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SPATIO-TEMPORAL VARIATION IN SURFACE WATER AVAILABILITY IN UPPER KRISHNA BASIN

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Abstract

India possesses 5 per cent of the World's total water resources. According to K. L. Rao (1975), there are about 10,360 rivers of at least 1.6 km length each with average annual flow of 1869 km^3. From the geographical perspective, only 69000 corers km^3 (32 %) surface water is used, due to uneven distribution and other hindrances (Gurjar, 2008). The study region 'Upper Krishna Basin' extends between 15˚44′ to 18˚ 03′16′′ North latitude and 73˚ 33′ to 75˚ 16′30′′ East longitudes. The main objective of present research paper is to study Spatio-temporal variation of surface water availability in sub basins of upper Krishna basin in Maharashtra. River Krishna basin is divided into two major basins namely western and eastern upper Krishna basin. Total area of upper Krishna basin is 20,400 km², out of it western part of upper Krishna covers 15,116 km² and eastern part of upper Krishna coverage is 5284 km². In western part of the study region, water availability is more than 99 per cent in Krishna NW and Krishna SW sub-basin. In eastern part of study region, Yerala and Agarani sub-basins are highly water deficit basins and the surface water availability is only 01 per cent.

Key Words – *Surface Water, River Basin, Water Availability*

1. Introduction:

Availability of annual surface water in India is 18, 6900 corers m^3. The water which is available in streams, rivers, dams, canals, lakes, ponds and wetland is known as surface water. In

other words surface water is naturally occurred by various types of precipitation and naturally lost through discharge to the seas and oceans, evaporation, evapo-transpiration and percolation etc., the total quantity of water in this system at any given time is also dependent on many other factors. Such factors are like as storage capacity in artificial reservoirs, soils permeability, and runoff of water and duration of rainfall as well as rate of evaporation. Main sources of surface water in India are rivers, lakes, ponds and tanks etc. Maharashtra has 400 rivers; the total length of these rivers is 20,000 km. The total geographical area of the state is divided into 5 river basins, namely Godavari, Tapi, Narmada, Krishna and West flowing rivers of the Konkan region. The estimated average annual availability of water resources consists of 164 km^3 of surface water and 20.5 km^3 of subsurface water. Water availability in Konkan region and Narmada basin are abundant and surplus, whereas Tapi basin shows water deficit, Godavari and Krishna basins are normal level. Various Interstate Water Tribunal awards / agreements, decisions on water sharing have reduced estimated available surface water resources in these river basins for the state of Maharashtra to about 125 km^3. Maharashtra has 1427 large dams and out of these 1813 irrigation projects were completed and 2817 irrigation projects are under construction (Ghate, 2010).

Maharashtra is one of the surface water rich states in India. The recent scenario of availability of surface water reflects from its geographical area (307762 km^2) and from this area Maharashtra has capacity of 75 per cent dependable yield (131562 Mm^3). From that available water Maharashtra can use only 126936 Mm^3 water. On the basis of river basins Maharashtra state has divided into five main river basins and out of them Krishna basin is second largest basin in Maharashtra. Total Geographical area of Krishna basin (including Bhima) is 70114 km^2 and 75 per cent dependable water yield is 28371 Mm^3. The Krishna basin has permitted to use only 16818 Mm^3. The other basins of Maharashtra state are west flowing rivers in Konkan, Tapi, Narmada and Godavari.

Considering these things the upper Krishna basin has taken to study of surface water resources. The surface water of upper Krishna basin is mostly found into two categories and they are flowing river and artificial reservoirs.

2. Objective:

The main objective of present research paper is to study the spatio-temporal variation of surface water availability in upper Krishna basin of Maharashtra.

1. To study the geographical area of the upper Krishna basin.
2. To find out the spatio-temporal variation of surface water availability in upper Krishna basin.
3. To calculate the annual water availability in western and eastern upper part of Krishna basin.
4.

3. Study region:

The study region 'Upper Krishna Basin' extends between 15˚44′ to 18˚ 03′16′′ North latitude and 73˚ 33′ to 75˚ 16′30′′ East longitudes. Total catchments area covered by the river basin is about 15,190 km² with about 97 watersheds and 232 km of the total run in Maharashtra (Diddee J. et al 2002) covering majority of the area of Kolhapur, Satara, and Sangli districts.

The tripartite study region of three districts confined by the political boundaries of Raigarh and Pune districts from the north, Solapur district and part of Karnataka State from east and south, whereas, from the western direction Sindhudurg and Ratnagiri districts limit the boundary of study region.

4. Surface water in river basins:

Krishna basin is divided into two major basins namely west upper Krishna basin and east upper Krishna. Total area of upper Krishna basin is 20400 km², out of it west upper Krishna covers 15116 km² and east upper Krishna's coverage is 5284 km². Further west upper Krishna basin divided into two sub-basins and these are north-west and south-west upper Krishna basin. The east upper Krishna basin categorized in Yerala and Agrani sub-basins.

According to Maharashtra Water and Irrigation Commission Report, in Satara district two sub-basins are distributed namely upper Krishna West (56.91 %) and upper Krishna East (12.97 %). Sangli district is distributed into three sub-basins of upper Krishna namely upper Krishna

west (19.24 %), upper Krishna East Yerala (30.54 %) and upper Krishna East Agrani (15.25 %). Kolhapur district is totally covered by upper Krishna basin and divided into sub-basins of upper Krishna West-North (74.93 %), upper Krishna West-South (22.71 %) and Tillari (2.36 %).

River water is main source of surface water. Krishna basin has number of tributaries and these tributaries becomes the one sub-basin, namely Krishna, Koyana, Warana, Panchganga, Dudhganga, Vedganga and Ghatprabha on the right bank of Krishna. The left bank of Krishna is poor drainage pattern developed. Yerala and Agarani is the main tributary of river Krishna.

Table 1

Geographical area of the upper Krishna basin.

Basin Segment	District	Tahsils	Geographical Location	Area (km^2)
Upper Krishna (North-West)	Satara	Satara, Mahabaleshwar, Wai, Javali, Koregaon, Karad, Patan	16°2´ to 18°2´ N 73°32´ to 74°40´ E	15116
	Sangli	Shirala, Walwa, Miraj, Tasgaon, Khanapur		
	Kolhapur	Shahuwadi, Panhala, Hatkanangale, Shirol, Karveer, Kagal, Radhanagri, Bavda, Bhudargad, Gadhinglaj, Ajara		
Upper Krishna (South-West)	Kolhapur	Chandgad, Gadhinglaj, Ajara	15°49´ to 16°15´ N 74°00´ to 74°30´ E	
Upper Krishna (East) Yerala	Satara	Karad, Khatav	16°55´ to 17°28´ N 74°20´ to 74°40´ E	
	Sangli	Khanapur, Tasgaon, Miraj		

Upper Krishna (East) Agrani	Sangli	Khanapur, Tasgaon, Miraj, Jat, Kavtemanhkal	16°40´ to 17°28´ N 74°20´ to 75°15´ E	5284

Source: *Based on Maharashtra Water and Irrigation Commission Report, 1999.*

Koyana, Warana and Bhogawati rivers have average length is more than 100 km. Another some tributaries of Krishna namely Venna, Panchganga, Kasari, Kubhi, Bhogavati, Dudhganga, Vedganga, Ghatprabha, Hiryankeshi and Tamrparni rivers course length is more than 50 km. Surface water in western tributaries is rich in water resources in study region. But eastern sub-basin of Krishna river namely Yerala and Agrani are observed poor in the respect of availability of water resources.

Surface water availability depends on the average rainfall in the basin. According to Krishna Water Dispute, Maharashtra state can get 594 TMC water for utilization from Krishna basin. In 1950-51 Government of India declared that 1800 TMC water is available in whole Krishna river basin. But Government of Maharashtra is not agreed with this decision. Then Central Government appointed one commission under the Chairperson of N. D. Gulati to count discharge of Krishna basin. As per survey it was proved that Krishna basin has 2060 TMC water.

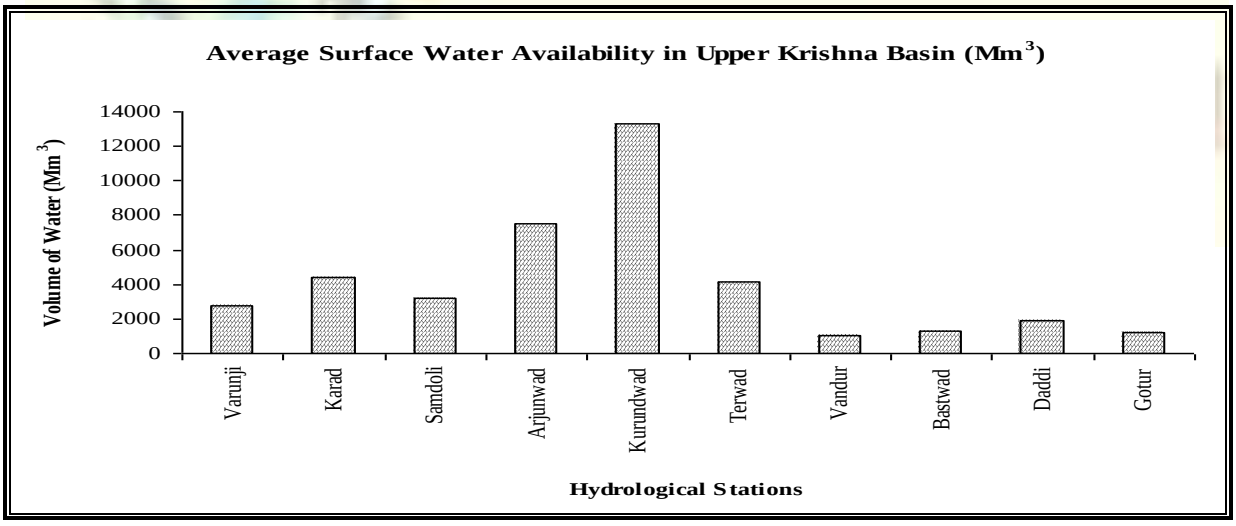

Fig. 1

According to Government of Maharashtra Irrigation Department and Central Water Commission the surface water availability in Krishna basin, near Kurundwad station is 13330

Mm^3 at Panchganga and Krishna confluence. Average water availability in the river Dudhganga is 1062 Mm^3, river Vedganga and Hiryankeshi have 1267 Mm^3 and 1230 Mm^3 water availability respectively per year. Both Hiryankeshi and Ghatprabha rivers discharge 1873 Mm^3 water per year. Per capita water availability from Krishna basin is 899 m^3 and per hectare water availability is 2600 Mm^3 (Jugale, 2000).

The table 2 shows spatio-temporal variation in surface water availability in upper Krishna basin. In western part of the study region, water availability is more than 99 per cent in Krishna NW and Krishna SW sub-basin. In eastern part of study region, Yerala and Agarani sub-basins are highly water deficit basins and the surface water availability is 01 per cent. From 1979 to 1994 surface water availability is varying from year to year. In 1991 - 92, 27397.92 Mm^3 surface water was available in upper Krishna basin which is highest recorded in study region and 11852.57 Mm^3 lowest water availability was recorded in 1987-88 in study region. From 1979 to 1994, in this period annual average water availability was 21324 Mm^3 (fig. 2).

Table 2

Annual water availability in western and eastern upper part of Krishna basin.

Year	Annual Water Availability				Total (Mm^3)
	Upper Krishna (West)		Upper Krishna (East)		
	Mm^3	%	Mm^3	%	
1979-80	22220	98.91	245.51	1.09	22465.51
1980-81	26814	99.93	18.69	0.07	26832.69
1981-82	23926	96.87	772.48	3.13	24698.48
1982-83	20006	99.96	7.65	0.04	20013.65
1983-84	24779	99.83	43.04	0.17	24822.04
1984-85	18949	99.78	41.63	0.22	18990.63
1985-86	18432	99.86	25.20	0.14	18457.20
1986-87	16222	99.75	40.49	0.25	16262.49
1987-88	11566	97.58	286.57	2.42	11852.57

1988-89	22492	96.57	797.97	3.43	23289.97
1989-90	17548	98.99	179.81	1.01	17727.81
1990-91	25706	99.90	25.20	0.10	25731.20
1991-92	26722	97.53	675.92	2.47	27397.92
1992-93	19318	99.95	8.78	0.05	19326.78
1993-94	21158	99.61	82.69	0.39	21240.69
Average	21057.20	99.00	216.77	1.00	21273.98

Source: *Based on Maharashtra Water and Irrigation Commission Report, 1999.*

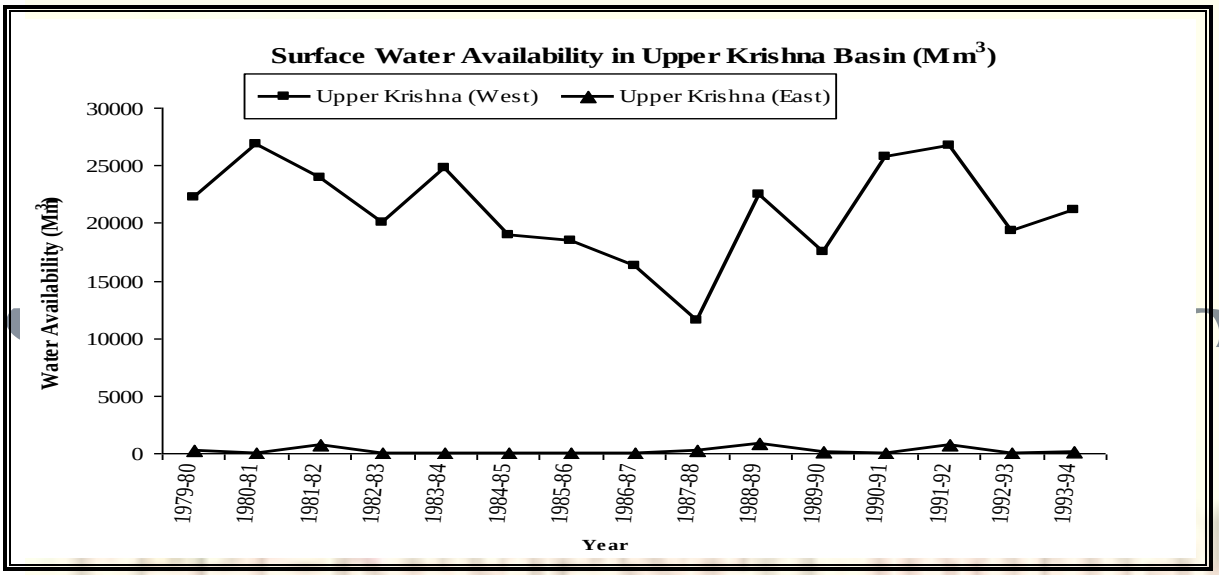

Fig..2

5. Conclusion:

Surface water availability in study region is unevenly distributed. In western zone surface water availability in rivers is high. Total average annual water availability in upper Krishna basin is 21,273.98 Mm³. But the eastern part of upper Krishna basin namely Yerala and Agarni sub basins are highly water deficit basins. Western south west and north west sub basins are water surplus basins. But both surplus and deficit water availability creates flood and drought contra verses problem in upper Krishna basin. So to utilize per drop of water and minimize the water

problem in upper Krishna basin there is need of water transfer from surplus zone towards deficit zone.

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