

Sub basin water transfer studies in upper Krishna river basin

■ **B.K. SATHE AND M.V. KHIRE**

ABSTRACT : In India, the Central Water Commission has classified upper Krishna river basins as Upper Krishna (NW) 15A, Upper Krishna (East Yerala) 16A, Upper Krishna East Agrani (16B), and remaining Bhima (downstream of Ujani including Man (18B)). This area is flood prone and necessitates proper water management. In these river basins, as a remedial measure, it is proposed to divert abundant water from river sub-basin 15A to Sub-basin 18B by gravity (diverting water from upper river Krishna to sub-basin of Man to Jath, Atpadi, Talukas of Sangli district and Sangola taluka of Solapur district.) through tunnels. This would be useful in contributing to minimize flood in Krishna basin and also utilization of extra water. It is proposed to divert water to feed existing water resources and small storages in Man sub-basin. This study was carried out by remote sensing and GIS techniques. Using ERDAS, ARC-INFO and Landsat7 imagery a detail topographical studies are carried out along with field survey .It helps to get actual ground levels, high flood levels and topography features to locate inlet and outlet. Satellite imagery substantiated to calculate areas under benefits and economic aspect of the proposal.

Key words : Sub basin, Remote sensing, GIS

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INTRODUCTION

To maintain quality of life and a steady state of economic growth, it would not be proper to consider problems of floods, drought, urban and rural drinking water needs, irrigation and industrial developments, power supply and pollution control compartmentally. All these problems have to be addressed in an integrated manner for the entire river basin or sub-basin. Sub-basin wise planning is to be accomplished to achieve optimum development of water resources and to realise sustainably beneficial management (Maharashtra Water and Irrigation Commission's Report, 1996. Both these subjects are quite involved, exhaustive and multidisciplinary. Moreover, there is diversity among the sub-basins in respect of factors such as geographical disposition, climate, rainfall, types of

soil, ways of land holding, population, per capita water availability, history of irrigation, current status of irrigation development, unutilised irrigation potential, cropping patterns and agricultural productivity, means of transport, industry and commerce. The planning of respective sub-basins should reflect this diversity. Therefore, planning of water of all sub-basins is not going to be of the same pattern or similar (Kale, 2003).

Water availability and its utilisation can only be assessed within the limits of a basin or sub-basin. Several sub-basins encompass extensive drought-prone areas. Large scale water conservation works will be required to be undertaken to reduce the degree of drought-proneness.

The present study about water use rights focuses Man sub basin,(18B) which is categorised by the Central Water Commission as highly deficit. In the months of June and July every year due to heavy rainfalls in Sahyadri ranges, Krishna river flows with abundant water and flood passes through Sangli District but at same time Yerala, Agrani and Man which are tributaries of Krishna remain totally dry.

Flood situation occurs in Palus, Walva, Shirala, and Miraj Talukas on the banks of Krishna. At the same time water supply

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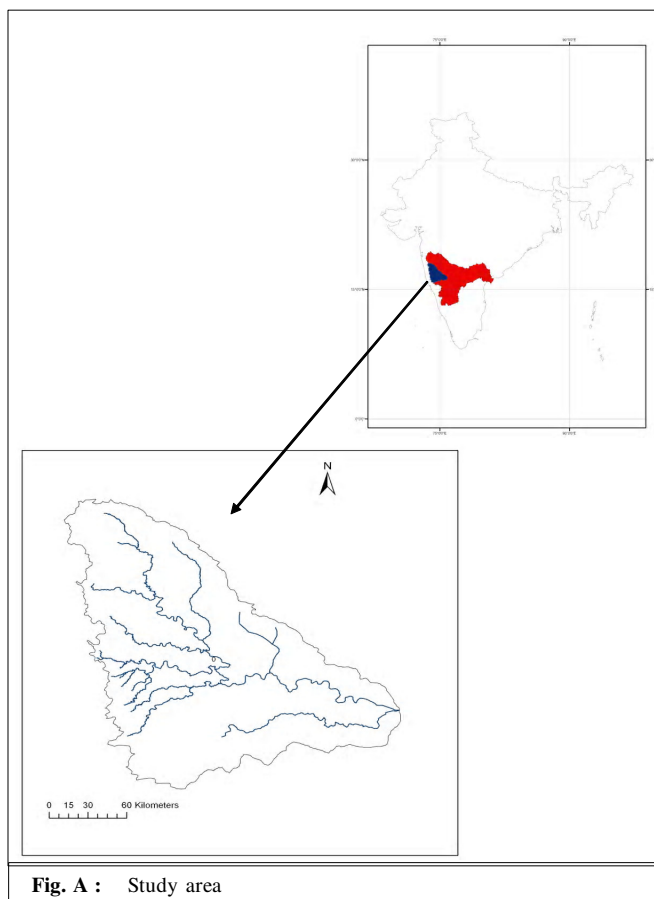
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for drinking water in Jath, Kavathe Mahankal and Atpadi, Sangola Talukas is made by water tankers. This diversity is within radius of 50-100 km. To overcome this, water transfer is going to benefit the drought-prone area.

The main objectives of the study are underlain by diverting water from abundant to deficit sub-basins and assessment of water and its effects on deficit sub-basin.

The study area:

Three tributaries meet the Krishna near Sangli. Warna meets Krishna near Sangli at Haripur. This spot is also known as Sangameshwar. Panchganga River meets the Krishna at Narsobawadi near Sangli. Fig. A. The study area is subdivided into Upper Krishna West -15A (West-North) and Upper Krishna 15B (West-South) and East -16A (Yerala) and 16B (Agrani) for easy formulation of appropriate water accounting and planning, in conformity with their respective local features.. The total geographical area of this sub-basin is 15A and 15B, 116 sq. km. Upper Krishna (East) is mostly drought prone and measuring 5,284 sq. km area on the eastern side of Krishna falls.



15A extends between latitude 16°02' to 18°02' N and longitude 73°32' to 74°40' E and comprises of the following

talukas

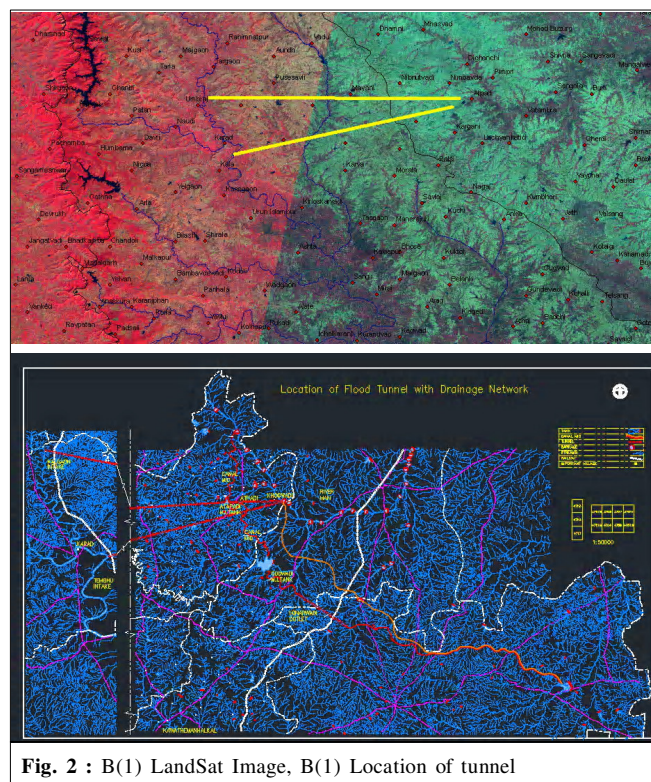
Districts	Talukas
Satara :	1) Satara, 2) Mahabaleshwar, 3) Wai, 4) Jawali, 5) Koregaon, 6) Karad, 7) Patan
Sangli:	1) Shirala, 2) Walva, 3) Mira, 4) Tasgaon, 5) Khanapur
Kolhapur:	1) Shahuwadi, 2) Panhala, 3) Hatkanangale, 4) Shirol, 5) Karvir, 6) Radhanagari, 7) Ganganbawada, 8) Bhudargad, 9) Kagal, 10) Gadhinglaj, 11) Ajara

15B extends between latitude 15°49' to 16°15' N and longitude 74° 0' to 74° 30' E and encompasses the following talukas.

Districts	Talukas
Kolhapur:	1) Chandgad 2) Gadhinglaj 3) Ajara.
Satara :	1) Karad 2) Khatav
Sangli :	1) Khanapur 2) Tasgaon 3) Miraj 4) Jat, and 5) Kawathemahankal

16A (Yerala) extent of Sub-basin is Yerala : Latitude 16° 40' to 17° 28' N and Longitude 74° 20' to 75° 15' E and comprises the following talukas

Districts	Talukas
Satara :	1) Karad 2) Khatav
Sangli :	1) Khanapur 2) Tasgaon 3) Miraj
16B (Agrani) :	Latitude 16° 40' to 17° 28' N and Longitude



74° 20' to 75° 15' E

Districts Talukas
Sangli : 1) Khanapur 2) Tasgaon 3) Miraj 4) Jat and 5) Kawathemahankal

Most of the area of this sub-basin falls in more than 1200 mm rainfall zone. Normally 85 per cent rainfall occurs during June to September due to south-west monsoon, 10 per cent between September and December due to north-east monsoon and 5 per cent after December. Average annual rainfall in component basins 15(A) and 15 (B) is 1584 mm and 1907 mm, respectively. Rainfall decreases from west to east in this sub-basin. The Yerala and the Agrani have 550mm and 470 mm average rainfall, respectively.

The main objectives of the study are underlain by diverting water from high flood to deficit sub-basins and assessment of water and its effects on flood and deficit sub-basin.

EXPERIMENTAL PROCEDURE

- The topographical maps of 1:2,50,000 scale
- The Landsat TM digital satellite False Colour Composite (FCC) February, 1999.
- The land use and soil map of the area with scale 1: 250,000.
- Hydrological and Hydraulic data.

Methodology:

- Various base maps for study area were prepared in GIS environment
- Land sat 7 TM digital satellite data were used for formation

of FCC and super imposed this image to base maps prepared.

- Slope maps were analysed and verify to identified the exact elevations, high flood levels (HFL).
- With the help of remote sensing imagery, location of inlet and outlet of flood tunnels were identified.
- These all data observed and calculated were verified with ground truth and field work.
- All detailed flood studies examine the areas through which floodwater flows.

After the field work is completed the information so obtained in incorporated in the GIS analysis to analyze and compile the diverging of flood water and analysis was carried out to minimize the flood risk.

The planning perspective:

Central Water Commission has categorized the sub basin on the basis of water availability (Table B).The two rivers - Yerala and Agrani of this sub-basin rise in a drought prone area and flow throughout its length through a drought prone area. The natural average availability of water in this sub-basin is hardly 217 Mm³. (Table A). The stipulated local water use in this sub-basin is 80 Mm³.By nature this basin being a deficit one and has conceived by interbasin transfer of water. This is planned to be achieved by topographical studies (Fig. C) and undertaking present schemes and available water.

The proposals:

As the water diversion by lift has not economical as compared to gravity flow. The various alternatives to connect

Table A : Comparison of sub basin in Sangli and Solapur district (Hydrological, Meteorological, and statistical)					
Sr. No.	Description	Upper Krishna (North West)	Upper Krishna (East Yerala)	Upper Krishna (East Agrani)	Remaining Bhima Down Stream of Ujani including Man
1.	Classification as per Maharashtra Water and Irrigation Commission	15 A	16 A	16 B	18 B
2.	Local name	Krishna	Yerala	Agrani	Man
3.	Talukas from Sangli district	Shirala ,Walawa, Miraj, Tasgaon, Khanapur	Miraj, Tasgaon, Khanapur	Miraj, Tasgaon, Khanapur, Jath, Kavathe Mahankal	Jath, Atpadi, Sangola
4.	Rainfall in mm				
	a) Average	1584	569	589	552
	b)Maximum	9480	1206	1596	1157
	c)Year of max. rainfall	1961	1981	1994	1987
5.	Average available water in Mm ³	9676	130	87	1607
6.	Available water at 75 per cent Dependability	8539	14	11	1254
7.	Available water at 50 per cent Dependability	9341	34	29	1729
8.	Available water per ha. for 50 per cent	6987	119	252	1657
9.	Available water per capita in M ³	2195	32	112	907
10.	Average G.L. for command area in m.	525 to 600	600 to 700	625 to 850	600 to 750

Note: Water available per ha. and per capita is calculated for total sub basin for Krishna i.e. 15A

Table B : Water availability in M ³ per ha. of culturable area		
Sr. No.	Category	Water availability per ha.
1.	Highly deficit	Less than 1500
2.	Deficit	Between 1500 - 3000
3.	Normal	Between 3000 - 8000
4.	Surplus	Between 8000 - 12000
5.	Abundant	More than 12000

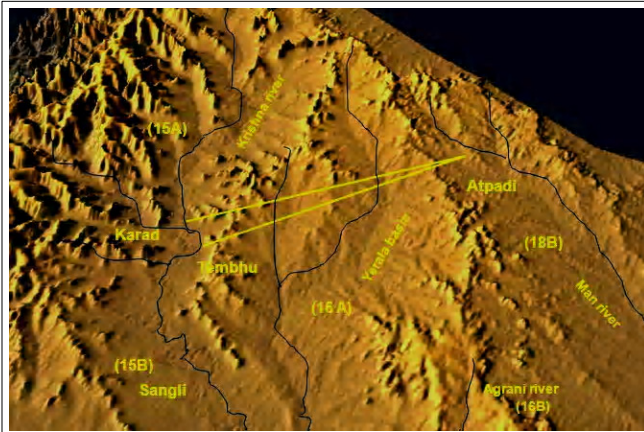


Fig. C : 3D view of study area

river sub-basins are examined and the best three alternatives proposed are;

- Tunnel start point near u/s of Umbraj (Kalgaon Village 74°7'14"E 17°28'11"N) and exit point near Atpadi minor irrigation tank(MI) (74°53'50"E 17°23'58"N) and from exit point to Dighanchi K.T. Weir on Man river of Sangli District by natural existing canal.
- Tunnel start point at Tembhu Barrage (74°14'3"E 17°16'52"N) and exit point at Lonarwadi K.T. weir downstream of Atpadi on Man River
- Tunnel starting point at Tembhu Barrage and exit point Lonarwadi K.T.weir and lift from Lonarwadi to Atpadi MI tank.

While studying the alternatives the water availability at entry point and water requirements at the exit points are considered to design the tunnel. The river Man joins river Bhima at Sarkoli village of Pandharpur, downstream of Ujani dam. Most of the shore of river Bhima downstream of Ujani is under command of Ujani reservoir. Hence, while evaluating water requirement the water reservoirs in the command of Ujani are deleted and only drought prone uncommand area is considered. It is assumed that 80per cent of storage capacity of minor irrigation (MI) tanks and K.T. weirs will be feed by this flood tunnel.

Details of proposal I :

Tunnel from Kalgoan to Atpadi (Krishna river to Man

river through Atpadi MI tank)

In this proposal, the proposed tunnel start point is at Umbraj (Kalgaon village) with bed level is 587 m (at Kalgaon), and bed gradient 1:4100. The length of this tunnel works out to 82km from GIS layout. The tunnel opens near Atpadi minor irrigation.

After tunnel the flood tunnel is divided into three branches.

Atpadi MI tank to man river through Dighanchi K.T. Weir:

After opening the tunnel at Atpadi, first flood canal *i.e.* Dighanchi branch is diverted towards Dighanchi in opposite direction of Man river and it is ended in Man at Dighanchi KT weir. This is gravity flow by natural existing channel of 17.30 km length.

Atpadi MI tank to man river through SankhWeir:

This branch not connect to direct Man river.This helps to fed the water to West side of Man river.This is the second flood canal in this proposal. This branch is further divided into three parts.

- Atpadi to Buddhehal MI tank,20 km by natural existing chanel
- Buddhehal to Jujarpur 11 km by gravity flow
- Jujarpur toSankh by proposed tunnel of 11 km at Jujarpur and 42 km through open natural chanel.

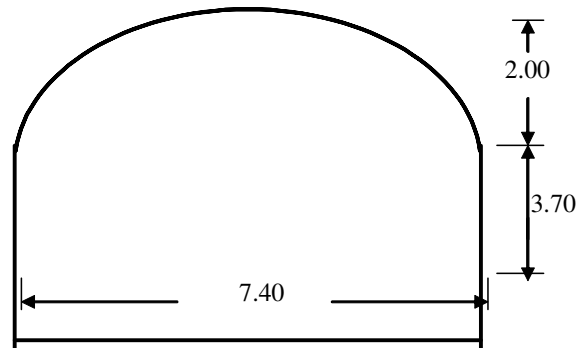
Hydraulic design of main tunnel:

The main tunnel from Kalgaon to Atpadi having length of 82km.

Total water requirement 0.80 x 138.49 + 30 per cent (For capacity factor and losses)

The discharge calculated is 33.35 cumecs

Assuming tunnel section as following below :



The cross-sectional area 31.99 sqm

The total tunnel excavation in hard rock works out to 26, 23,180Cum.

Table C : List of reservoirs feed			Water utilisation Mcum.
Name of project			
I) Completed projects			
A	Medium projects		
1	Sankh Tal :- Jath		14.87
2	Doddanala Tal :- Jath		6.06
3	Budhihal Tal :- Sangola		19.03
	Total of medium projects		39.96
B	Minor projects		
1	Bhivargi Tal :- Jath		8.62
2	Atpadi Tal :- Atpadi		7.96
3	Kacharewasti Tal :- Atpadi		2.37
	Total of minor projects		18.95
C	Kolhapur type weirs		
1	Kamalapur Tal :- Sangola		2.187
2	Akole Wasud Tal :- Sangola		2.095
3	Manjri Tal :- Sangola		1.913
4	Wadhegaon Tal :- Sangola		2.296
5	Balawadi Tal :- Sangola		1.031
6	Nazare Tal :- Sangola		1.44
7	Alegaon Tal :- Sangola		2.251
8	Kadals Tal :- Sangola		2.018
9	Chinake Tal :- Sangola		1.391
10	Watambari Tal :- Sangola		1.51
11	Save Tal :- Sangola		1.962
12	Methawade Tal :- Sangola		2.009
13	Khavaspur Tal :- Sangola		1.649
14	Lotewadi Tal :- Sangola		1.118
15	Gunjegaon Tal :- Mangalwedha		24.33
16	Dighanchi Tal :- Atpadi		0.60
17	Lonarwadi Tal :- Atpadi		0.59
18	Koutholi Tal :- Atpadi		0.80
	Total of KT Weirs		51.190
D	Local sector		
1	Banpuri Tal :- Atpadi		1.29
2	Shetfale Tal :- Atpadi		1.14
3	Deshmukhwadi Tal :- Atpadi		0.59
4	Pandharewadi Tal :- Atpadi		0.61
5	Jawala Tal :- Sangola		1.234
6	Jawala KTWeir Tal :- Sangola		0.289

Table Contd....

Contd..... Table C			
7	Sonand KTWeir Tal :- Sangola		0.553
8	Manjari KT Weir No.2 Tal :- Sangola		0.553
9	Kadlas (K.V.) KT Weir Tal :- Sangola		0.962
10	Manjari KT Weir No.1 Tal :- Sangola		0.596
11	Sonand No 1 KT Weir Tal :- Sangola		0.499
12	Ankalgi Tal :- Jath		0.283
13	Belondagi Tal :- Jath		0.151
14	Jalihah (Budruk) Tal :- Jath		0.17
15	Morbaggi No 2 Tal :- Jath		0.184
16	Maniknal Tal :- Jath		0.191
17	Balgaon Tal :- Jath		0.365
18	Sonyal No 2 Tal :- Jath		0.283
19	Nigadi Karandewadi Tal :- Jath		0.198
20	Balgaon Tal :- Jath		0.142
	Total of local sector		10.283
Total for completed projects in Mcum			120.383
Projects under construction			
A	Minor Projects		
1	Ankalgi Storage Tank Tal :- Jath		4.64
2	Shegaon No 2 Storage Tank Tal :- Jath		1.01
	Total of minor projects		5.65
B	Kolhapur type weirs		
1	Singanhalli Tal :- Jath		1.05
2	Bamani Tal :- Sangola		2.793
3	Bombewadi Tal :- Atpadi		0.30
	Total of KT weirs		4.143
C	Local sector		
1	Udanwadi K.T. weir Tal :- Sangola		0.913
2	Jawala No.2 Tal :- Sangola		1.156
	Total of local sector		2.069
Total for projects under construction in Mcum			11.862
Proposed projects			
A	Minor projects		
1	Umadi No.1 Tal :- Jath		3.48
2	Umadi No.2 Tal :- Jath		1.75
3	Morbaggi Tal :- Jath		1.01
	Total of minor projects		6.24
Total for proposed projects in Mcum			6.24
Total for all projects in Mcum			138.49

Design of Dighanchi branch canal:

Dighanchi, Khavaspur, Lotewadi, Kouthuli and Bombewadi KT weirs comes under command of this branch.

The total water requirement works out 4.467 Mcum. The length of branch is 17.5 km. The discharge works out 2.15 cumecs and cross sectional area is 3.25 sqm (Annexture I).

Annex I : List of reservoirs to feed by Dighanchi Branch		Water Utilisation Mcum.
Name of project		
I) Completed projects		
A)	Kolhapur type weirs	
1.	Khavaspur Tal :- Sangola	1.649
2.	Lotewadi Tal :- Sangola	1.118
3.	Dighanchi Tal :- Atpadi	0.60
4.	Koutholi Tal :- Atpadi	0.80
Total of KT weirs		4.167
Total for completed projects in Mcum		4.167
II) Projects under construction		
A)	Kolhapur type weirs	
1	Bombewadi Tal :- Atpadi	0.30
Total of KT weirs		0.30
Total for projects under construction in Mcum		0.300
Total for all projects in Mcum		4.467

Design of Singanhalli Sankh branch canal:

This branch is further divided into four parts

Buddhel canal:

From the storage capacities of reservoirs in command of this canal .the discharge works out 17.62 cumecs, cross sectional area 15.84 sqm and length 20 km. (Annexture II).

Jujarpur canal:

From the storage capacities of reservoirs in command of this canal the discharge works out to 13.55 cumecs, cross sectional area 12.08 sqm and length 11km.

Jujarpur tunnel:

From the storage capacities of reservoirs in command of this canal the discharge works out to 13.55, cross sectional area 13.04 sqm and length 11 km. Total tunnel excavation in hard rock works out 1,85,735 cum (Annexure III).

Sankh branch:

From the storage capacities of reservoirs in command of this canal the discharge works out to 13.39 cumecs, cross sectional area 12.08 sqm and length 49 km.(Annexture IV)

Annex II : List of reservoir to feed by Buddheal Branch		Water utilisation Mcum.
Name of project		
I) Completed projects		
A)	Medium projects	
1	Sankh Tal :- Jath	14.87
2	Doddanala Tal :- Jath	6.06
3	Bhuddheal Tal : Sangola	19.03
Total of medium projects		39.96
B)	Minor Projects	
1	Bhivargi Tal :- Jath	8.62
Total of minor projects		8.62
C)	Kolhapur type weirs	
7	Alegaon Tal :- Sangola	2.251
Total of KT weirs		2.251
D)	Local sector	
1.	Jawala Tal :- Sangola	1.234
2.	Jawala KT Weir Tal :- Sangola	0.289
3.	Sonand KT Weir Tal :- Sangola	0.553
4.	Sonand No 1 KT Weir Tal :-Sangola	0.499
5.	Ankalgi Tal :- Jath	0.283
6.	Belondagi Tal :- Jath	0.151
7.	Jalihal (Budruk) Tal :- Jath	0.17
8.	Morbaggi No 2 Tal :- Jath	0.184
9.	Maniknal Tal :- Jath	0.191
10.	Balgaon Tal :- Jath	0.365
11.	Sonyal No 2 Tal :- Jath	0.283
12.	Nigadi Karandewadi Tal :- Jath	0.198
13.	Balgaon Tal :- Jath	0.142
Total of local sector		4.542
Total for completed projects in Mcum		36.343
Projects under construction		
B)	Minor projects	
1.	Ankalgi Storage Tank Tal :- Jath	4.64
2.	Shegaon No 2 Storage Tank Tal :Jath	1.01
Total of minor projects		5.65
C)	Kolhapur type weirs	
1.	Singanhalli Tal :- Jath	1.05
2.	Bamani Tal :- Sangola	2.793
Total of KT weirs		3.843
D)	Local sector	
1.	Udanwadi K.T. weir Tal :- Sangola	0.913
2.	Jawala No.2 Tal :- Sangola	1.156
Total of local sector		2.069
Total for projects under construction in Mcum		11.562
Proposed projects		
B)	Minor projects	
1.	Umadi No.1 Tal :- Jath	3.48
2.	Umadi No.2 Tal :- Jath	1.75
3.	Morbaggi Tal :- Jath	1.01
Total of minor projects		6.24
Total for proposed projects in Mcum		6.24
Total for all projects in Mcum		73.18

Annex III : List of reservoir to feed by Jujarpur canal and tunnel		
Name of project		Water utilisation Mcum.
I) Completed projects		
A) Medium projects		
1 Sankh Tal :- Jath		14.87
2 Doddanala Tal :- Jath		6.06
Total of medium projects		20.93
B) Minor projects		
1 Bhivargi Tal :- Jath		8.62
Total of minor projects		8.62
C) Kolhapur type weirs		
1 Alegaon Tal :- Sangola		2.251
Total of KT weirs		2.251
D) Local sector		
1 Jawala Tal :- Sangola		1.234
2 Jawala KT Weir Tal :- Sangola		0.289
3 Sonand KT Weir Tal :- Sangola		0.553
4 Sonand No 1 KT Weir Tal :- Sangola		0.499
5 Ankalgi Tal :- Jath		0.283
6 Belondagi Tal :- Jath		0.151
7 Jalihal (Budruk) Tal :- Jath		0.17
8 Morbaggi No 2 Tal :- Jath		0.184
9 Maniknal Tal :- Jath		0.191
10 Balgaon Tal :- Jath		0.365
11 Sonyal No 2 Tal :- Jath		0.283
12 Nigadi Karandewadi Tal :- Jath		0.198
13 Balgaon Tal :- Jath		0.142
Total of local sector		4.542
Total for completed projects in Mcum		36.343
Projects under construction		
B) Minor projects		
1 Ankalgi Storage Tank Tal :- Jath		4.64
2 Shegaon No 2 Storage Tank Tal :- Jath		1.01
Total of minor projects		5.65
C) Kolhapur type weirs		
1 Singanhalli Tal :- Jath		1.05
2 Bamani Tal :- Sangola		2.793
Total of KT weirs		3.843
D) Local sector		
1 Udanwadi K.T. weir Tal :- Sangola		0.913
2 Jawala No.2 Tal :- Sangola		1.156
Total of local sector		2.069
Total for projects under construction in Mcum		11.562
Proposed projects		
B) Minor projects		
1 Umadi No.1 Tal :- Jath		3.48
2 Umadi No.2 Tal :- Jath		1.75
3 Morbaggi Tal :- Jath		1.01
Total of minor projects		6.24
Total for proposed projects in Mcum		6.24
Total for all projects in Mcum		54.15

Annex IV : List of reservoirs to feed by Sankh canal		
Name of project		Water utilisation Mcum.
I) Completed projects		
A Medium projects		
1 Sankh Tal :- Jath		14.87
2 Doddanala Tal :- Jath		6.06
Total of medium projects		20.93
B Minor projects		
1 Bhivargi Tal :- Jath		8.62
2 Atpadi Tal :- Atpadi		7.96
Total of minor projects		16.58
C Local sector		
1 Ankalgi Tal : Jath		0.283
2 Belondgi Tal : Jath		0.151
3 Jalihal (Budruk) Tal : Jath		0.17
4 Morbaggi No 2 Tal : Jath		0.184
5 Maniknal Tal : Jath		0.191
6 Balgon Tal : Jath		0.365
7 Sonyal No 2 Tal : Jath Tal : Jath		0.283
8 Nigadi Karandewadi Tal : Jath		0.198
9 Balgon Tal : Jath		0.142
Total of local sector		1.967
Total for completed projects in Mcum		39.47
Projects under construction		
A Minor projects		
1 Ankalgi Storage Tank Tal :- Jath		4.64
Total of Minor projects		4.64
B Local sector		
1 Udanwadi K.T. weir Tal :- Sangola		0.913
2 Jawala No.2 Tal :- Sangola		1.156
Total of local sector		2.069
Total for projects under construction in Mcum		7.719
Proposed projects		
B Minor projects		
1 Umadi No.1 Tal :- Jath		3.48
2 Umadi No.2 Tal :- Jath		1.75
3 Morbaggi Tal :- Jath		1.01
Total of minor projects		6.24
Total for proposed projects in Mcum		6.24
Total for all projects in Mcum		53.43

Annex V : List of reservoir to feed by proposal II		
Name of project		Water utilisation Mcum.
D) Completed projects		
A	Medium projects	
1	Sankh Tal :- Jath	14.87
2	Doddanala Tal :- Jath	6.06
	Total of medium projects	20.93
B	Minor projects	
1	Bhivargi Tal :- Jath	8.62
	Total of minor projects	8.62
C	Kolhapur type weirs	
1	Lonarwadi Tal :- Atpadi	0.59
2	Kamalapur Tal :- Sangola	2.187
3	Akole Wasud Tal :- Sangola	2.095
4	Wadhegaon Tal :- Sangola	2.296
5	Manjri Tal :- Sangola	1.913
6	Balawadi Tal :- Sangola	1.031
7	Nazare Tal :- Sangola	1.44
8	Alegaon Tal :- Sangola	2.251
9	Kadlas Tal :- Sangola	2.018
10	Chinake Tal :- Sangola	1.391
11	Watambari Tal :- Sangola	1.51
12	Save Tal :- Sangola	1.962
13	Methawade Tal :- Sangola	2.009
14	Gunjegaon Tal :- Mangalwedha	24.33
	Total of KT weirs	47.023
D	Local sector	
1	Banpuri Tal :- Atpadi	1.29
2	Shetfale Tal :- Atpadi	1.14
4	Jawala Tal :- Sangola	1.234
5	Jawala KT Weir Tal :- Sangola	0.289
6	Sonand KT Weir Tal :- Sangola	0.553
7	Manjari KT Weir No.2 Tal :- Sangola	0.553
8	Kadlas (K.V.) KT Weir Tal :- Sangola	0.962
9	Manjari KT Weir No.1 Tal :- Sangola	0.596
10	Sonand KT Weir No.1 Tal :- Sangola	0.499
11	Ankalgi Tal :- Jath	0.283
12	Belondagi Tal :- Jath	0.151
13	Jalihah (Budruk) Tal :- Jath	0.17
14	Morbaggi No 2 Tal :- Jath	0.184
15	Maniknal Tal :- Jath	0.191
16	Balgaon Tal :- Jath	0.365
17	Sonyal No 2 Tal :- Jath	0.283
18	Nigadi Karandewadi Tal :- Jath	0.198
19	Balgaon Tal :- Jath	0.142
	Total of local sector	9.083

Annexure V contd....

Contd.... Annexure V

Total for completed projects in Mcum	104.096	
II) Projects under construction		
B	Minor projects	
1	Ankalgi Storage Tank Tal :- Jath	4.64
	Total of minor projects	4.64
C	Kolhapur type weirs	
1	Singanhalli Tal :- Jath	1.05
2	Bamani Tal :- Sangola	2.793
	Total of KT weirs	3.843
D	Local sector	
1	Udanwadi K.T. weir Tal :- Sangola	0.913
2	Jawala No.2 Tal :- Sangola	1.156
	Total of local sector	2.069
Total for projects under construction in Mcum	10.552	
Proposed project		
B	Minor projects	
1	Umadi No.1 Tal :- Jath	3.48
2	Umadi No.2 Tal :- Jath	1.75
3	Morbaggi Tal :- Jath	1.01
	Total of minor projects	6.24
Total for proposed projects in Mcum	6.24	
Total for all projects in Mcum	102.448	

Details of proposal II:

Tunnel form Tembhu Barrage to Lonarwadi (Krishna river to Man river directly):

In this proposal, the tunnel start point is considered at upstream of Tembhu Barrage whose F.R.L. is 558 m. The intake point of tunnel will be 500m u/s of Tembhu LIS intake point. The tunnel bed level is proposed at 554.85 m. Considering tunnel gradient 1:2520, length works out to 80 km. The tunnel opens near Lonarwadi KT weir. The Lonarwadi KT weir is on river Man having nalla bed level of 523.10 m (F.R.L. 527.60 m). From this KT weir, part of flood water will be released in to Man river and remaining flood water will be diverted through flood canal towards Singanhalli and then towards Sankh medium project.

Hydraulic design:

Main tunnel:

Total water requirement 0.80 x 102.45+ 30 per cent (For Capacity factor and losses)

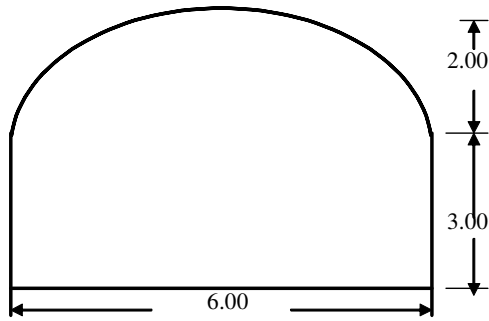
The discharge calculated 24.66 cumecs

The cross-sectional area 24.83 sqm, length of tunnel 80 km and total excavation in hard rock works out 19,86,400 Cum.

Canals:

The canal is divided in two reaches.

– Lonarwadi to Singanhalli



– Singanhalli to Sankh

The discharges for first canal is 10.96 Cumec and length 36.00km

The discharge for second canal is 10.71 Cumecs and length is 49.00 km.

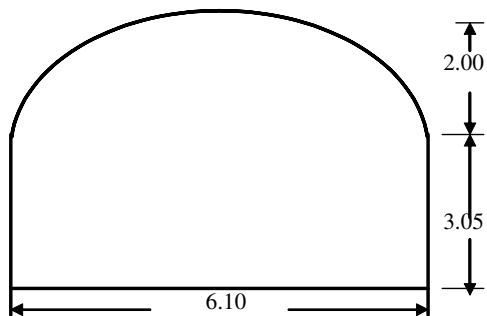
Details of proposal III:

Tunnel from Tembhu Barrage to Lonarwadi (Krishna river to Man river by gravity flow and Man river to Atpadi MI by Lift):

The proposal I is having intake at Kalgoan, which is at u/s of Koyana confluence, so it will have lesser water availability than the proposal II even during floods. In the proposal II, the outlet of main tunnel opens at Lonarwadi KT weir, which is located at the end of Atpadi taluka and the major scarcity command is omitted from benefits.

To overcome these limitations of the above two proposals, the third proposal has been studied. This proposal is combination of the proposal I and II. The command area is as per proposal I and main tunnel alignment is as per proposal II. The main tunnel is as per proposal II i.e. intake at Tembhu and outlet at Lonarwadi. But the capacity of tunnel is increased to match increased command area. The command area is increased equal to proposal I by providing mini LIS from Lonarwadi to Atpadi MI tank. Then from Atpadi MI tank the two flood canals Diganchi branch and Singanhalli Sankh branch are proposed. The proposals are tabulated in the Table A.

Hydraulic design of main tunnel:



The cross-sectional area 25.37 sqm

Total water Requirement 0.80x138.49+30 per cent (For Capacity factor and losses)

The discharge is 33.35 cumecs

EXPERIMENTAL FINDINGS AND ANALYSIS

To increase per hectare water availability sub basins 16A, 16B, 18B (i.e. Yerala, Agrani and Man), Government of Maharashtra is implementing lift Irrigation Schemes namely Tembhu, Takari and Mhaisal. LIS. The topographical conditions shows that Agrani and most part of Man sub basins are situated to 150m above the river Krishna (Fig. C) To divert water from river Krishna to these sub basins one has to implement the lift irrigation scheme. Some part of Man sub basin can be reinforced with water from abundant sub basin 15 A by gravity.

Some part Man sub basin (18B) though is having altitude of near about of Krishna, but it cannot be connected by open gravity channels. It has to cross the Mahadeva range hills to connect these sub basins. The altitude of river Krishna ranges from 555.00 to 530.00 in Sangli district while the altitude of Mahadeva range hills is having altitude of 750-850 m. It means, to connect these two sub basins, one has to do it by lifting or by means of a tunnel. While connecting these sub basins through tunnel it crosses the sub basin Nandani and sub basin Yerala. The clearance between top of tunnel and Nandani river at crossing is 126.00 m, and Yerala river is 82.00 m. It means it is not possible to divert water from Krishna to Nandani and Yerala sub basins by gravity.

In present study, it is proposed to divert abundant water from sub basin 15 A to Sub basin 18 B by gravity (Diverting water from proper river Krishna to sub basin of Man to Jath, Atpadi, Talukas of Sangli district and Sangola taluka of Solapur district) through tunnels.

It can be seen that the water availability along side of Krishna river is near about 45 times of water availability in Yerala Basin and 35 times more of water availability in Man basin, which is hardly 50 to 100 km away from Krishna river. The Table A shows reservoirs, MI tanks and KT weirs can be feed up to Bhima (excluding Ujani command).

Conclusions:

The above three proposals can easily divert water in Man

Description	Proposal I	Proposal II	Proposal III
Intake point of main Tunnel	Near Kalgon	500m u/s of Tembhu intake point	500m u/s of Tembhu intake point
Outlet point of Tunnel	Near Atpadi M.I. tank	Near Lonarwadi K.T.Weir	Near Lonarwadi K.T.Weir
Quantity of water to be diverted	131.79MCM	102.45 MCM	138.49 MCM

sub basin which will definitely increase area under irrigation. It will provide water and reduces the degree of drought-proneness. The comparison of these proposals are tabulated below:

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