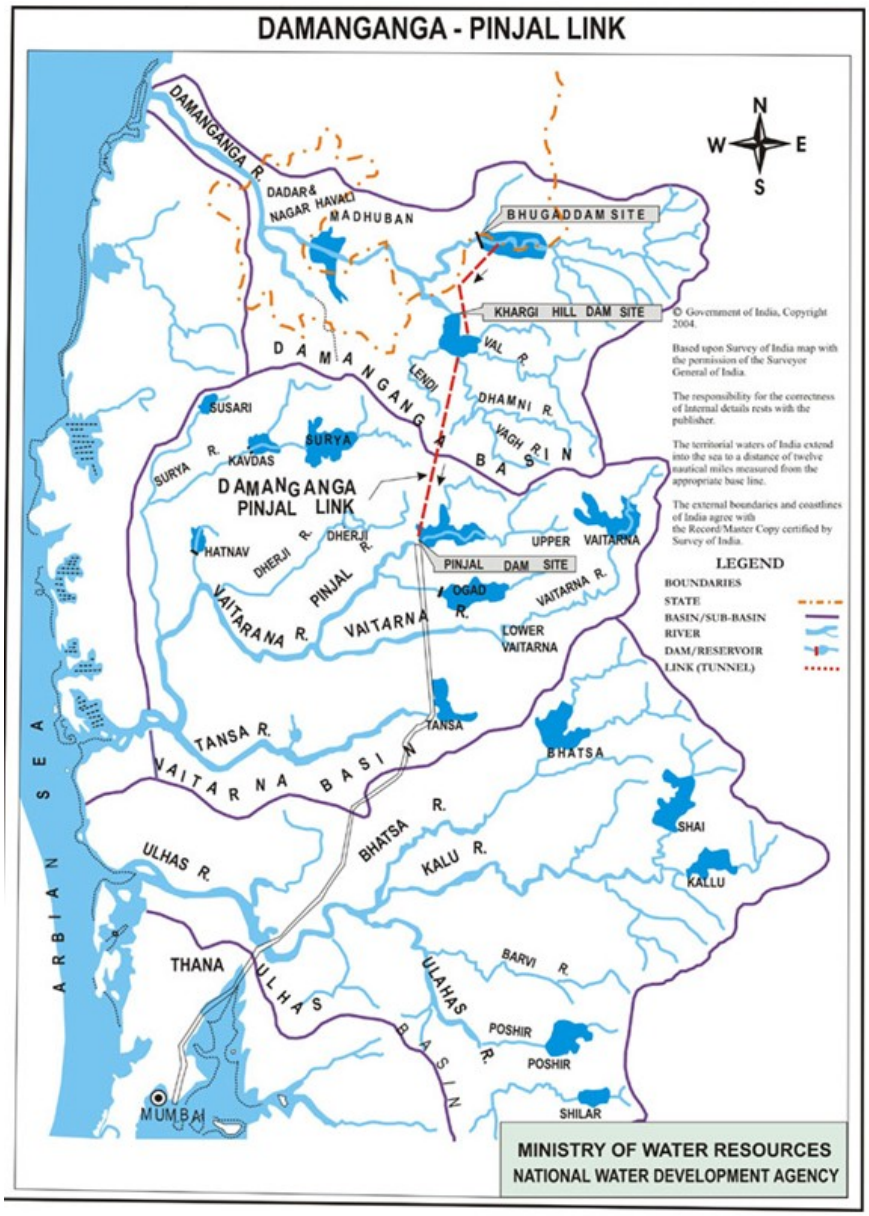
Cultural Aspects: Mythical river called as ***Vaitarni*** is supposed to be the river marking the boundary between the current and the netherworld in the ***Garuda Purana***. It also finds mention in Skandh Purana as a physical River, but that may refer to Baitarni in Odisha. *Vai-Tarini* also means Truly Saving as per the *Vaitarni Mahatmya.*

The River Basin also holds a **Community Fish Sanctuary** at Tilase which protects the endangered Mahseer Fish. SANDRP has documented the Sanctuary and its customs.[xlii]

Figure 27: Fate of the tribals in Vaitarna Basin to be displaced by Gargai Dam hangs in balance Photo: SANDRP

4. Ulhas River:[xliii]

The Ulhas basin lies between North latitudes of 18º 44’ to 19º 42’ and East longitudes of 72º 45' to 73º 48’. The Ulhas drains an area of 4,637 sq km which lies completely in Maharashtra. Thane, Raigad and Pune districts fall in the basin. The Ulhas rises from Sahyadri hill ranges in the Raigad district of Maharashtra at an elevation of 600 mts. The total length of Ulhas to its outfall in to the Arabian Sea is 122 km.



Map 9: Interlinking Map showing Ulhas Basin. Source: India WRIS

The important tributaries of the Ulhas River are Pej, Barvi, Bhivapuri, Murbadi, Kalu, Shai, Bhasta, Salpe, Poshir and Shilar. The Kalu and Bhasta are the major right bank tributaries which together accounts for 55.7% of the total catchment area of Ulhas.

The average rainfall in the Ulhas basin is 2,943 mm. The basin receives most of the rainfall from the South-West monsoon during June to October. Almost 99% of the total rainfall in the basin is received during this period. The average maximum and minimum temperatures are 38.90 C and 12.40C respectively.

Issues: Major Drinking water supply dams Kalu, Shai, Poshir and Shilar are planned in the Ulhas basin, in addition to existing dams like Bhatsa and Barvi. Mumari Dam is proposed for irrigation. Kalu Dam will submerge as area of 2175 hectares, including nearly 1000 hectares of forest land and 18 villages, while Shai dam is set to submerge 3040 hecatres of land, nearly 52 villages and more than 490 hectares of Forest land.[xliv]

Height of **Barvi** Dam has been increased four times to increase its water supply, each time affecting tribal population[xlv]

Cultural Significance: The region is densely forested, but lesser-studied part of the Northern Western Ghats. It holds several Devrais (Sacred Groves). Movement of animals like Leopards is common.

5. Savitri River:

Savitri is one of the five rivers that originate in Mahabaleshwar, a famous Hill station in Western Ghats of Maharashtra. Savitri then turns westwards and flows through Raigad district and eventually meets Arabian Sea at Harihareshwar. It passes through Poladpur, Mahad, Mangaon and Shrivardhan taluks. There are a number of Shiva temples along the banks of river Savitri. In last 100 km it forms the border between Raigad and Ratnagiri. Approximate length is 90 kms and basin area is 2899 sq. kms. [xlvi]

The major tributaries of Savitri are Kal River, Gandhari River, Ghod nala, Kal nadi, Nageshri. The source of Savitri River is crest line scarp located east of Mahad. This river flows towards west and meets to the Arabian Sea near Bankot. The drainage pattern around Mahad is trellis shaped. Most of the tributaries join the Savitri River nearly at 90° in the Mahad region. One of the abnormal drainage characters is that of Kal River, which is a tributary of Savitri. This river flows from North to South and shows barbed drainage pattern indicate drainage reversal and possibly due tilting of the region during tectonic activity. The Basin of Kal River is within the Mangaon depression or basin.

Average Annual yield of Savitri River at 75% dependability is 5786 MCM. [xlvii]
There are around 11 medium projects in the Savitri Basin, but no major project.
There are several hot springs in the basin.
Major Tributary of the Savitri Kal River has a spectacular community conserved fish sanctuary at a place called Walen Kondh.[xlviii]

The Sanctuary and Kal river is threatened by Kal Kumbhe Hydropower Project, which is mired in corruption. SANDRP has documented this.

Recently, the Maharashtra Government has scrapped all contracts for Kal Kumbhe Project. However, the half constructed dam obstructs the river and is a cause of danger to downstream villages.
Savitri River is also polluted severely due to Chemical Industrial Development Corporation on its banks. Fish Kills are common due to increased pollution.[xlix] Unabated Sandmining is also a serious threat in Savitri Basin.

Savitri River System meets the sea forming a creek called as the Bankot Creek. There are some records of new fish species from the region[l], [li]

6. Vashishthi River Basin

Vashishthi Basin falls entirely in Ratnagiri District of Maharashtra. Main town along the Vashishthi is Chiplun. Its origin is at 900 meters near a town called Tiware in Ratnagiri. Approximate length of the river is 68 kms.[lii] Average Annual yield at 75% dependability is 4491 MCM.
Major Tributaries include: Jagbudi, Baitarni, Tambinadi, Dhavati Nadi and Kaamaal Nala.

Map 10: Vashishthi River basin

The natural character of Vashishthi has been affected tremendously due to two reasons:

- **Koyna Hydroelectric project:** The Koyna project diverts 1911 MCM of water from the Koyna basin (part of the water deficit Krishna basin) into the Vashishti for electricity generation using the It has a vertical drop of 487.68 m at Pophali. Total installed capacity of Koyna Stage I, II, III and IV is 1960 MW. Koyna stage IV is a peaking power project and water level fluctuations downstream can happen at any time in the day. Vashishti has a narrow basin and excess water from Koyna adds to floods in rainy season for Chiplun city. It has been documented that sudden water levels fluctuations brought about by hydropower dams have a severe impact on fish life cycles and constitution of mangroves. This can be one of the factors affecting the fish production in Vashishti estuary and needs to be studied further.
- **Lote Parshuram Industrial Area (LIA):** In 1978, the Maharashtra Industrial Development Corporation (MIDC) appropriated 570.73 hectares of land of Lote, Awashi,Sonegaon,Dhamandevi and some other villages of the Chiplun block, Ratnagiri district for setting up a Chemical Industry Zone. The development of the industrial belt was part of the government's plan to develop the Konkan region and provide better survival opportunities for people. LIA was developed in two phases, Around 200 chemical (agro chemicals, dyes and pharmaceutical) and a few engineering units began operations in the 1980s. • By the year 2002 there were about 122 units in business, the rest having closed down, due a number of reasons, including closure orders by MPCB. One of the important criteria for selecting Lote Parshuram site was also the proximity of the region with Vashishti creek, to ease the disposal of effluents. **Indeed, effluents are being released from the LIA into the streams and Vashishti creek for more than 25 years now, entirely changing the ecology, sociology and economy*** of the region. (*Economy: According to a study done in 1997, of 773 local residents seeking employment in the four villages, only 92 people (11.9%) got jobs. Only 25 among these were permanent employees, the remaining 67 working as contract labourers. 80% of work in factories is done through contractors.)
- **Socio ecological impacts of untreated pollutants Release** of untreated pollutants in the streams and Vashishti river had several far-reaching impacts of the community and ecosystem: Fish and biodiversity: Fishing as an industry in Vashsihti Estuary is finished.

There were (and still are) around 6000 fishing families in from Lote to Dabhol and estuarine fish dependant livelihoods of all of them are destroyed. Income from estuarine fishing started to drop rapidly from 1997 and has reached negligible levels now.

- Fish kills are still very common and the Pollution Control Board neglects them most of the times Fishermen have received no compensation what so ever for the losses they have /are sustaining. In Dabhol, which at the mouth of Vashishti about 45 kms from Lote, estuarine fishing is dead. According to fisheries cooperatives members in Dabhol, fish catch has been falling every year. They used to get approx.10 kilos fish for every net that they casted and they did this 3-4 times a day. Now, getting half kg from the estuary in a day is difficult. Barely 5% of the original estuarine fishermen are now members of the fishing cooperatives. Rest have moved to Mumbai or work with Trawler ships in open sea. Around 70% of estuarine fish and marine species found in Vashishthi are now locally extinct

- **Loss of agricultural productivity:** Riparian farming in 6 villages around Lote is abandoned because of crop burning and rotting incidences A number of cattle have died after drinking water from the streams. Pipes carrying effluent are generally broken, a situation observed by a number of surveys (CGWB, MPCB, NGOs) and agricultural land is grossly polluted due to seepage and illegal dumping of pollutants.
    - Studies indicate that ph of soils around Lote MIDC is acidic (less than 5) and soil moisture is much higher (BG College, 2004) Health Impacts: During a survey conducted in 1997 (there have been no health surveys after that) 30% population in the 5 villages suffers from Lung disorders and skin diseases. According to a study conducted by BJ College (which had to be obtained under RTI),Chiplun in six villages around Lote, cattle milk and human milk samples show high proportion of lead, aluminum and chromium

7. Shastri River[liii]

River Shastri originates near Prachitgad, on the crestline of the Western Ghats, in the newly formed Sahyadri Tiger Reserve, a Project Tiger Habitat in 17 Degrees 27' W and 73 Degrees 48' E on the western slopes of the Western Ghat complex in the Konkan region of Maharashtra, at an elevation of 839 masl. It falls entirely in the Ratnagiri district, covering three talukas of

Sangameshwar, Ratnagiri and Guhagar. Its length is approximately 80 kilometers, with first 20 kilometers in hilly areas of severe slope.

Basin area is 2173.55 square kilometers. Average annual yield is 6261 MCM (4496 MCM with 75% dependability). Tributaries of the river include rivers and rivulets of Gadgadi, Bav, Gad, Asavi and Gandagi which join Shastri at various points. It is one of the rare free flowing rivers of Maharashtra without a dam on its mainstem.

Figure 28: farming nourished by the water and silt of the free flowing Shastri Photo: SANDRP

It meets the sea at Jaygad, where the historic port of Jaygad has been established. During its short journey, it exhibits diversity of aquatic habitats, with features like falls, glides, runs, pools, riffles, pocket waters, potholes, etc,. Mono culture and intensive farming practices are not observed on the banks. Rural population is dependent on the various provisioning, regulating and cultural ecosystem services of the river. Local community in all the three blocks and 80 villages of Ratnagiri depend directly or indirectly on the river for ecosystem benefits, drinking water and water for agriculture. The river is of high cultural significance with sacred groves and Shiva Temples at each hydrological junction

Dependence of local population on Shastri:

Upstream: Shringarpur-Sangameshwar

Drinking water: The entire town of Sangameshwar with a population of 12000 also depends on the river for domestic water supply through jackwells in the river.

Other riverside villages have wells in the riparian areas which are closely linked with the water level in the river. Nearly 55 villages which are spread over the ridge and slopes of the watersheds have community wells and village water supply systems from wells . Spring tanks through springs emanating from Sacred Groves is a common feature here like across Konkan. The region has one of the highest density of sacred groves which protect water sources (streams and temple tanks) and are a sanctuary to rare biodiversity. The Shastri basin is home to about 22 sacred groves. Water management is decentralized, autonomous and strong.

Upstream: Shringarpur-Sangameshwar

Water for Irrigation: The main crop of the region is monsoon paddy, ragi and vari (on mountain slopes) and a rich variety of horticultural crops like Mango, Cashewnuts, Kokum, Areca nut, etc. The horticultural crops do not have a high water demand and are irrigated by village spring tanks. However, the region also produces vegetables and indigenous varieties of pulses like Masoor, Val and Pawta Vegetables gardens: 10-12 villages on the banks of Shastri, Bav, Sonvi, Saptalingi and Gad have flourishing riparian vegetable gardens. Some villages like Wanjale have vegetable gardens irrigated by river which are cultivated and managed exclusively by women.

Water is drawn from the river directly through traditional systems like Ukti, channels or recently, pumps. This provides income to about 2200 families in the Shastri basin

River bank cultivation along the zone of tidal influence is also rich. This zone, with an area of nearly 550 ha. has small land holdings of an hectare or less. Pulses and vegetables are cultivated in the riparian zone. Cropping pattern changes with seasons and changing salinity of water. Vegetables from this area are sold in markets of Ratnagiri, famed for their unique taste, which is locally attributed to brackish water. The zone is organic ‘ by default’. This riparian zone provides subsistence and employment to nearly 1550 households.

Freshwater Fisheries: There has been no systematic study of freshwater fish of the region, but it is estimated that the river may be supporting more than 60 species of fish, with high endemism, because of its pristine nature and a number of habitats. Freshwater fish are caught by

all the riparian villages and form an important part of diet, though they form a small part of the village fish markets. Interesting sustainable methods of fishing exist in the region.

Estuarine Fisheries: Considering the pristine state of Shastri, one would expect that the river would support rich estuarine fisheries and dependent livelihoods. But, as it turns out, Estuarine fisheries are dying a slow death in Shastri bay, the Jaigad Creek. Jaigad creek is one of the important fishing creeks in Western coast, supporting nearly 42 fishing villages. Fish catch for the year 2009-10 was 3953 Tonnes (Fish Production Report, GOM, 2010)

While most fishermen go out in the open sea, some are specialized to estuarine fishing, around 20 kms in the mouth of the river. These fishermen specifically do not have mechanised boats and use diesel fired 'dibkos' or manual boats. Their proportion in the overall catch is barely 1.2% (98.8% by mechanised boats with trawlnets). Fish catch for these fishermen has been going down drastically for the past three years, with last year being the most critical, some cooperatives claiming a 65- 70% decrease in estuarine varities. This is severely affecting their subsistence, economy and livelihoods.

Jaigad creek has three under construction and in-operation mega projects, JSW 4 X 300 MW Coal based thermal power plant which is producing 300 MW in Phase I currently. M/s JSW Jaigarh Port Ltd., a constituent company of Jindal Group concessional agreement signed, works ongoing: The port complex will have a 1200 MW coal-based thermal power plant (operational now in first phase) and a port-based SEZ. The port is being dredged to handle vessels with a draft of 14 m in the first phase. Expected to handle 20 million tonnes cargo every year. M/s Chowgule Ports & Infrastructure Pvt. Ltd., a constituent company of Chowgule Group. Dredging activities upto 10-14 mts going on. Expected to handle 5 million tonnes cargo every year. Concessional agreement for the next 50 years have been signed, with Maharashtra Maritime Board and these ports will be operated on a Build, Own, Operate, Share and Transfer (BOOST) basis

Dredging is being done for the ports nearly 10-12 kms inside the mouth of the river to a depth of 14 mts (which is not monitored). This sort of dredging entirely destroys the nutrients, releases pollutants in the water, destroys mangroves and larvae, eggs and young of fish and crustaceans. Richness of zooplankton and phytoplankton (which are a component of the fish

food chain) depends on this zone. Both the ports are continuously dredging the area, reclaiming it and building infrastructure inside the estuary.

8. Karli River

Karli river is called Sarambal at its origin, Bhagsal near Kudal and Karli at the confluence with sea., Its origin lies at around 899 meters at Manohargad near Shirole Village in Devagd, Sindhudurg. Its length is around 92 kms. Approximate basin area is 753 sq kms and Average Annual Yield id 1559 MCM.[liv]

Town of Malwan is based on the estuary of Karli.

Major Projects on Karli include one of Maharashtra's and country's oldest Mud Dams called Dhamapur.[lv]

Talamba Major Irrigation Project has been ongoing on Karli River for the past 35 years without completion. The project does not have Forest Clearance till date.

Figure 29: Dhamapur Lake in Karli Basin, one of the oldest mud dams in Maharashtra Photo: SANDRP

Map 11: Mahadayi Basin Source: Down to Earth

Maharashtra holds a tiny part of the Mahadayi River Basin, majority falling in Karnataka and Goa States. One of the tributaries called Valvanti originates in Maharashtra and flows into Keri. Maharashtra has built a dam called Virdi in Sindhudurga. The project does not have either environmental or Forest Clearance and is stayed by the Mahadayi Disputes Tribunal between Goa, Karnataka and Maharashtra.

Note on status of Large Dams in West Flowing Rivers based on SANDRPs field visits and research:

A reconnaissance of the current situation is disturbing. It indicates that despite spending more than Rs 6,000 Crores in building these dams for decades, not a single Major or Medium irrigation project has been completed in Konkan till date by Konkan Irrigation Development Corporation (KIDC). Actual Irrigation Potential created is less than 25%, of which less than one percent is actually used by people for irrigation, for projects tested by CAG[i]. Hydropower generation from projects is shockingly low.

But for building these non-performing dams, not only have we spent thousands of crores of tax-payers money, we have displaced thousands of people, affected ways of life, desecrated sacred

conservation areas, deforested thousands of hectares of forests in Western Ghats, destroyed habitats of wildlife, affected migration routes of Elephants, Tigers and Fish. The sum of these impacts maybe more tragic as compared to monetary corruption alone.

Currently, 12 irrigation projects of KIDC (Konkan Irrigation Development Corporation) in Thane, Raigad and Ratnagiri Districts of Kokan, undertaken by FA Constructions and FA Enterprises are facing enquiry by the Anti-Corruption Bureau for severe corruption charges. Water Resource Minister Girish Mahajan has indicated that a charge-sheet will be filed shortly in which former Deputy CM Ajit Pawar and Former Water Resource Minister Sunil Tatkare may also be named. Stories of corruption in KIDC are varied and amusing. According to some, when Talamba Major Irrigation Project was being sanctioned, a Sumo full of cash was given as a bribe to one of the leading politicians of Konkan, who kept the money…and the Sumo as well.

Several of KIDC Irrigation projects have violated Environmental Laws and Project Affected People of almost all projects are protesting due to insufficient compensation and shoddy rehabilitation. Man-Animal Conflicts are not rare in regions where dams blocked migration routes.

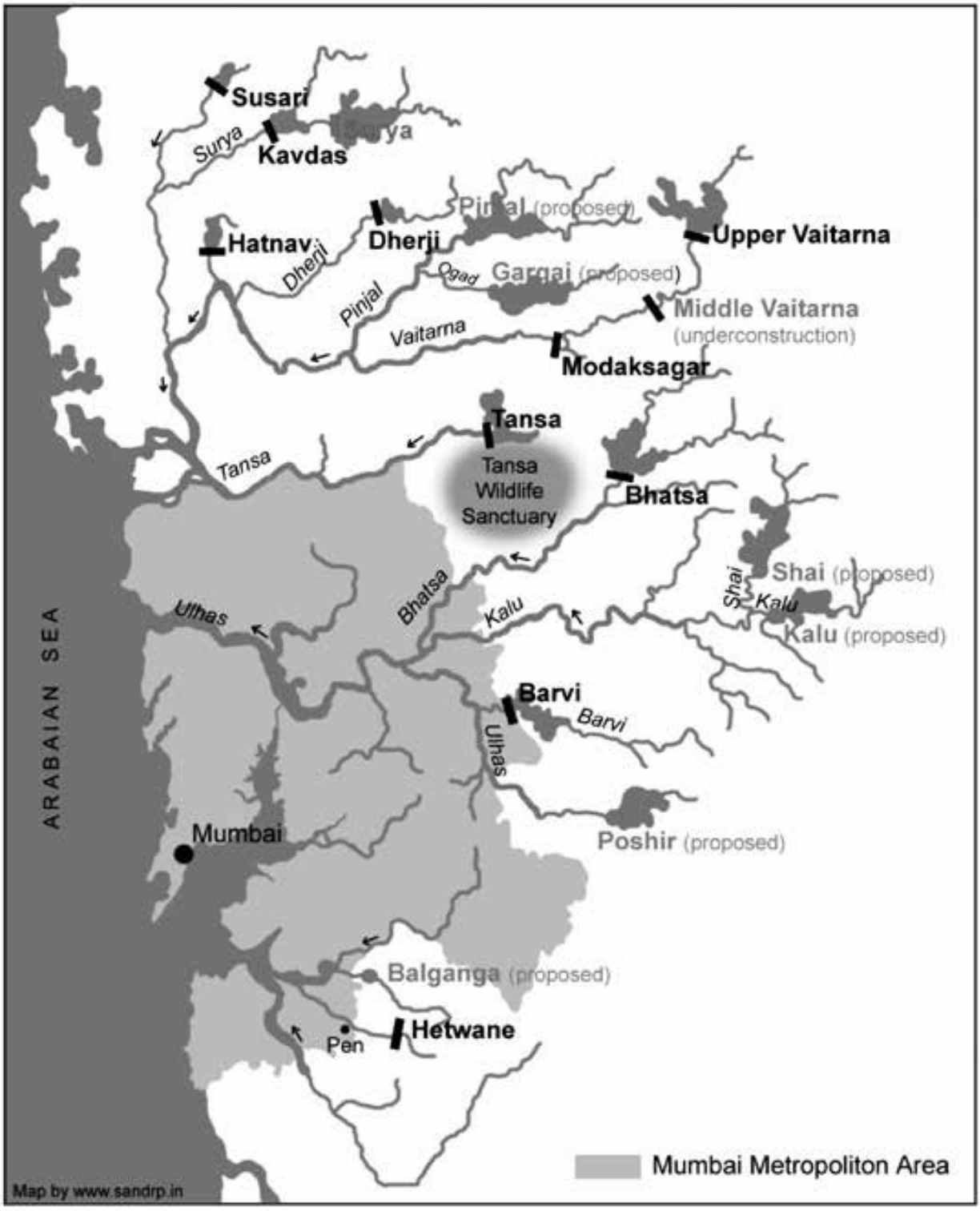
SANDRP has put together a report on the Dams in Konkan and their impacts on ecology and communities. lvi

4.4 Summing up the other major Issues surrounding West Flowing Rivers:

1) Damanganga Pinjal and Par Tapi Narmada Links

Damanganga Pinjal Link proposed by NWDA involves Pinjal Dam is a part of the Damanganga

Pinjal Link project, a component of Interlinking of Rivers project under the National water Development Agency (NWDA). Pinjal Dam will receive inflows from Khargihill and Bhugad dams. This river link project will involve three massive dams and tunnels through forest area running for 42.15 kms.



Map 12: Location of Dams on Rivers

2) Par Tapi Narmada and Nar Par Girna Link:

While Gujarat wants water from the Par Nar Basins area falling in Maharahsra, Maharashtra government has made a scheme to divert all waters from Par Nar to GIrna Basin inside Maharashtra and also to Marathwada[lvii]. Tapi Irrigation Development Corporation (TIDC) of Maharashtra has come up with a detailed Plan consisting of 22 dams to transfer all the surplus water (549 MCM) from the four west flowing basins into eastern Maharashtra, leaving no water for diversion onto Gujarat.

Par-Tapi-Narmada link envisaged to transfer 598 MCM or 21.11 TMC from Maharashtra catchment. It envisages 7 huge reservoirs and a canal which is more than 400 kms long. The Par Tapi Narmada Link would submerge nearly 7500 hectares of land, including 3572 ha forestland. It would also affect more than 35,000 tribals.

3) Dams around Mumbai

12 dams are planned or are under construction by Mumbai Metropolitan Region for supplying water to Mumbai Metropolitan region, which will together submerge more than 22,000 hectares (more than 54,000 acres) of predominantly tribal land, which includes over 7000 hectares' forest, lakhs of trees and over 750 hectares of Tansa Sanctuary. The cumulative dam building activity will displace over one lakh tribals from their homes and livelihoods. These dams include: Kalu, Shai, Balganga, Khargihill, Bhugad, Pinjal, Gargai, Susari, Poshir, Shillar, Barvi and Middle Vaitarna.

Most of these dams are escaping the social and environmental impact assessments and management plans, environment clearance requirements, environmental monitoring or public consultations due to blunders in Environmental Impact Assessment Notification of Sept 2006, which excludes domestic and industrial water supply projects from environmental clearance process.

Mumbai Metropolitan region has not done any sort of options assessment before pushing these projects. A cursory review shows that many feasible and practical options exist. At the city or region level, there is no shortfall in water supply currently and the existing problems are more due to inequitable, non-transparent, non-participatory and wasteful water governance in MMR.

4) West-Ward Water diversions:

Rivers like Kundalika, Ulhas and Patalganga annually receive 1413 MCM water from the Bhima Basin through Tata Power Dams located in Pune District which include Mulshi, Valvan, Shiravata, Thokarwadi and Uksan.

Similarly, Vashisthi River in Ratnagiri receives 1920 MCM from Krishna Basin through the Koyana Hydropower Project. The salinity change of the Vashisthi estuary due to receiving massive freshwater has also affected the fish population of the estuary.

5) Damming on the West Flowing Rivers:

Most of the Irrigation Dams on the West Flowing Rivers of Maharashtra have been built by the Konkan Irrigation Development Corporation (KIDC). However, after spending more than 6000 Crores, not a single KIDC Project has been complete. All of them lie languishing as half complete projects, affecting ecology as well as the communites to a large extent. A number of dams have been

6) Pollution:

There are several chemical Industrial Development Corporations on the banks of West flowing rivers in Maharashtra. The Chemical MIDC at Vashishthi veritably finished the marine and aquatic life in the Vashishthi Estuary.[lviii] Of the 13 Chemical MIDCs in Maharashtra[lix], nearly 9 are located on the banks of West Flowing Rivers. [lx] In fact the Maharashtra Pollution Control Board itself claims that most of the chemical industries are set up on the "coastline" for "easy and safe

disposal of treated effluent." What is actually means is easy disposal into biodiversity rich west flowing rivers.

Fisherfolk, farmers, villagers and residents have been raising these issues for several years without resolution.[lxi]

5. KRISHNA RIVER BASIN

Map 13: Entire Krishna Basin Source: NIH Roorkee

5.1 Salient Features

The Krishna River rises from the Western Ghats near Jor village of Satara district of Maharashtra at an altitude of 1337 m just north of Mahabaleshwar and empties into the Bay of Bengal at Hamasaladeevi (near Koduru) in Andhra Pradesh, on the east coast. The total length of river from origin to its outfall into the Bay of Bengal is 1400 km.

The Krishna River is the fourth biggest river in terms of water inflows and river basin area in India, after the Ganga, Godavari and Brahmaputra. Krishna Basin occupies an area of 2,58,948Sqkm(Reported Area) which is nearly 8% of the total geographical area of the country. The Krishna Basin extends over the states of Maharashtra (26%), Karnataka (44%), Telangana (approx. 15%) and Andhra Pradesh (approx. 15%).

Basin Boundaries: The basin is roughly triangular in shape and is bounded by Balaghat range on the north, by the Eastern Ghats on East & the South and by the Western Ghats on the west. Clusters of hills running to the East of Sahyadris range of Western Ghats mark the South

Western Boundary of The basin. Boundary between the Krishna & Cauvery Basins is marked by Devarayana Durga Forest- a small patch of 42.27km situated along the hill chains running across Eastern part of Tumkur District of Karnataka.[lxii]

The interior of the basin is a plateau generally sloping eastwards. Great undulating plains, divided from each other by flat-topped ranges of hills are the main characteristics of this plateau. Large flat areas of the type seen in the Indo-Gangetic plains are scarce, except in the delta.

Figure 30: Temple, supposed to be the origin of Krishna at Mahabaleshwar Photo: SANDRP

5.2 Principal tributaries:

As Krishna flows about 135 km from its origin near Mahabaleshwar Hills, it is joined by the Koyna River flowing from the western side of the same hill. Further along its course. it is joined by tributaries like Warna, Panchaganga and Doodhganga draining about 150 km of the Western Ghats. As the river emerges from the eastern slopes of the Western Ghats, it is joined by Ghataprabha and Malaprabha from the south at a distance of approximately 500 km from the origin. After traversing the Deccan plateau the east flowing Krishna then enters the alluvial lands and at a distance of about 800 km from the source, just before it enters Telangana, a major tributary Bhima, draining the Western Ghats, north of Mahabaleshwar joins it from the north. Near Kurnool the river is joined by another major tributary, Tungabhadra from the south, draining a major section of the Western Ghats in Karnataka. Within a short distance from this confluence, the river enters the Naliamali Ranges characterised by peep gorges. Srisailam Dam and Nagarjunasagar Dam have been constructed at this place. Tributaries like Dindi, Musi, Palleru and Muneru draining the dry north-eastern parts of the basin join the river between Srisailamad Vijayawada but do not add much water. Below Vijayawada, where the Krishna is blocked by the barrage constructed during the British period, the river spreads out into the delta and below the last major village Nagailanka it joins the Bay of Bengal in three branches, thus ending the long eastward journey of the waters of the Western Ghats. Table below gives length of major tributaries

Length of River & its major tributaries *(Source: Krishna Basin Profile by CWC)*

Sr. No.	Tributary	Length (km)
1	Krishna	1435.07
2	Bhima	860.67
3	Tungabhadra	551.56
4	Musi	352.02
5	Malaprabha	325.74
6	Ghataprabha	298.73
7	Munneru	217.79
8	Varna	158.43
9	Koyna	151
10	Dudhganga	129.78
11	Panchganga	128.68

Figure 31: Length of River & its major tributaries

5.3 Climate

The Krishna basin has a tropical climate characterized by Cold weather, hot weather, Southwest monsoon and Post monsoon.

The mean annual surface temperature in the Western Ghat area is about 24° C, and it increases gradually towards the east and attains a maximum of 29.4° C on the East Coast. During January, the mean daily minimum temperature increases from West to East from 15° C on the Western Ghats to about 18° C on the East Coast. The mean maximum daily temperature generally exceeds 30° C in the western part of the Godavari basin and it is only slightly less than 30°C in the Eastern part.

Basin receives 85% of its annual rainfall during south-west monsoon. The rainfall, fairly heavy though irregular and unevenly distributed varies temporally and spatially across the basin. South-west monsoon sets in by July and ends by September entering through the west and south-west coast meets the Sahyadri Range sweeps across the interior of the peninsula. Upper reaches of Krishna Basin lie in the 25 Km wide crest zone of Western Ghats which is the belt of heaviest rainfall region. Annual rainfall varies from 1000 to 3000 mm in this reach. River further enters in the region falling in the rain shadow area of the Western Ghat which receives less than 600 mm annual rainfall. Rainfall gradually increases to about 900 mm towards the East coast. Annual rainfall varies from 755 mm to 1531 mm and the average annual rainfall in the basin is 1096.92 mm

5.4 Principle Sub-Basins

Tungabhadra: The Tungabhadra, an important tributary of the Krishna, is formed by the union of the Twin Rivers Tunga and Bhadra, which rise together in the Western Ghats at Gangamula at an elevation of about 1196 m. After the confluence, the Tungabhadra River takes a northeast direction and flows through uneven ridges formed by boulders, which is the Deccan Plateau. After meandering through the plains generally in north-easternly direction to a distance of 531 km through the states of Karnataka and Andhra Pradesh it falls in the mighty Krishna River at Gondimalla, near the famous Alampur in Mahaboobnagar District of Telangana.The total drainage area of the Tungabhadra is 71,417 sq km. Like the Bhima, it drains about 206 km length of the Western Ghats.

The Hindus consider this river sacrosanct and there is a mention of the river in Ramayana where it is referred to as Pampa. According to the legends, Pampa, the daughter of Brahma (the God of creation) did penance to please Lord Shiva. Impressed by her devotion Shiva married her and taken the name Pampapati meaning husband of Pampa. The name Hampi has origin in Pampa. Hampi, the capital of the ancient Hindu dynasty of Vijayanagar stands on its right bank. On the banks if the river, there are numerous shrines and idols associated with the worship of Lord Shiva.

An important feature of the river banks is the flood protection walls along the river, constructed by Sri Krishna Devaraya between 1525 and 1527 AD. It starts at Sringeri and ends at Kurnool, just few kilometers from its mouth. They are stone constructions well intact. Huge boulders of 3' x 4' x 5' are also used in its construction.

It then takes a northeasterly direction through rugged ridges towards Hampi creating a narrow ravine. Piles of granite in varying shades of grey, ochre and pink dominate this landscape and ruins of Vijayanagara and Hampi, the seat of power of the Vijayanagar empire, overlook this holy river, creating a mythological landscape.[2] The granite outcrops slowly disappear as the river flows south and the land opens into a long, broad plain ending at the rising slopes of the Sandur hills, rich in iron and manganese, beyond which is the town of Hosapete where Tungabhadra Dam was constructed in the middle of the 20th century.

Bhima: Bhima River is second largest tributary of Krishna River. The river is also referred to as Chandrabhaga River, especially at Pandharpur, as it resembles the shape of the Moon.Originating at Bhimashankar in Ambegaon Taluka of Pune district it flows southeast for 861 kilometers through Maharashtra, Karnataka, and Telangana states, before confluence with the Krishna River at Kadlur (Raichur) in Karnataka. After the first sixty-five kilometers in a narrow valley through rugged terrain uptoKhed (Rajgurunagar) taluka of Pune district, the banks open up and form a fertile agricultural area which is densely populated.[lxiii] Origin of Bhima River is marked by Bhimashankar Temple. The temple is considered to be one of the twelve Jyotirlingas (self emerged) Shiva temples in the country, making it one of the important pilgrimages for Hindus.

Pandharpur is another important pilgrimage centre of India located on the right bank of Bhima River also known as Chandrabhaga in this region because of its moon like shape. The city hosts

temple of 'Vitthal' a widely worshipped deity in Maharashtra. While thousands of devotees visit daily, during the yearly pilgrimage called 'wari' the town of Pandharpur sees 10-12 lakh pilgrims in 15 days. Taking holly bath in Bhima River forms an important part of the pilgrimage.

Bhima originates in a mountainous, high rainfall area with cliffs and steep slopes. Upper basin still has prime multi-tiered evergreen forest.[lxiv] An area of 130.78 sq.km. around the origin of Bhima River which is a part of the Western Ghats (Sahyadri Ranges) has been notified by the Government of Maharashtra as a wildlife sanctuary in 1985 mainly to protect the habitat of the state animal- Indian Giant Squirrel.[lxv] This sanctuary spreads across Ambegaon & Khed tehsil of Pune District and includes nine tribal villages. Sanctuary is named after Bhimashankar temple located inside the sanctuary and surrounded by Bhimashankar sacred grove. The sanctuary forests house 14 sacred groves. These are patches of near virgin forests traditionally protected by the local people because of spiritual sentiments associated with these.

Middle and lower reaches of the river however suffer from deforestation, soil erosion and pollution. Bhima River and its tributaries including Mula-Mutha, pawana, Indrayani feature in the CPCB list of critically polluted rivers. BOD exceeds 30mg/l at certain locations of these rivers.

Pune &Pimpri Chinchwad cities which depend on upper reaches of Mula-Mutha rivers for water supply historically have had more than average water consumption as well as sewage generation. Mula-Mutha river(s) carry more than 750 MLD of sewage and industrial effluents from Pune and Pimpri-Chinchwad areas into the Bhima River which then pours it in Ujni Dam near Solapur causing severe pollution.

Ujni blocks the river flow for Pandharpur. Water is released only during waari. In this period, chemical oxygen demand (COD) of the river water often crosses 50mg/l.[lxvi] This large increase in the COD despite the large dilution factor (due to Ujni water) indicates that huge quantity of raw sewage is joining river.

5.5 Biodiversity of the basin

Krishna River during its course supports a large array of biodiversity. Especially the borders of the basin lined with Western & Eastern Ghats harbor various native species of plants, trees,

birds and wild animals. Thick forested slopes of the Ghats are a home for four tiger reserves viz. Chandoli in Sangli Dist. of Maharashtra, Bhadra&Kudremukh Wildlife Sanctuaries in Chikmangalur Dist. of Karnataka & Nagarjunasagar Srisailam in Mahbubnagar Dist of Telangana. Grassland of the basin in Solapur Dist. of Maharashtra is a home for Great Indian Bustard, the endangered bird species.

Delta of the river also harbors vast tracts of mangrove forests. Krishna Wildlife Sanctuary (KWS) a pristine mangrove habitat located in the estuary of the Krishna River is one of the rare eco-regions in the world. It is the home to the endangered fishing cat and many endangered species such as the smooth-coated Indian Otter as well as innumerable migratory birds.[lxvii] It is believed to be one of the last remaining tracts of primary mangrove forests of South India which is rapidly disappearing due to absence of protective measures.

List of the wildlife sanctuaries & protected areas in the basin is given below-

Sr. No.	**Name of Sanctuary**	**Type**	**District**	**State**	**Fauna**
1	Bhadra Wildlife Sanactuary	Tiger Reserve	Chikamagalur	Karnataka	Tiger, leopard, elephant, sloth bear, pangolin etc.
2	Chandoli National Park	Tiger Reserve	Sangali	Maharashtra	Tigers, Gaurs, Deer, Leopard cats, Panthers, Sloth bears, Barking deer, Mouse deer etc.
3	Daroji Sloth Bear Sanctuary		Bellari	Karnataka	Sloth Bear, Leopards, Hyena, Jackals, Wild Boars, Porcupine, Pangolins, Star Tortoise, Monitor Lizard, Mongoose, Pea Fowls, Partridges, Painted Spur Hen, Quails etc.
4	Ghataprabha Wildlife Sanctuary	Bird Sanctuary	Belgaum	Karnataka	Jackal, Wild Boar, Indian Porcupine, Indian Pangolin, Small Indian Civet, Common Palm Civet, Grey Mongoose, and Jungle Cat etc.
5	Nannaj Great Indian Bustard	Bird Sanctuary	Solapur	Maharashtra	Great Indian Bustard, Indian Wolf, Indian Fox, Blackbuk

	Sanctuary				
6	Gudavi Bird Sanctuary	Bird Sanctuary	Shimoga	Karnataka	White Pebis, Stone Bill, Egret, Cormorant, Snake bird, Heron etc.
7	Kudremukh National Park	Tiger Reserve	Chikamagalur	Karnataka	malabar civets, wild dogs, sloth bears and spotted deer
8	Nagarjunasagar	Tiger Reserve	Mahabubnagar	Telangana	Bengal tiger, Indian leopard, sloth Bear, dhol, Indian Pangolin, chital, sambar deer, Chevrotain, blackbuck, chinkara and chowsingha etc.
9	Pakhal Wildlife Sanctuary		Warangal	Telangana	Tiger, Wild Dogs, Panthers, Storks, Foxes Hyena, Gaurs, Teals, Spotted Deers, Pythons, Jackals, Ducks, Sloth Bears, Nilgai, and Sambars etc.

Figure 32: List of the wildlife sanctuaries & protected areas

5.6 Dams & Barrages

The Krishna River has been impounded right after its origin by Dhom located at 5 km of the origin. According to report by Central Water Commission on Krishna Basin there are 660 Dams, 12 Barrages, 58 Weirs, 6 Anicuts and 119 lifts are situated in the Krishna. This storage and diversion of water from the original river course has destroyed the fishing economy which was dominant on both banks of the river as well as the indigenous irrigation system that existed throughout the course of the river.

In the sixteenth century, especially during the reign of King Krishnadevaraya, needs of the Vijayanagar Empire led to the first major intervention in the natural water flow and there were attempts to divert the water of Tungabhadra through Vijayanagar Canals in Bellari District. The canals provided water for irrigation as well as satisfied the needs of the large army stationed in the capital city of Hampi.

The first large-scale intervention in the natural flow of water in the Krishna river basin was seen in the late nineteenth century for irrigating crops like cotton and ground nuts. The Krishna delta canal system based on the Vijayawada barrage was constructed in 1855. The Nira Canal in Maharashtra was constructed in 1835 to irrigate about 150,000 acres and the Kurnool Cuddapah

Canal was constructed in 1886 to irrigate 100,000 acres. With the passage of time an increasing number of government aided large and medium projects came up and today the Krishna river has numerous dams including the Dhom Dam which is at a distance of 5 km from its source. Midstream, we find the Alamatti and Narayanpur Dams of the Upper Krishna Project while further downstream Srisailam and Nagarjunsugar Dams generate electricity and divert water for irrigation. The tributaries have also been used extensively in this respect.

The Almatti dam, built over river Krishna in Karnataka, is part of the Upper Krishna project (UKP) in the Krishna river valley. Almatti on the border ofBijapur and Bagalkot districts was constructed in 2000 with a Full Reservoir Level (FRL) of 519.6m. Though the construction of dam was started with an active patronage of World Bank the aid to the dam was stopped at least twice for poor rehabilitation facilities. In the haste to complete the dam, rehabilitation took a back seat.[lxviii] Raising height of Almatti dam has been a bone of contention between United Andhra Pradesh & Karnataka. Brijesh Kumar tribunal allowed Karnataka to raise the height of the dam from 519.6m to 524.26m. Andhra's apprehension is that in case the height is raised dams built by AP including Srisailam, Nagarjunasagar, Jerula and Krishna barrage will be redundant.[lxix] Karnataka however claims that the additionally stored water will be for non-consumptive use and will be released back to the river.[lxx] The matter is pending in the court.

Region of Koyna and Warna dams is considered to be the world's best site to prove the correlation of dams and earthquakes.[lxxi] In fact Koyna is said to be the unique example in world to study the reservoir-induced seismic activity. Seismologist emphasise that the reservoirs such as Koyna and Warna are responsible for the earthquakes in south Maharashtra region which has officially experienced more than 1.19 lakh quakes in five decades.

Prakasam barrage which marks last of the dams built on Krishna River has been a highlight for damage to the riverine ecosystem caused by interlinking of rivers. Riverine environment at the Prakasam Barrage has been altered for worse with linking Godavari with Krishna though Pattiseema canal.[lxxii] Massive deposition of soil and mineral sediments from the canal has threatened the very survival of aquatic fauna of Prakasam Barrage. The canal has also introduced an alien fish- sailfin fish (Pterygoplichthys) to Krishna River. The fish infamous as the 'devil fish' has been wreaking havoc on the local fish and shrimp population in Prakasam Barrage. It has also damaged many fishing nets and caused injuries to dozens of fishermen,

forcing the state government to order officials to find a solution to the new environmental challenge. Experts have time and again warned against the project saying that the 174-km-long Pattiseema canal that carries 80 TMC of Godavari water into the Krishna, upstream of the Prakasam barrage in Vijayawada, may affect fish production as the water environment changes due to mixing of water from two river basins.[lxxiii] It seems like worst nightmare of environmentalists has come true.

Srisailam, constructed from 1976 to 1981, ousted 22 000 families. The project shows a poor track record of rehabilitation. A study in 1986-87 showed that compensation treatment varied between districts. Whilst large to medium-sized farmers received 65% of what they were due, the landless and most vulnerable received only 5.6% of the compensation.[lxxiv] Cash payment made to the project affected proved to be far inadequate. Surveys of the oustees post eviction found the people to be worse off.

Some of the major dams are as follows-

Important dams in Krishna Basin ***(Source: Krishna Basin Profile by Central Water Commission)***					
Sr. No.	**Name of dam**	**Name of the project**	**Location**	**Storage Capacity**	**Year of Completion**
1	Dhom Dam	Krishna Major Irrigation Project	Wai SataraDist Maharashtra	14	1977
2	Hippargi Barrage	Hippargi Irrigation Project	BagalkotDist Karnataka	6	1973
3	Ghataprabha Dam	Ghatprabha medium irrigation Project (HEP & Irrigation)	Kolhapur Dist Maharashtra	51.16	2009
4	Almatti Dam Narayanpur Dam	Upper Krishna project stage-I& II	BijapurDist Karnataka	42.19 TMC	2000
5	Narayanpur	Upper Krishna project stage-I	BijapurDist Karnataka	37.86	1982
6	Malaprabha Dam	Malaprabha Major Irrigation Project	Belgaum	37.73	1972
7	Tungabhadra Dam	Tungabhadra Right Bank Canal & Left Bank Canal	KoppalDist Karnataka	132	1953
8	Khadakwasla	Khadakwasla	Pune Dist	1.96	1880

	dam	Major Irrigation Project	Maharashtra		
9	Warasgaon dam			12.81	1993
10	Panshet dam			10.64	1972
11	Ujjani Dam	Bhima Major Irrigation Project	SolapurDist Maharashtra	110	1980
12	Koyna Dam	Koyna Irrigation Project	SataraDist Maharashtra	105	1964
13	Jurala Dam	Jurala Major Irrigation Project	MahabubnagarDist Telangana	11.94	1995
14	Bhadra Dam	Bhadra Major Irrigation Project	ChickamagularDist Karnataka	71.50	1965
15	Srisailam Dam	Srisailam project	Kurnool Dist Andhra Pradesh	178.84	1984
16	Nagarjunasagar Dam	Nagarjunasagar project	GuntoorDist Telangana	405	1974
17	Prakasam Barrage		Guntur Dist Andhra Pradesh	3.07	1957

Figure 33: major dams

5.7 Proposed Inter Basin Transfers

The most objectionable water transfer in Bhima Basin happens through the Tata dams, at the headwaters of the Bhima Basin. Annually, about 1400 Million Cubic Metres (MCM) water is transferred from the water deficit Bhima basin to the water rich Vashishthi Basin for generating Hydropower in Tata Power stations, SANDRP has raised a voice against this several times[lxxv].

As many as seven inter-basin transfer links are proposed on Krishna River. Many of these links are fraught with inadequate scientific studies to establish water surplus and deficit basins. Experts & activists have been highlighting that water transfer through canals cannot be called as river linking. Feasibility of River Linking projects has been in question in light of uncertain benefits &unassessed impacts. In fact Pattiseema canal meant to transfer 80 TMC water from Polavaram dam in Godavari Basib to Prakasam Barrage in Krishna Basin malfunctioned on the day of inauguration.[lxxvi] The project has not sought environmental clearance required. Power cost of the operation could be huge. E.g. power required for transfer of 80 TMC water from Godavari to Krishna Basin will cost Rs 137.7 Cr.

Given bellow is a list of Inter-Basin Transfer projects

1. The Almatti-Pennar Link will divert 1,980 Mcum water from Krishna River (Almatti Dam) to Pennar Basin(Maddileru river-Tributary of Pennar River), to irrigate 2.58 lakh hectares area (1.76 lakh hectares in Andhra Pradesh and 0.82 lakh hectares in Karnataka).The length of link canal 587 km., which includes 5 tunnels of total length of 35.66 km.

2. The Srisailam-Pennar Link proposes to transfer 2,310 Mcum of water from Srisalam Reservoir (Krishna Basin) to Pennar Basin. The water transferred to be used in four mini hydel schemes utilizing the natural falls of the streams with total installed capacity of 17 MW of power. The total length of the link canal will be 204 km.

3. The Nagarjunasagar-Somasila link proposes to divert 12,146 Mcum of water from Nagarjunasagar (Krishna Basin) to Pennar Basin to irrigate 5.81 lakh hectares in the State of Andhra Pradesh. The total length of the link canal is about 393 km.

4. The Inchampalli-Nagarjunasagar Link will transfer 16,426 Mcum of water from Godavari Basin to Krishna Basin to irrigate 2.87 lakh hectares in Andhra Pradesh. Total length of Link Canal is about 299 km that includes 9 km. long tunnel.

5. The Inchampalli –Pulichintala Link envisages diversion of 4,370 Mcum of water from Mahanadi and Godavari Basins to Krishna Basin to irrigate 6,13,442 ha in Andhra Pradesh. The Length of link canal is about 312 km including 12.50 km long tunnel.

6. The Polavaram-Vijayawada Link proposes to transfer 5,325 Mcum of water from the Right Bank of Godavari at the proposed Polavaram reservoir up to existing Prakasam Barrage on Krishna River at Vijayawada to irrigate about 5.82 lakh hectares in Andhra Pradesh. Total length of link canal is about 174 km.

7. The Bedti - Varada Link envisages diversion of 242 Mcum of surplus waters of Bedti basin to Tungabhadra Sub-Basin to irrigate 60,200 hectares in Raichur district of Karnataka. The Conveyance System is divided into two main components of length 8.5 km (2.2 km long tunnel) and 14.83 km (6.8 km long tunnel)

5.8 Proposed Intra-Basin Transfers

Apart from the interstate river links proposed by NWDA, there are also several intrastate links proposed by Gov of Maharashtra over Krishna Basin. Following table summarizes these links and the status of their Detailed Project Report (DPR).

Sr. No.	Name of the Intra-State Link	Rivers	Status of DPR
1	Upper Krishna – Bhima (System of six links)	Krishna-Bhima	Completed
2	Koyna - Nira	Koyna-Nira	Completed
3	Koyna – Mumbai City	Koyna	Completed
4	Middle Konkan – Bhima Valley	Savitri-Kundalika-Amba-Bhima	Completed
5	Mulsi - Bhima	Mulsi & Bhima	Completed
6	Savitri - Bhima	Savitri & Bhima	Completed
7	Kolhapur-Sangali-Sangola	Krishna & Bhima	Completed

Figure 34: Intra-State Link

5.9 Water Disputes

Like every other river waters of Krishna are also ridden with disputes. History of the disputes dates back to colonial times. The 1892 agreement between the Mysore Princely State and the Madras Presidency and the 1933 agreement between the Hyderabad Princely State and the Madras Presidency governed the water sharing before establishment of Krishna Water Disputes Tribunal (KWDT)I headed by Bawachatin 1969.[lxxvii]Currently it is governed by KWDT II headed by Brijesh Kumar.

Limits set up by the tribunal and the mega project-centered mindset of the water resources bureaucracy and politicians, seem to be root of the problem. In their haste to show maximum utilisation of Krishna waters, all three states are building oversized reservoirs, without taking into consideration social, environmental or financial implications of the projects.[lxxviii]

Award of the first KWDT headed by Bachawat given in 1976 gave two types of schemes viz. Scheme A and Scheme B, where Scheme A was based on 75 % availability and Scheme B was based on the sharing of surplus waters. Maharashtra was allocated with 560 TMC (Thousand Million Cubic feet) water, Karnataka was allocated with 700 TMC and United Andhra Pradesh with 800 TMC. During award of Bachawat Tribunal rainfall data for last 50 years required to

estimate dependable flow was not available. Thus dependable flow was estimated based on stream flow data. The award also provided for a review of the award post May 2000.

In April 2004 the riparian states requested Central Govt to create second KWDT to address the prevailing disputes. Second KWDT headed by Brijesh Kumar delivered its final award in 2013 making allocations of Krishna waters to Karnataka, Maharashtra and united Andhra Pradesh (AP) based on 65 % dependability, considering the data of flow of water of the past 47 years. Maharashtra was given a share of 666 TMC, Karnataka 1001 TMC & United AP 1001 TMC.

Immediately after the award United Andhra Pradesh contending that it has emerged loser as the surplus flows which were allocated solely to the state by Bachawat Tribunal were now divided amongst Maharashtra, Karnataka and Andhra Pradesh[lxxix] filed a special leave petition in Supreme Court which stayed the publication of tribunal award in gazette. Karnataka on the other hand says that Andhra Pradesh was building large infrastructure to store not only flood waters but also the unallocated water.[lxxx]Raising height of Almatti dam of Karnataka allowed by the Brijesh Kumar Tribunal has also been an important fulcrum of the dispute. The dispute over Krishna River water has been dragging in Supreme Court for more than a decade. The stay is still in place.[lxxxi]

The dispute has complicated further after bifurcation of Telangana from AP. Telangana filed a complaint with the extended tribunal for a review of its award, claiming it had been discriminated against since the formation of AP in 1956. Currently, cases are pending before Brijesh Kumar Tribunal and Supreme Court on KWDT-2. Saying that two upper riparian States were not only utilising water for irrigation purposes but also storing it in dams, denying Telangana and Andhra Pradesh their due both TS and AP demandedbefore the Tribunal and the Apex court to include all the four beneficiary states for reallocation of Krishna waters.[lxxxii] However, the Tribunal and the apex court said that the dispute of Krishna water sharing was limited to AP and TS, as per the provisions of the AP Reorganisation Act, 2014.[lxxxiii]

In September 2016 all the States finally concluded their arguments before the tribunal. The Apex Council on river water-sharing between Telangana and Andhra Pradesh has now resolved to constitute a joint team of engineers to study the availability of water in the Krishna River.[lxxxiv] It has also decided to assess the drawl of water by the two States and request the Krishna Tribunal to make proportionate allocation of water. In October 2016 the Brijesh Kumar tribunal

has made it clear that it would not take a relook into allocation of water among the riparian States afresh but would take up distribution of water allocation to combined AP to Telangana and residuary AP States.[lxxxv]

5.10 Water Quality

Krishna River along with its several tributaries features prominently in the Central Pollution Control Board's report of 2014-15 which identifies polluted stretches of rivers and prioritizes them for restoration. Throughout its course urban centres seem to play a major role in polluting the river.

Water quality survey carried out by the Maharashtra Pollution Control Board (MPCB) found Bhima upper sub basin in Pune district, which has Mutha, Pavana, Indrayani and Bhima rivers, as the most severely polluted in Maharashtra, and has marked their water quality in the 'bad to very bad' category. The survey has also found that the filth load on these water bodies has remained unchecked for years. Almost half of the observations across all the monitoring stations recorded the quality of water as 'bad' or 'bad to very bad' on the index. These rivers carry the pollution load further to Bhima River and ultimately to Krishna.

Pune has been routinely dumping its sewage and polluting its rivers for more than a decade. Shockingly during an ongoing PIL Pune Municipal Corporation in (PMC) May 2016 failed to furnish even the basic details like present and future generation of level of domestic sewage in the city and even present handling capacity and performance of STPs for last six months. Later PMC admitted in the print media that Out of total 744 MLD sewage generated (the figure incidentally dates back to 2011) present STPs treat only 290 MLD so the balance 454 MLD – over 60% of the sewage – is going into the river untreated.

Similarly in a case filed on February 2016 under the Water (Prevention and Control of Pollution) Act of 1974, MPCB has accused PCMC of discharging 70 million litres per day (MLD) of untreated sewage daily into Pavana, Mula and Indrayani rivers. Though PCMC hosts 13 sewage water treatment plants with the capacity to treat 338 MLD of sewage every day, it treats only around 190-220 MLD. As a result, 75 per cent of sewage water is treated, while the remaining 71 MLD is discharged sans treatment into the three rivers.

In Telangana, the Greater Hyderabad Municipal Corporation (GHMC) is the major culprit for the poor water quality in the Krishna. The GHMC discharges 598 million litres a day of the 1,250 MLD sewage that the city generates daily into the Musi River, which meets the Krishna at Wadapally in Nalgonda district.

There is also a marked deterioration in the quality of water in the Krishna River as it approaches the Krishna Delta. Water of reservoir at Prakasam Barrage which marks the last of barrage on Krishna River is polluted by several municipal sewerages that discharge directly into it.

Polluted stretches in Krishna Basin
(Source: River Stretches for Restoration of Water Quality, CPCB, 2014-15)

Sr. No.	River	Details of Stretch	Length (km)	BOD Range or Max value (mg/l)	Priority Class defined by CPCB
Maharashtra					
1	Krishna	Shindi to Kurundwad	200	5.4-24.0	II
2	Bhima	Vitthalwadi to Takli	200	9.5 to 12.7	III
3	Indrayani	Moshi to Alandi	96	8.1-9.2	I
4	Pnchaganga	Shirol to Kolhapur	40	4.6-7.6	IV
5	Nira	Sangavi to Shindewadi	80	8.1-14.6	III
6	Chandrabhaga	Pandharpur to Shegaon	12	8.4-10.6	III
7	Koyna	Karad to Papdarde	7	7.8	IV
8	Mula	Bopodi to Aundh	6	13.5-16.5	III
9	Mula-Mutha	Theur to Mundhwa	15	18.2	III
10	Mutha	Shivajinagar to kondhawa	12	6.5 to 20	III
12	Pawana	Dapodi to Rawel	12	6.5 to 20	III
Karnataka					
13	Bhadra	Holehunnur to Bhadravati	10	6	V
14	Bhima	Ghanapur to Yadgir	80	3.5-5.0	V
15	Ghataprabha	Gokak to Chigadolli	5	4	V
16	Krishna	Yadurvadi to Tintni Bridge	200	3.2-4.8	V
17	Malaprabha	Khanapur to Dharwad	80	3.4-4.6	V
18	Tungabhadra	Harihar to Korlahall	60	3.5-9.3	IV
19	Tunga	Shimoga to Kudli	10	6.7	IV
Telangana					
20	Krishna	Thangadigi to Wadapally	80	6.0-2.4	II

21	Musi	Hyderabad to Suryapet	15	8.6-16.5	I
22	Nakkawagu	Gandilachapet to Sevalal Thanda	50	6.4	I
23	Maner	Warangal to Somanpally	150	25-27	II
Andhra Pradesh					
24	Krishna	Amarawathi to Hasaldevi	270	3.5 to 5.3	V
25	Tungabhadra	Manthralayam to Bavapuram	50	3.4-3.6	V

Figure 35: Polluted stretches in Krishna Basin

5.11 Basin Closure

Incessant dam building in Krishna Basin has led to trapping nearly all the sediment in the river. For Krishna, flows as well as suspended sediments in the delta have nearly reached zero, a phenomenon described as 'basin closure'. There has been an overall 94% reduction in Krishna sediments with consistently lower sediment quantities observed at locations downstream of dams than the upstream counterparts.[lxxxvi] The basin is said to be closed not just at mouth but also at the sub basin levels. As a result the Krishna delta is losing land at the rate of 82.5 ha per year, leading to destruction of mangroves & loss of land.

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6. BHIMA RIVER BASIN

Bhima River is second largest tributary of Krishna River. The river is also referred to as Chandrabhaga River, especially at Pandharpur, as it resembles the shape of the Moon. Originating at Bhimashankar in Ambegaon Taluka of Pune district it flows southeast for 861 kilometres through Maharashtra, Karnataka, and Telangana states, before confluence with the Krishna River at Kadlur (Raichur) in Karnataka. After the first sixty-five kilometers in a narrow valley through rugged terrain upto Khed (Rajgurunagar) taluka of Pune district, the banks open up and form a fertile agricultural area which is densely populated.[lxxxvii]

Figure 36: Dry Bhima River bed at Pandharpur Photo: SANDRP

Total area of the basin is 68446.02 Sqkm which is 27.26% of Krishna Basin. Basin is divided into Upper Bhima & Lower Bhima sub-basins. Upper Bhima basin receives water from Mula, Mutha, and Pavana rivers that confluence at Pune. In the downstream, the Bhima river is joined

by Ghod, Nira, Man, Sina, Bori tributaries. While Upper Bhima basin falls entirely in Maharashtra about 5% area of Lower Bhima basin falls in the state.

6.1 Spiritual Significance

Origin of Bhima River is marked by Bhimashankar Temple. The temple is considered to be one of the twelve Jyotirlingas (self-emerged) Shiva temples in the country, making it one of the important pilgrimages for Hindus. Pandharpur is another important pilgrimage centre of India located on the right bank of Bhima River also known as Chandrabhaga in this region because of its moon like shape. The city hosts temple of 'Vitthal' a deity widely worshipped in Maharashtra. While thousands of devoties visit daily, during the yearly pilgrimage called 'wari' in July the town of Pandharpur sees 10-12 lakh pilgrims in 15 days. Taking holly bath in Bhima River forms an important part of the pilgrimage.

6.2 Forests & wildlife

Bhima originates in a mountainous, high rainfall area with cliffs and steep slopes. Upper basin still has prime multi-tiered evergreen forest.[lxxxviii] The basin is rich in biodiversity with six wildlife sanctuaries.[lxxxix] An area of 130.78 sq.km. around the origin of Bhima River which is a part of the Western Ghats (Sahyadri Ranges) has been notified by the Government of Maharashtra as a wildlife sanctuary in 1985 mainly to protect the habitat of the state animal-Indian Giant Squirrel.[xc] This sanctuary spreads across Ambegaon & Khed tehsil of Pune District and includes nine tribal villages. Sanctuary is named after Bhimashankar temple located inside the sanctuary and surrounded by Bhimashankar sacred grove. The sanctuary forests house 14 sacred groves. These are patches of near virgin forests traditionally protected by the local people because of spiritual sentiments associated with these. Some of the other sanctuaries are Rehekuri Blackbuck Sanctuary (Ahmednagar), Mauyreshwar Wildlife Sanctuary, Nanaj Great Indian Bustard Sanctuary (Solapur) and Ujani Wetland. Ujjani in fact was one of the 16 proposed Ramsar wetland sites declared by the Ministry of Environment and Forests. It was declared as a Bird Sanctuary in 1991 but was dereserved due to political pressures in 1992.[xci]

6.3 Upper Bhima Basin dotted with dams

KWDT award specifically states that in order to safeguard interest of Andhra Pradesh there should not be over crowding of projects in Upper & Lower Bhima sub-basins. Ground reality

seems to a flip scene. Maharashtra is the highest dam building state in India. This is aptly reflected in the Bhima basin scenario as well. Upper Bhima sub-basin which falls in Maharashtra has highest number of dams amongst all the sub-basins of Krishna River. Of total 660 dams built in Krishna Basin 273 dams are built in Upper Bhima sub-basin alone! (Compare this to Lower Bhima sub-basin falling in Karnataka has 68 dams) While the area of the sub-basin is 17.58% of Krishna basin it hosts over 40% dams of the basin. Despite such huge investment in large dams, barely 4.74% of the cultivable area is irrigated through dams and canals.[xcii]

Sr. No.	Sub-Basin	Dams
1	Bhima Lower	68
2	**Bhima Upper**	**273**
3	Krishna Lower	29
4	Krishna Middle	34
5	**Krishna Upper**	**188**
6	Tungabhadra Lower	37
7	Tungabhadra Upper	31

Figure 37: Upper Bhima Basin & dams

Studies show that flow of Bhima River which makes significant contribution to Krishna River has reduced substantially in decade of 2001-11.[xciii] Because of incessant dam building and allocation of water till last drop the basin is moving towards closure. There is no allocation for environmental flows.[xciv] Runoff Coefficients for upper Bhima sub-basin decreased from 0.33 to 0.27 between 1971-74 and 1996-2001.[xcv] While more and more sediment from the basin is trapped the basin also has the highest of erosion rates of the major tributaries of Krishna. As a result the dams are rapidly silting. For example Ujjani reservoir has lost 17.5% of its dead storage & 7.14% of the live storage.[xcvi]

Figure 38: Ujani Project, the largest dam in Bhima Basin Photo: SANDRP

6.4 Growing inequities & water conflicts in Upper Bhima basin

Along with the highest number of dams the basin also harbors growing inequity in water sharing and intra-state conflicts stemming from it. Upper Bhima Basin has been one of the epicentres of water sharing conflicts of Maharashtra. Some examples of inequity are as follows-

- Growing cultivation of sugar cane is one of the major reasons causing skew in water sharing. The water guzzling crop covers 6,66,600 ha in basin which is 23% of the net sown area.[xcvii] Of the total 4.74% of the cultivable area irrigated through dams and canals, sugarcane is planted on 3% area and consumes 22% of the irrigation water.[xcviii] There are nearly 28 sugar factories (mostly cooperative) in the basin.
- Pune City has rapidly emerged as large water consumer over last two decades. The population of Pune Municipal Corporation area, as per census of 2011 was 3,115,431, with 29% growth in the preceding decade. Pune's water consumption has doubled in last 15 years, from 8 TMC in 1998-99 to 16 TMC in 2014-15. When agreement with Irrigation Department permits Pune city to source 11.5 TMC water Pune has been routinely sourcing more than 14 TMC water for last five years. Last year with average per capita water supply

of 194 lpcd hugely more than CPHEEO norm of 172 LPCD, PMC has drawn 28% excess water than it is actually allocated.

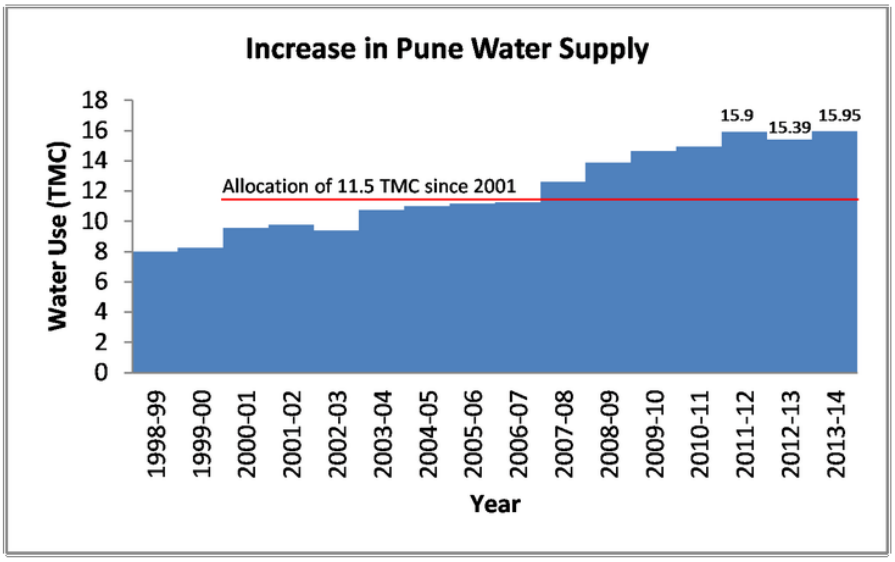

Figure 39: Water Supply

- Tata Hydropower Dams, at the origin of the Mula-Mutha sub-basin of Bhima basin, have been diverting water **of the Bhima Basin** to water surplus Konkan for the past century for power generation. KWDT award has allocated 45 TMC water to Tata Hydropower Dams for westward diversion. Unfortunately this water transfer from a water-deficit basin like Bhima-Krishna to water surplus basin like Konkan, has continued even in severe drought of 2015. The hydropower stations of Khopoli, Bhivpuri and Bhira together transferred more than 136.64 MCM water just in about five weeks between 1 July-6th August 2015 when downstream Ujani had nearly zero live storage.[xcix]

Such growing inequities are giving rise to recurring intra-state water conflicts. Maharashtra State Gov has been trying to deal with the conflicts through institutional mechanisms such as Maharashtra Water Resources regulatory Act 2005 (MWRRA). Albeit the mechanisms are proving to be inadequate. MWRRA which has been riddled with several flaws was dysfunctional till 2013. When a farmers' group from Solapur District filed a case against GoM & MWRRA in March 2013 for releasing water from upstream dams of Pune to Ujani High Court had to order the release as MWRRA was non-functional.

6.5 Growing Pollution

Bhima River and its tributaries including Mula-Mutha, Pawana & Indrayani feature in the CPCB list of critically polluted rivers. BOD exceeds 30mg/l at certain observation locations of these rivers.

Pune & Pimpri Chinchwad cities which depend on upper reaches of Mula-Mutha rivers for water supply historically have had more than average water consumption as well as sewage generation. Mula-Mutha river(s) carry more than 750 MLD of sewage and industrial effluents from Pune and Pimpri-Chinchwad areas into the Bhima River which then pours it in Ujani Dam near Solapur causing severe pollution.

While Ujani is polluted by Mula-Mutha, its downstream areas are as polluted since Ujni blocks the river flow for Pandharpur. Water is released in the river only during waari- the yearly pilgrimage. In this period town of Pandharpur sees an exodus of people from across Maharashtra and Chemical Oxygen Demand (COD) of the river water often crosses 50mg/l.[c] This large increase in the COD despite the large dilution factor (due to release of Ujani water) indicates that huge quantity of raw sewage is joining river.

Cleaning Bhima

Maharashtra government has decided to make the Bhima river at Pandharpur pollution free and revive its sanctity through the 'Namami Chandrabhaga' project constructing Sewage Treatment Plants (STPs).[ci] A river cleaning plan for the entire Bhima Basin was prepared by a district level committee headed by Pune Collector along with MPCB in August 2010 after Health Department declared that 70 villages in Pune District were drinking polluted water. Action plan worth 1433 crores mostly focused on building new centralised STPs.[cii]

For this project State Government is looking at funding this project through Public Private Partnership (PPP).[ciii] Following footprints of Sabarmati Riverfront it is also planning to reclaim land on the periphery of Bhima and commercially exploit the reclaimed patches. Setting up STPs on PPP basis and selling the treated sewage to nine industrial clusters located on the banks of Bhima is also considered for raising finance.

Apart from setting up a treatment plant in Pune which is woefully nonfunctional (in fact

polluting groundwater at the site), no progress has been made so far on the Bhima Cleaning Project. It is now converted into Namami Chandrabhage Mission, but there is absolutely no clarity about what it will entail, whether it will have a basin vision, or will be confined to Pandharpur.

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