Government of Maharashtra

WATER RESOURCES DEPARTMENT

WATER YEAR BOOK 2015 & 2016

DATA ANALYSIS CIRCLE
NASHIK

HYDROMETEOROLOGICAL
DATA PROCESSING DIVISION, NASHIK

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1. INTRODUCTION

Water plays crucial role in the socio-economic development of the country. Safe drinking water is required for very large and growing population. Water has also become a major constraining factor for the growth of the agricultural and industrial sectors. In contrast, flooding frequently threaten populations and civil structures.

The Hydrological Information System provides information about Hydrological and Hydro meteorological parameters that vary with respect to time and space. The information is useful to the decision/policy makers, designers and researchers.

Earlier, Water Resources Department (GOM) was collecting the Hydrometeorological Data and was recording manually in the form of registers for the use of Water Resources Department only. In 1995 National Hydrology Project was established in collaboration with Ministry of Water Resources, Government of India, CWC, CGWB, National Institute of Hydrology (Roorkee), CWPRS (Pune), CPCB, India Meteorological Department, with nine states i.e. Maharashtra, Orissa, Tamilnadu, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Gujrat, Karnataka & Kerala to develop sustainable HIS with following characteristics.

- Demand driven i.e. output is as per the users needs.
- Use of standardized equipments and adequate procedures for data Collection and processing.
- Computerized, comprehensive and easily accessible database.
- Proper infrastructure to ensure sustainability.

Under this Project since 1995, Hydrology Project (SW) Water Resources Department, Maharashtra State has started to collect the data on these lines and entering it in electronic mode. Stage discharge data is measured on GD stations. Hourly & Daily rainfall is measured on ARG & SRG stations respectively. On FCS station climatic parameters namely minimum & Maximum temperature, dry & wet bulb temperature, humidity, pan evaporation, wind direction & wind velocity, pan water temperature are measured. On water quality sampling stations water samples are collected and tested in the laboratory for turbidly, BOD, COD, PH etc. All these data is observed either daily, twice daily or hourly.

Three softwares are used for data entry, validation and data dissemination.

1. SWDES (Surface Water Data Entry System) for data entry and primary validation
2. HYMOS (Hydrological Modeling System) for secondary validation
3. WISDOM (Water Information System Data Online Management) for data storage and dissemination

The finally validated data is then given to Hydrological Data Users Group (HDUG) members online/ offline with nominal cost.

The idea of preparing and publishing water year book is to communicate the intended data users, the kind of meteorological and hydrological scenario in the basins of the state during the hydrological year under consideration. A list of stations is attached herewith (Annexure A). The intended users can have this data from data bank as per the procedure laid down. Analysis of data is illustrated basin wise and basin is the unit for presentation of this data for Maharashtra State.

This water year book contains following information of the Maharashtra State.

1. Extreme rainfall events
2. District wise average rainfall.
3. Basin wise annual Isohyets.
4. Extreme temperature events
5. Discharges at Gauge Discharge sites

2. HYDROLOGICAL REVIEW

2.1 Basins of Maharashtra and network :

There are five river basins in Maharashtra namely Godavari, Krishna, Tapi, Narmada and West Flowing Rivers. However length & spread of Godavari basin is much more, it is divided in to two parts in Maharashtra as Upper Godavari basin up to Nanded district & Lower Godavari covering Vidarbha districts up to boundary of Maharashtra state for convenience of administration & operation purpose.

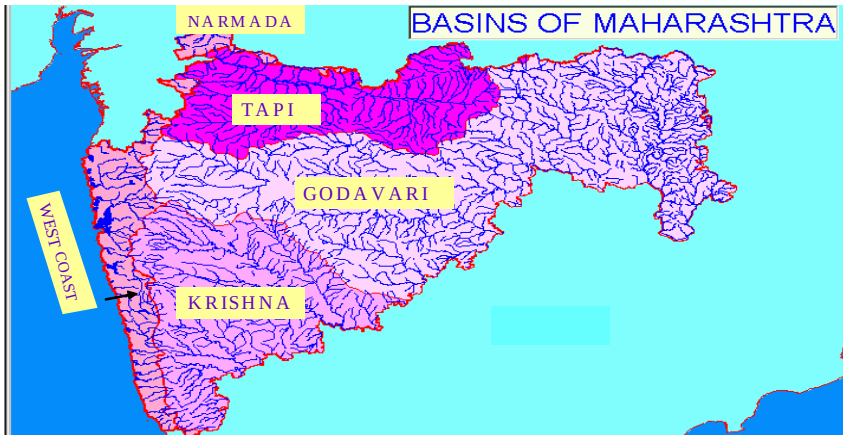


Fig 2.1 Map showing Major River Basins in Maharashtra

Table 2.1 Network of Hydrology Project (SW) Maharashtra

S. N.	Name of Basin		ARG	SRG	FCS	GD
1	Godavari	Upper Godavari	35	181	34	42
		Lower Godavari	120	89	34	55
2	Tapi		40	48	14	42
3	Narmada		-	3	-	-
4	Krishna		31	128	45	55
5	West Flowing Rivers		114	192	26	70
	Total		**340**	**641**	**153**	**264**

2.2 Maximum Rainfall in Basins:

After analysing the daily rainfall data, it is observed that the maximum daily rainfall is not same as that of the previous years. Also it is observed that the maximum daily rainfall is not occurring on same station. It varies with respect to the location and period. It is also observed that yearly maximum rainfall and maximum daily rainfall is not occurring on the same station. The comparison is shown in the table given below.

Table 2.2 Comparison of Annual Maximum Rainfall and Maximum Daily Rainfall for year 2015

Sr. No.	Basin	Maximum Daily rainfall in mm			Annual Maximum Rainfall in mm		
		Station	Dist/ Tal	Rainfall	Station	Dist/ Tal	Rainfall
1	Lower Godavari	Sakhararaja	Chandrapur / Warora	251	Hardoli	Nagpur/Kuhi	1955
2	Upper Godavari	Dhodambe	Nasik/ Chandwad	176	Ambai	Nashik/ Nashik	1839
3	Krishna	Kitwade	Kolhapur/ Ajara	317	Dajipur	Kolhapur/ Radhanagri	3517
4	Narmada	Virpur	Nandurbar/ Shahada	125	Dab	Nandurbar/ Shahada	1158
5	Tapi	Manasgaon	Buldhana/ Shegaon	240	Tarubanda	Amravati/ Chikhaldara	1480
6	West Flowing Rivers (Konkan)	Dhamni	Thane/ Bhiwandi	404	Walawal	Sindudurg/ Kudal	5208

Fig 2.2: Graph of Basin wise maximum Daily Rainfall in mm for Year 2015.

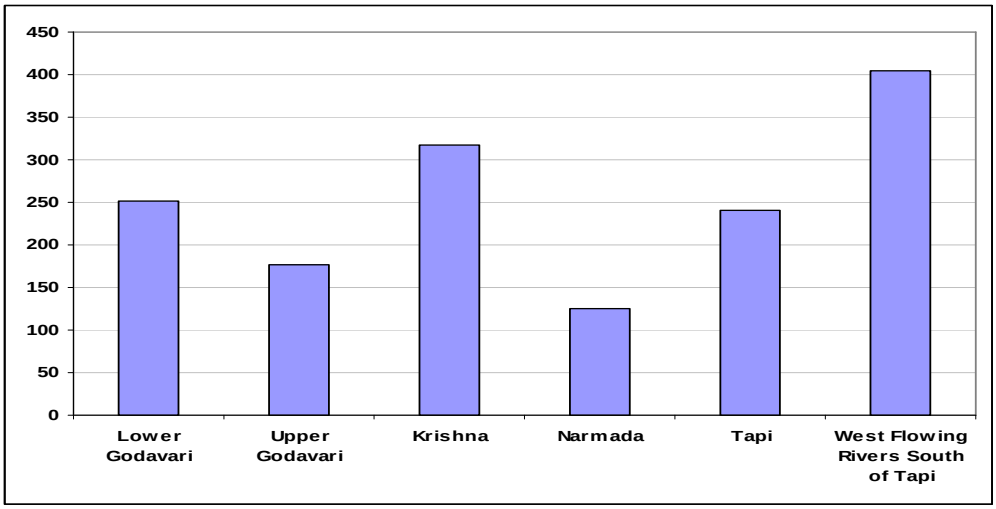


Fig 2.3: Graph of Basin wise Annual maximum Rainfall in mm for Year 2015.

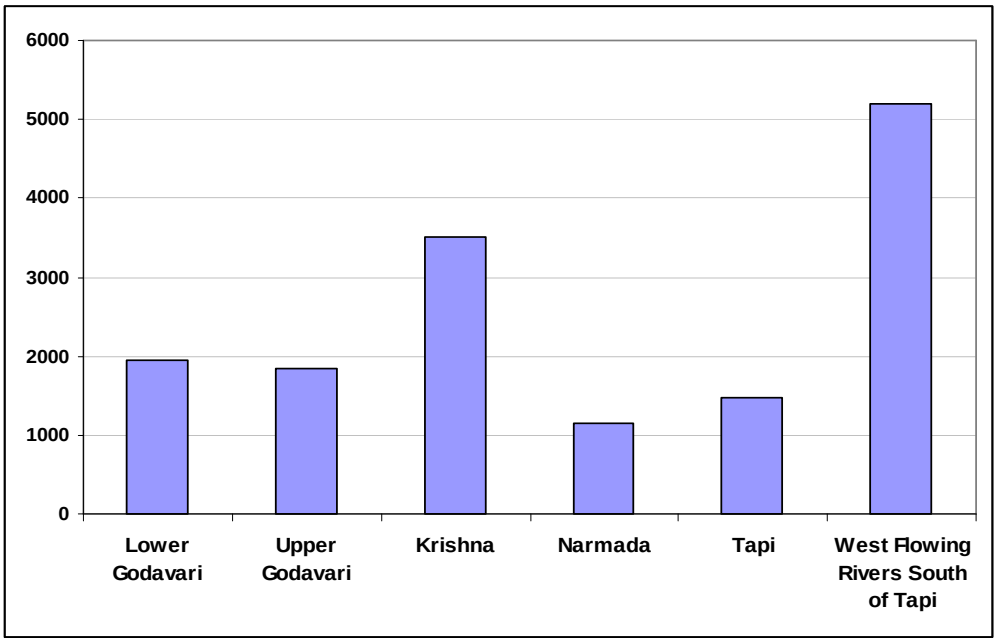


Table 2.3 Comparison of annual Maximum Rainfall and Maximum Daily Rainfall for year 2016

Sr. No.	Basin	Maximum Daily rainfall in mm			Annual Maximum Rainfall in mm		
		Station	Dist/ Tal	Rainfall	Station	Dist/ Tal	Rainfall
1	Lower Godavari	Aksapur	Chandrapur/ Gondpipri	332	Petta	Gadchiroli/ Ettapalli	2199
2	Upper Godavari	Kushegaon	Nashik/ Igatpuri	365	Ambai	Nashik/ Nashik	3070
3	Krishna	Kitwade	Kolhapur/ Ajara	528	Kitwade	Kolhapur/ Ajara	7623
4	Narmada	Virpur	Nandurbar/ Shahada	217	Dab	Nandurbar/ Shahada	1040
5	Tapi	Warsa	Dhule/Sakri	217	Jarida	Amravati/ Chikhaldara	2831
6	West Flowing Rivers (Konkan	Bhave	Raigad/Mahad	348	Amboli	Sindudurg/ Sawantwadi	7128

Fig 2.4: Graph of Basin wise maximum Daily Rainfall in mm for Year 2016.

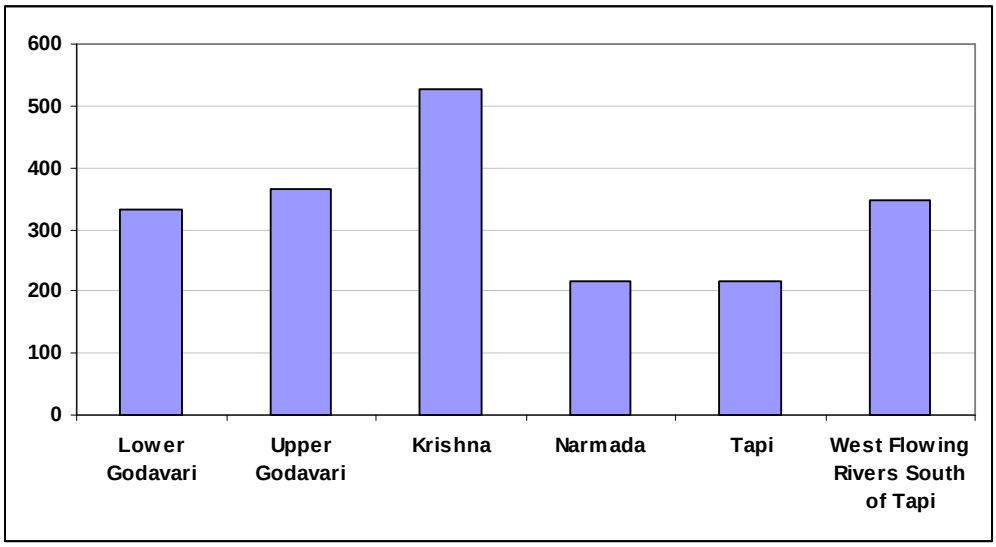
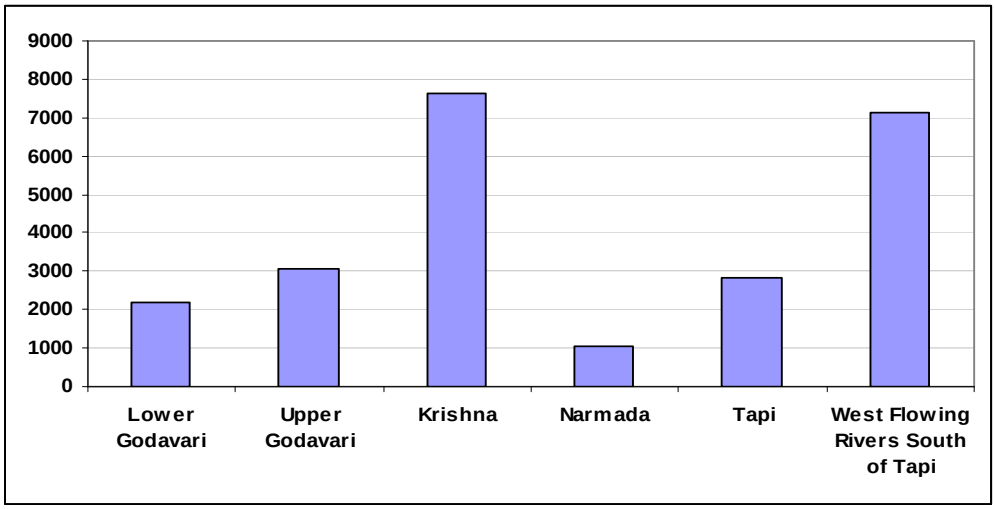


Fig 2.5: Graph of Basin wise Annual maximum Rainfall in mm for Year 2016.



2.4 Following table shows comparison of average annual rainfall for various basins

Sr. No	Name of Basin	Average Rainfall in mm	
		Year	
		2015	2016
1	Lower Godavari	1057	1263
2	Upper Godavari	518	941
3	Krishna	739	1254
4	Narmada	835	701
5	Tapi	585	778
6	West Flowing Rivers (Konkan)	2148	3406

Fig 2.6: Graph of Basin wise Average Annual Rainfall in mm for Year 2015.

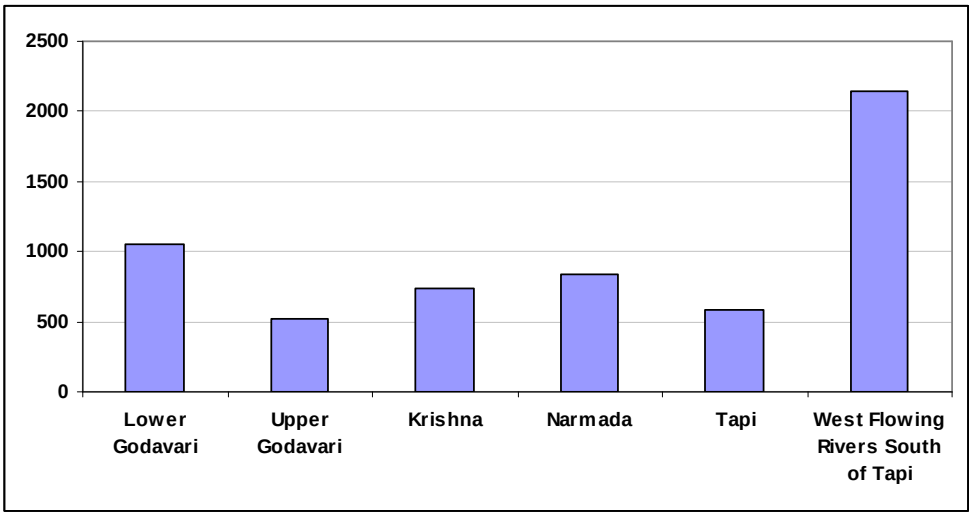


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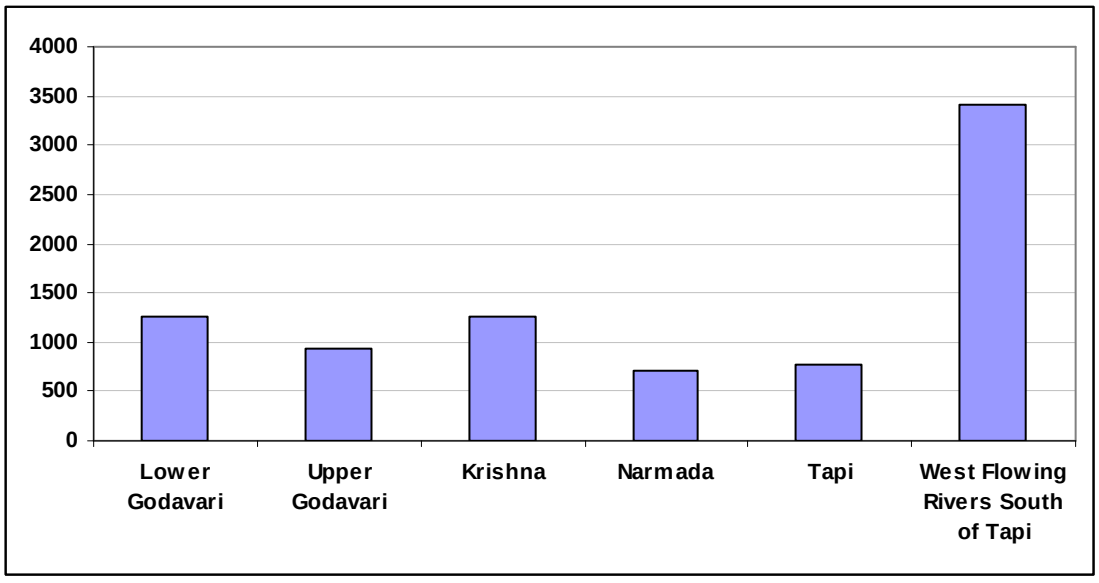
Fig 2.7: Graph of Basin wise Average Annual Rainfall in mm for Year 2016.



2.4 District wise yearly average rainfall:

District wise yearly average rainfall for year 2015, 2016 over Maharashtra is shown in following table. Maximum average rainfall occurred at Sindhudurga district for year 2015 & at Ratnagiri district for year 2016. Minimum average rainfall occurred at Solapur district for year 2015 and 2016

Table 2.5: District wise average Rainfall for year 2015, 2016

Sr. No.	Name of Region	Name of District	Average Rainfall in mm (Year 2015)	Average Rainfall in mm (Year 2016)
1	Konkan	Thane	1849.6	2603.8
2		Palghar	1876.9	2791.76
3		Raigad	2180.2	3410.2
4		Ratnagiri	1971.8	3867.2
5		Sindhudurga	2582.6	3823.0
6	Nashik	Nashik	617.7	956.9
7		Dhule	373.3	464.8
8		Nandurbar	627.9	539.0
9		Jalgaon	363.4	639.4
10		Ahemadnagar	393.9	577.0
11	Pune	Pune	775.2	973.2
12		Satara	651.2	1236.1
13		Sangli	401.4	723.0
14		Solapur	290.6	442.0
15		Kohapur	1459.5	2585.8
16	Aurangabad	Aurangabad	301.7	510.1
17		Jalna	417.0	811.4
18		Parabhani	506.4	1163.3
19		Hingoli	538.8	959.7
20		Beed	394.7	958.8
21		Nanded	514.7	1112.1
22		Osmanabad	409.1	848.9
23		Latur	488.7	1105.7
24	Amravati	Buldhana	610.2	777.8
25		Akola	595.8	838.5
26		Washim	658.8	987.8
27		Amarawati	917.1	1040.1
28		Yavatmal	785.6	1040.4
29	Nagpur	Wardha	1028.9	1194.1
30		Nagpur	1169.7	949.0
31		Bhandara	1137.3	959.7
32		Gondia	1018.9	1268.9
33		Chandrapur	1051.6	1407.8
34		Gadchiroli	1274.6	1711.8

Fig 2.8: Graph of District wise Average Annual Rainfall in mm for Year 2015.

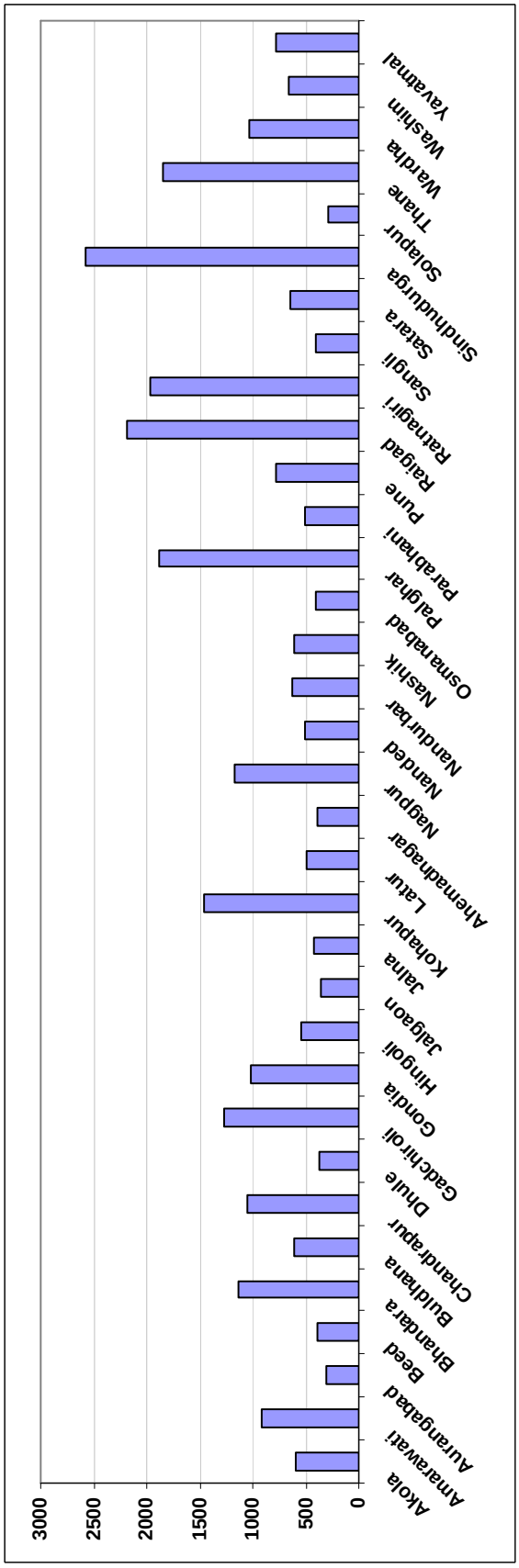


Fig 2.9: Graph of District wise Average Annual Rainfall in mm for Year 2016.

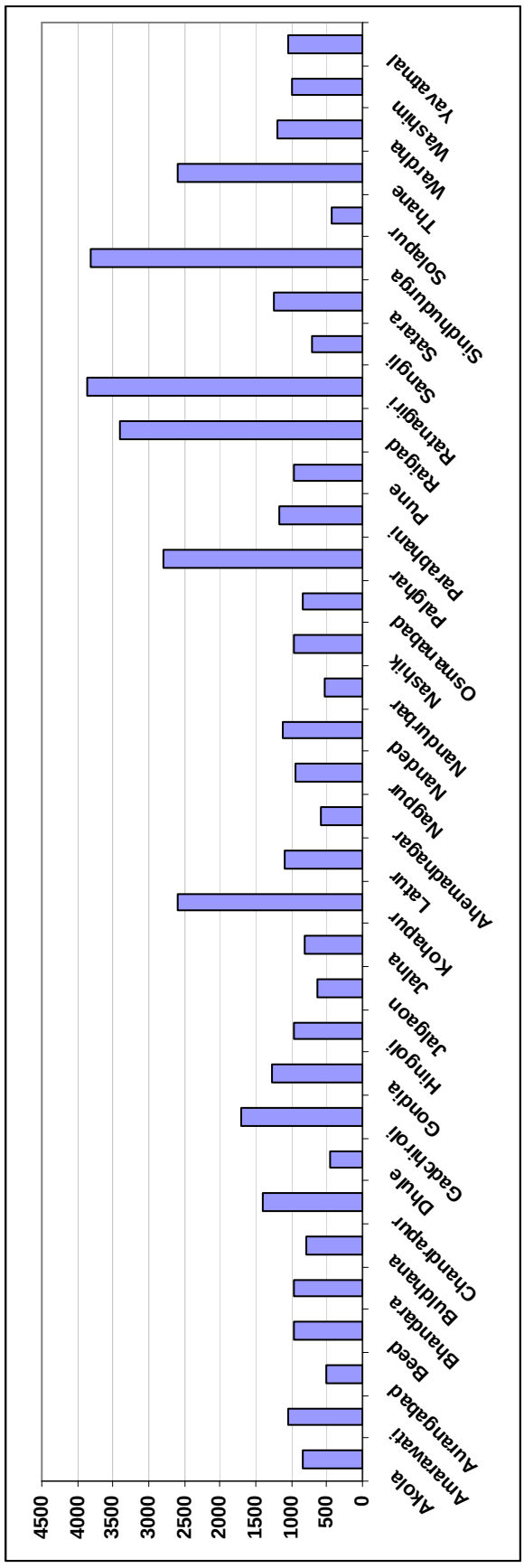


Table 2.6: Rainfall in scarcity zone for year 2015:

Sr. No.	Name of District	Rainfall in mm Year 2015
1	Akola	595.8
2	Aurangabad	301.7
3	Beed	448.2
4	Buldhana	610.2
5	Dhule	373.3
6	Hingoli	538.8
7	Jalgaon	363.4
8	Jalna	417.0
9	Ahemadnagar	393.9
10	Nanded	514.7
11	Nandurbar	627.9
12	Nashik	617.7
13	Osmanabad	409.1
14	Parabhani	506.4
15	Sangli	401.4
16	Satara	651.2
17	Solapur	290.6
18	Washim	658.8

Table 2.7: Rainfall in scarcity zone for year 2016:

Sr. No.	Name of District	Rainfall in mm Year 2016
1	Aurangabad	510.1
2	Dhule	464.8
3	Jalgaon	639.4
4	Ahemadnagar	577.0
5	Nandurbar	539.0
6	Sangli	723.0
7	Solapur	442.0

Comparison of Rainfall in scarcity zone i.e. rainfall < 750mm shows that in year 2015, 18 districts were in scarcity zone; in year 2016, 7 districts were in scarcity zone. Districts, Ahamadnagar, Aurangabad , Dhule and Solapur are consistently in scarcity zone. It is observed that most of the districts were in scarcity zone in year 2015.

2.5 Basin wise Number of rainy days in month: - Following table shows average number of rainy days in month for year 2015 & 2016. Months of June to October are considered. IMD criteria which states that, **"a day with a rain amount of 2.5 mm or more is considered as a rainy day"** is applied to calculate rainy days**.**

Table 2.8: Comparison of Monthly average rainy days in various basins in Maharashtra of 2015

Name of Basin	Monthly average rainy days					Max Rainy Days in Month
	June	July	Aug.	Sept.	Oct	
West Flowing Rivers South of Tapi (Konkan)	16	22	24	11	6	31 Days in July & August at Walawal
Upper Godavari	5	4	6	6	1	24 Days in July at Waghera
Lower Godavari	11	8	12	6	2	28 days in August at Hardoli
Krishna	9	7	7	7	4	30 Days in August at Dajipur
Tapi	5	4	5	4	0	24 Days in July at Rahu
Narmada	6	6	2	5	0	9 Days In July at Toranmal

Table 2.9: Comparison of Monthly average rainy days in various basins in Maharashtra of 2016

Name of Basin	Monthly average rainy days					Max Rainy Days in Month
	June	July	Aug.	Sept.	Oct	
West Flowing Rivers South of Tapi (Konkan)	15	30	27	19	6	31 Days in July & August at Amboli, Bhave, Kankawali, Kotheri, Shirshingi
Upper Godavari	5	11	6	8	3	29 Days in July at Ambai, Kushegaon, Waghera
Lower Godavari	8	19	10	11	5	26 Days in July at Temburdoh
Krishna	13	25	22	12	3	31 Days in August at Revechiwadi
Tapi	6	13	9	8	4	31 Days in July at Jarida
Narmada	4	10	13	7	3	15 Days in August at Toranmal

2.6 Basin wise annual rainfall:

Following figures shows isohyets maps of Maharashtra and the 5 major basins in it for year 2015, 2016.

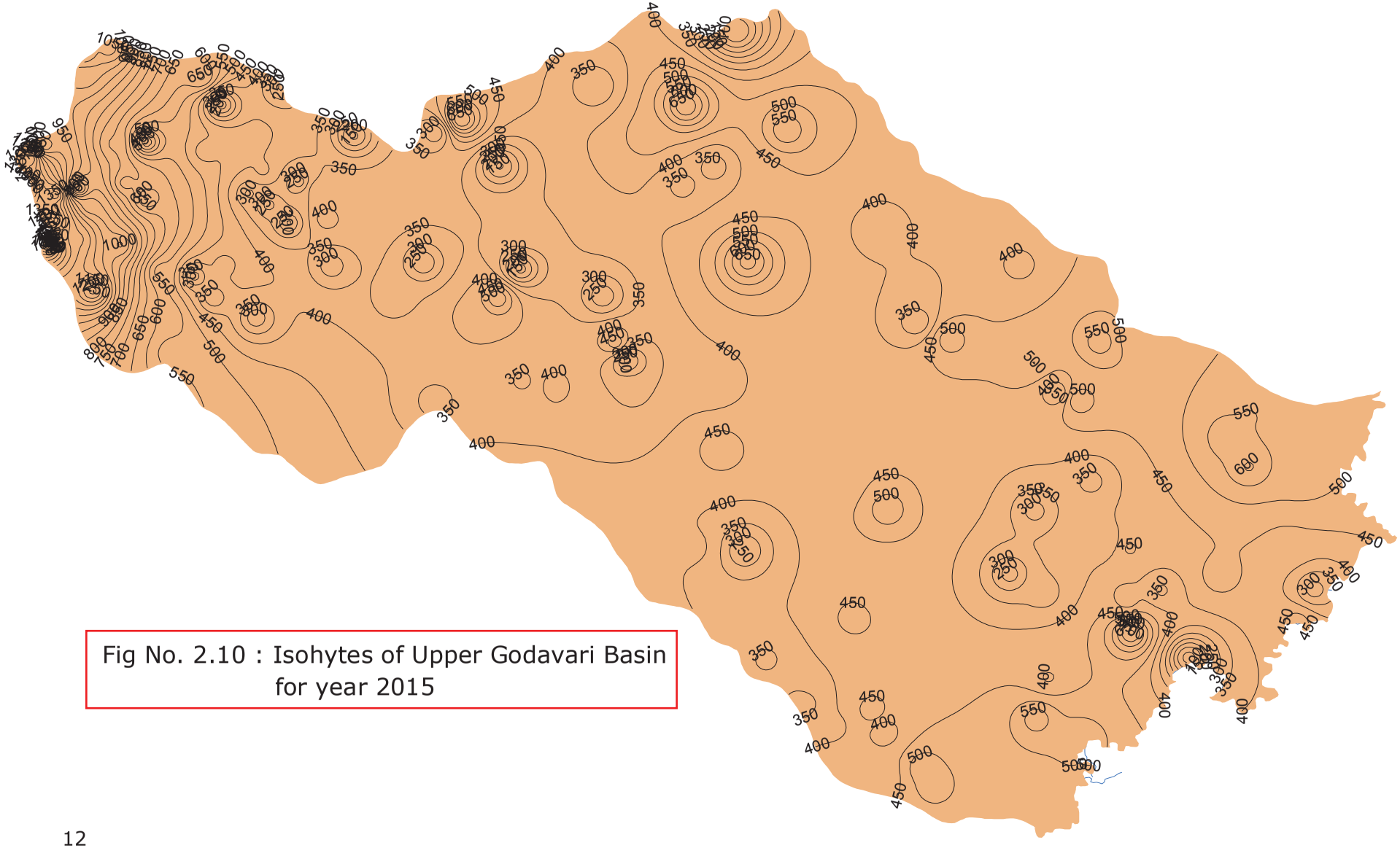


Fig No. 2.10 : Isohytes of Upper Godavari Basin for year 2015

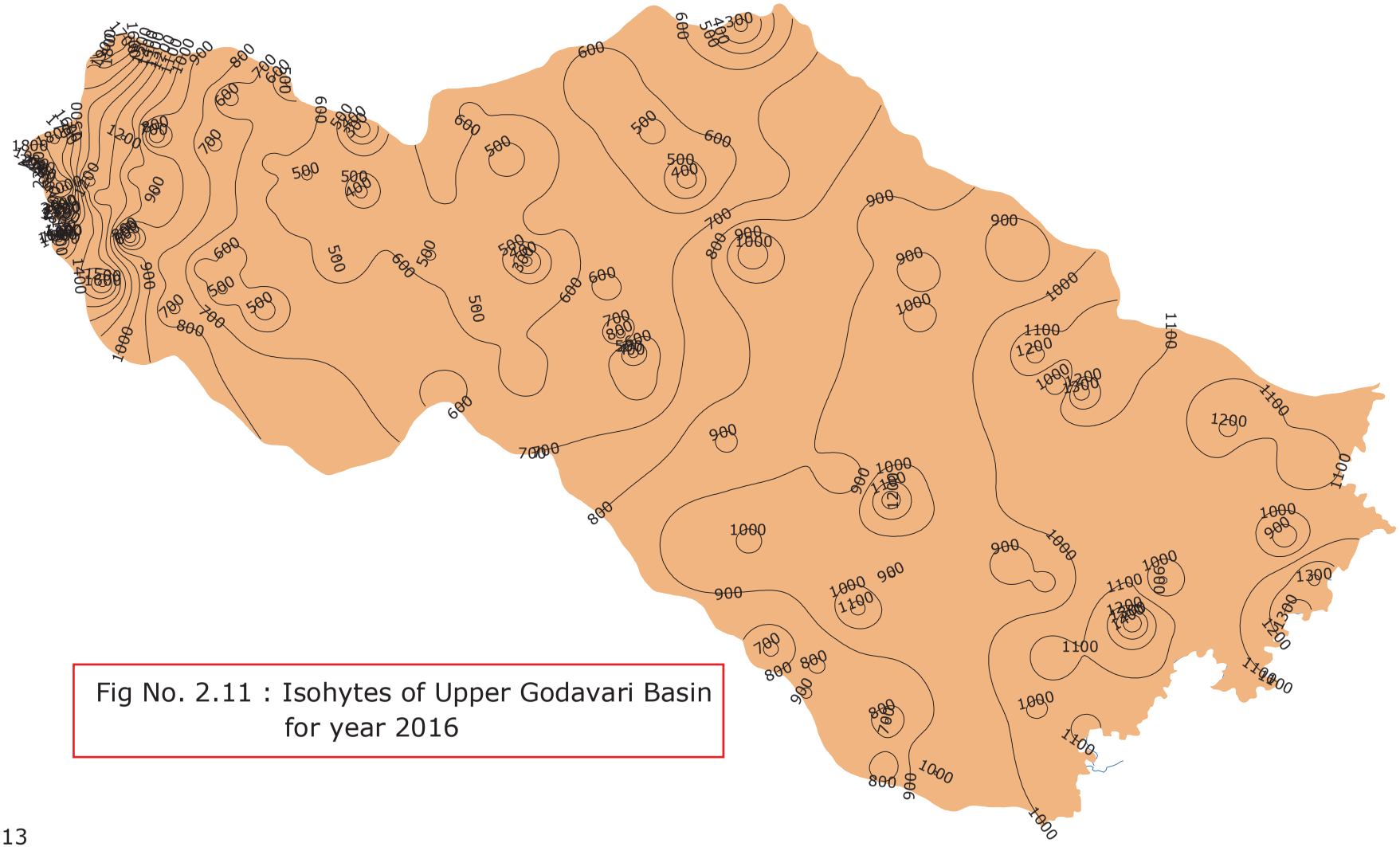


Fig No. 2.11 : Isohytes of Upper Godavari Basin for year 2016

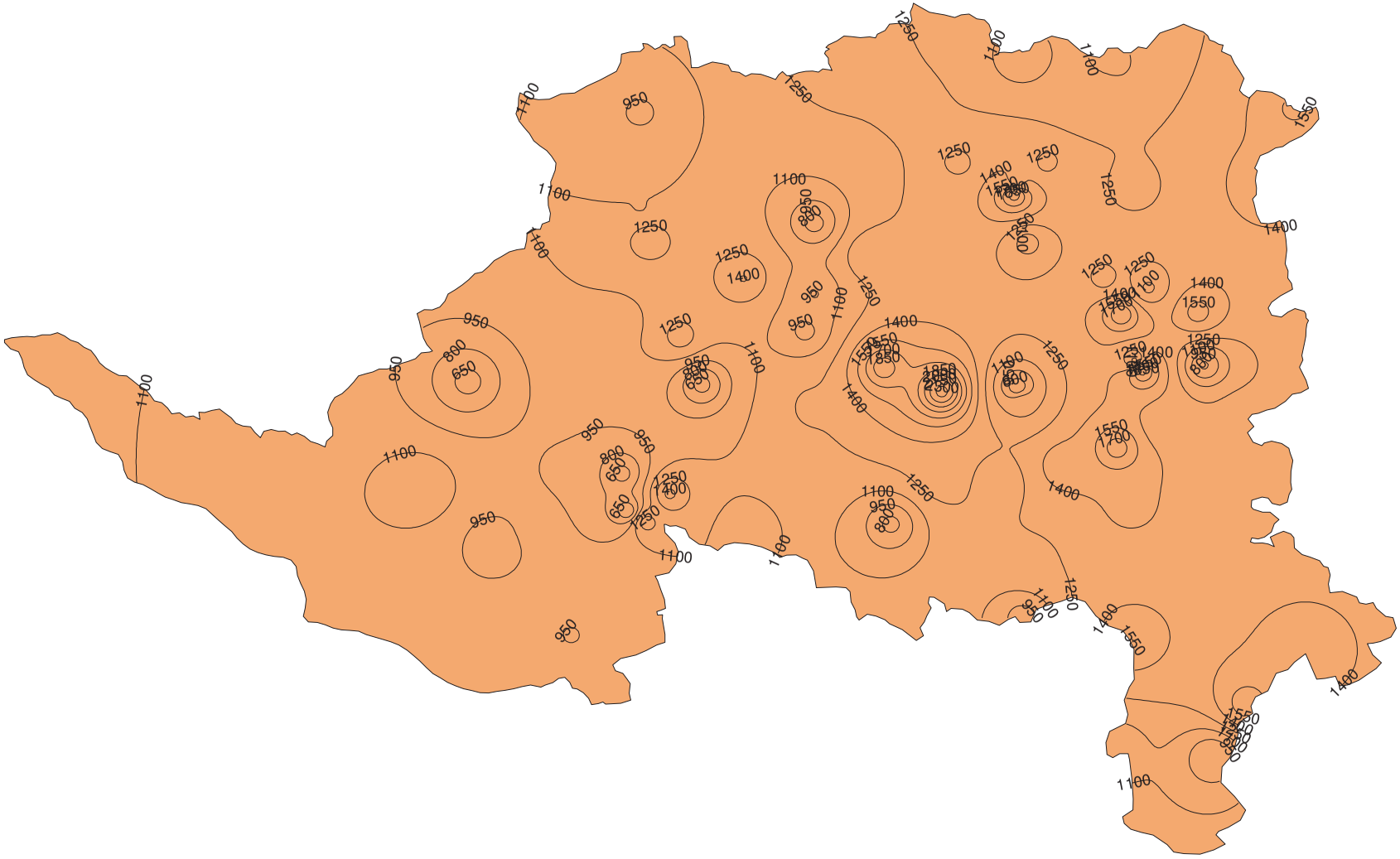


Fig. No. 2.12 : Isohytes of Lower Godawari Basin for year 2015

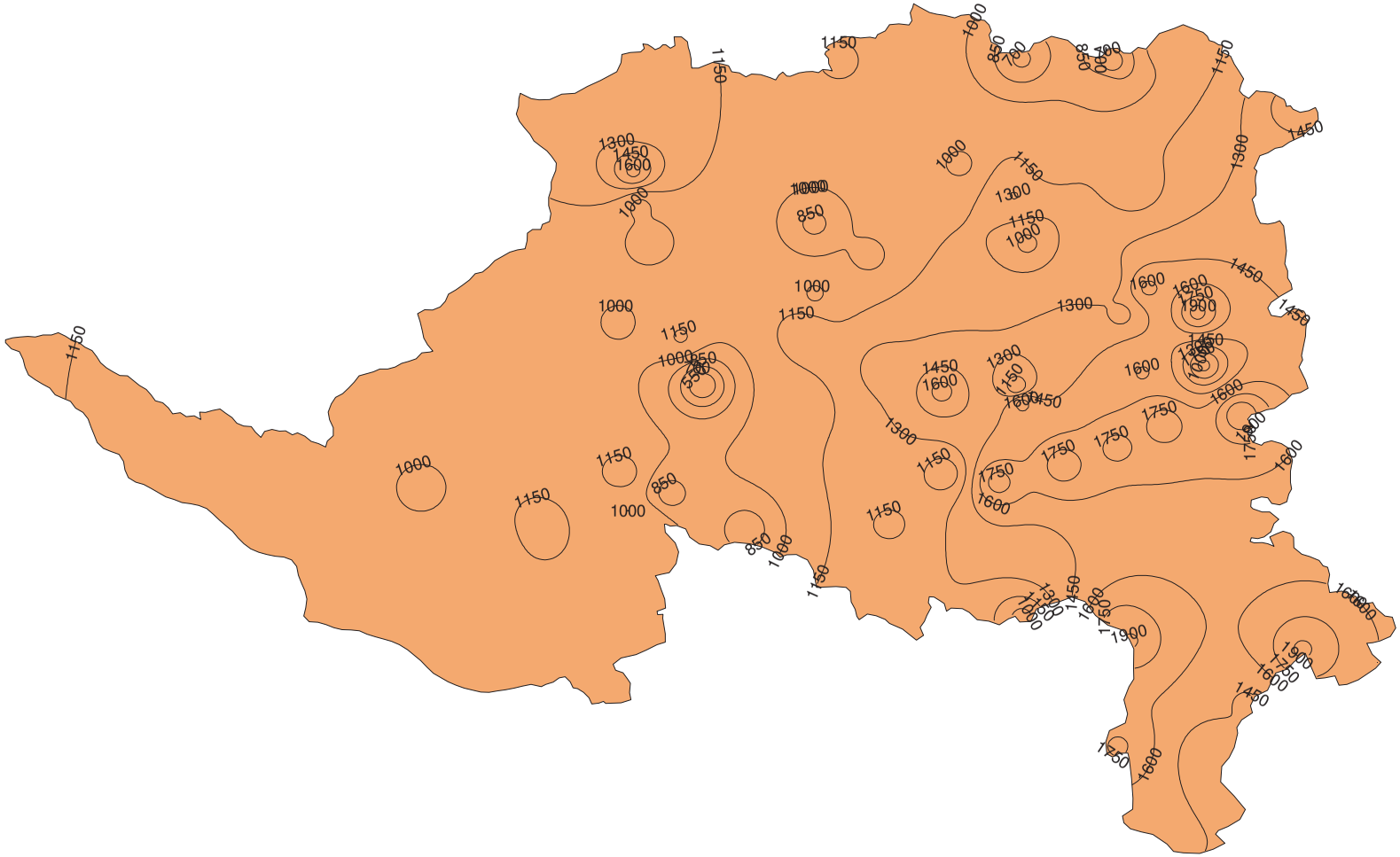


Fig. No. 2.13 : Isohytes of Lower Godawari Basin for year 2016

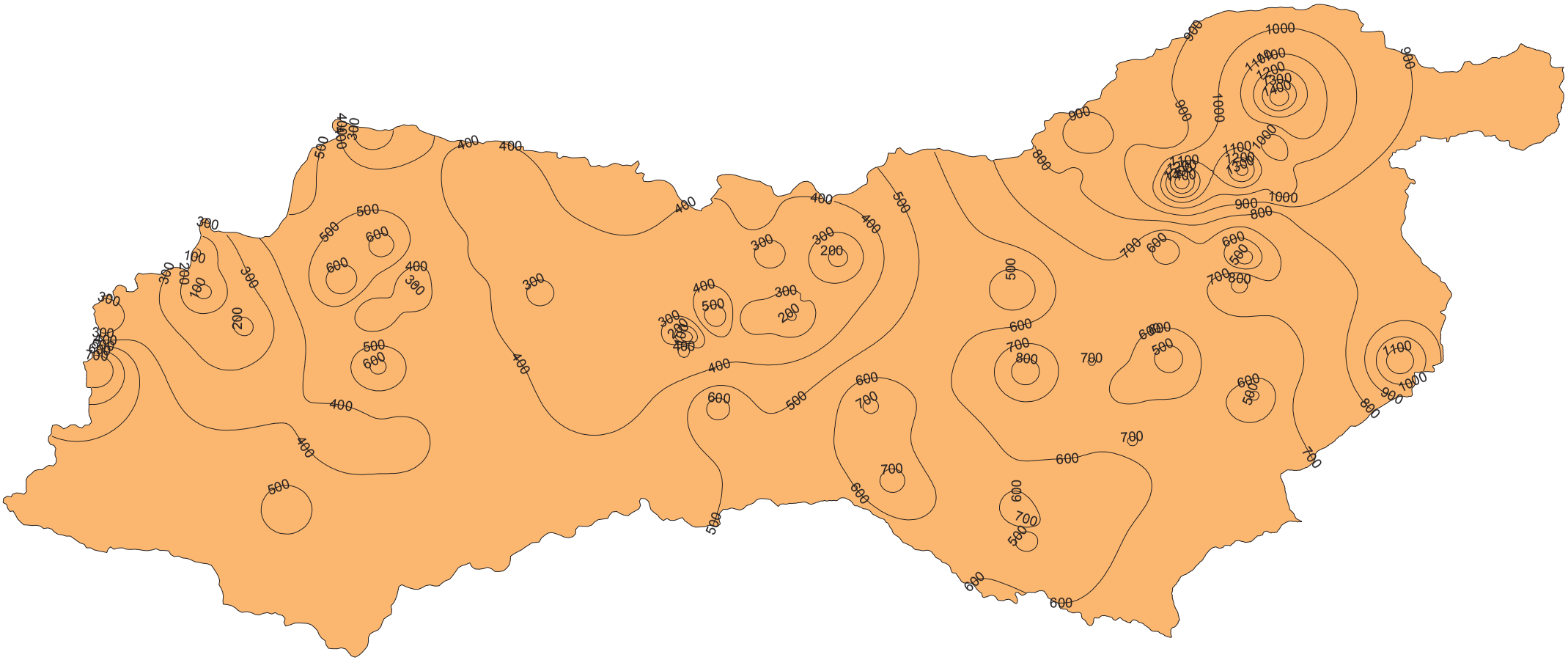


Fig. No. 2.14 : Isohytes of Tapi Basin for year 2015

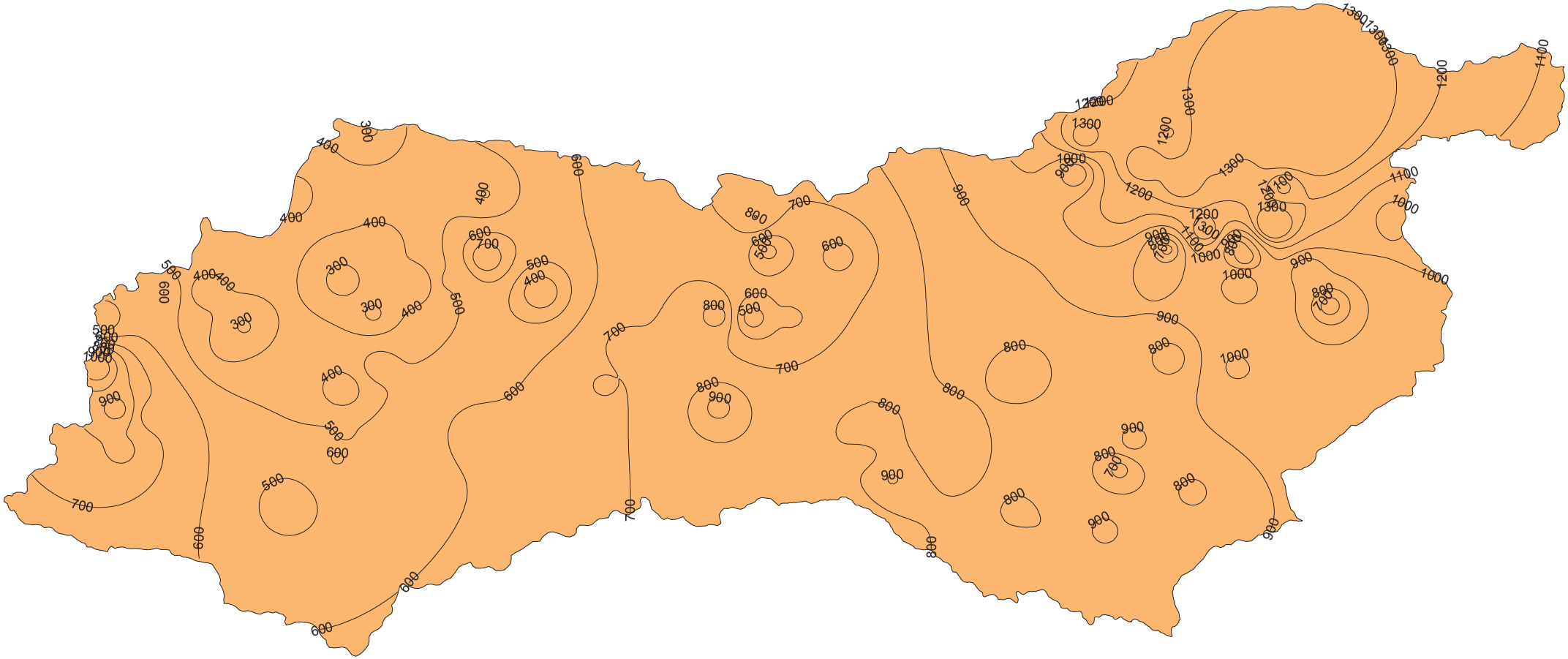


Fig. No. 2.15 : Isohytes of Tapi Basin for year 2016

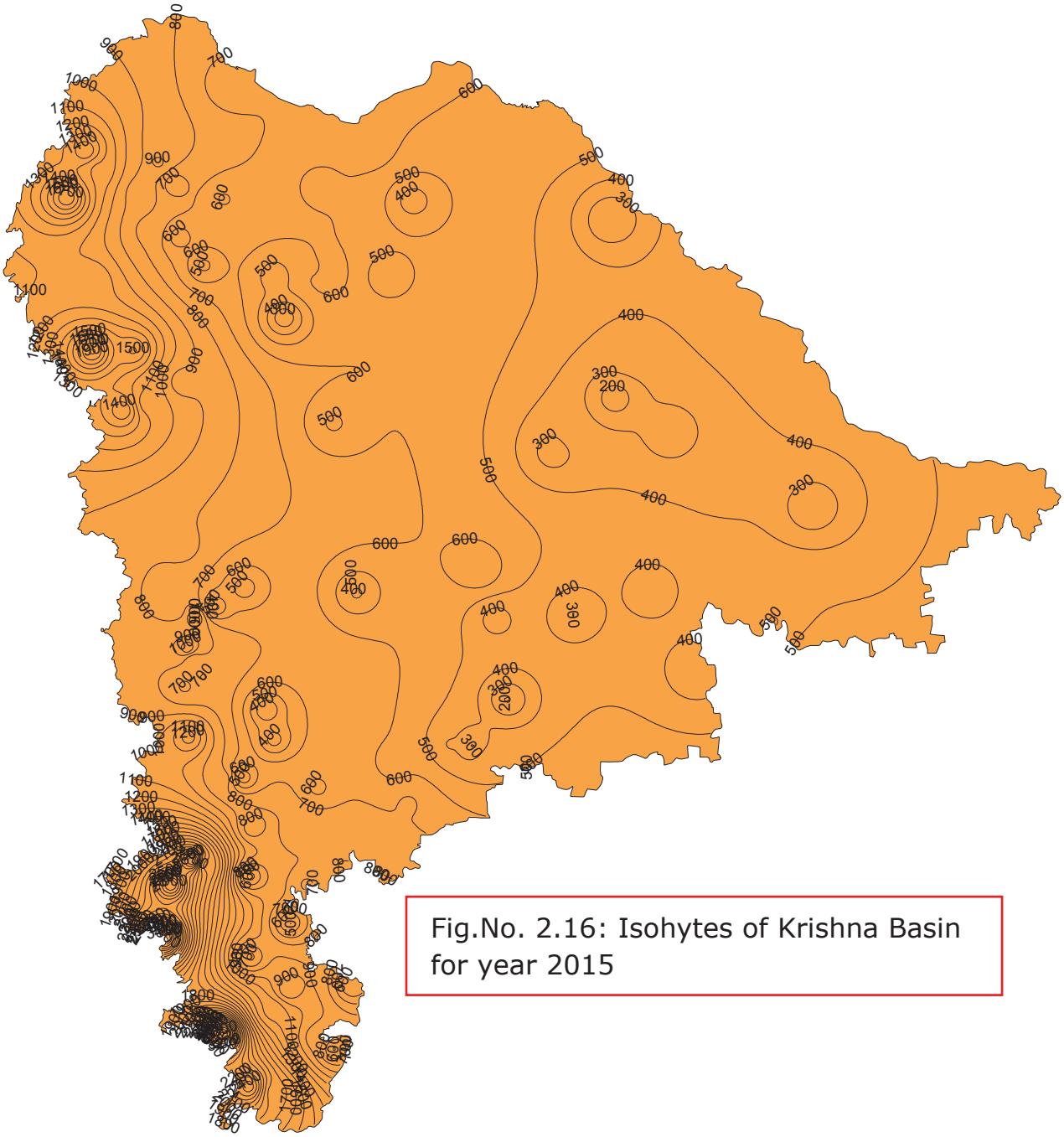


Fig.No. 2.16: Isohytes of Krishna Basin for year 2015

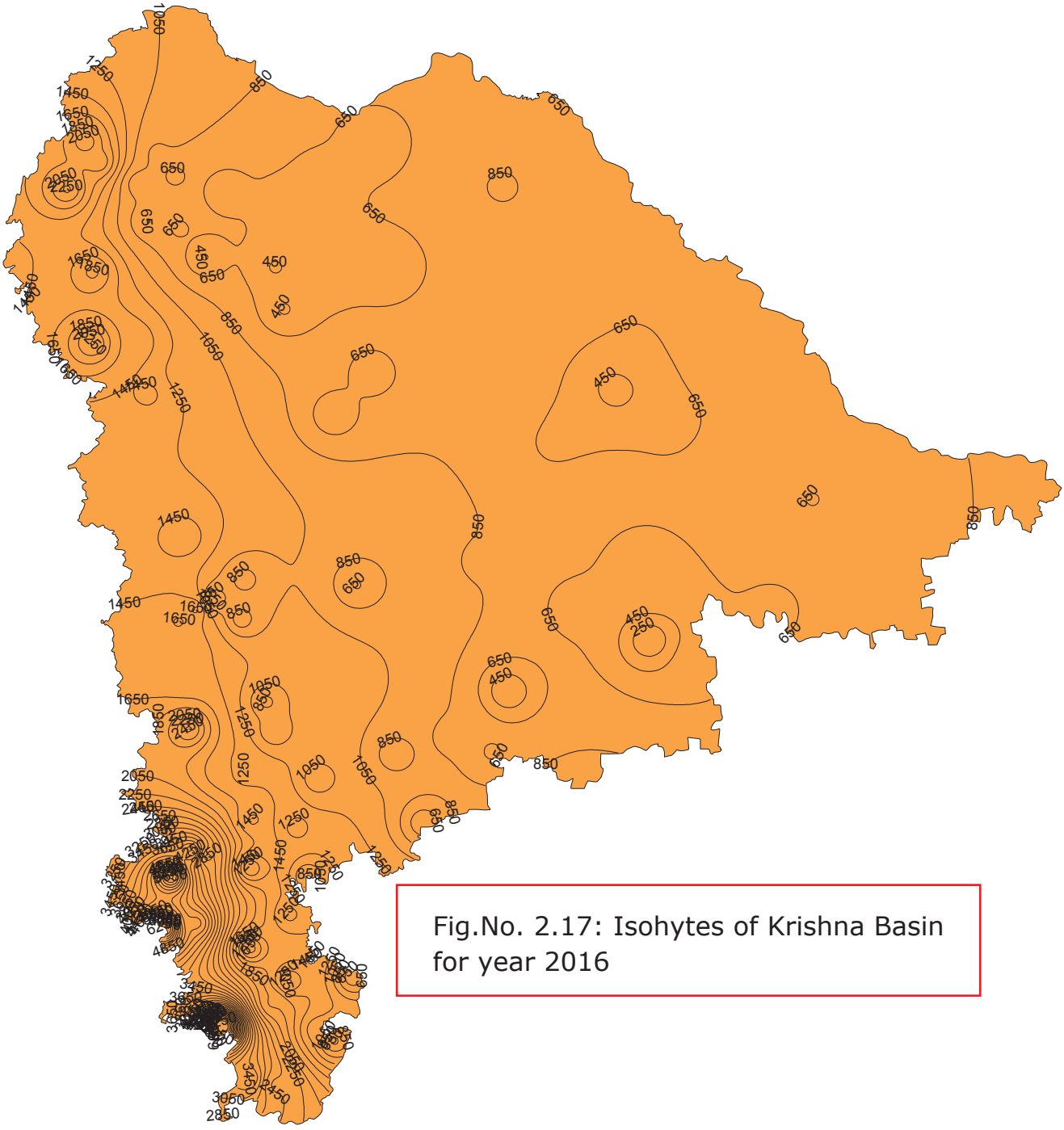


Fig.No. 2.17: Isohytes of Krishna Basin for year 2016

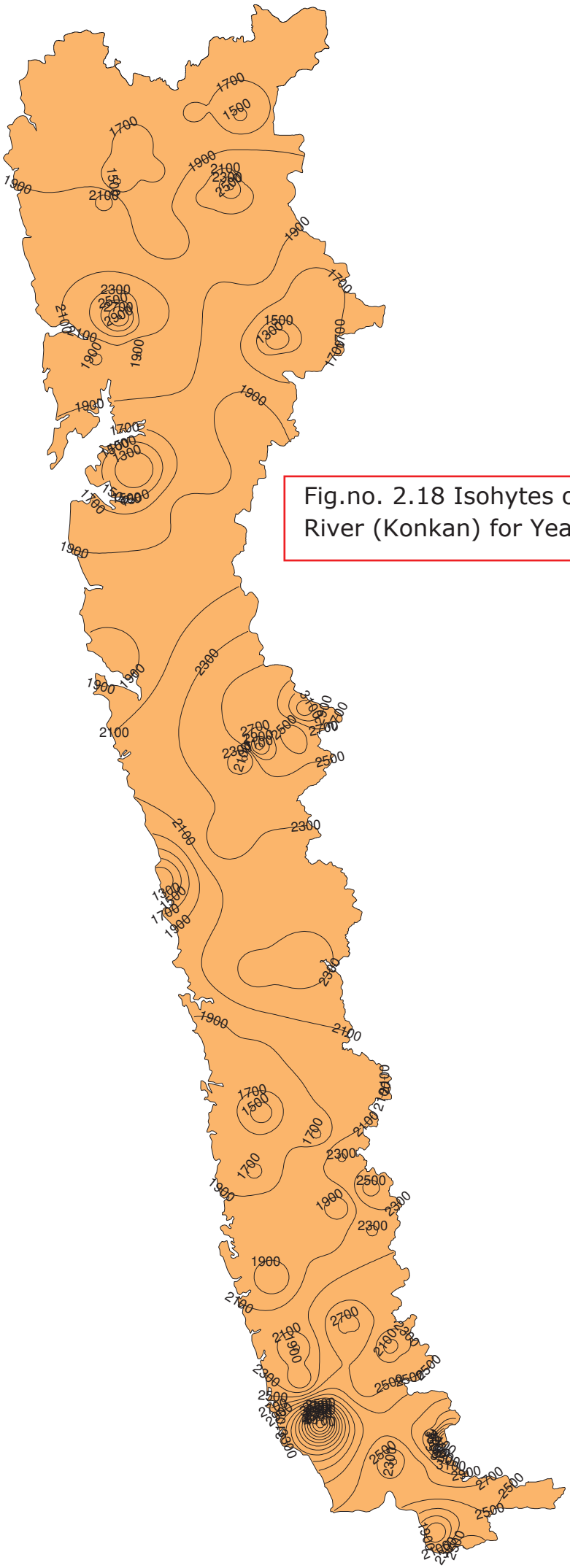


Fig.no. 2.18 Isohytes of West Flowing River (Konkan) for Year 2015

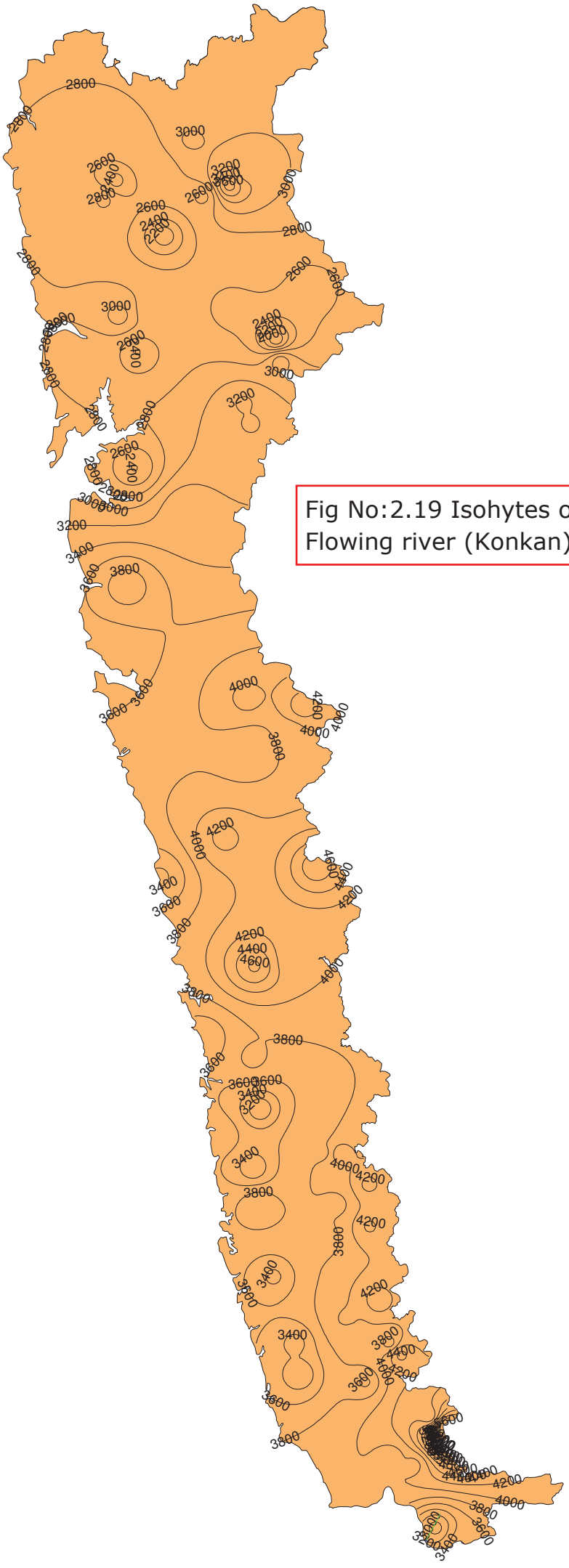


Fig No:2.19 Isohytes of West Flowing river (Konkan) for Year 2016

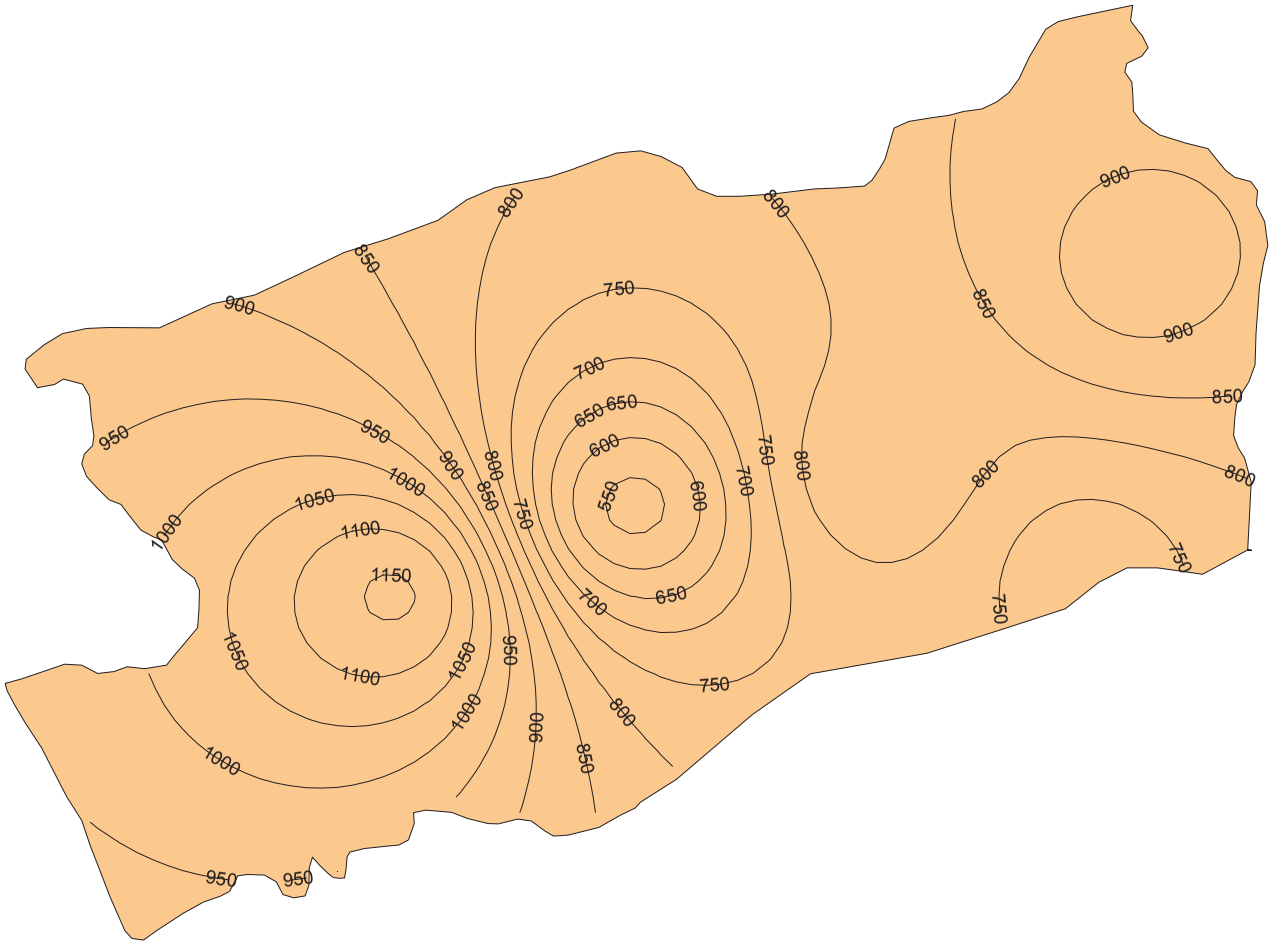


Fig. No. 2.20 : Isohytes of Narmada Basin for year 2015

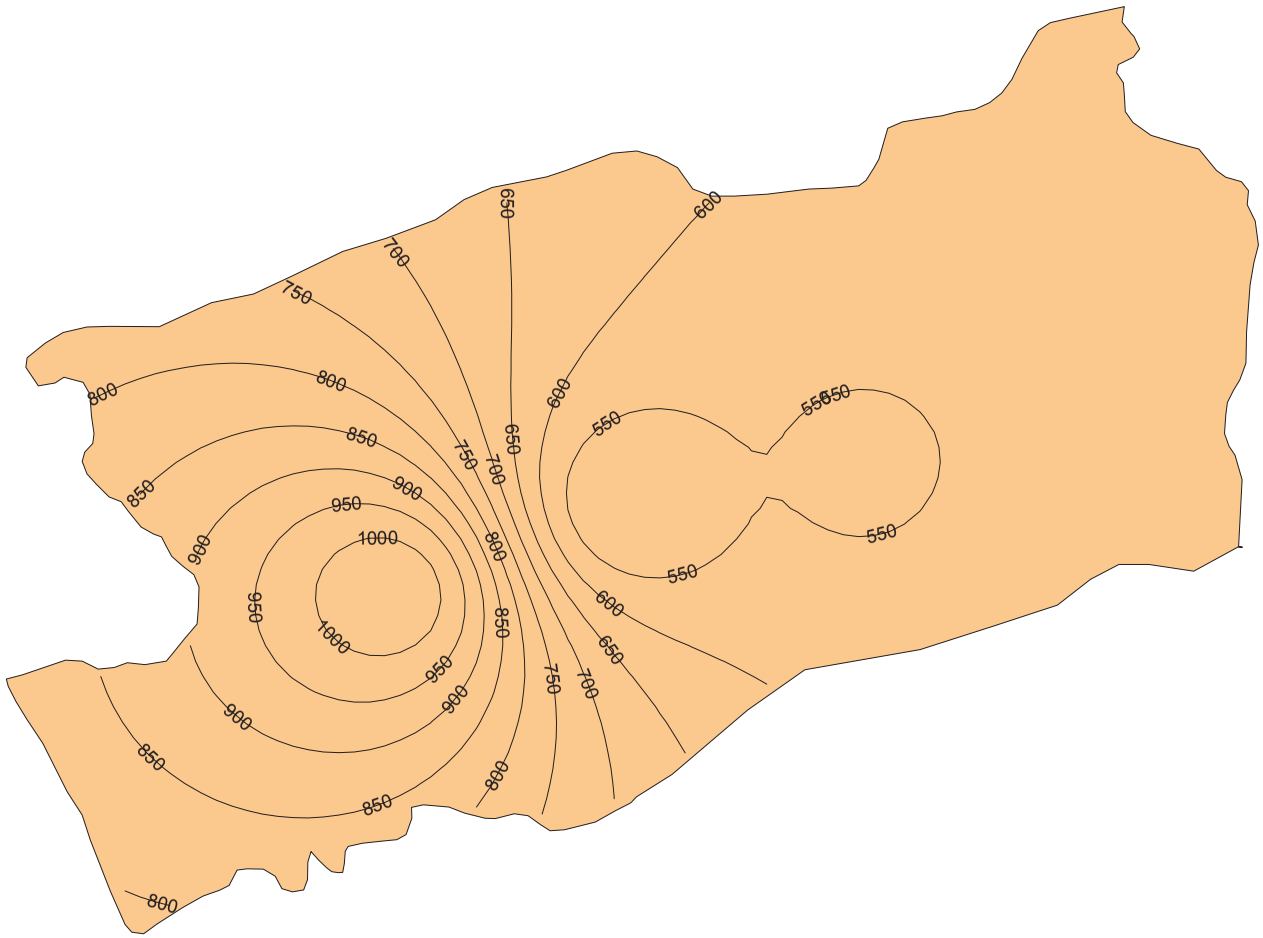


Fig. No. 2.21 : Isohytes of Narmada Basin for year 2016

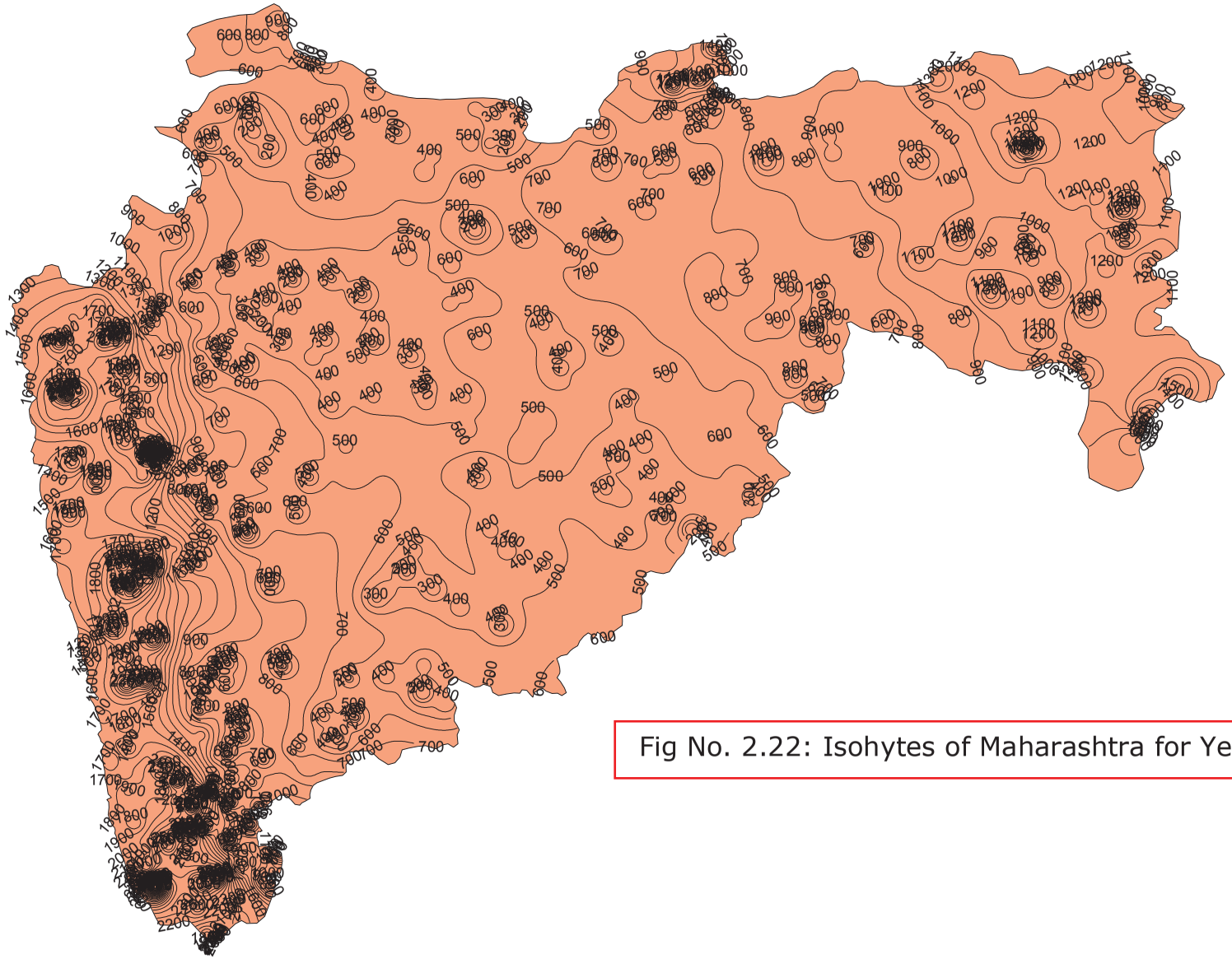


Fig No. 2.22: Isohytes of Maharashtra for Year 2015

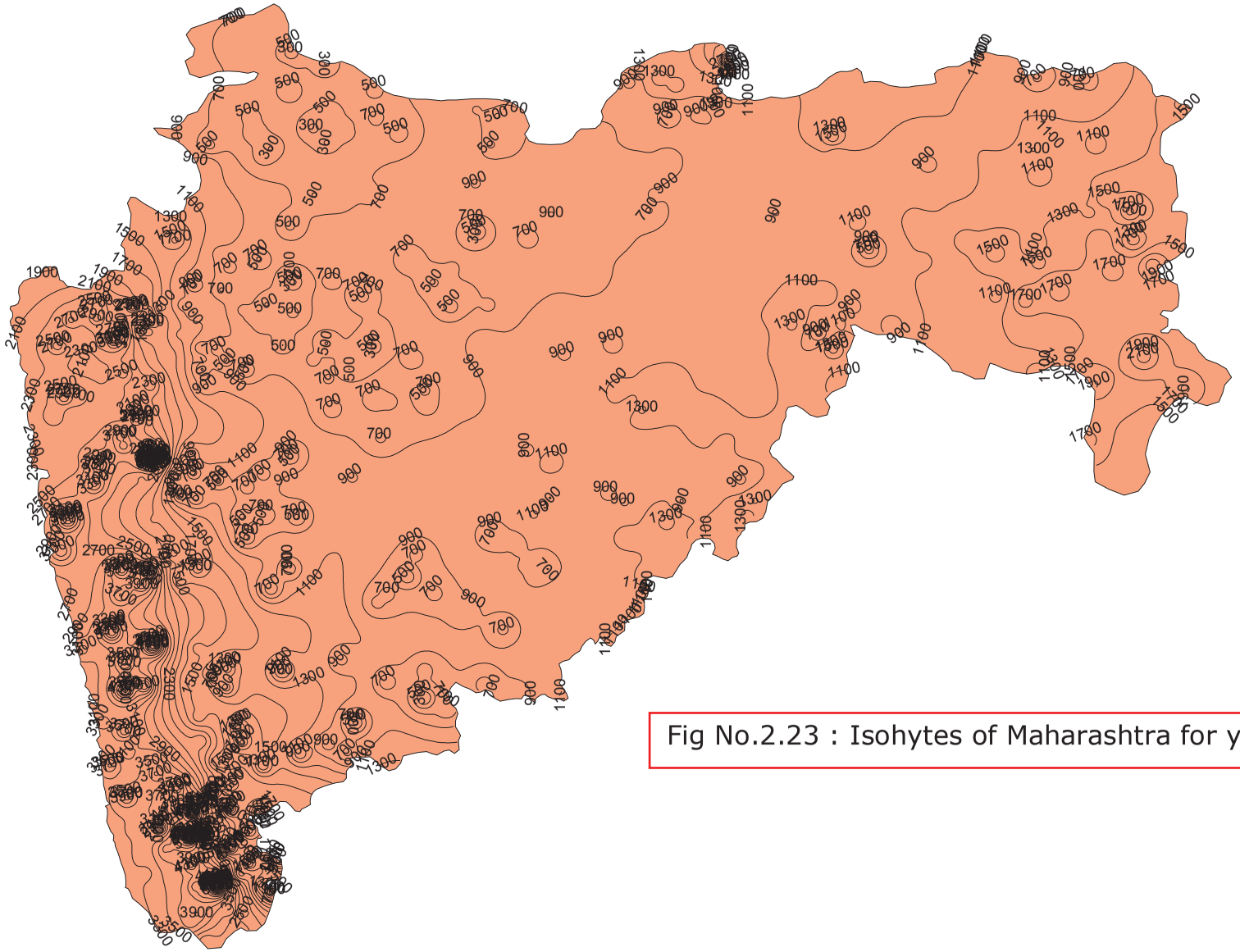


Fig No.2.23 : Isohytes of Maharashtra for year 2016

3. Review of Maximum Minimum Temperature

Following tables show daily maximum & minimum temperature for various basins for period 2007 to 2016.

Table 3.1: Daily maximum & minimum temperature for Lower Godavari Basin

Sr.no.	Year	Max Temp ^{0}C	Name of station	Min Temp ^{0}C	Name of station
1	2007	47.1	Bhamaragad	4.0	Warudbagaji
2	2008	47.3	Lakhandur	1.0	Kamtikhairi
3	2009	48.8	Lakhandur	0.9	Bori
4	2010	50.0	Lakhandur	3.5	Mathani
5	2011	48.0	Bhamragad	2.0	Warudbagaji
6	2012	48.6	Bhamragad	2.4	Warudbagaji
7	2013	48.0	Bori	4.4	Warudbagaji
8	2014	47.5	Gosekhurda	5.1	Kamtikhairi
9	2015	47.5	Hinganghat	1.0	Armori
10	2016	47	Wagholibutti	1.0	Armori

Fig 3.1: Yearwise Graph of maximum temperature for Lower Godavari Basin

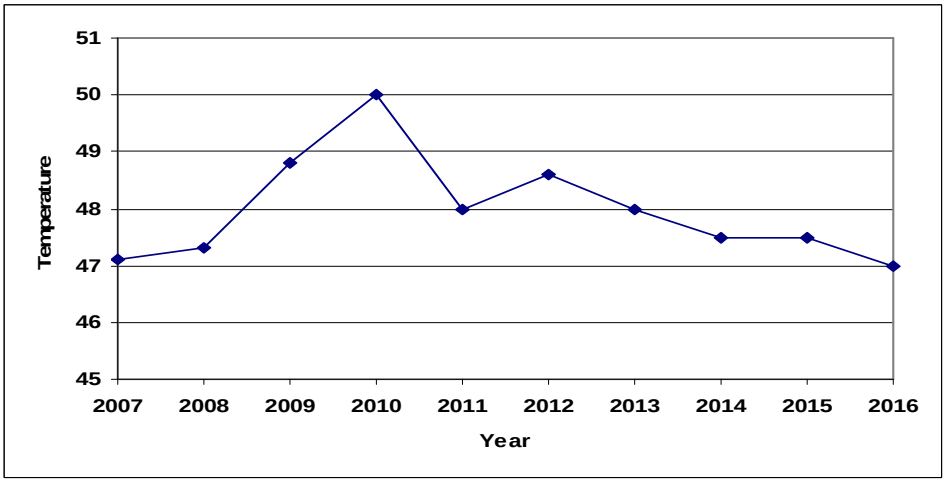


Fig 3.2: Yearly Graph of minimum temperature for Lower Godavari Basin

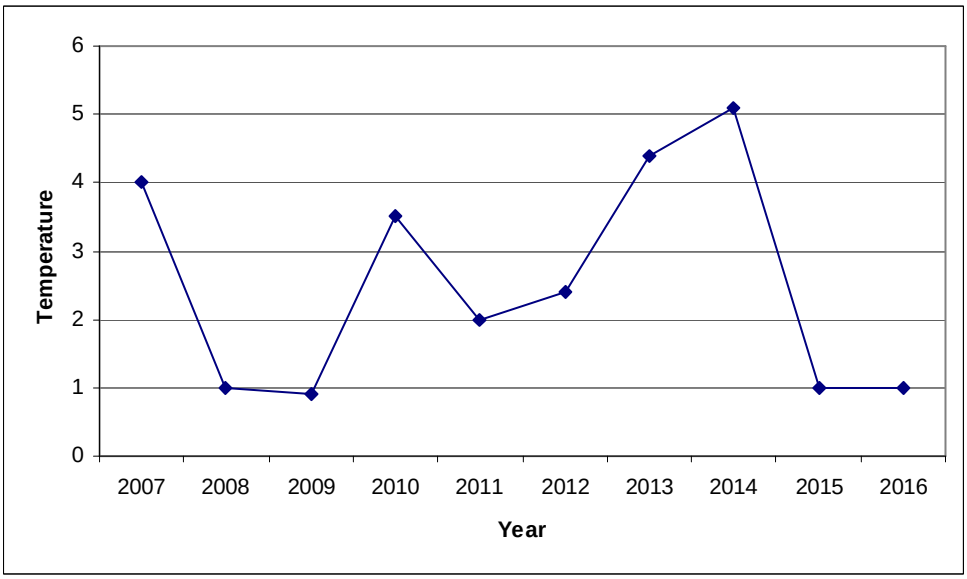


Table 3.2: Daily maximum & minimum temperature for Tapi Basin

Sr.no.	Year	Max Temp ^{0}c	Name of station	Min Temp ^{0}c	Name of station
1	2007	48.6	Bhusaval	5.0	Furdapur & Belval
2	2008	46.5	Bhusaval	3.2	Jamner
3	2009	47	Bhusaval,Aurangpur, Belval, Padalse	3.5	Manasgaon
4	2010	48	Bhusaval	2.5	Aurangpur
5	2011	47	Bhusaval	2.0	Furdapur, Padalse, Shirla, Aurangpur
6	2012	46	Bhusaval	2.0	Furdapur
7	2013	47	Khariya	2.0	Padalse
8	2014	46.5	Khariya& Aurangpur	2.0	Belval
9	2015	47	Dhule	2.5	Jamner
10	2016	48	Bhusawal	3	Fardapur, Jamner

Fig 3.3: Yearly Graph of Daily maximum temperature for Tapi Basin

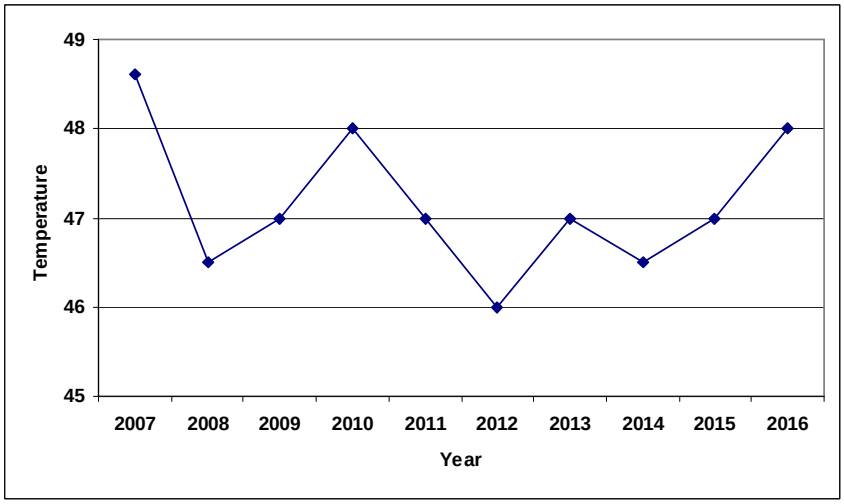


Fig 3.4: Yearly Graph of Daily minimum temperature for Tapi Basin

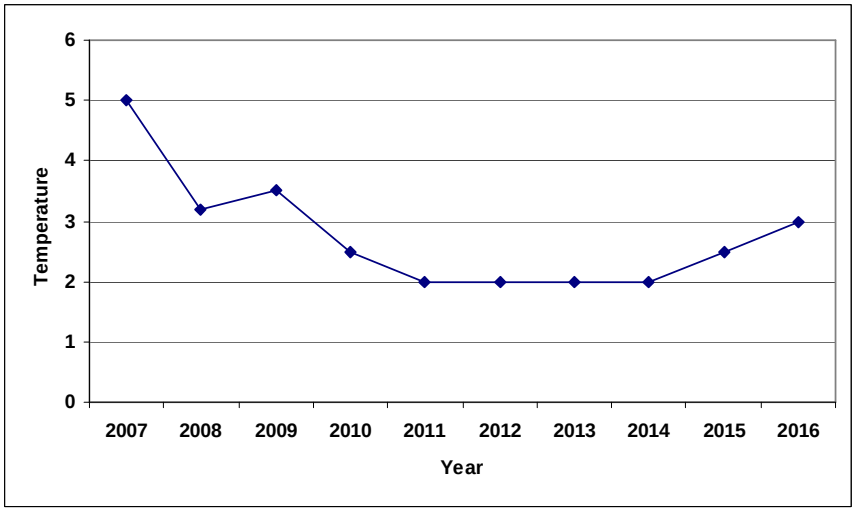


Table 3.3: Daily maximum & minimum temperature for West Flowing River Basin

Sr.no.	Year	Max Temp ^{0}c	Name of station	Min Temp ^{0}c	Name of station
1	2007	46	Khapri	5.0	Khapri
2	2008	48.5	Parali	4.5	Alman
3	2009	45.2	Suksale	2.0	Suksale
4	2010	45.3	Suksale	8.3	Suksale
5	2011	43.5	Suksale	6.2	Suksale
6	2012	43	Awlegaon, Bhatsanagar, Karak,Suksale	1.5	Suksale
7	2013	44	Karak	6.2	Suksale
8	2014	45	Karak	10.0	Bhatsanagar
9	2015	46	Pwarwadi	7	Raipatan
10	2016	45	Karak	8	Pawarwadi, Raipatan

Fig 3.5: Graph of Daily maximum temperature for West Flowing River Basin

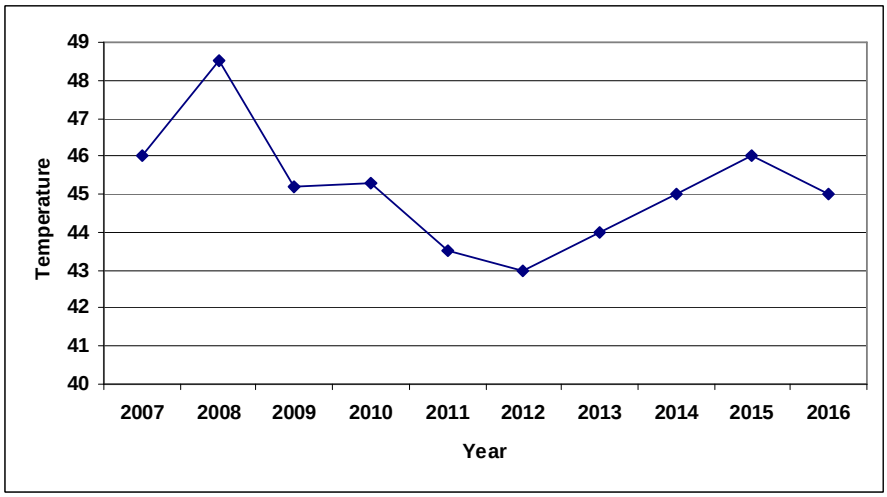


Fig 3.6: Graph of Daily minimum temperature for West Flowing River Basin

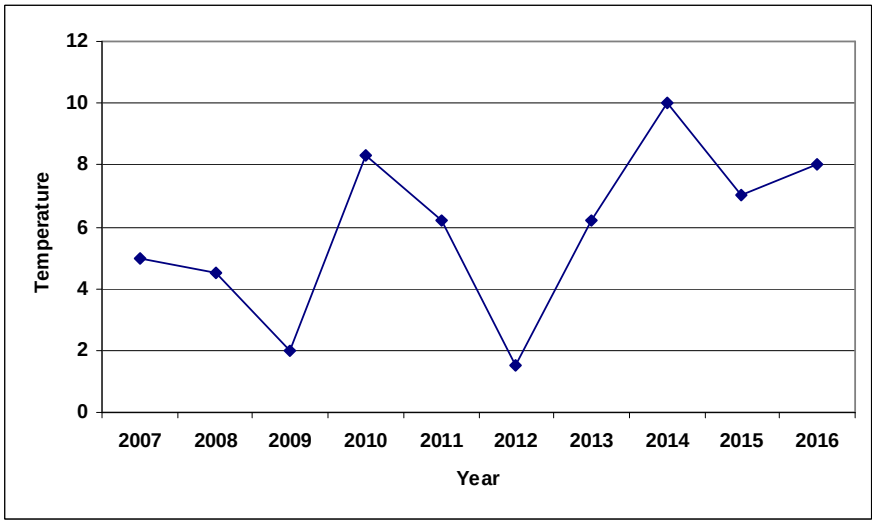


Table 3.4: Daily maximum & minimum temperature for Upper Godavari Basin

Sr.no.	Year	Max Temp ^{0}c	Name of station	Min Temp ^{0}c	Name of station
1	2007	44.5	Kopargaon	3.5	Jaffrabad, Kopargaon, Newasa, Padali
2	2008	44.6	Manoor	3.0	Newasa
3	2009	45.0	Potnandgaon	1.5	Newasa
4	2010	46.0	Potanandgaon, Manoor	4.5	Newasa
5	2011	44.4	Sundgi	1.0	Potanandgaon
6	2012	45.5	Sundgi	2.0	Kopargaon
7	2013	45.0	Potanandgaon, shahgad, sundgi, Nandednagapur	4.0	Padali
8	2014	45.0	Sundgi	5.0	Mannor, Jaffrabad
9	2015	46.0	Sundgi, Potanandgaon	4.5	Takli
10	2016	46.0	Nanded, Potanandgaon, Manoor	5	Jaffrabad, Kopargaon, Newasa

Fig 3.7: Graph of Daily maximum temperature for Upper Godavari Basin

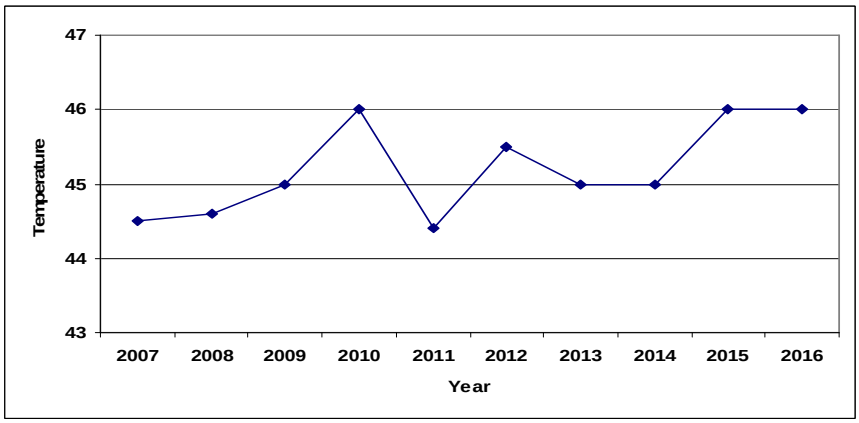


Fig 3.8: Graph of Daily minimum temperature for Upper Godavari Basin

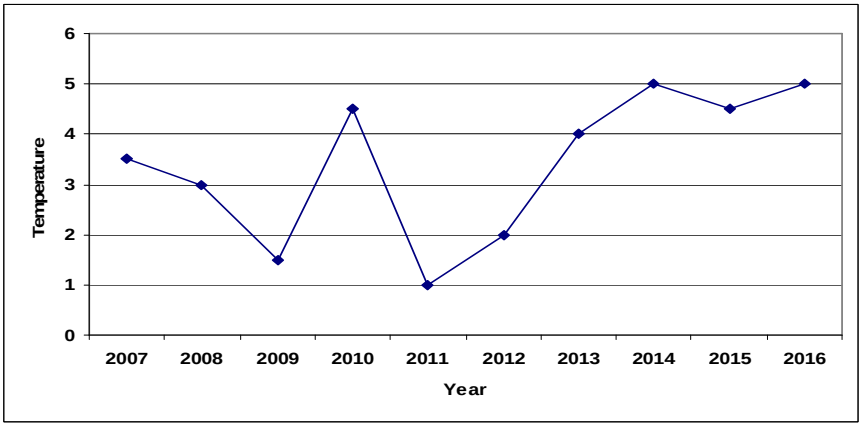


Table 3.5: Daily maximum & minimum temperature for Krishna Basin

Sr.no.	Year	Max Temp ^{0}C	Name of station	Min Temp^{0}c	Name of station
1	2007	44	Rosa, Khamgaon	4.5	Askheda
2	2008	43.5	Barur	4.0	Barhanpur,Paud,Velhe
3	2009	43.5	Barur, Kashti, Sidhewadi(Sol)	1.5	Ambwade
4	2010	45.0	Barur	2.5	Parali
5	2011	42.5	Pargaon	4.0	Pargaon
6	2012	43.0	Barur	4.0	Kashti
7	2013	43.5	Barur	4.0	Kashti
8	2014	43.0	Barur	5.0	Kashti
9	2015	43.0	Rosa	5.0	Patryachiwadi
10	2016	44.0	Rosa	5.0	Sakhar

Fig 3.9: Graph of Daily maximum temperature for Krishna Basin

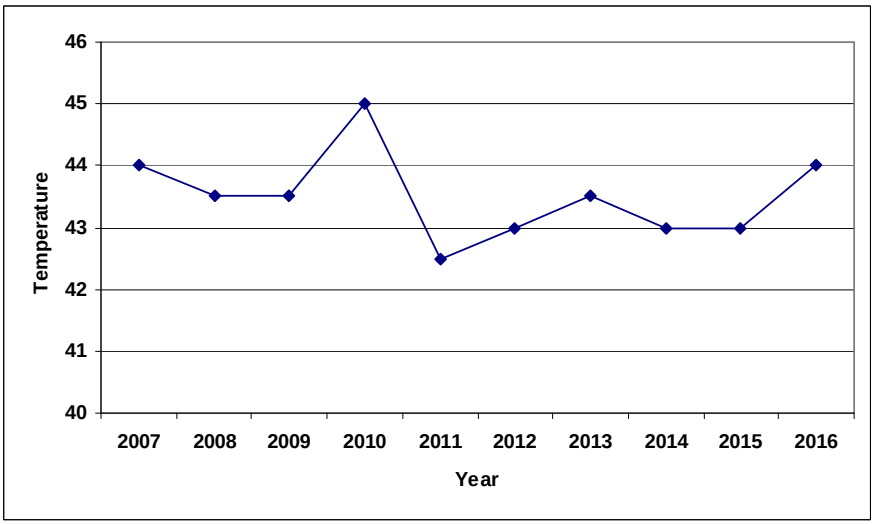
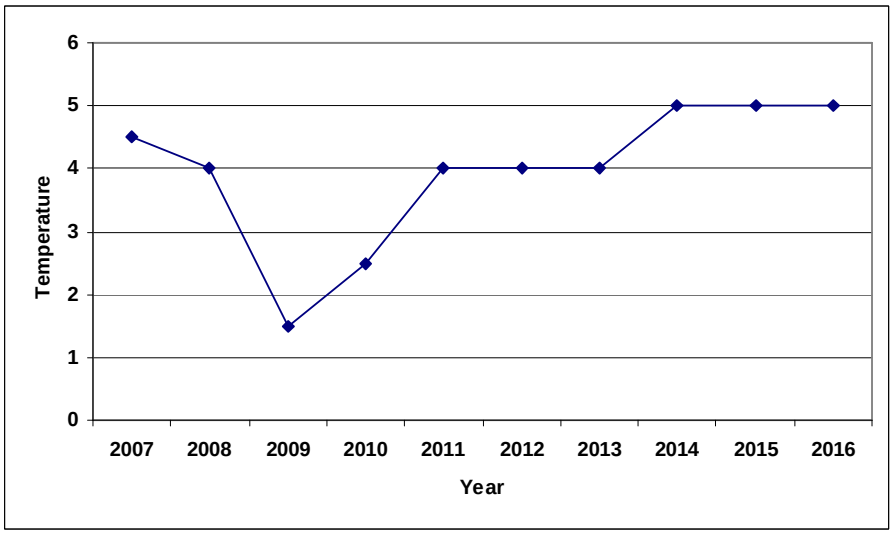


Fig 3.10: Graph of Daily minimum temperature for Krishna Basin



Inference from comparison of maximum and minimum temperature:

It is observed that there is not much variation in maximum temperature in all basins. But there is much variation in minimum temperature in all basins. Maximum temperature reached up to 50^0C at station Lakhandur in 2010 and 0.9^0C at station Bori in 2009.

4. Review of Evaporation

Following tables show Evaporation for various basins. All available data is considered up to Year 2016 for computing average monthly evaporation.

Table 4.1: Monthly Average Evaporation mm. for Various Basins in Maharashtra.

Name of Basin	Monthly Average Evaporation in mm											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Lower Godavari	95.9	114.2	171.7	213.4	**260.2**	183.8	97.9	94.7	95.8	107.7	91.0	86.8
Upper Godavari	126.4	148.3	214.4	270.1	**321.2**	211.3	141.2	121.3	124.6	146.0	130.0	123.1
Krishna	128.0	147.6	209.1	242.7	**253.7**	153.9	105.9	99.3	110.6	128.2	123.8	120.2
Tapi	117.6	142.1	211.7	276.0	**347.2**	230.5	140.9	122.0	133.6	149.6	127.6	113.6
West Flowing Rivers (Konkan)	125.8	141.3	192.9	210.8	**221.6**	117.4	70.8	69.1	82.0	108.4	112.5	116.7

Fig. 4.1 Graph of Monthly Average Evaporation of Lower Godavari Basin in mm

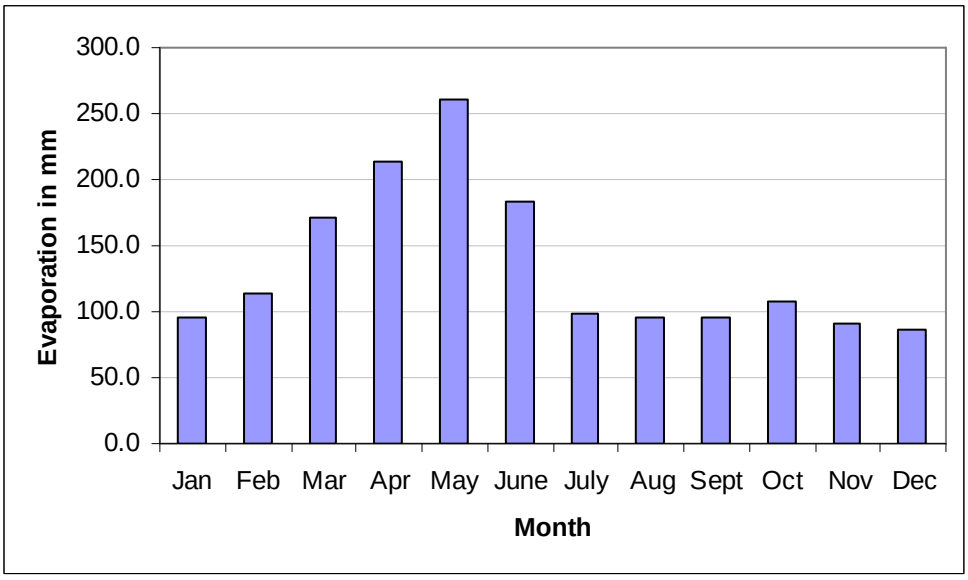


Fig. 4.2 Graph of Monthly Average Evaporation of Upper Godavari Basin in mm

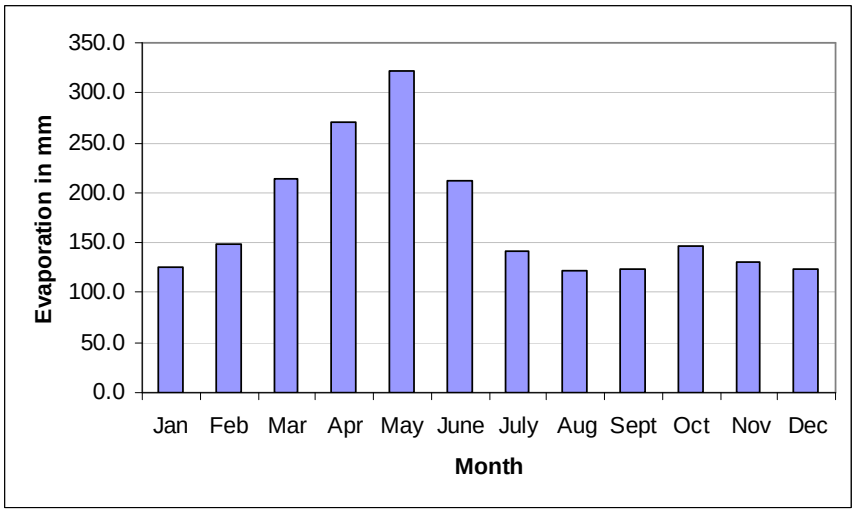


Fig. 4.3 Graph of Monthly Average Evaporation of Krishna Basin in mm

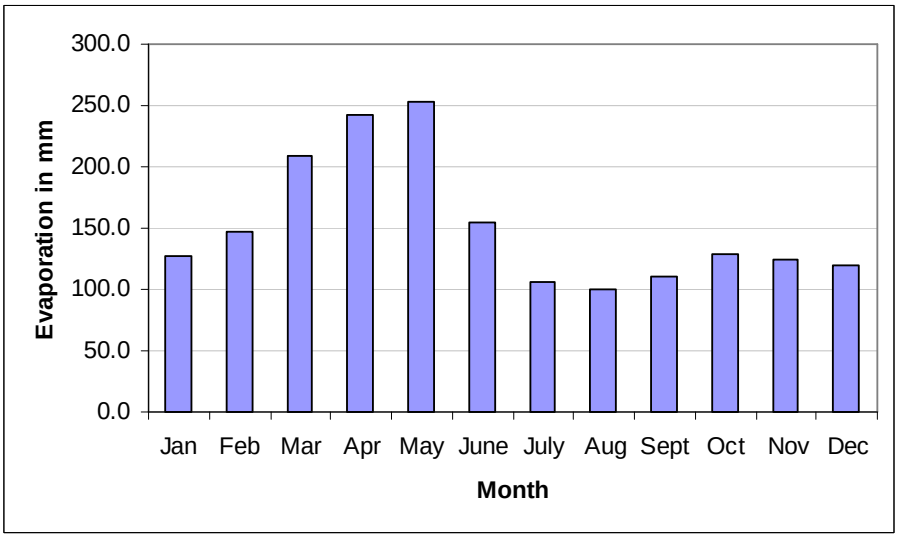


Fig. 4.4 Graph of Monthly Average Evaporation of Tapi Basin in mm

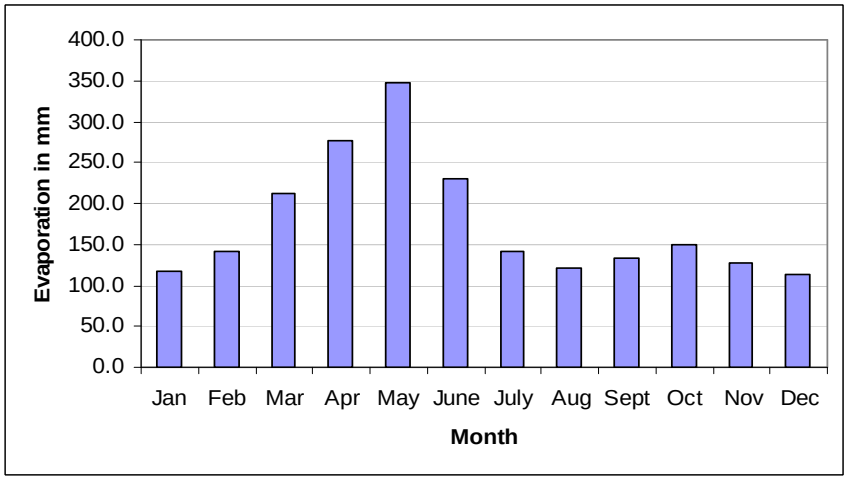


Fig. 4.5 Graph of Monthly Average Evaporation of West Flowing River Basin South of Tapi (Konkan) in mm.

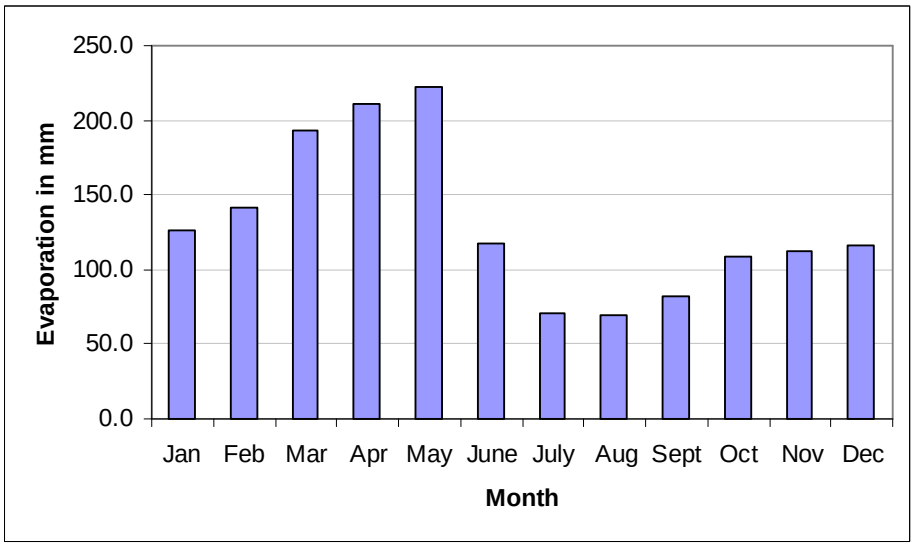


Table 4.2: Average Maximum & Minimum Evaporation mm. in month for Various Basins of Maharashtra.

Name of Basin	Average Maximum, Minimum & Evaporation in the month & Yearly Total in mm.				
	Maximum	Month	Minimum	Month	Av. Yearly Total
Lower Godavari	260.2	May	86.8	December	1613.2
Upper Godavari	321.2	May	121.3	August	2077.9
Krishna	253.7	May	99.3	August	1822.9
Tapi	347.2	May	113.6	December	2112.3
West Flowing Rivers South of Tapi	221.6	May	69.1	August	1569.3

Fig. 4.6 Graph of Average Maximum Monthly Evaporation in Various Basins of Maharashtra in mm.

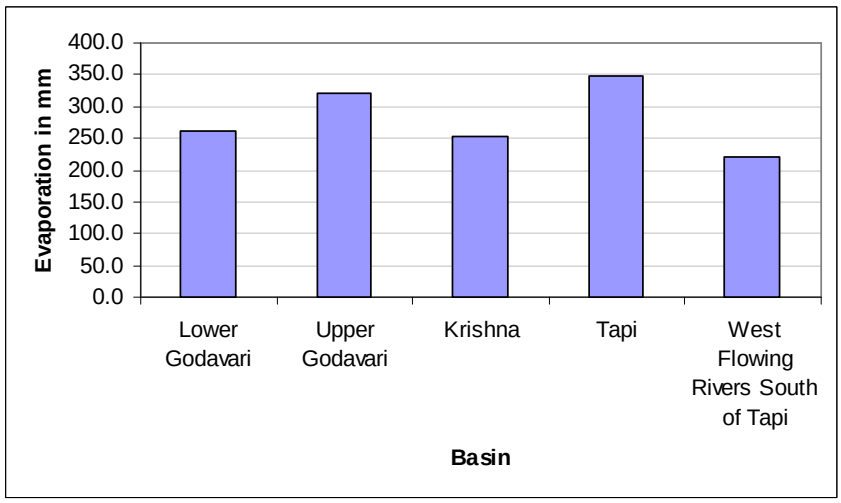


Fig. 4.7 Graph of Average Minimum Monthly Evaporation in Various Basins of Maharashtra in mm.

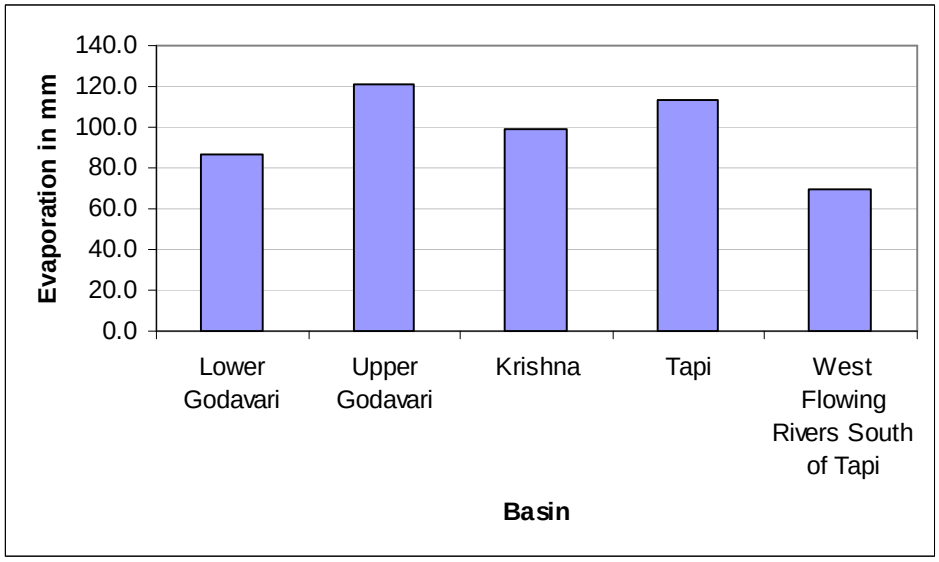
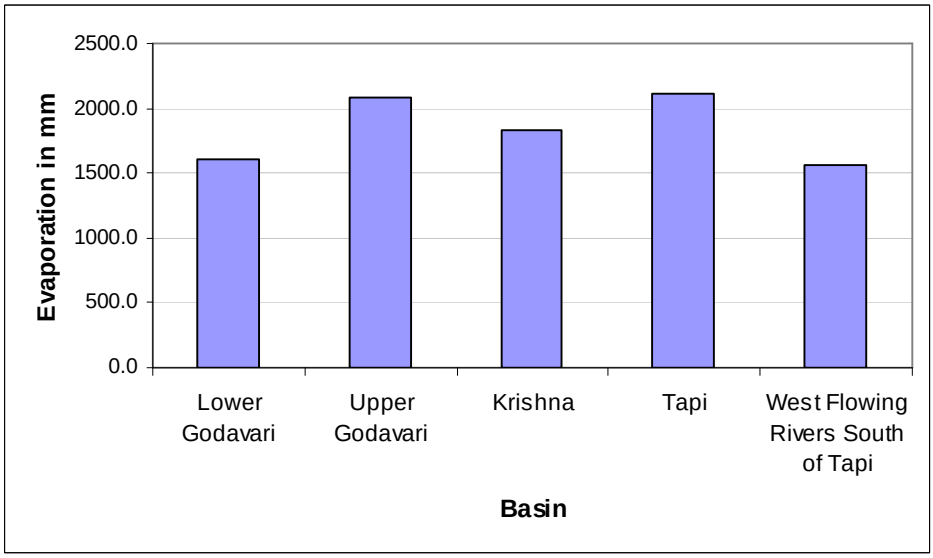


Fig. 4.8 Graph of Average Yearly Evaporation in Various Basins of Maharashtra in mm.



For computing averages of evaporation all available data considered up to year 2016. It is observed that average maximum evaporation is observed at Tapi basin and Upper Godavari basin in the month of May 347.2 & 321.2 mm. Where as Average minimum evaporation is observed at West Flowing Rivers basin (Konkan) in the month of August 69.1 mm. Considering over all Maharashtra average maximum evaporation is observed in month of May and average minimum evaporation is observed in the month of December for Lower Godavari, Tapi basin and in month of August for Upper Godavari, Krishna & West Flowing River basin (Konkan). Average yearly maximum evaporation is observed in Tapi basin 2112.3 mm. and Minimum in West Flowing River basin (Konkan) 1569.3 mm.

5. Discharges at GD sites in various basins in Maharashtra

Maharashtra is divided into five major river basins namely Godavari, Krishna, Tapi, WFR south of Tapi and Narmada. Hydrometeorological network is spread all over the Maharashtra. There are 263 Gauge Discharge stations under the control of Hydrology Project (SW) Maharashtra.

5.1 Discharges at GD sites in Lower Godavari basin:

The catchment area of Lower Godavari Basin in Maharashtra is 81097 SqKm. There are 55 Gauge discharge stations in this catchment. Following table shows 2 years' discharges for GD stations on which discharge data is available in this catchment.

Discharges in Mm^3

Anantwadi, Tal. Mahagaon, Dist. Yevatmal, Area 1629.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	93.54	73.86	46.04	594.82	5.10	813.36
2016	231.46	684.57	800.69	65.09	43.44	1825.26

Armori, Tal. Armori, Dist. Gadchiroli, Area 1455.20sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	14.32	17.82	72.39	44.64	8.84	158.02
2016	0.00	153.03	121.38	169.81	49.99	494.21

Bamni, Tal. Dhanora, Dist. Gadchiroli, Area 857.70 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	152.45	158.52	385.85	325	129.09	1150.92
2016	17.18	1212.21	1143.31	801.20	484.57	3658.46

Damrench, Tal. Aheri, Dist. Gadchiroli, Area 36317.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	3239.37	2171.56	5249.15	5374.37	1779.03	17813.48
2016	0.00	17252.98	9330.00	9447.94	3940.71	39971.64

Dhaba, Tal. Gondpipri, Dist. Chadrapur, Area 45795.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	1083.98	1476.46	1314.96	2388.07	1296.76	7560.23
2016	604.44	2615.56	2295.28	1891.53	2024.74	9431.56

Gadbori, Tal. Sindewahi, Dist. Chadrapur, Area 1051.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	9.73	54.71	161.48	55.83	0	281.750
2016	0.00	164.63	23.82	64.95	41.41	294.81

GhotangaonBori, Tal. Arjuni –Morgaon, Dist. Gondia, Area 1051.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	8.80	11.72	61.10	28.52	12.62	122.76
2016	0.09	38.3	18.52	44.62	14.56	116.09

Hamdapur, Tal. Samudrapur, Dist. Vardha, Area 2297.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	12.25	75.75	42.57	68.75	18.97	218.26
2016	0.00	258.46	229.67	83.52	42.39	614.04

Hingangaht, Tal. Hingangaht, Dist. Vardha, Area 4109.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	23.45	102.25	373.01	157.58	0	656.29
2016	0.00	232.08	123.63	10.76	12.88	379.34

Khadka, Tal. Arni, Dist. Yeotmal, Area 4484.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	81.50	315.29	356.38	222.12	72.61	1047.91
2016	197.30	1149.80	581.47	368.27	425.89	2722.72

KolgaonGod, Tal. Vani, Dist. Yevatmal, Area 23046.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	344.14	27.02	390.55	338.55	23.14	1123.40
2016	133.48	2319.82	754.51	644.93	273.67	4126.40

KoliBk, Tal. Ghatanji, Dist. Yevatmal, Area 2698.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	44.26	152.08	124.22	52.36	5.07	378
2016	10.26	214.01	159.68	43.88	20.55	448.38

Mahagaon, Tal. Aheri, Dist. Gadchirolo, Area 100395.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	5681.83	6357.01	13956.8	14314.5	5290.25	45600.47
2016	1226.78	8830.70	7049.20	5510.74	5733.07	28350.48

Mandvi Vain, Tal. Tirora, Dist. Yevatmal, Area 20440.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	19.55	82.78	175.48	128.86	19.66	426.33
2016	0.00	554.26	1032.02	572.48	153.62	2312.36

Mathani, Tal. Mouda, Dist. Nagpur, Area 12259.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	172.45	249.77	1252.58	422.78	191.05	2288.63
2016	13.14	1076.77	546.95	411.83	287.38	2336.06

Murli, Tal. Umerkhed, Dist. Yevatmal, Area 8334.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	41.30	7.66	128.39	254.79	308.86	741.01
2016	162.64	257.03	124.08	530.80	448.37	1522.92

Parsewada, Tal. Shironcha, Dist. Gadchiroli, Area 146.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	14.20	14.29	48.06	60.64	18.35	155.53
2016	8.93	270.96	118.50	152.15	78.10	628.65

Petta, Tal. Ettapali, Dist. Gadchiroli, Area 1474.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	227.01	282.61	412.18	774.72	66.92	1763.45
2016	224.95	1932.83	768.33	1033.27	433.32	4392.70

Pipriya, Tal. Satekasa, Dist. Gondiya, Area 607.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	3.30	13.65	30.40	21.13	7.84	76.34
2016	0.00	21.82	33.63	27.96	18.25	101.66

Saiphal, Tal. Ghatanji, Dist. Yavatmal, Area 17108.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	448.20	219.99	514.48	820.87	177.22	2180.75
2016	286.54	1704.79	880.38	822.28	717.93	4411.91

Shivni, Tal. Armori, Dist. Gadchiroli, Area 1810.53sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	123.61	112.62	196.06	186.88	0.00	619.18
2016	0.00	381.57	354.75	545.67	270.54	1552.53

Temburdoh, Tal. Saoner, Dist. Nagpur, Area 5105.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	6.00	215.11	222.13	82.69	0.00	525.93
2016	0.00	102.56	01.73	01.73	0.00	106.02

Bhamaragad, Tal. Bhamaragad, Dist. Gadchiroli, Area 5953.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	791.85	654.21	1053.55	1151.79	334.51	3985.91
2016	27.87	2126.83	2246.30	2293.62	1124.27	7818.89

Bhimkunda, Tal. Chamroshi, Dist. Gadchiroli, Area 754.40sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	136.12	209.77	136.20	208.30	76.98	767.37
2016	0.00	670.72	395.78	577.39	171.62	1815.50

Bori, Tal. Aheri, Dist. Gadchiroli, Area 950.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	146.34	79.49	137.80	120.40	18.15	502.18
2016	27.34	292.25	161.23	214.90	80.91	776.62

Dechali, Tal. Aheri, Dist. Gadchiroli, Area 476.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	32.08	14.16	10.57	17.64	3.94	78.39
2016	0.00	47.68	34.44	47.70	12.83	142.64

Deori, Tal. Gondia, Dist. Gondia, Area 16068.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	33.45	38.21	68.63	57.24	12.99	210.52
2016	0.00	4808.65	5797.40	4126.71	2606.26	17339.02

Kamthikhairi, Tal Parseoni, Dist. Nagpur, Area 4825.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	2.98	9.08	51.51	8.21	7.19	78.97
2016	0.97	0	14.18	10.97	10.97	37.09

Mangdatola, Tal. Armori, Dist. Gadchiroli, Area 783.82sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	5.43	0.18	0.00	38.58	0.00	44.19
2016	0.00	1.07	81.88	43.82	37.49	164.25

Lakhandur, Tal. Lakhandur, Dist. Nagpur, Area 2575.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	7.91	118.59	412.08	313.47	35.97	888.02
2016	0.00	165.40	187.58	204.98	108.86	666.82

Sirpur, Tal. Deoli, Dist. Bhandara, Area 10239.65sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	93.35	93.35	93.35	93.35	93.35	93.35
2016	59.76	1240.19	831.65	542.79	852.54	3526.93

Soitdindora, Tal. Warora, Dist. Chadrapur, Area 17776.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	129.15	177.57	1228.27	557.29	281.83	2374.11
2016	111.64	2803.67	1305.03	851.32	930.11	6001.78

Takali, Tal. Zari Jamni, Dist. Yavatmal, Area 1366.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	54.71	168.81	133.98	77.26	1.96	436.72
2016	31.09	303.67	168.38	78.12	47.65	628.90

Wadsachicholi, Tal. Brahmapuri, Dist. Chadrapur, Area 38172sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	415.42	782.90	3213.69	1681.92	431.72	6525.65
2016	78.11	2688.10	3055.64	2168.06	986.39	8976.30

Wagholibuti, Tal. Saoli, Dist. Chadrapur, Area 43798sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	204.82	375.86	2547.01	1066.49	74.52	4268.71
2016	7.72	2300.49	2126.38	1814.97	653.30	6902.86

5.2 Discharges at GD sites in Krishna basin:

The catchment area of Krishna Basin in Maharashtra is 68397 sq km. There are 50 Gauge discharge stations in this catchment. Following table shows 2 years discharges for 25 GD stations in Krishna basin.

Discharges in Mm^3

Ambeghar (K), Tal. Bhor, Dist. Pune, Area 249.44 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	18.31	29.25	32.06	18.51	0	98.13
2016	0	81.42	295.31	71.56	12.17	460.46

Budhwad (V) , Tal. Maval, Dist. Pune, Area 151.919 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	5.16	18.92	5.36	12.70	3.40	45.54
2016	0	16.12	63.84	8.13	0	88.09

Nighoje , Tal Khed, Dist. Pune, Area 832.30 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	46.35	91.26	36.32	39.48	22.55	235.96
2016	0	148.45	249.35	84.25	7.75	489.80

Pargaon , Tal. Daund, Dist. Pune, Area 6251.00 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	179.73	313.85	142.23	236.15	178.68	1050.64
2016	0	557.31	1253.18	387.21	134.00	2331.7

Sakhar, Tal. Velhe, Dist. Pune, Area 182.57 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	22.13	24.00	15.94	15.62	1.08	78.77
2016	0.43	41.03	61.02	2.90	0	105.38

Ajara Ramtirth, Tal.Ajara, Dist. Kolhapur, Area 244.57 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	88.44	126.19	115.83	59.38	34.94	424.78
2016	3.63	252.11	257.31	89.31	45.46	647.82

Belwade, Tal. Patan, Dist. Satara, Area 117.24 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	17.83	18.24	0.25	0	36.32
2016	0	157.57	185.70	31.13	1.36	375.76

Gudhe, Tal. Patan, Dist. Satara, Area 229.92 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	20.76	23.53	9.33	0.92	0	54.54
2016	0	196.26	252.55	137.23	68.51	654.55

Jambre Umgaon, Tal. Chandgad, Dist. Kolhapur, Area 26.43 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	2.81	0	0	0	0	2.81
2016	0	3.65	24.25	0	14.34	42.24

Kadal, Tal. Gadhinglaj, Dist. Kolhapur, Area 869.98 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	179.71	254.19	283.23	174.36	549.19	1440.68
2016	0	495.91	556.23	247.92	245.27	1545.33

Kagal (NH4), Tal. Kagal, Dist. Kolhapur, Area 642.71 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	79.62	69.45	52.19	49.31	115.45	366.02
2016	70.18	285.97	225.38	130.23	141.68	853.44

Mandukli , Tal. Gaganbavada, Dist. Kolhapur Area 107.01 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	54.80	113.26	113.29	78.30	10.29	369.94
2016	7.80	90.75	Data Not observed			

Mhaisal, Tal. Miraj, Dist. Sangli, Area 12740.59 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	857.99	527.49	560.92	474.23	491.21	2911.84
2016	139.26	2751.04	3705.78	1107.00	645.87	8348.95

Nadgadwadi , Tal. Chandgad, Dist. Kolhapur, Area 557.92 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	125.18	292.80	201.31	0	0	619.29
2016	0	335.89	428.17	169.56	0	933.61

Nitwade, Tal. Karveer, Dist. Kolhapur, Area 600.30 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	296.59	295.55	333.17	151.33	124.01	1200.65
2016	0	875.96	920.99	303.40	115.87	2216.22

Patryachiwadi, Tal. Panhala, Dist. Kolhapur, Area 162.94 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	90.54	140.05	144.93	78.86	29.04	483.42
2016	0	315.36	219.13	53.97	1.03	589.49

Sarud , Tal. Shhuwadi, Dist. Kolhapur, Area 362.64 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	121.01	99.81	112.72	17.49	6.34	357.37
2016	0.00	366.88	455.05	81.64	36.55	940.12

Shivade, Tal. Karhad, Dist. Satara, Area 3261.03 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	73.60	64.03	90.71	183.73	129.64	541.71
2016	41.16	77.29	626.98	58.18	71.49	875.1

Tarewadi , Tal. Gadhinglaj, Dist. Kolhapur, Area 326.71 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	130.52	264.37	361.21	85.32	60.70	902.12
2016	0.63	554.60	762.54	244.28	122.96	1685.01

Wadange (RT), Tal. Karveer, Dist. Kolhapur, Area 1940.34 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	597.40	488.43	570.64	169.66	84.73	1910.86
2016	43.25	1885.46	1989.76	366.89	42.27	4327.63

Ichalkaranji , Tal. Hatkanangale, Dist. Kolhapur Area 2374.74 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	743.98	606.26	655.79	275.61	306.92	2588.56
2016	101.07	2180.96	2399.56	628.68	246.98	5557.25

Bubnal , Tal. Shirol, Dist. Kolhapur Area 15391.71 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	1452.47	2913.59	2613.00	1908.44	1034.47	9921.97
2016	1942.98	6378.41	7791.61	3336.55	1656.34	21105.89

Pandharpur , Tal. Pandharpur, Dist. Solapur Area 24082 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	0	0	453.16	119.15	715.70	1288.01

Devikawathe , Tal. Akkalkote, Dist. Solapur Area 46706 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0.097	0	0	29.44	15.14	44.68
2016	0	0	226.02	203.55	363.99	793.56

Ankali Bridge , Tal. Miraj, Dist. Sangli Area 12341 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	501.43	353.44	389.42	228.34	191.29	1663.92
2016	224.46	1958.87	2621.05	1007.59	377.03	6189.00

Sangli, Tal. Sangli, Dist. Sangli Area 13700 sq km						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	519.68	201.23	133.66	546.37	563.79	1964.73
2016	111.06	1552.90	2781.66	782.11	536.27	5764.00

5.3 Discharges at GD sites in Upper Godavari basin:

The catchment area of Upper Godavari Basin in Maharashtra is 71812 sqkm. There are 43 Gauge discharge stations in this catchment. Following table shows 2 years discharges for GD stations on which discharge data is available in this catchment.

Discharges in Mm^3

Aurad (Sh), Tal. Nilanga, Dist. Latur, Area 3145.00sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	Data not observed					0
2016	195.60	286.75	372.16	558.25	471.14	1883.91

Asegaon, Tal. Jintur, Dist. Parbhani, Area 765 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	1.29	11.33	5.31	11.27	5.06	34.29

Golapangri, Tal. Jalna, Dist. Jalna, Area 2600sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	Less flow / Data unavailable					0
2016	0	12.70	2.21	12.19	0.63	27.74

Sundgi, Tal. Deglur, Dist. Nanded, Area 1460 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	15.39	9.44	2.15	129.50	123.53	280.03

Niphad, Tal. Niphad, Dist. Nashik, Area 1322.96sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	0	79.21	443.83	0	0	523.05

Kopargaon, Tal. Kopargaon, Dist. Ahamadnagar, Area 7095.69 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	363.17	61.42	276.59	82.10	783.27
2016	0	194.67	1854.87	73.52	69.94	2193.02

Newasa, Tal. Newasa, Dist. Ahamadnagar, Area 6556.04 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	0	0	168.08	499.61	642.41	1310.12

Nagamthan, Tal. Vaijapur, Dist. Aurangabad, Area 9399.47 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	193.30	66.91	565.16	0	825.37
2016	0	226.96	1665.31	57.34	64.08	2013.70

Nanded Nagapur , Tal. Nanded, Dist. Nanded, Area 53000.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	0.00	255.91	214.75	1898.13	797.91	3166.72

Nashik, Tal. Nashik, Dist. Nashik, Area 727.23 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	57.02	3.77	43.89	77.11	7.73	189.53
2016	0	72.81	566.85	7.54	1.41	648.60

Potanandgaon, Tal. Parabhani, Dist. Parabhani, Area 7795.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	53.17	0	53.18
2016	513.03	722.98	0	319.31	32.04	1587.38

Samangaon(B), Tal. Nashik, Dist. Nashik, Area 1730.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	11.39	178.33	126.60	55.95	13.02	385.28
2016	0	193.21	556.66	152.76	39.61	942.26
Sangamner (Waghapur), Tal. Sangmner, Dist. Ahemednagar, Area 1470.32 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	0	18.11	254.50	83.44	17.05	373.12

Takli, Tal. Devni, Dist. Latur, Area 6571.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	14.44	12.12	26.57
2016	0	78.15	18.86	1820.58	1853.76	3771.37

Zari, Tal. Prabhani, Dist. Parabhani, Area 5700.00 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	0	0	0
2016	8.08	35.92	5.09	194.48	95.46	339.04

5.4 Discharges at GD sites in Tapi basin:

The catchment area of Tapi Basin in Maharashtra is 55101.54 sqkm. There are 28 Gauge discharge stations in this catchment. Following table shows 2 years discharges for GD stations on which discharge data is available in this catchment.

Discharges in Mm^3

Aurangpur, Tal. Murtizapur, Dist. Akola, Area 1418 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	42.87	31.97	107.44	35.49	0.67	218.47
2016	235.80	4127.96	1238.49	774.50	280.48	6657.23

Bhusawal, Tal. Bhusawal, Dist. Jalgaon, Area 29871 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	293.33	541.20	2538.72	498.07	11.20	3882.55
2016	0	80.13	61.66	27.95	26.78	196.53

Daryapur, Tal. Daryapur, Dist. Amrawati, Area 1309sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	4.24	1.85	27.58	0.62	0	34.30
2016	7.28	133.43	35.85	8.20	3.69	188.46

Fardapur, Tal. Mehekar, Dist. Buldhana, Area 1250 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	1.10	0	6.37	5.72	1.55	14.75
2016	18.44	67.41	36.81	23.09	13.72	159.47

Jamner, Tal. Jamner, Dist. Jalgaon, Area 746 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	29.96	0	29.96
2016	0	10.90	63.79	230.12	187.16	491.96

Khariya, Tal. Dharni, Dist. Amravati, Area 5945 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	192.46	431.52	1890.61	530.13	21.43	3066.17
2016	0	10216.97	5769.25	1316.19	668.81	17971.23

Malegoan Girna, Tal. Malegaon, Dist. Nashik, Area 2741 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	3.01	5.28	21.34	0	29.64
2016	0	105.86	1107.34	143.08	189.09	1545.36

Manasgaon, Tal. Shegaon, Dist. Buldhana, Area 12016 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	3750.90	59316.41	18347.81	9579.88	9975.11	100970.10
2016	210.45	51.44	1421.87	207.61	5.14	1896.53

Sawkheda, Tal. Jalgaon, Dist. Jalgaon, Area 9349 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	0	0	11.10	0	11.10
2016	0	26.19	38.92	206.96	394.83	666.89

Suple, Tal. Kalvan, Dist. Nashik, Area 157 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	63.42	41.31	40.74	0	145.49
2016	0	200.90	457.44	227.13	192.70	1078.17

Tonda, Tal. Shirpur, Dist. Dhule, Area 1739 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	7.72	4.23	4.23	6.64	4.23	27.06
2016	25.20	312.84	78.56	53.77	41.49	511.85

5.5 Discharges at GD sites in West Flowing River basin:

The catchment area of West Flowing River basin in Maharashtra is 18062.29 sqkm. There are 44 Gauge discharge stations in this catchment. Following table shows 2 years discharges for GD stations on which discharge data is available in this catchment.

Discharges in Mm^3

ALMAN, Tal. Wada, Dist. Thane, Area 647.51 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	22.74	145.30	31.66	36.12	2.07	237.89
2016	0.63	114.88	279.18	74.55	6.02	475.27

ASGA, Tal: Lanja,Dist: Ratnagiri, Area 6.65 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	4.81	2.90	2.66	2.13	0.80	13.31
2016	2.32	13.04	7.83	4.38	0.96	28.53

AWALEGAON, Tal: Kudal, Dist: Sindhudurg, Area 67.32 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	7.87	31.65	43.65	17.39	3.20	103.76
2016	11.46	100.28	25.83	10.23	1.40	149.21

BHAVE,Tal: Deogad, Dist: Mahad, Area 45.62 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	83.63	173.71	234.38	167.24	155.75	814.71
2016	13.77	270.07	303.63	274.77	194.69	1056.93

BIRWADI,Tal: Deogad, Dist: Sindhudurg, Area 338.80 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	554.99	825.20	544.38	562.39	558.03	3044.99
2016	147.72	1679.63	1725.03	968.43	766.81	5287.63

BURMALI, Tal. Sudhagad, Dist. Raigad, Area 61.74 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	31.47	22.19	15.77	17.30	7.28	94.00
2016	4.48	72.11	68.06	88.69	24.92	258.28

CHATAV, Tal. Khed, Dist. Ratnagiri, Area 116.09 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	207.78	261.87	170.68	121.79	65.24	827.36
2016	58.52	866.28	702.32	424.92	55.68	2107.71

DUKANWADI, Tal. Kudal, Dist. Sindhudurga,Area 130.40 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	19.10	53.39	85.10	74.69	49.72	282.01
2016	8.94	194.37	185.13	124.40	47.16	559.99

GADHI, Tal. Panvel, Dist. Raigad,Area 125.22 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	33.34	69.99	37.47	31.60	11.93	184.33
2016	2.95	145.60	114.22	71.29	19.94	354.00

GAHELI, Tal. Jawhar, Dist. Thane, Area 636.96 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	23.18	351.73	65.17	36.03	8.47	484.59
2016	2.26	367.72	331.58	82.18	30.97	814.70

GHONSARI (L), Tal. Kankavali, Dist. Sindhudurga, Area 48.29 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	4.24	1.99	4.91	1.43	0.51	13.08
2016	4.43	46.44	22.62	43.54	24.68	141.71

HET, Tal. Vaibhavwadi, Dist. Sindhugurga, Area 28.77 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	21.96	35.08	45.87	24.20	12.37	139.48
2016	3.87	56.50	33.79	19.57	7.26	120.99

KAKEWADI, Tal. Rajapur, Dist. Ratnagiri, Area 13.95 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	1.49	0.57	0.55	0.10	0.01	2.72
2016	0.71	5.25	1.94	1.92	0.03	9.86

KALAMB, Tal. Karjat, Dist. Raigad,Area 110.85 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	13.87	72.80	62.78	63.49	38.72	251.65
2016	0.00	125.22	173.50	142.58	46.44	487.73

KAMAN, Tal. Vasai, Dist. Thane, Area 12.44 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	14.63	38.65	30.44	48.10	65.37	197.19
2016	6.37	94.50	81.15	145.88	122.51	450.42

KANGULE, Tal. Poladpur, Dist. Raigad,Area 379.28 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	267.39	245.27	123.63	146.14	98.54	880.98
2016	23.08	683.11	889.13	364.81	105.82	2065.95

KANPOLI, Tal. Panvel, Dist. Raigad, Area 31.35 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	7.25	33.02	28.15	27.25	18.14	113.81
2016	4.44	31.68	26.69	25.10	16.50	104.40

KARAK, Tal. Rajapur, Dist. Ratnagiri Area 31.74 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	5.03	26.93	33.10	22.84	5.23	93.12
2016	1.54	96.99	86.37	43.12	7.87	235.89

KHAPARI, Tal. Murbad, Dist. Thane, Area 227.30 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	126.91	379.41	347.04	274.50	55.80	1183.66
2016	0.00	411.39	618.87	589.22	228.19	1847.67

KOCHARA, Tal. Murbad, Dist. Thane, Area 203.76 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	40.51	115.52	88.78	104.78	40.83	390.42
2016	4.80	209.25	168.59	81.36	39.51	503.50

KOKARE, Tal. Raigad, Dist. Mahad, Area 84.43 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	36.16	26.47	17.78	9.95	6.33	96.69
2016	3.98	93.90	89.40	55.20	11.15	253.62

KOLHARE, Tal. Karjat, Dist. Raigad Area 306.04 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	96.60	307.15	191.91	194.85	101.51	892.02
2016	0.00	799.11	655.30	608.69	142.05	2205.15

KOTHURDE, Tal. Mahad, Dist. Raigad, Area 33.87 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	30.61	26.08	23.95	13.46	5.86	99.95
2016	3.75	70.79	68.00	34.51	6.62	183.67

KUMBHARKHANI, Tal. Ratnagiri, Dist. Sangmeshvar, Area 143.53 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	43.86	64.97	47.14	27.74	7.31	191.02
2016	9.23	266.88	175.92	116.09	17.03	585.16

MAHAN, Tal. Alibag, Dist. Raigad Area 29.96 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	48.05	30.60	35.77	21.36	14.24	150.01
2016	9.93	224.33	139.12	127.68	43.52	544.59

MIRVANE, Tal. Chiplun, Dist. Ratnagiri, Area 6.18 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	8.46	5.44	7.50	6.67	2.84	30.91
2016	4.36	27.33	15.85	11.36	3.30	62.20

NALDHE, Tal. Karjat, Dist. Raigad Area 94.41 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	10.74	43.96	44.09	40.80	8.00	147.59
2016	0.00	93.80	113.31	59.21	26.54	292.87

PALI, Tal. Sudhagad, Dist. Raigad Area 308.82 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	72.99	168.23	60.44	51.48	21.22	374.37
2016	55.73	338.92	269.27	194.65	38.01	896.57

PARALI, Tal. Wada, Dist. Thane, Area 136.06 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	51.01	173.81	81.58	91.13	18.08	415.61
2016	Data not observed					

PASTEWADI, Tal. Sangmeshvar, Dist. Ratnagiri, Area 49.52 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	14.67	20.31	21.09	12.51	3.34	71.92
2016	6.28	69.36	46.75	22.67	4.95	150.01

PAWARWADI, Tal. Lanja, Dist. Ratnagiri, Area 40.98 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	22.97	21.42	26.61	29.17	16.12	116.29
2016	11.11	91.92	53.90	36.97	16.10	210.00

POYNAR, Tal. Khed, Dist. Ratnagiri, Area 30.77 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	29.89	10.71	20.76	5.97	10.79	78.11
2016	6.88	90.40	137.40	114.21	43.10	392.00

RAIPATAN, Tal. Rajapur, Dist. Ratnagiri , Area 91.08 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	27.96	52.82	61.06	58.09	27.62	227.55
2016	10.95	181.77	136.18	74.13	26.80	429.83

SAIVAN, Tal. Vasai, Dist. Thane, Area 519.56 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	51.31	367.68	97.15	95.21	20.10	631.46
2016	0.00	329.05	359.67	155.76	16.98	861.46

SAJGAON, Tal. Khalapur, Dist. Raigad, Area 28.53 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	69.00	124.58	73.82	57.42	37.33	362.15
2016	Data not observed					

SALINDE, Tal. Pen, Dist. Raigad, Area 84.91 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	46.67	54.00	27.51	34.13	14.95	177.28
2016	9.69	146.34	88.28	89.24	19.98	353.53

SANGULWADI, Tal. Vaibhavawadi, Dist. Sindhudurga, Area 50.28 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	14.37	31.26	41.93	25.72	5.18	118.47
2016	8.83	126.36	70.63	53.60	13.29	272.71

SARAMBALA, Tal. Savantwadi, Dist. Sindhudurga Area 70.98 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	0.00	78.69	92.14	50.37	14.43	235.62
2016	Data not observed					

SHEMBAVANE, Tal. Rajapur, Dist. Ratnagiri, Area 15.97 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	17.69	13.24	19.67	17.25	11.69	79.53
2016	5.64	28.52	23.13	20.76	15.57	93.62

SHIRSHINGI, Tal. Savantwadi, Dist. Sindhudurga, Area 36.83 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	9.59	22.01	26.88	9.49	1.91	69.88
2016	1.97	44.77	43.64	17.19	1.89	109.46

SHIVDAV, Tal. KAnkavali, Dist. Sindhudurga, Area 247.51 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	77.39	129.17	156.62	35.33	7.09	405.59
2016	42.00	378.17	179.14	180.15	11.87	791.33

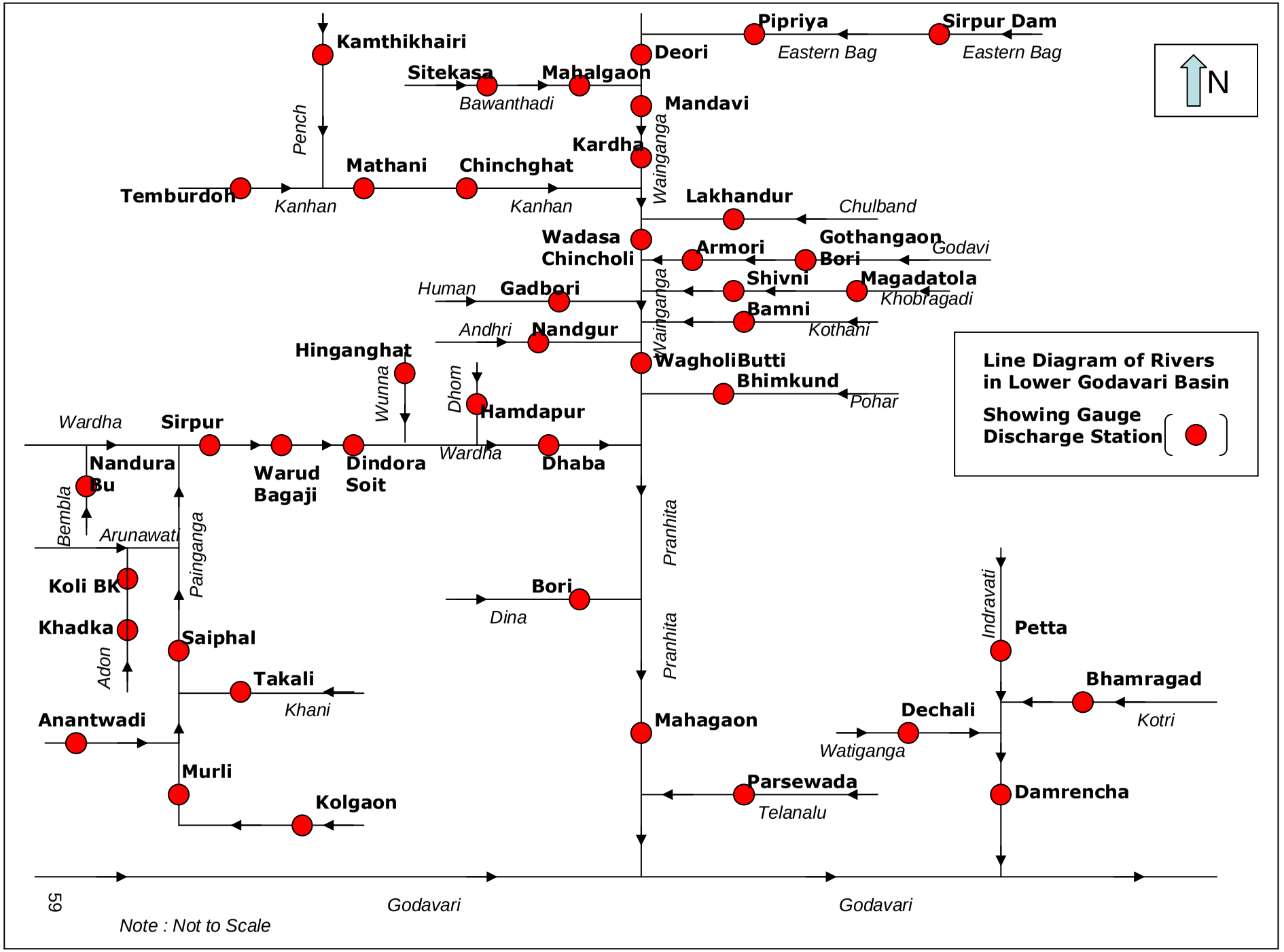
SUDKOLI, Tal. Roha, Dist. Raigad Area 37.42 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	10.28	2.10	2.85	0.90	0.41	16.53
2016	1.32	38.30	32.00	27.96	4.38	103.97

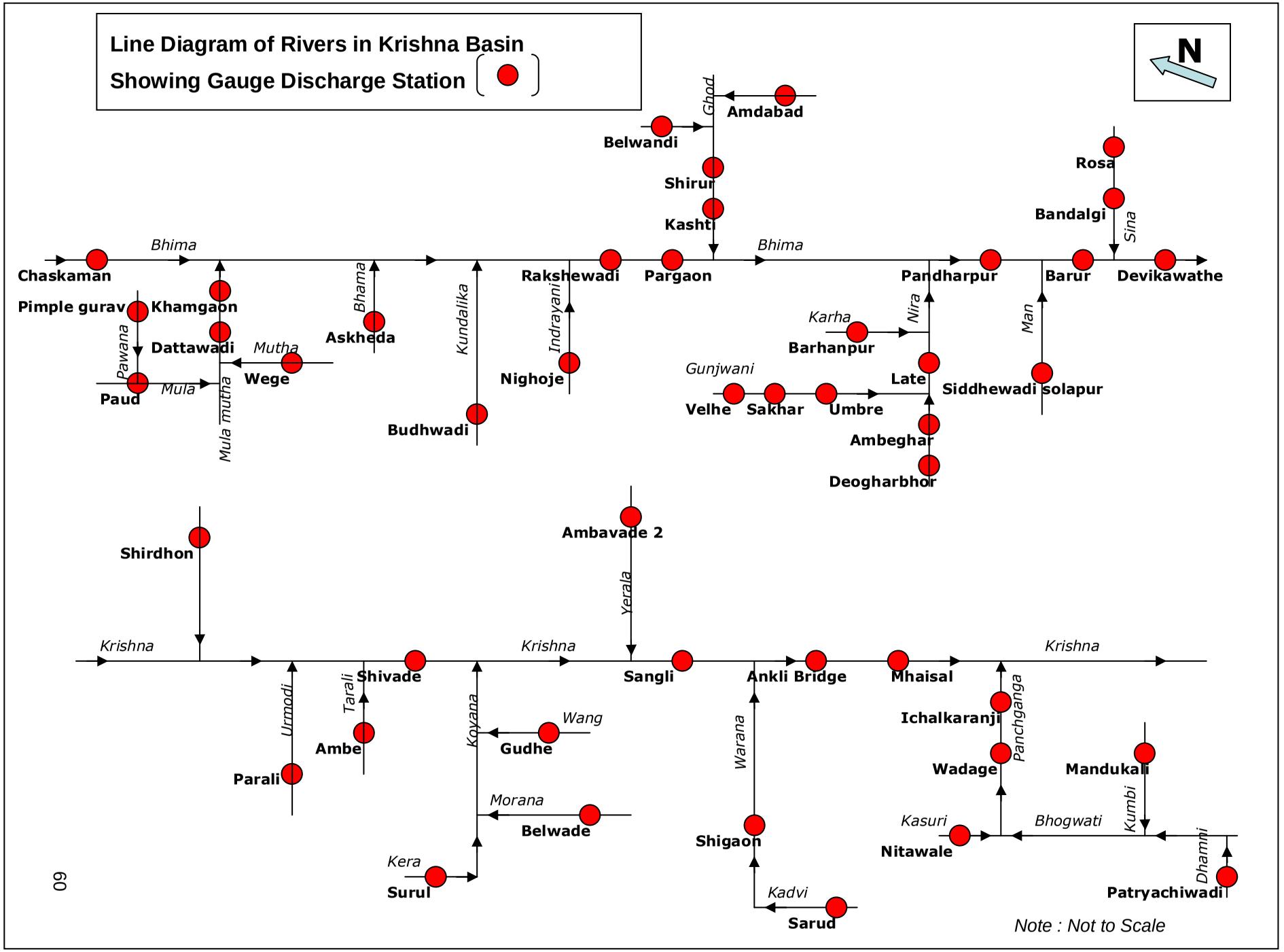
TURADE, Tal. Panvel, Dist. Raigad, Area 317.57 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	74.37	282.35	83.31	39.52	12.31	491.86
2016	0.00	258.32	179.17	190.99	18.15	646.63

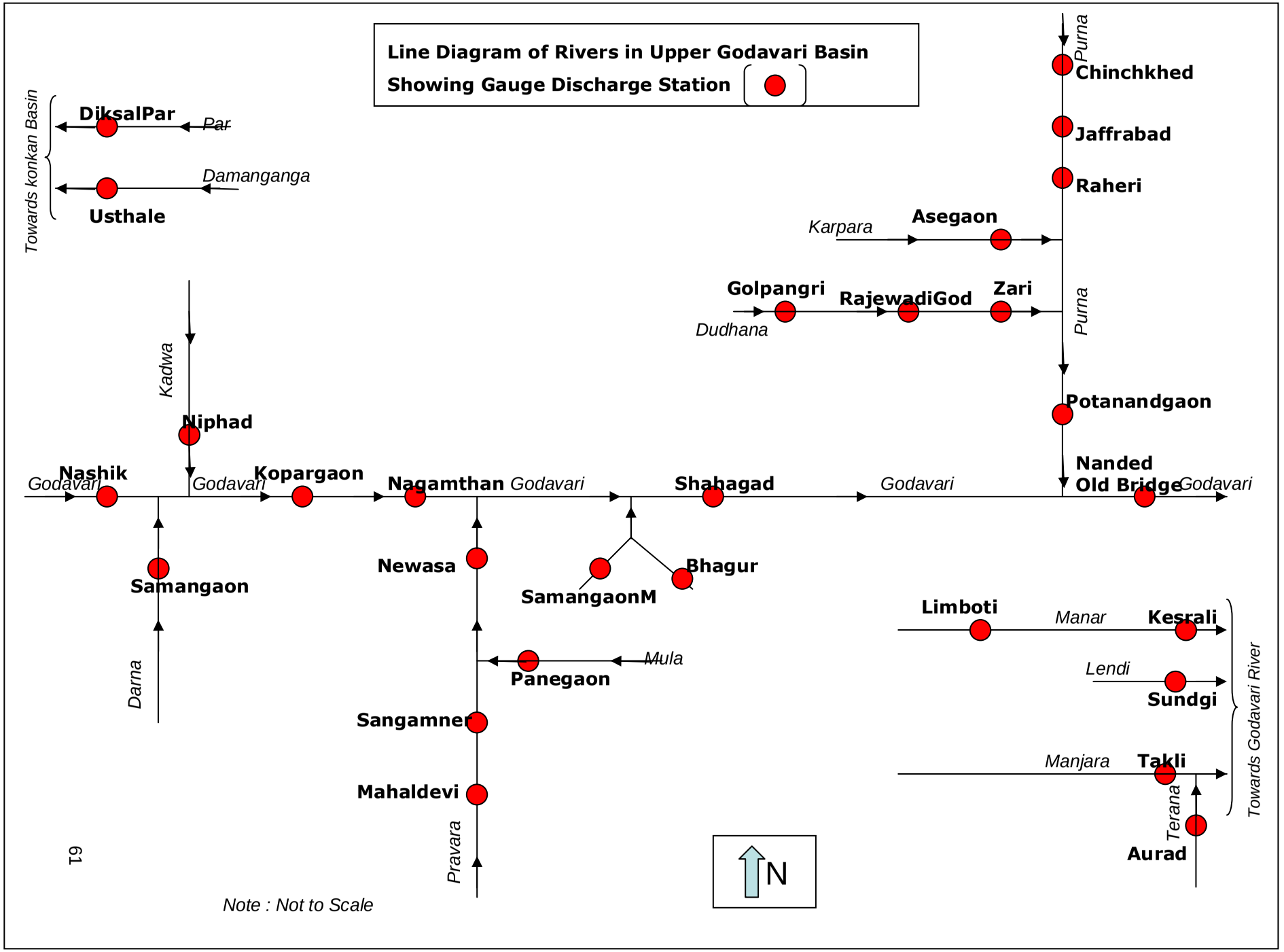
VIRDI, Tal. Dodamarg, Dist. Sindhudurga Area 35.43 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Manson Total in Mm3**
2015	12.39	21.26	16.58	2.83	1.17	54.22
2016	5.27	47.80	22.28	14.55	1.37	91.27

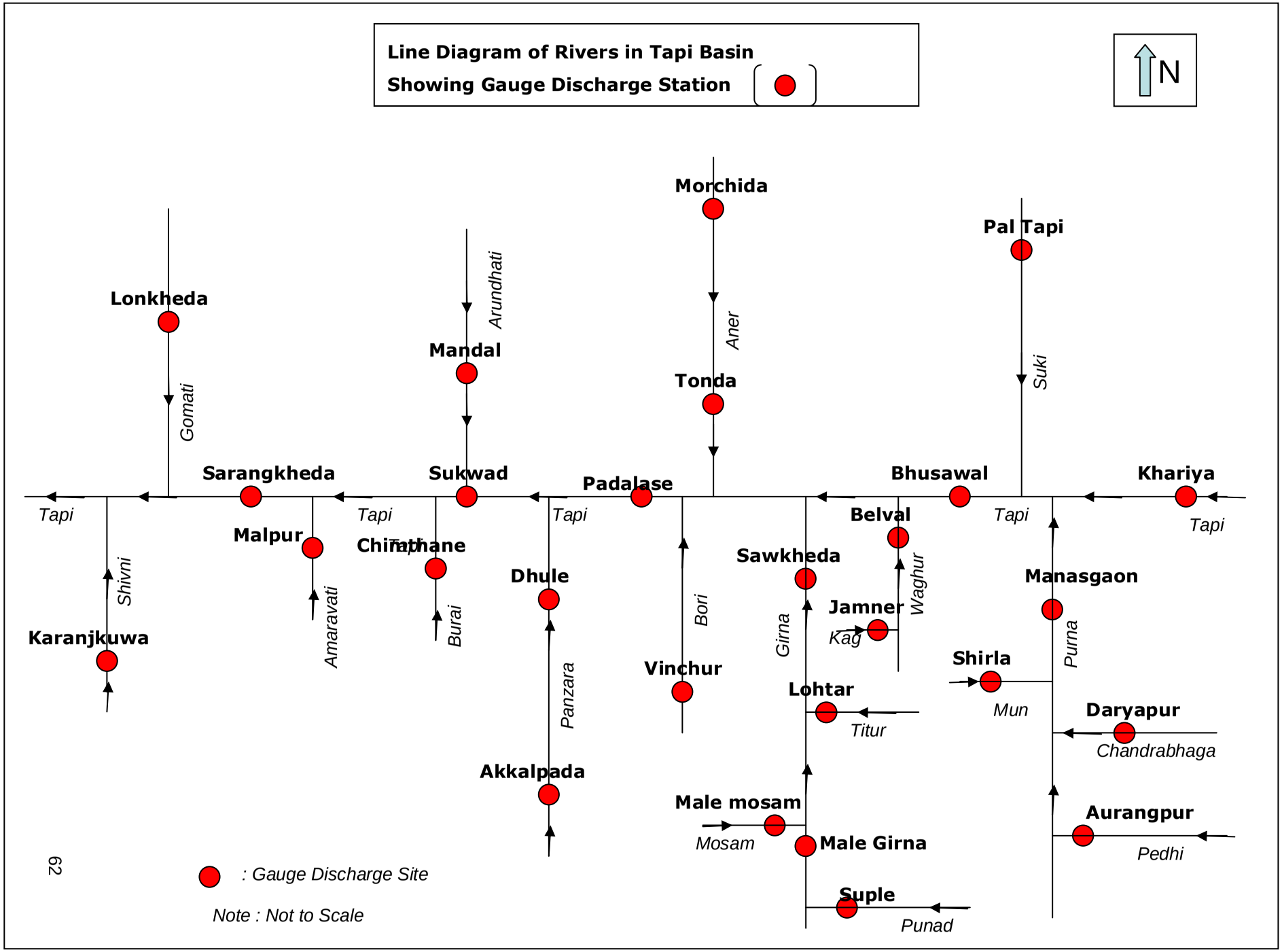
Diksal Par , Tal. Peth, Dist. Nashik, Area 193.15 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	24.14	8.85	14.35	3.44	50.79
2016	0	59.16	119.48	22.70	41.32	242.67

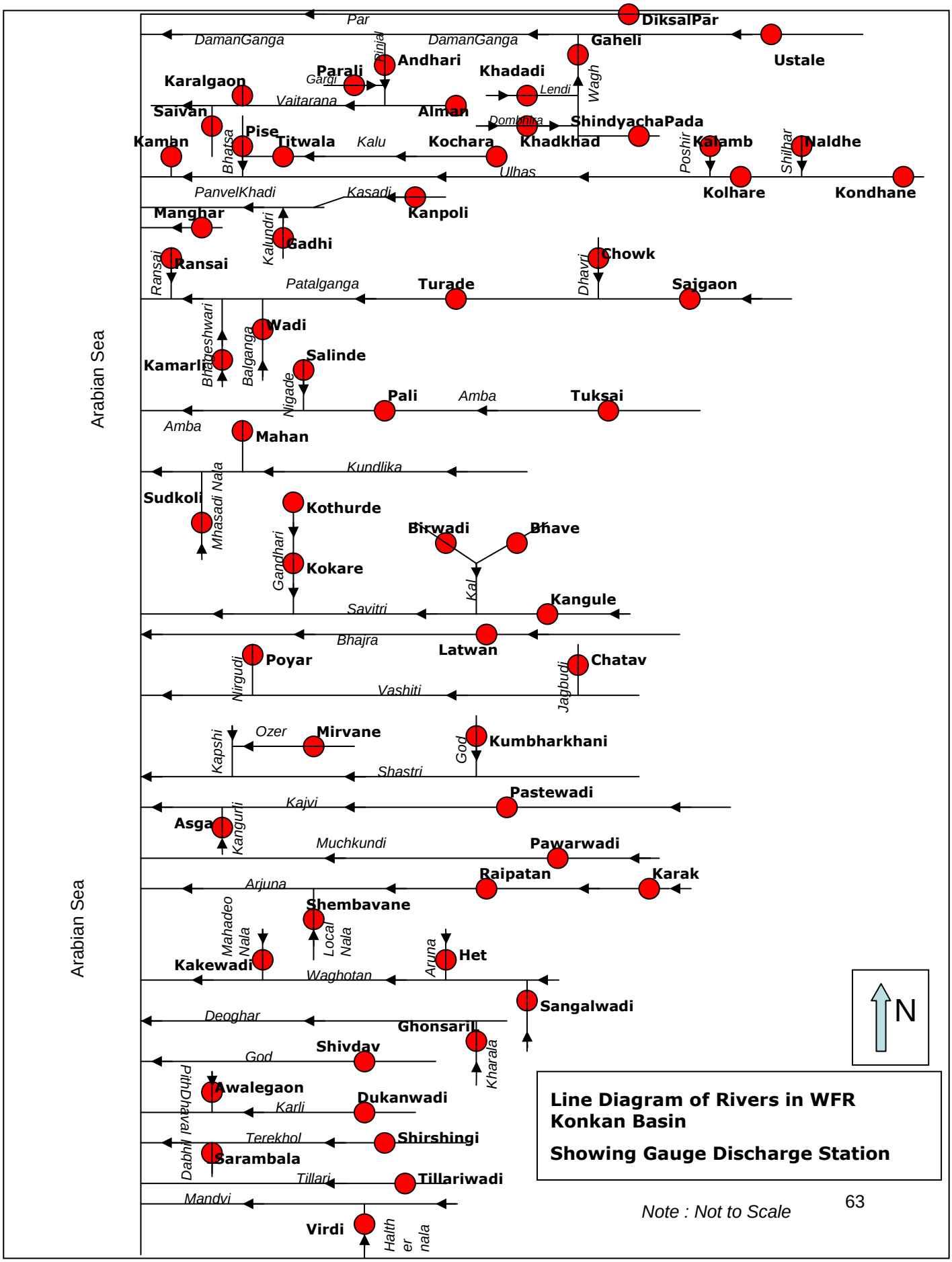
Usthale, Tal. Peth, Dist. Nashik, Area 111.96 sqkm						
Year	**June**	**July**	**August**	**September**	**October**	**Monsoon Total in Mm3**
2015	0	25.93	33.10	36.72	0	95.76
2016	0	91.25	216.11	90.51	88.50	486.38


Kamthikhairi
Pipriya
Sirpur Dam
Eastern Bag
Eastern Bag
Deori
Sitekasa
Mahalgaon
Bawanthadi
Mandavi
N
Pench
Kardha
Wainganga
Mathani
Chinchghat
Temburdoh
Kanhan
Kanhan
Lakhandur
Chulband
Wadasa
Chincholi
Armori
Gothangaon
Bori
Godavi
Shivni
Magadatola
Khobragadi
Human
Gadbori
Wainganga
Bamni
Kothani
Andhri
Nandgur
Hinganghat
WagholiButti
Bhimkund
Pohar
Line Diagram of Rivers
in Lower Godavari Basin
Showing Gauge
Discharge Station
Wunna
Dhom
Hamdapur
Wardha
Sirpur
Wardha
Nandura
Bu
Warud
Bagaji
Dindora
Soit
Wardha
Dhaba
Bembla
Arunawati
Painganga
Pranhita
Koli BK
Bori
Dina
Pranhita
Indravati
Petta
Khadka
Saiphal
Adon
Bhamragad
Takali
Khani
Dechali
Kotri
Anantwadi
Mahagaon
Watiganga
Murli
Parsewada
Damrencha
Telanalu
Kolgaon
59
Godavari
Godavari
Note : Not to Scale


Line Diagram of Rivers in Krishna Basin
Showing Gauge Discharge Station
N
Ghod
Amdabad
Belwandi
Shirur
Kasht
Rosa
Bandalgi
Sina
Bhima
Chaskaman
Pimple gurav
Khamgaon
Pawana
Dattawadi
Mutha
Wege
Mula
Paud
Mula mutha
Bhama
Askheda
Kundalika
Budhwadi
Rakshewadi
Indrayani
Nighoje
Pargaon
Bhima
Karha
Barhanpur
Nira
Gunjwani
Velhe
Sakhar
Umbre
Late
Ambeghar
Deogharbhor
Pandharpur
Man
Siddhewadi
Barur
solapur
Devikawathe
Shirdhon
Krishna
Ambavade 2
Yerala
Urmodi
Parali
Tarali
Ambe
Shivade
Krishna
Koyana
Wang
Gudhe
Morana
Belwade
Kera
Surul
Sangli
Warana
Shigaon
Kadvi
Sarud
Ankli Bridge
Mhaisal
Krishna
Panchganga
Ichalkaranji
Wadage
Kasuri
Nitawale
Bhogwati
Kumbi
Mandukali
Dhammi
Patryachiwadi
Note : Not to Scale
09


Line Diagram of Rivers in Upper Godavari Basin
Showing Gauge Discharge Station
Towards konkan Basin
DiksalPar
Par
Damanganga
Usthale
Purna
Chinchkhed
Jaffrabad
Raheri
Karpara
Asegaon
Golpangri
RajewadiGod
Zari
Dudhana
Purna
Potanandgaon
Nanded
Old Bridge
Godavari
Kadwa
Niphad
Nashik
Godavari
Godavari
Kopargaon
Nagamthan
Godavari
Shahagad
Godavari
Godavari
Newasa
SamangaonM
Bhagur
Samangaon
Darna
Mula
Panegaon
Sangamner
Mahaldevi
Pravara
Limboti
Manar
Kesrali
Lendi
Sundgi
Manjara
Takli
Terana
Aurad
Towards Godavari River
N
Note : Not to Scale


Line Diagram of Rivers in Tapi Basin
Showing Gauge Discharge Station
N
Morchida
Aner
Tonda
Pal Tapi
Suki
Lonkheda
Gomati
Arundhati
Mandal
Sarangkheda
Sukwad
Padalase
Bhusawal
Khariya
Tapi
Tapi
Tapi
Tapi
Tapi
Shivni
Karanjkuwa
Malpur
Amaravati
Chimthane
Tapi
Burai
Dhule
Panzara
Akkalpada
Vinchur
Bori
Belval
Waghur
Sawkheda
Girna
Jamner
Kag
Lohtar
Titur
Male mosam
Mosam
Male Girna
Suple
Punad
Shirla
Mun
Manasgaon
Purna
Daryapur
Chandrabhaga
Aurangpur
Pedhi
: Gauge Discharge Site
Note : Not to Scale



Line Diagram of Rivers in WFR Konkan Basin

Showing Gauge Discharge Station

Note : Not to Scale

6. Interpretation Of Various Statistics presented in the Water Yearbook

Some important terms used in interpretation of various statistics are explained as follows:

6.1 Daily rainfall –Time frame of daily rainfall refers to:

All rainfall observations are made at 0830 hrs IST daily. The quantity of rainfall recorded at 0830 hrs is the rainfall of the preceding 24 hours ending at 0830 hrs of the observation day (Today's date). In other words, the rainfall of the day is the total rainfall collected in the rain gauge from 0830 hrs IST of previous day to 0830 hrs IST of the day and is recorded (entered) against today's date.

5.2 Mean Daily Runoff –The mean daily runoff is computed as follows:

To facilitate comparison between rainfall and runoff, it is usual practice to express values of rainfall and runoff in similar terms. Both may be expressed as a total volume over a specified period (in metre cube, thousand metre cube (TCM), or million metre cube (Mcum). Alternatively, discharge may be expressed as a depth in millimetres over the catchment.

Volume is simply the rate in metre cube /sec (Cumecs), multiplied by the duration of the specified period in seconds, i.e. for daily volumes in cubic metres with respect to daily mean flow *Qd* in cumecs following equation may be used:

Vd (m^3) = (24 x 60 x 60 seconds) Qd(cumecs) = 86400 Qd (m^3)

Runoff depth (Rd) is the volume expressed as depth over the specified catchment area with a constant to convert units to millimeters; i.e. for daily runoff:

$$Rd(mm) = \frac{Vd(m^3)*10^3}{area(km^2)*10^6}$$

$$= \frac{Vd(m^3)}{area(km^2)*10^3}$$

$$= \frac{86.4Qd\ (Cumecs)}{area(km^2)}$$

7. Water Quality Monitoring In Maharashtra

7.1 Introduction

The Water Quality Monitoring is carried out by various agencies in the Maharashtra State viz Central Water Commission (SW), Central Pollution Control Board, Groundwater Surveys & Development Agency (GW), Hydrology Project (SW), Maharashtra Pollution Control Board, Central Ground Water Board (GW), Directorate of Irrigation Research & Development (DIRD). Hydrology Project takes care of surface water quality through sampling stations spread over the State throughout the year. DIRD monitors dug wells in the command area of major and medium Irrigation Projects. Ground Water Surveys & Development Agency also monitors the dug wells as well as ground water levels of the State intermittently.

Table 7.1 Agency wise Water Quality Monitoring Details:

Sr. No.	Monitoring Agency	Water Quality Monitoring Sites
(A)	**State**	
1.	Water Resources Department, Hydrology Project (SW)	129
2.	Groundwater Surveys & Development Agency (GW)	1871
(B)	**Central**	
3.	Central Pollution Control Board (CPCB) (SW) through Maharashtra Pollution Control Board (MPCB)	48
4.	Central Water Commission (SW)	12
5.	Central Pollution Control Board (CPCB) (GW) through Maharashtra Pollution Control Board (MPCB)	25
6.	Central Ground Water Board (CGWB, NHNS) (GW)	803
	Total no. of stations for surface water	187
	Total no. of stations for ground water	2701

7.2 Hydrology Project and HIS

Hydrology Project (SW) aims at establishing a Hydrological Information System (HIS) in the state and the HIS includes Water Quality Monitoring of Surface Water. The basic objectives for WQ Monitoring are:

a) Monitoring for establishing baseline water quality.

b) Observing trend in water quality changes.

c) Calculating flux of water constituents of interest.

d) Control and management of water pollution.

Distribution of 129 WQ sampling locations is done amongst 5 Level-II laboratories located at different places of Maharashtra i.e

Table 7.2 Laboratory location, Type of laboratory and no. of sample collection locations.

Location of Laboratory	Type of Laboratory	No. of sample collection locations
Pune	Level-II	15
Nashik	Level-II+	17
Nagpur	Level-II	30
Aurangabad	Level-II	17
Kolhapur	Level-II	31
Kalwa (Thane)	Level-II	19

Table 7.3 The WQ Sampling location category & frequency of sampling designed for SW, Maharashtra:-

WQ Sampling Location Category	Sampling Frequency upto first 3 years	After 3 years monitoring
Baseline - 50 no.	Monthly One Sample	Break for 3 years
Trend - 67 no.	Fortnightly One Sample	After classification as 'Trend' monthly one sample
Flux - 09 no.	Fortnightly One Sample	After classification as 'Flux' fortnightly one sample
Trend / Flux – 03 no.	Fortnightly One Sample	After classification as 'Trend/Flux' fortnightly one sample.

Table 7.4 Statement showing Frequency of Sampling & Parameters to be analyzed

Station	Sampling Frequency	Test Parameters	Remark
Baseline	Once in a month first 3 years	30 parameters for 1st sample 20 Parameters for remaining Sample	After 3 years monitoring break for 3 years
Baseline after 3 years break and classification as baseline stations	Once in 2 months	30 parameters for 1st sample 20 Parameters for remaining Sample	One year monitoring again break for 3 years.

Trend	Twice a month	--do--	Initially 3 year monitoring
Trend (after classification as trend)	Once in a month	-- do --	Continuous monitoring
Flux	Twice a month	-- do --	Initially 3 year monitoring
Flux (after classification as Flux)	Twice a month	-- do --	Continuous monitoring with flow measurements
Reservoir and lakes (treated as Trend)	Twice a month	32 parameters for 1st samples. 22 parameters for remaining sample	Continuous monitoring

Note: - The parameters to be analyzed as mentioned above are minimal requirement. This is not however restricted. Additional parameters shall be analyzed as per the requirement or on the basis of geographical location of stations or certain circumstances.

Table 7.5 List of Parameters

Sr. No.	Parameter 32	Parameter 30	Parameter 22	Parameter 20
1	Colour	Colour	Colour	Colour
2	Odour	Odour	Odour	Odour
3	Temperature	Temperature	Temperature	Temperature
4	pH	pH	pH	pH
5	Electric Conductivity	Electric Conductivity	Electric Conductivity	Electric Conductivity
6	Dissolved Oxygen	Dissolved Oxygen	Dissolved Oxygen	Dissolved Oxygen
7	Turbidity	Turbidity	Total Solids	Total Solids
8	Total Solids	Total Solids	Dissolved Solids	Dissolved Solids
9	Dissolved Solids	Dissolved Solids	NO2	NO2
10	Suspended Solids	Suspended Solids	NO3	NO3
11	NH3-N	NH3-N	B.O.D.	B.O.D.
12	NO2	NO2	C.O.D.	C.O.D.
13	NO3	NO3	Total Coliforms	Total Coliforms
14	Total Phosphorous	Total Phosphorous	Faecal Coliforms	Faecal Coliforms
15	B.O.D.	B.O.D.	Turbidity	Turbidity
16	C.O.D.	C.O.D.	NH3-N	NH3-N
17	Potassium K+	Potassium K+	Total Phosphorous	Total Phosphorous
18	Sodium (Na)	Sodium (Na)	Chloride (Cl)	Chloride (Cl)
19	Calcium (Ca)	Calcium (Ca)	Alkalinity	Alkalinity
20	Magnesium	Magnesium	Sodium	Sodium
21	Carbonate (CO3)	Carbonate (CO3)	Total Kjeldhal Nitrogen	
22	Bi-Carbonate (H CO3)	Bi-Carbonate (H CO3)	Chlorophyll	
23	Chloride (Cl)	Chloride (Cl)		
24	Sulphate (SO4)	Sulphate (SO4)		

25	Fluoride	Fluoride		
26	Boron	Boron		
27	Total Coliforms	Total Coliforms		
28	Faecal Coliforms	Faecal Coliforms		
29	Alkalinity	Alkalinity		
30	Total hardness	Total hardness		
31	Total Kjeldhal Nitrogen			
32	Chlorophyll			

It is also decided to monitor water quality testing of reservoirs, lakes considering separate issue & frequency of sampling for such locations are considered twice in a month continuously & parameters are to be analyzed 32 for the first sample in the water year (June to May) and 30 parameters for rest of the samples.

8. Data Dissemination

8.1 Introduction

In the set up of the Hydrological Information System, the first question to be addressed is the type of information to be provided. This determines the layout of the observation network (parameters, network density, observation frequency, equipment, etc.) and the data available in the databases. The type of information to be provided requires an analysis of the potential hydrological data users. The Central and State Government agencies, which support the Hydrological Information System, are the major users of the generated information. There are sources of other governmental, non-governmental and private agencies also, which make good use of this information. It is obvious that the hydrological data needs of the users also change over time. Therefore, it is very important to identify the potential data users and regularly analyse their data needs. Normally, it is expected that the hydrological information service agencies satisfy most of the genuine data needs of the potential users in particular and society at large. For ensuring an optimal use of the public resources spent for maintaining such a Hydrological Information Service, it is therefore very essential to have a proper balance between the data needs of various users and mandate of various services supporting the hydrological information system. To ensure that the HIS output remains at all times **'demand driven'** each state/agency has to constitute a **Hydrological Data Users Group** (HDUG). These HDUGs must represent all potential users within the State or intended to be covered by an agency.

Hydrological Data Users Group is a State or National Level Representative Group of current & potential large scale and repeat users of HIS data who have a stake in water resources utilization, assessment & management.

Purpose

1) To provide a common platform for discussion between hydrology data users & data provider.
2) To create awareness amongst users about Hydrological Information System (HIS) data & educate them.
3) To understand, analyze & update information on the changing needs of data users.
4) To review & recommend addition /deletion in the data collection networks related to HIS, if appropriate.

Table 8.1 The extent of data availability

Sr. No.	Data Type	No. of stations	Data Availability
1	Rainfall	506	Since 1976
2	River gauge	210	Since 1980
3	Climatic	67	Since 1980
4	Water Quality	127	Since 1999

8.2 The user can request for the data as below

The HDUG member can request the data by filling the request form. (Please see Annexure-A). Data is made available online/offline through any available media such as E-mail, Floppy, CD, Tape or hard copy against payment for the required data. Catalogue services are being lunched on central NIC server, shortly and will be available on Internet.

The registration form may be downloaded from our website

http://www.mahahp.gov.in

8.3 The pricing of data:

1	ARG Data.....	Rs.225 /Station/Year
2	SRG Data.....	Rs.225 /Station/Year
3	FCS Data.....	Rs.225 /Station/parameter/Year
4	GD Data.....	Rs.600 /Station/Year
5	Sedimentation Data…..	Rs.600 /Station/Year
6	W.Q.Data	Rs.240 /Station/ parameter/Year

Discounts: -

1. For Research or Academic purpose, 25 % of above sanctioned rates will be charged.
2. Individual students having no grants for research from any source, data will be supplied free of cost.
3. For individual farmers, 50 % of above sanctioned rates will be charged.
4. For Private organisations, double of the above sanctioned rates will be charged as the data is used for commercial purpose.

8.4 The members of HDUG can be

1 Government Institutions.
2 Voluntary Non Government Organizations.
3 Universities, Educational & Research Institutions
4 Associations - Farmers, Water users, Industrial
5 Individuals engaged in Operational Research & Development
6 All Professional Bodies
7 Consulting Representatives

8.5 Various Data Users:

Data Disseminated by this office is utilized by different categories as shown in the table below. Maximum data is utilized for educational research purpose. Many students from renowned colleges/institutes have utilized this data for their M.Tech, Ph. D degrees such as students from UNESCO-IHE Delft- Netherlands, IIT Mumbai, IIT Rurkee, IIT Kharagpur, different NIT's , College of Engineering Pune, Government college of Aurangabad, VJTI Mumbai, National Institute of Oceanography Mumbai, Nowrosjee Wadia College Pune, SP College Mumbai, VIT Pune, TERI University, , Indian Agricultural Research Institute New Delhi etc. These users have also submitted their project reports to this office as an acknowledgement of usage of data. Few references for the same are

1) Hydrologic modeling of runoff & sediment yield.
2) Rainfall runoff modeling using ANN.
3) Soil erosion modeling of agriculture watershed using GIS.
4) Study of estimating evaporation.
5) Silt load assessment & watershed management.
6) Watershed modeling using remote sensing & GIS.
7) Surface water quality analysis.
8) Spatiotemporal analysis of the effects of forest covers on water yield in the western ghats of peninsular India.
9) Multivariate Flood Frequency analysis using copulas.
10) Risk assessment of hydro climatic variability on ground water levels in Manjara basin aquifers using Archimedean copulas.

Data provided to the offices under Government category is utilized for the work of SWIP (Surface Water Integrated Plan for different basins of Maharashtra), Design of water resources structures (such as dams, barrages, KT Weir, Bridges etc.) Preparation of Master Plan, Hydro Power Potential, Irrigation Management, Water Quality etc.

Table 8.2 Revenue generated for period 2015

Sr No.	Category	Cost of Data Disseminated (in Lakhs of Rs.)	Revenue generated (in Lakhs of Rs.)
1	Educational	54.56	0.006
2	Farmers	0	0
3	Government	41.62	5.04
4	NGO	1.50	1.50
5	Private	5.33	1.41
6	Semi-Government	0.064	0
7	HDU Membership	-	0.52
	Total	**103.07**	**8.47**

Table 8.2 Revenue generated for period 2016

Sr No.	Category	Cost of Data Disseminated (in Lakhs of Rs.)	Revenue generated (in Lakhs of Rs.)
1	Educational	67.78	3.15
2	Farmers	0	0
3	Government	5.86	2.38
4	NGO	0	0
5	Private	0.22	0.10
6	Semi-Government	0.77	0.27
7	HDU Membership	-	0.64
	Total	**74.63**	**6.54**

Annexure : A

Ref: No. : **Date: / / 200**

DATA REQUEST FORM

The Superintending Engineer,
Data Analysis Circle,
Hydrology Project (SW)
Nashik- 422 004

Sub: Data Request Form

Sir,

The DRF is submitted herewith for the following data.

						Period	
						From	**To**
1							
2							
3							
4							
5							
6							

Name:	**Organization:**
Phone Number:	**Email:**
Postal Address:	

Media for Dissemination *	Floppy / Hard Copy / CD / DAT Cartridge
Format for Dissemination *	MS Access / MS Excel / CSV
Purpose of Data *	Academic / Research / Design of Water Resource Structures / Design of Roads, Rail, Bridges etc / Navigational Purpose / Hydro Power Potential / Irrigation Management / Sedimentation / Water Quality / Other (Specify)
Communication method for password of protected file. *	Telephone **/** E-Mail **/** Post

***** *Tick √Whichever is applicable*

Terms and Conditions:

I / We agreed hereby to abide by the following conditions in respect of the data requested:

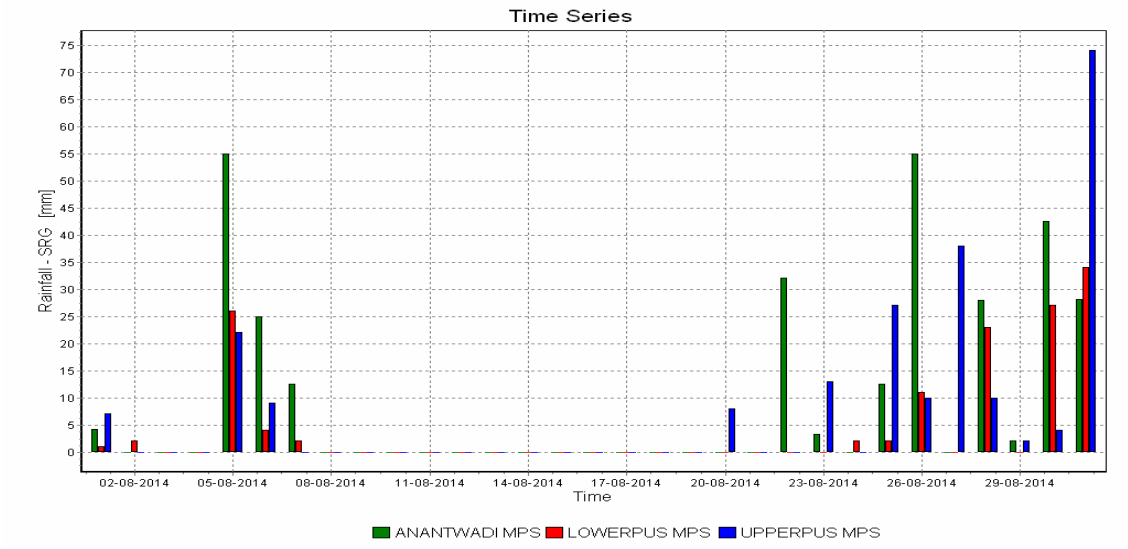
1. The data will be used strictly for the said purpose for which the data has been asked for.
2. The data will not be supplied to any governmental/non-governmental or public sector undertaking without the prior concurrence/fresh permission from the owner agency.
3. The data will not be published in any form without the prior permission of the owner agency.
4. The data shall not be used for commercial purpose.
5. The data will not be put on Internet or NIC Net.
6. Any inference drawn based on these data will be the sole responsibility of the Users and the Owner agency will not be responsible for any kind of loss or damage in any form occurring due to the use of data.

Please send the Demand note of data pricing at the above address by Post / Email.

Signature
Name ……

For Office Use:
HDUG Reg. No Joining Date: Category:

Annexure : B



Sample Daily Rainfall for Year 2014

	ANANTWADI	LOWERPUS	UPPERPUS
	MPS	MPS	MPS
01/08/2014	4.2	1	7
02/08/2014	0	2	0
03/08/2014	0	0	0
04/08/2014	0	0	0
05/08/2014	55	26	22
06/08/2014	25	4	9
07/08/2014	12.5	2	0
08/08/2014	0	0	0
09/08/2014	0	0	0
10/08/2014	0	0	0
11/08/2014	0	0	0
12/08/2014	0	0	0
13/08/2014	0	0	0
14/08/2014	0	0	0
15/08/2014	0	0	0
16/08/2014	0	0	0
17/08/2014	0	0	0
18/08/2014	0	0	0
19/08/2014	0	0	0
20/08/2014	0	0	8
21/08/2014	0	0	0
22/08/2014	32	0	0
23/08/2014	3.2	0	13
24/08/2014	0	2	0
25/08/2014	12.5	2	27
26/08/2014	55	11	10
27/08/2014	0	0	38
28/08/2014	28	23	10
29/08/2014	2	0	2
30/08/2014	42.5	27	4

Annexure C

Sample Twice Daily Climatic Data, Sept 2009

Station Code : Bori **Station Name : Bori**

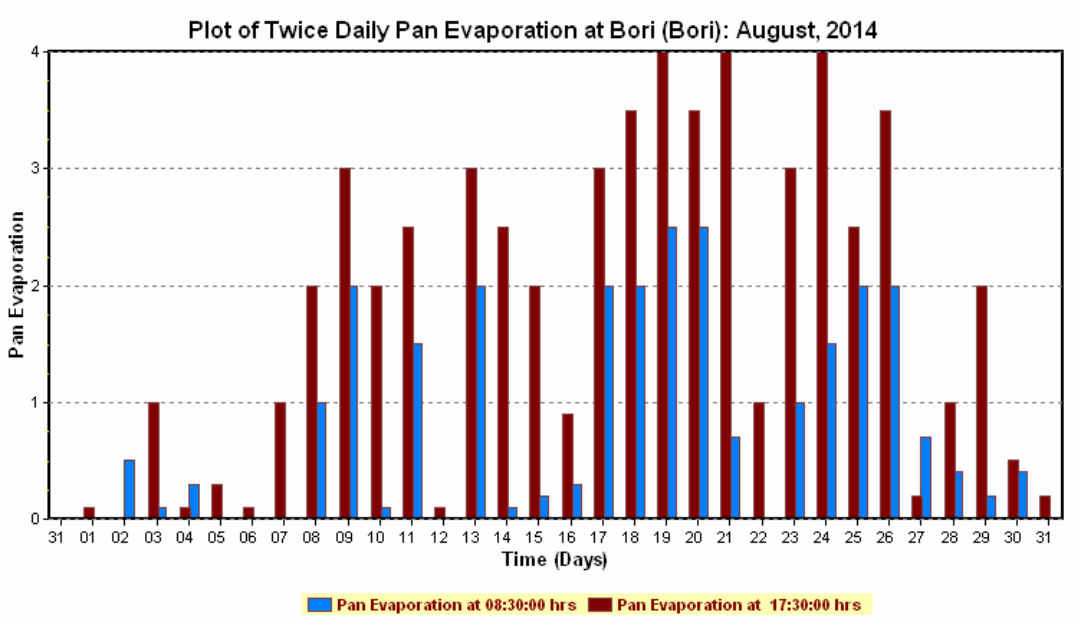
Local river : Dina **Sub-Division : SDDPC, Chadrapur**

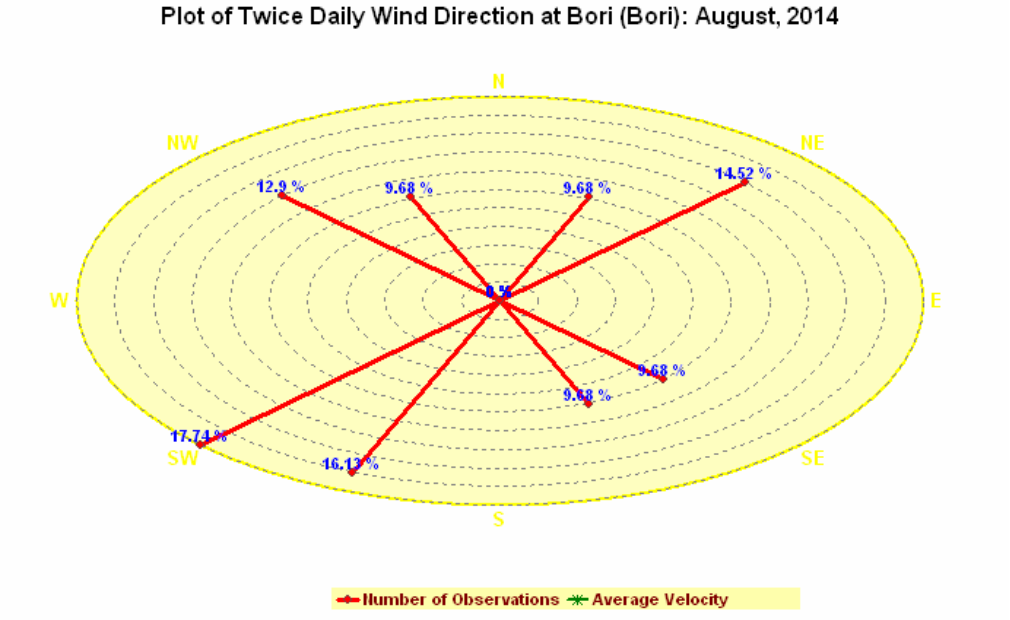
Day	Hour	Min Temp	Max Temp	Temp dry Bulb	Temp wet Bulb	Relative Humidity	Inst Wind Speed	Av Wind Speed	Wind direction	Rainfall	Pan Evaporation	Temp - Pan water
1	08:30	23.50	31.00	29.00	27.00	85.00	2.00	0.62	SSW	1.40	0.00	28.00
1	17:30	24.00	32.00	27.00	25.00	84.00	0.00	1.98	NE	2.60	0.10	27.00
2	08:30	23.00	28.50	27.00	26.00	92.00	0.00	1.12	SE	0.40	0.00	26.00
2	17:30	24.00	31.50	29.00	27.00	85.00	2.00	1.41	SE	0.60	0.00	28.00
3	08:30	22.00	29.00	27.00	26.00	92.00	0.00	0.85	SW	26.80	0.50	25.00
3	17:30	23.50	31.50	30.00	28.00	85.00	0.00	1.65	SSW	0.00	1.00	29.00
4	08:30	22.00	28.50	26.00	24.00	84.00	0.00	0.44	SSW	3.60	0.10	25.00
4	17:30	23.50	26.50	25.00	22.00	76.00	0.00	0.77	SW	2.00	0.10	24.00
5	08:30	22.00	25.50	24.00	23.00	91.00	2.00	1.84	SSW	15.60	0.30	23.00
5	17:30	23.00	26.00	24.00	22.00	83.00	4.00	3.46	NW	7.60	0.30	24.00
6	08:30	22.50	26.00	25.00	24.00	92.00	4.00	3.21	SW	0.80	0.00	25.00
6	17:30	25.00	31.00	30.00	28.00	85.00	2.00	5.12	SSW	2.60	0.10	29.00
7	08:30	23.00	29.00	27.00	26.00	92.00	2.00	0.73	SW	0.00	0.00	26.00
7	17:30	25.50	32.00	30.00	27.00	78.00	0.00	2.46	NNE	0.00	1.00	29.00
8	08:30	23.50	30.50	29.00	28.00	92.00	0.00	0.28	NNW	1.20	0.00	27.00
8	17:30	24.00	31.00	30.00	28.00	85.00	0.00	3.54	NW	0.00	2.00	29.00
9	08:30	23.50	30.50	29.00	27.00	85.00	0.00	0.08	SSW	0.00	1.00	28.00
9	17:30	25.50	33.50	32.00	27.00	67.00	4.00	2.45	SW	0.00	3.00	31.00
10	08:30	24.00	32.00	29.00	28.00	92.00	0.00	1.66	SSW	0.00	2.00	28.00
10	17:30	25.00	32.50	30.00	28.00	85.00	2.00	3.76	SW	0.00	2.00	29.00
11	08:30	23.50	29.50	27.00	26.00	92.00	0.00	0.22	SSE	3.00	0.10	26.00
11	17:30	24.50	31.50	30.00	27.00	78.00	0.00	0.54	SW	0.00	2.50	29.00
12	08:30	24.00	30.50	28.00	26.00	85.00	0.00	0.12	SSE	0.00	1.50	27.00
12	17:30	24.50	31.00	29.00	26.00	78.00	0.00	2.93	NW	3.40	0.10	28.00
13	08:30	24.00	30.50	27.00	26.00	92.00	0.00	0.74	NNW	0.00	0.00	26.00
13	17:30	25.00	32.00	30.00	27.00	78.00	2.00	2.60	SE	0.00	3.00	29.00
14	08:30	24.50	30.00	28.00	27.00	92.00	2.00	2.98	NNE	0.00	2.00	27.00
14	17:30	25.50	32.50	30.00	28.00	85.00	0.00	3.71	NE	0.00	2.50	29.00
15	08:30	25.00	31.50	30.00	29.00	93.00	0.00	2.07	NW	2.60	0.10	28.00
15	17:30	23.50	31.00	29.00	27.00	85.00	2.00	3.05	SE	0.20	2.00	28.00
16	08:30	22.00	29.00	26.00	25.00	92.00	0.00	0.84	NNW	3.40	0.20	26.00
16	17:30	21.50	27.50	25.00	23.00	84.00	6.00	2.31	NE	30.00	0.90	25.00
17	08:30	21.00	26.50	24.00	23.00	91.00	0.00	1.23	SSE	0.30	0.30	24.00
17	17:30	25.00	31.00	29.00	27.00	85.00	4.00	5.35	SE	3.00	3.00	28.00
18	08:30	24.00	30.00	28.00	27.00	92.00	0.00	0.04	NE	2.00	2.00	27.00
18	17:30	25.50	33.50	32.00	30.00	86.00	2.00	2.68	NNE	3.50	3.50	31.00
19	08:30	24.50	31.00	30.00	29.00	93.00	0.00	0.05	NE	2.00	2.00	30.00
19	17:30	28.00	34.00	32.00	30.00	86.00	0.00	0.41	NNW	4.00	4.00	31.00
20	08:30	24.50	31.00	29.00	28.00	92.00	0.00	0.48	SSW	2.50	2.50	29.00
20	17:30	26.00	34.00	30.00	27.00	78.00	0.00	2.30	NE	3.50	3.50	3.00
21	08:30	24.00	31.00	29.00	27.00	85.00	2.00	0.16	SSE	2.50	2.50	28.00

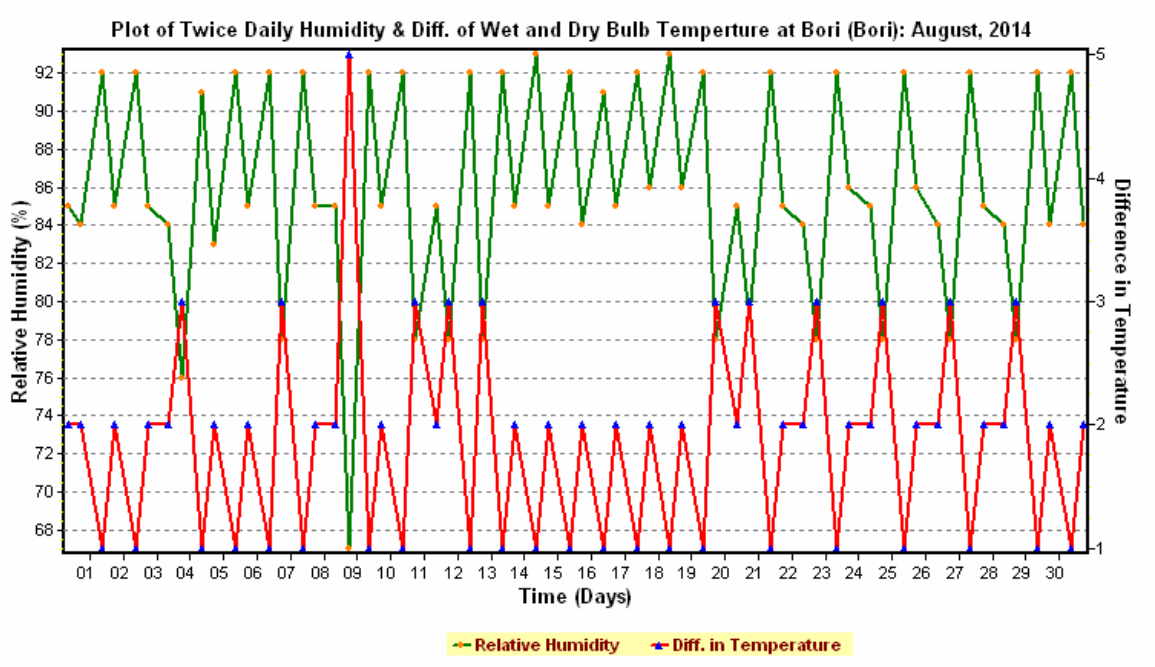
21	17:30	26.00	34.50	32.00	29.00	79.00	0.00	3.63	SSE	4.00	4.00	31.00
22	08:30	21.00	29.00	25.00	24.00	92.00	0.00	0.82	SSW	0.70	0.70	25.00
22	17:30	22.00	29.50	28.00	26.00	85.00	0.00	1.10	SSE	1.00	1.00	27.00
23	08:30	22.00	27.50	26.00	24.00	84.00	0.00	0.10	SE	0.00	0.00	26.00
23	17:30	23.50	31.50	30.00	27.00	78.00	0.00	0.64	NNE	3.00	3.00	29.00
24	08:30	23.00	29.50	28.00	27.00	92.00	2.00	0.33	SW	1.00	1.00	27.00
24	17:30	26.00	34.00	32.00	30.00	86.00	0.00	2.35	NNE	4.00	4.00	31.00
25	08:30	23.50	30.50	28.00	26.00	85.00	0.00	0.04	NNW	1.50	1.50	27.00
25	17:30	25.00	33.00	29.00	26.00	78.00	2.00	0.88	NE	2.50	2.50	28.00
26	08:30	23.00	31.00	27.00	26.00	92.00	0.00	0.86	SW	2.00	2.00	27.00
26	17:30	25.50	33.50	32.00	30.00	86.00	0.00	0.60	SSW	3.50	3.50	31.00
27	08:30	23.00	31.50	27.00	25.00	84.00	0.00	0.50	NNE	2.00	2.00	27.00
27	17:30	23.00	31.50	30.00	27.00	78.00	4.00	1.56	NE	0.20	0.20	29.00
28	08:30	21.00	30.00	25.00	24.00	92.00	0.00	0.55	NNW	0.70	0.70	24.00
28	17:30	22.50	30.50	29.00	27.00	85.00	2.00	4.16	NW	1.00	1.00	29.00
29	08:30	21.00	27.50	25.00	23.00	84.00	4.00	3.97	NW	0.40	0.40	25.00
29	17:30	23.50	31.00	30.00	27.00	78.00	2.00	4.07	NW	2.00	2.00	29.00
30	08:30	23.00	29.00	27.00	26.00	92.00	0.00	1.14	NE	0.20	0.20	27.00
30	17:30	22.50	28.50	26.00	24.00	84.00	0.00	2.54	SW	0.50	0.50	25.00
31	08:30	22.00	27.00	25.00	24.00	92.00	2.00	0.93	SW	0.40	0.40	24.00
31	17:30	22.00	28.50	26.00	24.00	84.00	0.00	2.26	NW	0.20	0.20	25.00

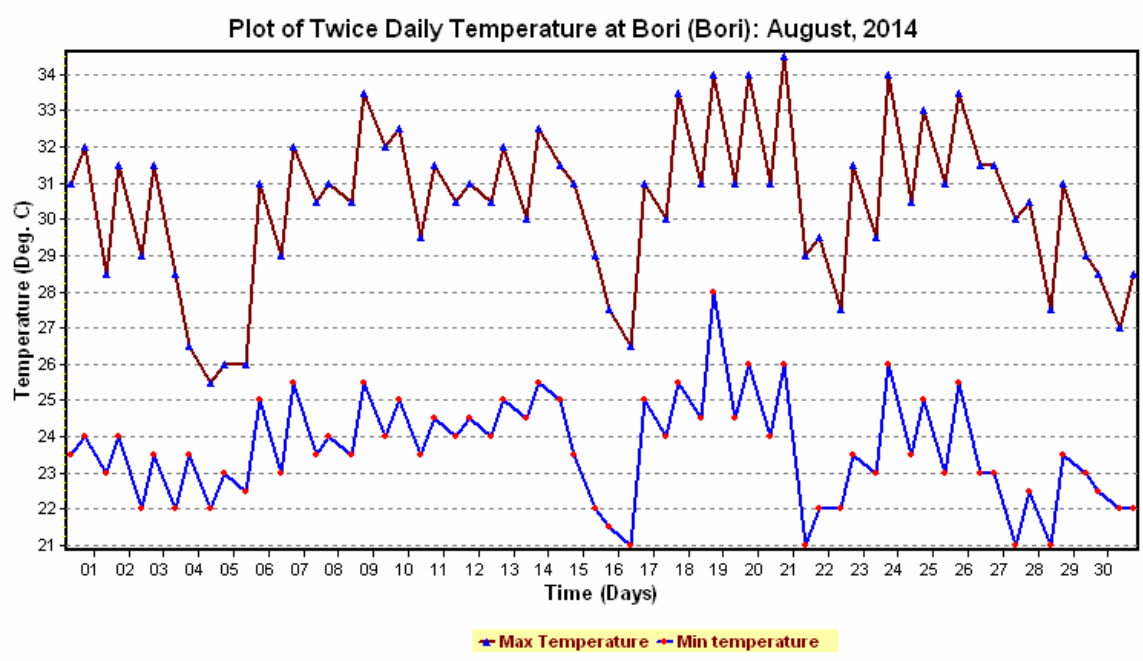
Note : Rainfall at 08:30 hrs is pertaining to previous day

Graphical Representation of above Data






Plot of Twice Daily Humidity & Diff. of Wet and Dry Bulb Temperture at Bori (Bori): August, 2014
Relative Humidity (%)
Difference in Temperature
Time (Days)
Relative Humidity
Diff. in Temperature


Plot of Twice Daily Temperature at Bori (Bori): August, 2014
Temperature (Deg. C)
Time (Days)
Max Temperature
Min temperature