Status of Water Availability and Use in Man River Basin

Neither Water nor Governance

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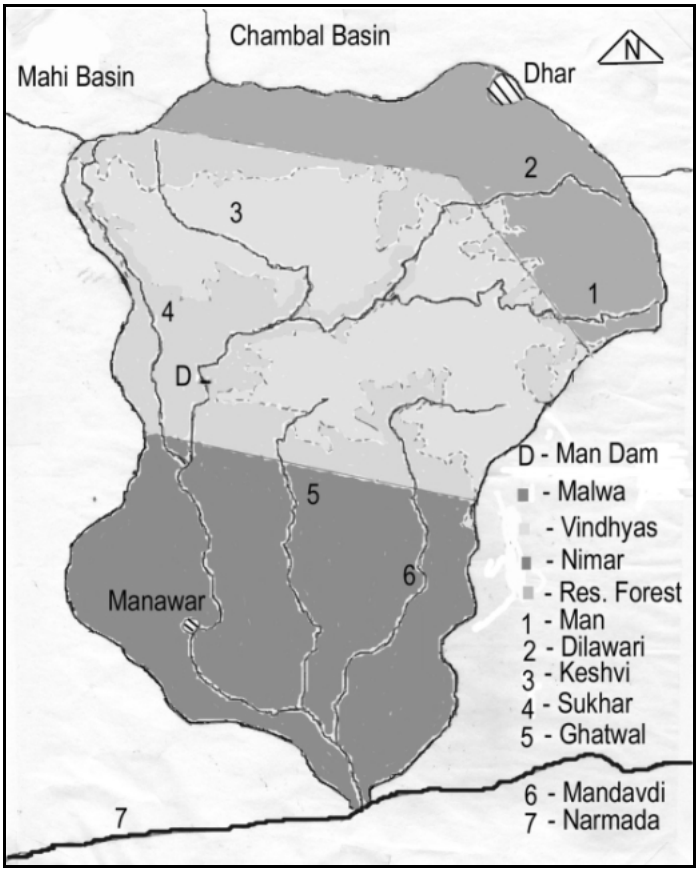
The western Madhya Pradesh region is a naturally water scarce region due to four characteristics that are peculiar to it: The average annual rainfall is low, around 700 mm with the number of rainy days being around 50. Secondly, the soil is mostly clayey and so infiltration of rain water is low. Moreover such soils tend to get waterlogged if subjected to flood irrigation. Thirdly, the underlying rocks are basaltic and sedimentary having low porosity and permeability and so their capacity to store water in underground aquifers is limited. Lastly, the average evapo-transpiration rate for the area is very high at about 2100 mm and so a considerable amount of the rainfall evaporates immediately. In the dry periods during the monsoons and later the moisture retained in the soil gets evaporated. A large amount of the water stored in surface storages big and small too gets evaporated.



Thus traditionally the agriculturists of this region had adopted practices that made the most use of the soil moisture and conserved the ecosystem to ensure a sustainable output. However, from the decade of the 1970s a more intensive agricultural system was introduced involving the use of hybrid seeds, chemical fertilisers and higher irrigation either through canals from dams or through groundwater extracted with pumps. This has led to a growing shortage of water and the need for water governance to regulate use. The effects of this new system on the availability and use of water in the basin of the Man River (a tributary of the Narmada River) as revealed by a study are described briefly here (abridged from a larger study). The characteristics of the Man River basin which make it ideal for such a study of water governance are: the basin spans the three distinct agro-ecological zones of the Malwa plateau, Vindhya hills and the Nimar plains; there is a serious problem of over extraction of ground water in the basin; there is a large dam in the basin affecting water governance drastically; there is a significant tribal population in the basin; considerable soil and water conservation work has taken place in the basin; and the basin has a considerable reserved forest area which is mostly degraded.

The Man River rises in Lunehra village in a tank called Man Sarovar on the Malwa Plateau and then flows for about 12 kms eastwards before plunging down the hilly escarpment of the Vindhya Range for 35 kms upto the Man dam at Zirabad. Thereafter it flows for a further 44 kms through the Nimar plains to its confluence with the Narmada at Kothra village.

The water availability is more or less related to the rainfall in the area whose trends are given in Table 1 over the period from 1987 to 2006. As is evident in more than half the total number of years the rainfall is below the average values and these are the years when the kharif crop is also under water stress leading to lower yields.

Table 1: Annual Rainfall in the Man Basin

(mm)

Year	Dhar	Gan	Man
1987	739	640	602
1988	1099	483	907
1989	783	801	785
1990	1246	1017	1014
1991	596	574	535
1992	540	413	363
1993	969	665	694
1994	1416	1056	1147
1995	822	532	457
1996	1123	954	981
1997	1104	861	763
1998	916	742	709
1999	781	584	632
2000	524	328	385
2001	694	603	585
2002	725	868	619
2003	1091	1017	788
2004	874	590	626
2005	743	543	406
2006	1103	1171	1050
Average	913	738	711

The water use in agriculture in the kharif season in a normal year is well supplied by the rainfall and does not require the application of irrigation.

Thus traditionally the agriculturists of this region had adopted practices that made the most use of the soil moisture and conserved the ecosystem to ensure a sustainable output. However, from the decade of the 1970s a more intensive agricultural system was introduced.

In years of less than normal rainfall there is little scope for providing protective irrigation and this effectively results in water stress and lower yields. Consequently what is more of a concern from the water governance point of view is the water used for the irrigated crops in the rabi season. What has been attempted here first is a rough estimation and comparison of the amount of water used in irrigated agriculture in the Man River basin in 1989-90 and 2005-06 which were both years of normal rainfall. The estimation is based on an empirical formula relating the water requirement to crop coefficients, the potential evapo-transpiration in the different growing periods of various crops and irrigation efficiency as given below.

$Q = 1/I.E.\{ \sum A_i (kc_i \sum ET_o)\}$, where
Q = Total water needed for irrigation
I.E. = The Irrigation Efficiency given by the ratio of the water actually evapotranspirated by the crop and the total water needed to flood the field. This ratio is assumed to be 60% as a considerable amount of the water is lost to seepage.
A_i = The area under a particular irrigated crop
kc_i = Crop coefficient for the particular crop
ET_o = The daily Evapotranspiration rate for a theoretical crop during the different periods

The ET_o for the region varies from a high of 9 mm per day in October to a low of 5 mm per day in late December when the temperatures are lowest and these are summed up depending on the total life period of the crop from germination to harvesting. The average kc value for wheat is about 0.8, for cotton it is 0.9 and for gram it is 0.7

The estimation is done by summing the total water use over the areas of cultivation of the different rabi season crops in Table 2.

Table 2: Estimation of Water Demand For Irrigation of Rabi Crops

	1989				2005			
	Area (ha)	kc	$\sum ET_o$ (mm)	Q (mcm)	Area (ha)	kc	$\sum ET_o$ (mm)	Q (mcm)
Wheat	43528	0.8	950	551.4	48843	0.8	950	618.7
Cotton	25894	0.9	900	349.6	39475	0.9	900	532.9
Gram	20107	0.7	850	199.4	17134	0.7	850	169.9
Total				1100.4				1321.5

Thus there has been an increase in water demand over the period by 20%. This water demand was being met in the Malwa region mostly by groundwater and with some lift irrigation from streams in the Vindhya region. In the Nimar region the component of lift irrigation is higher because of the enhanced flow in the Man River downstream of the Man dam due to seepage under the dam and from the canals. This water demand has to be compared with the average annual precipitation on the total geographical area which is about 3000 million cubic meters. Thus the water demand for irrigation in 2005 was 44% of the total annual precipitation and was mostly met from groundwater. Quantification of ground water recharge as a proportion of the precipitation is a problematic exercise. It is a complex function of meteorological conditions, soil, vegetation, physiographic characteristics and properties of the geologic material within the paths of flow. Soil layering in the unsaturated zone plays an important role in facilitating or restricting downward water movement to the water table. Also, the depth to the water table is important in ground water recharge estimations.

Table 3: Design Characteristics of Man Dam

Particular	Quantity
Total Catchment Area	69000 Ha.
Free Catchment	57680 Ha.
Command Area	15000 Ha., 48 villages
Height of Dam	53 m.
Max.Ht. Level	301 m
Full Reservoir Level	297.65 m
Dead Storage Level	273.0 m
Canal outlet Level	277 m
Full Reservoir Capacity	14503 Ha. m
Utilisable Capacity	12787 Ha.m
Dead Storage	1716 Ha.m
Full Reservoir Area	1094 Ha
Minimum Reservoir Area	283 Ha.
Total Submergence Area	1169 Ha of which - Res. Forest - 5 Ha; Agri. Land - 783 Ha; Waste Land - 381 Ha
Partial submergence villages	17
Number of Affected Households	993
R.B.Canal Flow	4.23 cumecs
L.B.Canal Flow	6.26 cumecs
R.B. Canal Length	11.64 kms
L.B. Canal Length	10.02 kms
R.B. Culturable Command Area	6053 Ha (27 villages)
L.B. Culturable Command Area	8947 Ha (21 villages)

Consequently it is not possible to accurately estimate what is the annual recharge in the Man basin without extensive physical measurements but estimates done in hard rock areas show that it is not more than 11% of the total annual rainfall. Thus, the current level of extraction being four times higher, the groundwater aquifers have become over exploited and the surface storages too are not capable of meeting this demand leading to water stress and lower yields of crops in the Rabi season in

recent years. Moreover, the nitrate levels in phreatic aquifer are also well above the permissible limit of 100 mg/l due to the excessive use of nitrogenous fertilisers.

On the surface water utilisation front the salient features of the Man dam at Jirabad are given in Table 3.

There are a number of points on which the operation of the Man Dam as it stands today can be critiqued.

Inadequate and Poorly Constructed Canal Network Contrary to the design the Right Bank Canal Network has been developed more than the Left Bank Canal Network. In both cases the main canals, the distributaries and the minors have been built less than the design length. Moreover the construction of the canals is very poor and in many stretches the proper trapezoidal section and dimensions as per the designs have not been adopted, even for the main canal. Moreover, even though it is claimed in the final cost estimates that 18.42 km length of the main canal has been lined this is not the case in reality as only those sections of the main canal that have been constructed above the ground level through earth filling to maintain the level have been lined and this length is far less. In fact the total final cost of lining is a meager Rs 2.7 crores. This together has led to the main canals being unable to take the design flows and consequently the actual flow in the LBC varies between 2 - 3 cumecs and that in the RBC between 3 - 6 cumecs.

Seepage and Water-logging The Water and Power Consultancy Services (WAPCOS) was engaged by the Madhya Pradesh Government to study the problems that might beset the canal network in the form of seepage given the kind of soil through which the canals were to pass and suggest remedies. The WAPCOS report of 1980 assumes the following estimates for losses:

1. Lined System
a) Main Canal and Branches - 4 cusecs/million sq. ft.
b) Distribution System - 6 cusecs/million sq. ft.
2. Unlined System
a) Main Canal and Branches - 15 cusecs/million sq. ft.
b) Distribution System - 20 cusecs/million sq. ft.

The costs are then worked out for the canal system for different scenarios of unlined and lined systems. This is done by estimating the area of command for each scenario which goes on increasing as the system is progressively lined. Consequently even though the cost of lining goes up the cost per hectare comes down as the increase in the command area due to lining more than offsets the increased cost of lining as follows:

1. Wholly Unlined - Rs 13,675/Ha
2. Main Canals and Branches Lined- Rs 12,380/Ha
3. Lining upto 40 Ha blocks Rs 11,033/Ha
4. Lining upto 8 Ha blocks Rs 10,607/Ha

Table 4: Water use in the Man Dam Command

	Name of Village	No. of Farmers Irrigating directly by Canal	No. of Farmers Irrigating by Motor Pumps on Canal	No. of Farmers Irrigating by Siphons on Canal	No. of Farmers with plots Waterlogged by seepage
R B C	Karondia	7	17	29	28
	Chakrud	11	32	49	22
	Bargodra	4	7	16	6
	Awalda	71	38	89	51
	Kharki	29	65	79	57
	Bhamori	2	15	15	33
	Panwa	83	60	34	63
	Lakhankot	5	27	73	25
	Baria	38	8	16	1
	Julwania	21	4	72	8
	Jaydi	23	19	51	52
	Kalwani	8	1	27	1
	Lunehra	93	8	9	1
	Chikhli	65	6	16	12
	Kustali	73	0	4	10
	Total RBC	**533**	**307**	**579**	**370**
L B C	Indiav	8	0	26	11
	Chirakhan	8	24	26	16
	Avral	3	0	23	3
	Borlai	25	51	29	47
	Temria	27	76	12	60
	Udiapur	31	0	21	9
	Muhali	30	8	23	54
	Jalkha	9	6	8	12
	Total LBC	**141**	**165**	**168**	**212**
	Total	**674**	**472**	**747**	**582**

The Detailed Project Report of the Man Dam goes on to say on the basis of this, "In view of this and the recommendations of the World Bank in their Staff Appraisal Report no. 3260-IN of February, 1981, lining of the whole canals system upto 5 to 8 Ha blocks is proposed in the Man Project."

Contrary to this, as mentioned earlier, only a small part of the main canal have been lined and so huge seepage losses are taking place. So great are these losses, given the poor construction of the canals, that as soon as the main canals are charged, the drainage nullahs begin to flow with seepage water and they continue to do so throughout the irrigation season.

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Naturally the command area has shrunk considerably as there is not enough water flowing in the canals and in the 2007-08 season the "Elan" was for only 5000 Ha or one third of the design command.

The actual irrigation took place in only 2765 Ha in 15 villages by the Right Bank Canal and 2153 Ha in 14 villages by the Left Bank Canal for a total of 4918 Ha. This includes, in addition to the irrigation from water taken from the distributaries through field channels, the irrigation done from the seepage water collected in tanks. The incompleteness of the canal network and the meager flow in the main canal itself, depleted by seepage, has led to the farmers using their own means to lift water from the canals quite audaciously. Moreover, the heavy seepage has also led to water-logging in several farm plots close to the main canals. A survey was conducted in the 2007-08 irrigation season of the ways in which water was being drawn by the farmers and the number of farmers who had been affected by seepage and the data is shown in Table 4.

Given that the final cost of the project in 2004 was Rs 176.75 crores (compared to the cost of Rs 35.94 crores in 1982) and the additional irrigation achieved is only 4000 Ha (5000 Ha minus the 1000 Ha lost to water-logging), the cost per hectare of irrigation provided turns out to be a whopping - Rs 4,41,875. This should be compared with the alternative of the watershed plus approach which can ensure soil moisture for rabi cultivation at a cost of Rs 12,000 per hectare only, apart from social and environmental benefits of communitarian soil and water conservation work.

Thus it is obvious that there are considerable problems with regard to withdrawal of water from the canals what with use by motor pumps and siphons exceeding by 80.8% that being supplied directly. There is also a large number of farmers affected by water-logging due to seepage. The proportion is as high as 30.1%. These farmers have had to either abandon this land or construct drainage channels to divert the seepage water. At least a thousand hectares or so of land is so affected by seepage and despite several petitions given by the affected people to the administration; no remedial action has been taken.

Thus, here the whole question of the appropriate method by which to ensure the presence of soil moisture in most of the lands in the command area during the Rabi season comes to the fore. Prima facie it can safely be said that there is neither water nor governance in the Man River basin.

Not surprisingly there is tremendous competition for canal water towards the lower reaches where the flow becomes very low due to seepages and unauthorised withdrawals are up. Regulatory structures have been broken by the farmers and they draw water at will.

Unsuitability of Command for Flood Irrigation 60.2% of the command area consists of land that is unsuitable for flood irrigation without extensive land leveling and bunding work and yet the project was sanctioned without any provision in the budget for such land leveling work. In fact in addition to this considerable length of drainage channels also need to be built but this finds only cursory mention and a provision of a paltry Rs 9.42 lakhs in the original DPR of 1982. However, later this absurdly low provision also has been done away with in the final cost estimate of 2004. This omission has obviously been done to keep down the costs of the project and artificially improve the cost benefit ratio. Costs of afforestation and soil conservation in the catchment have also been ignored and the oustees of the dam have been denied proper rehabilitation. All these economisations have added to the problems of the dam as the silt load has gone up and the oustees have not only remained in the submergence area to practice drawdown agriculture but have also engaged in agitation and litigation under the banner of the Narmada Bachao Andolan.

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