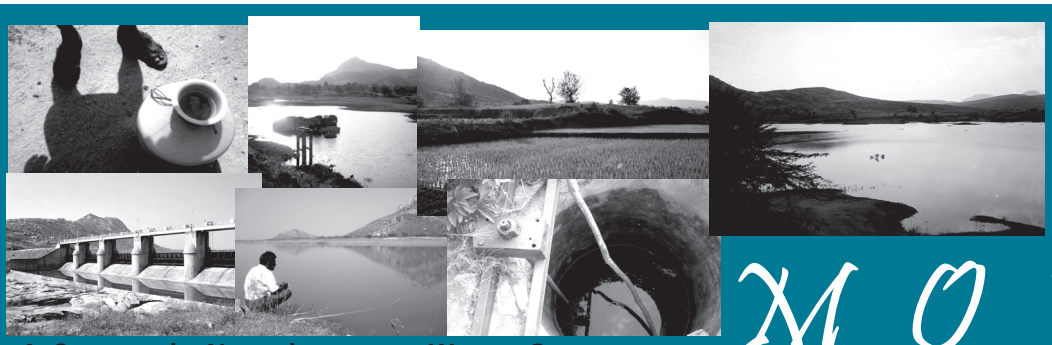

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Issues of Water Governance in the Man Basin

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This article is based on a study on water governance in the Man Basin, a medium sized sub- basin of the Narmada river basin in tribal-dominated western Madhya Pradesh. The study dealt with problematic issues of water governance in the basin and generated insights and guidelines that are important for both grassroots and policy level interventions in future. The article attempts to present a methodology to study the relationship between water availability and water use to see if it sustainable and suggest measures for improvement. It also presents an analysis of the use of agricultural water and energy use in the basin.

Hydrological Estimation

The most important technical information from a water governance point of view is that regarding the availability of water and its use. This is garnered from a study of the surface and groundwater hydrology of the basin. The concentration of hydrological studies in India has been on determining the runoff of rivers either to help in controlling floods or in estimating the dependable flow that can be impounded in dams for use in electricity generation and canal irrigation (Subrahmanya, 1994). Thus various empirical formulae have been derived that give a very rough idea of the runoff in large river basins like the Narmada. Invariably these models, which are broad approximations based on river flow measurements, tend to err on the higher side as has been amply demonstrated by the estimation of the flow of the Narmada river for the Narmada Water Disputes Tribunal which overestimates the actual flow by 27 per cent (Paranjpye, 1990).

Indeed the continuous measurement and estimation of surface and subsurface flows and water use has never been done in the Man basin and nor is it being done at present. So much so that for the design of the Man dam in the 1970s there was no data available from the basin regarding runoff, river flow, natural recharge and return flow. The design was done on the basis of the results of a linear regression equation set up between the rainfall and runoff data for the Narmada river between Mortakka and Garureshwar gauging stations which are over a hundred kilometres apart. No equipment has been installed at the Man dam for taking accurate measurements of the flow in the river. Neither have detailed geological investigations been carried out to determine the amount of natural recharge taking place in

the basin. Moreover, there is no compiled record with the various constructing agencies regarding the water storage capacities of the innumerable water storage structures that have been created in the basin. Consequently the water resources bureaucracy does not have any credible estimates of water availability and use in the Man basin.

On the other hand there have been another set of hydrological studies that are concerned with the water balance in small watersheds as an aid to watershed development work. These micro-models also rely on empirical formulae for the estimation of infiltration, surface runoff, evapo-transpiration and return flow based on the soil characteristics, gradient, underlying rock structure, cropping pattern and the rainfall pattern in these watersheds. A model was developed along these lines and scaled up for application at the larger sub-basin level for the purposes of this study (SOPPECOM, 2007). The model consists of empirical formulae for estimating the surface runoff, infiltration and evapo-transpiration. The return flow from groundwater is to be estimated in this model by measuring the flow of the river over a water structure at some point in the basin and deducting the contribution of surface runoff from it. However, this model turned out to be inappropriate for the Man river basin for the following reasons -

- The basin is very large in size and spans three agro-ecological regions with differing rainfall, soil, topography, underlying rock structure and cropping pattern. Under the circumstances it is not possible to assume a single average value of the empirical constants such as Curve Numbers and Crop Coefficients across the basin. Moreover without a detailed study of the underlying rock characteristics no worthwhile estimate of the infiltration or return flow could possibly be made.
- There are innumerable big and small water retaining structures in the basin and most of them do not have their dimensions formally recorded as mentioned earlier. Thus it is a Herculean task to account for the hydrological impact of these on surface and subsurface flows while attempting to estimate the water balance in the basin.
- Proper measurement of flow over the dam and the utilization of the capacity of the reservoir are not being done by the Narmada Valley Development Authority (NVDA) as only the level of the water at the dam is measured once daily. Moreover, in the Rabi season there is considerable drawal of water through lift irrigation. There is thus no possibility of getting a reliable estimate of the flow at the dam in Zirabad.

Consequently any authentic water balance estimation exercise in the basin will require the use of computer simulated models and a detailed primary investigation of soil, topographical and hydro-geological characteristics both on the ground and through satellite imagery (Singh & Woolhiser, 2002, Dhar et al. 2006). This is beyond the scope of the present research as the purpose of the present study is not so much to estimate the water balance as to study the relationship between water availability and water use to see to what extent it is sustainable and if not then suggest measures for improvement. The water availability is more or less related to the rainfall in the area whose trends were studied over the period from 1987 to 2006. 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 than potential yields.

Another major factor in both agricultural productivity and water availability are the characteristics of the soil. A perusal of the Dhar District Soil Map (Tamgadge et al., 2001) reveals that the soil depth in the catchment area of the Man dam is either very shallow or shallow except in a thin strip along the river. The soil depth is deep or slightly deep in the command area. The level and extent of soil degradation is quite high in the whole basin with a considerable amount of the land having become irreclaimable at the farm level. Most of the catchment area is subject to very severe soil erosion and the rest of the basin suffers from moderate and severe soil erosion. The available water holding capacity is either very low or low in most areas of the basin. While the organic carbon content of the soil is medium to high in the basin, the nitrogen content is low and the potassium content is medium with the overall soil quality being low in the catchment area and medium to high in the command area.

Given that the focus in Rajiv Gandhi Watershed Mission implementation in the district has been more

on constructing the structures rather than on ensuring people's participation and equity in the sharing of benefits, over time community maintenance of the structures has suffered and they have decayed (Londhe, 2003). Moreover, extensive soil and water conservation work has not been done because of this concentration on building structures and the per hectare investments have been only around Rs 2000 as opposed to the norm of Rs 10,000 for effective treatment (Ahluwalia, 2005). Thus in the absence of effective soil and water conservation work due to indifferent implementation of the RGWM and also inadequate catchment treatment work by the Narmada Valley Development Authority (NVDA), in years of less than normal rainfall there is minimal scope for providing protective irrigation to most of the land under kharif cultivation. This results in water stress and lower yields. The dryland sowing in the rabi season is also adversely affected in low rainfall years owing to lack of soil moisture. The characteristics of the soil also imply that even in a normal year there is comparatively low productivity in most farms due to water stress arising from low soil moisture given the trend in the region of there being long rainless periods between heavy showers combined with a high potential evapo-transpiration rate.

Consequently what is more of a concern from the water governance point of view is the availability and use of water for the irrigated crops in the rabi season which constitutes the highest human water consumption category. What has been attempted here is a rough estimation and comparison of the amount of water used in agriculture in the Man river basin in 1989-90 and 2005-06 which were both years of adequate 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 developed from crop water requirement research (Doorenbos et al. 1986) 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 evapo-transpirated by the crop and the total water needed to flood the field. This ratio is assumed to be 60 per cent and so the value will be 0.6. In the kharif season since there is no irrigation the value will be 1.

Ai = The area under a particular irrigated crop

kci = Crop coefficient for the particular crop

ETo = The daily evapo-transpiration rate for a theoretical crop during the different periods

The evapo-transpiration rate and the crop coefficient are highly location specific and ideally should be experimentally determined in the basin itself in the separate agro-ecological zones. However, for the purposes of this estimation the Indian Meteorological Department data have been relied on (http://indiawaterportal.org/metdata). The average daily ET_o for Dhar district over the year is mentioned in Table 1 below.

Table 1: Average Values of Daily Potential Evapo-transpiration Rate in Dhar District

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ET_o(mm)	6.03	6.86	7.82	8.75	8.96	7.67	5.88	5.19	5.93	6.97	6.48	5.91

Source: Indian Meteorological Department (http://indiawaterportal.org/metdata)

The daily values are summed up depending on the total life period of the crops from germination to harvesting. The cropping area data for the villages in the basin have been summed up for the main kharif season crops of sorghum, maize, paddy, soyabean, groundnut, redgram and blackgram and the three main rabi season crops of wheat, gram and cotton (this is sown in the summer or kharif season but continues into the rabi season when the cotton is harvested so its growing period has been divided into both the seasons) for 1989-90 and 2005-06 for the three agro-ecological regions. The average kc values for the crops are calculated on the basis of FAO guidelines (Doorenbos et al. 1986). This estimation gives the water demand for maximum yield under optimum conditions. The total precipitation over the whole area of the agro-ecological zone is also calculated. The results of these estimations for the three zones have been given in Table 2 in next page.

There is an increase in water demand in the kharif season in the Malwa region mainly due to the significant increase in area under soyabean which far outweighs the decrease in cultivation of coarse cereals, pulses, groundnut and cotton. The rabi season demand shows a slight decrease due to a corresponding decrease in area under the crops. Owing to lower rainfall in 2005-06 the water demand to total precipitation ratio shows more of an increase than has actually happened over the period. However, even at the 1989 level of 25.12 per cent of total precipitation the water demand in the rabi season is quite high.

Table 2: Estimation of Water Demand for Agriculture in Malwa Region of the Basin

Agro-ecological Zone	Crop	1989					2005				
		Area (ha)	Kc	∑ET$_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)	Area (ha)	kc	∑ET$_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)
Kharif	Sorghum	2101	0.8	750	12.61		133	0.8	750	0.80	
	Maize	1143	0.9	800	8.23		904	0.9	800	6.50	
	Paddy	105	1.1	800	0.92		28	1.1	800	0.25	
	Soyabean	6308	0.8	700	35.32		14399	0.8	700	80.63	
	Groundnut	128	0.9	800	0.92		29	0.9	800	0.21	
	Pulses	1084	0.9	700	6.83		412	0.9	700	2.60	
	Cotton	170	0.7	500	0.59		80	0.7	500	0.28	
	Total				**65.44**	**333.44**				**91.26**	**295.17**
	Water Demand/ Total Prec. (%)					**19.62**					**30.92**
Rabi	Wheat	4536	0.8	950	57.46		4465	0.8	950	56.55	
	Cotton	170	0.9	500	1.28		80	0.9	500	0.60	
	Gram	2522	0.7	850	25.01		2224	0.7	850	22.06	
	Total				**83.75**	**333.44**				**79.21**	**295.17**
	Water Demand/ Total Prec. (%)					**25.12**					**26.83**

Table 3: Estimation of Water Demand for Agriculture in the Vindhya Region of the Basin

Agro-ecological Zone	Crop	1989					2005				
		Area (ha)	kc	∑ET$_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)	Area (ha)	kc	∑ET$_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)
Kharif	Sorghum	8673	0.8	750	52.04		3754	0.8	750	22.52	
	Maize	7702	0.9	800	55.45		6089	0.9	800	43.84	
	Paddy	780	1.1	800	6.87		187	1.1	800	1.65	
	Soyabean	686	0.8	700	3.84		9066	0.8	700	50.77	
	Groundnut	1637	0.9	800	11.79		777	0.9	800	5.59	
	Pulses	8247	0.9	700	51.95		4253	1.0	700	26.79	
	Cotton	3580	0.7	500	12.53		7125	0.7	500	24.94	
	Total				**194.47**	**706.71**				**176.10**	**813.73**
	Water Demand/ Total Prec. (%)					**27.52**					**21.64**
Rabi	Wheat	2258	0.8	950	28.60		3024	0.8	950	38.30	
	Cotton	3580	0.9	500	26.85		7125	0.9	500	53.44	
	Gram	442	0.7	850	4.39		342	0.7	850	3.39	
	Total				**59.84**	**706.71**				**95.13**	**813.73**
	Water Demand/ Total Prec. (%)					**8.47**					**11.69**

There is a decrease in water demand in the kharif season in the Vindhya region. The increase in cotton and soyabean cultivation has been outweighed by the decrease in coarse cereals, pulses and groundnut cultivation and the reduction in area under cultivation as a whole. There is a significant increase in water demand in the rabi season owing to increase in wheat and cotton cultivation. But even then the ratio of water demand to total precipitation is still moderate. Even after factoring in the higher rainfall in 2005-06 the rabi water demand is within safe limits primarily because of the comparatively limited development of tubewell irrigation in the region due to unfavourable underlying deep aquifer characteristics. As noted earlier most of the additional irrigation has been achieved through lifts from tanks/ streams and well irrigation. This substantiates the earlier finding that aquifer characteristics govern the extent of water use in the basin more than landholding size or distribution.

Table 4: Estimation of Water Demand for Agriculture in Nimar Region of the Basin

Agro-ecological zone	Crop	1989					2005				
		Area (ha)	kc	$\sum ET_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)	Area (ha)	kc	$\sum ET_o$ (mm)	Q (mcum)	Total Annual Precipitation (mcum)
Kharif	Sorghum	7072	0.8	750	42.43		1183	0.8	750	7.10	
	Maize	7847	0.9	800	56.50		7407	0.9	800	53.33	
	Paddy	518	1.1	800	4.56		160	1.1	800	1.41	
	Soyabean	143	0.8	700	0.80		7278	0.8	700	40.76	
	Groundnut	2051	0.9	800	14.76		404	0.9	800	2.91	
	Pulses	5537	0.9	700	34.88		2370	0.9	700	14.93	
	Cotton	10265	0.7	500	35.93		15414	0.7	500	53.95	
	Total				**189.87**	**522.91**				**174.38**	**541.47**
	Water Demand/ Total Prec. (%)					**36.31**					**32.20**
Rabi	Wheat	4319	0.8	950	54.71		6784	0.8	950	85.93	
	Cotton	10265	0.9	500	76.99		15414	0.9	500	115.60	
	Gram	602	0.7	850	5.97		283	0.7	850	2.81	
	Total				**137.67**	**522.91**				**204.34**	**541.47**
	Water Demand/ Total Prec. (%)					**26.33**					**37.74**

There has been a slight decrease in water demand in the kharif season in the Nimar region accompanied by a significant increase in the rabi season achieved through both increase in tubewell and lift irrigation. The above water demand calculations are for maximum yield of crops which is defined as - "the harvested yield of a high producing variety, well adapted to the given growing environment, including the time available to reach maturity, under conditions where water, nutrients and pests and diseases do not limit yield" (Doorenbos et al. 1986). However, the reality in the basin is that the average yields are much lower than the maximum yields as indicated in Table below. Clearly the average yields in the basin taking all crops is only 40 per cent of the maximum yields and so the water demands calculated above will have to be scaled down by about 30 per cent assuming that the other 30 per cent deficit is due to the other factors that determine maximum yield in the definition above.

Table 5: Average Yields of Crops in Man Basin and Their Maximum Yields (kgs/ha)

	Sorghum	Maize	Paddy	Soyabean	Groundnut	Pulses	Cotton	Wheat	Gram
Man Basin	1225	2178	773	1076	921	609	1230	3323	781
Maximum	3500	6000	6000	2500	3000	1500	3000	5000	1500

Over and above this the average rainfall in the three regions is much less than that recorded in the years under consideration which were good rainfall years. Thus it would be more appropriate to correct total annual precipitation downwards to accord with the average rainfall also before assessing comparative water demand. The comparative change in the ratio of water demand to total precipitation in the basin corrected by taking the average yield and average rainfall for calculation are given in Table 6 below.

Table 6: Comparative Change in Water Demand/ Total Annual Precipitation Ratio*

Agro- Climatic Zone	Water Demand/Total Annual Precipitation (%)						Change (%)		
	1989			2005					
	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
Malwa	18.74	24.00	42.74	26.15	22.69	48.84	39.51	-5.45	14.27
Vindhya	26.55	8.17	34.72	24.04	12.98	37.02	-9.46	58.92	6.63
Nimar	36.25	26.29	62.53	33.29	39.01	72.30	-8.17	48.42	15.62

* Calculated by correcting values in Tables 2-4 downwards for average rainfall and average yields.

Thus there has been a substantial increase in water demand in the rabi season over the period in the Vindhya and Nimar regions, while the kharif water demand has decreased slightly. The opposite is true in the Malwa region where kharif water demand has risen substantially while the rabi demand has declined slightly. Assuming that the kharif water demand is mostly being met by the rainfall the crucial issue to be considered here is whether the rabi water demand is sustainable or not. As we have seen earlier, ninety per cent of the rabi demand in the basin is being met from groundwater either in the return flow in the streams or in the confined and unconfined aquifers. Thus it has to be assessed whether the groundwater demand in the rabi season is less than the groundwater recharge or not.

Quantification of groundwater 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 groundwater recharge estimations. Consequently it is not possible to estimate accurately what is the annual recharge in the Man basin without extensive physical measurements. But estimates done in dry hard rock areas with gentle slope show that it is not more than 11 per cent of the total annual precipitation (Rangarajan et al. 2009).

In the present case considerable parts of the basin have high slopes and degraded lands and so the natural recharge should be much less and since the quality and extent of soil and water conservation works has not been good not much artificial recharge is taking place. Consequently the total groundwater recharge in the basin is in all probability less than 10 per cent of the total annual precipitation. Thus, the current levels of the rabi season water demand as a proportion of total precipitation in the Malwa (22.69 per cent) and Nimar (39.01 per cent) regions is highly unsustainable and even the Vindhya (12.98 per cent) region is under stress resulting in the groundwater aquifers in the basin having become over exploited. It must be remembered that the actual water demand is higher because there are other crops also which have not been considered in the estimation because of their marginal acreage. The low average yields too seem to indicate that both in the kharif and the rabi season there is water stress despite this high level of extraction of groundwater primarily because in most farms soil depth is low leading to high evapo-transpiration losses and insufficient soil moisture.

A more detailed investigation of surface runoff, seepage and evapo-transpiration is in order to accurately estimate the water availability and use in the basin.

This would require the detailed study of the hydro-geology, topography, forest cover and cropping patterns at the farm plot level. Even if this were to be done only in the catchment and command areas of the Man dam this would involve the study of as many as 265 villages with 98317 different landholdings and more than 3,00,000 farm plots. Each farm plot's characteristics would have to be noted and then the values for curve numbers, crop coefficients, infiltration and the like calculated to arrive at the aggregate surface runoff, seepage and evapo-transpiration values. Approximation even at the level of the village will lead to errors as the characteristics vary considerably across farm plots. Consequently the exercise of rigorous estimation of water availability and use is not possible within the scope of the present project.

The above analysis has made it clear that this work of detailed and accurate hydrological estimation should ideally be taken up by an autonomous government agency that has the skills and financial resources to undertake the task. This agency should not be a part of the water resource project implementation setup so as to be objective and unbiased in its work. Moreover, the collation of the ground level data on land use, cropping patterns, agricultural production, irrigation prevalence and land distribution which are crucial to such estimation should also be made more authentic by involving the people and having it verified by the Gram Sabha. At present this work is being done by the Patwari who has typically been given charge of more than one village and so the data is unreliable. Without these ameliorative measures good water governance will not be possible.

Finally a word about the deterioration of the quality of groundwater in the basin due to policy failure with respect to provision of fertilizer subsidy. A tricky aspect of agriculture is the optimization of nutrient ratios in mixed fertilizer application (Trionfo, 2000). Depending on the soil characteristics there is an optimum ratio at which the nitrogen, phosphorus, potash and micro-nutrient fertilizers must be applied. If one of these fertilizers is applied in excess of its optimum requirement then this excess application will not be absorbed by the plants because they can take up only that much which accords with the amount applied of the other fertilizers. Over the past decade or so faced with a resource crunch the government has been reducing the subsidy given to fertilizers in a lopsided manner. The withdrawal of subsidy from potassium and phosphorus fertilizers has been much more than for nitrogen. This has made the farmers apply much more urea because it is comparatively cheaper than the others. Consequently most of this over application of urea has not been absorbed by the plants and has gone waste. It has either run off, been decomposed into nitrogenous gases by the denitrifying bacteria in the soil or mostly it has seeped into the groundwater. Consequently the nitrate levels in the phreatic aquifer were well above the permissible level of 100 mg litre in the Malwa and Nimar regions of the basin (CGWB, 2005).

Analysis of Agricultural Water and Energy Use in the Basin

The constraint on water availability for irrigation demonstrated above was sought to be overcome in the late 1970s by the government through provision of electricity at a subsidized rate for the operation of pumps and subsidized loans for the purchase of pumps and other accessories. Thus farmers could tap the water stored in the deeper confined aquifers by sinking tubewells and installing submersible pumps and also the base flow in the streams and rivers through lift irrigation at relatively small capital and operating cost to themselves. In 1993 the new Congress government in the state made the supply of electricity to agricultural pumps of five horsepower or less free thus further reducing the cost of water.

While this boosted agricultural production considerably it also created what has come to be characterized in natural resource economics as a "tragedy of the commons" (Hardin, 1968). Normally in the case of a non-renewable resource the user has to trade off resource use between successive time periods to optimize production in the long run because the more the resource is used the greater is its extraction cost and more is its scarcity value (Hotelling, 2003). The water in the deep confined aquifers in dry hard rock regions is akin to a non-renewable resource because it has accumulated over thousands of years from the minimal amount of percolation into these aquifers that has taken place annually. Thus when this water is pumped out in large quantities in a particular year far in excess of the minimal recharge that is taking place, the water level decreases and

in the next year the extraction cost will be greater and this will keep increasing with time. However, in a situation in which this extraction cost was rendered close to zero by electricity being made free and the water itself being a common property resource did not have any price attached to it and neither did its depletion result in a scarcity value, all the farmers tended to use as much water as they could get as in the long run the water would be finished even if a few farmers adopted a more conservationist approach.

In situations in which there are public goods with no well defined property rights as with groundwater either the state has to step in to regulate its use through fiscal or legal measures or there has to be communitarian command over its use as markets fail (Heal, 2000). However in this case the state too failed by adopting the opposite stance of subsidizing the greater use of water.

The crunch came at the turn of the century when the Madhya Pradesh government as part of the conditions for getting a loan from the Asian Development Bank (ADB) for restructuring its power sector had to begin charging farmers for electricity supplied to them at cost plus profit rates determined by the Madhya Pradesh Electricity Regulatory Commission. The ADB imposed this fiscal prudence on the government so as to ensure that it could pay back the loan that was being given. The prolonged bleeding of the finances of the Madhya Pradesh State Electricity Board and the government due to the free power supplied earlier had hampered the addition of new power generation capacity and so the quantity and quality of power supplied to rural areas also began to suffer. The shortfall had to be made up by purchasing power from the national grid and this too pushed up the cost of electricity further. In addition to this heavy withdrawals of water had led to the severe depletion of the confined aquifers and many of the tubewells had either gone dry or were yielding much less water. Most of the blocks in Western Madhya Pradesh were declared to be either critical or over exploited in terms of groundwater resources. Finally the continuous cultivation of the soyabean/ cotton - hybrid wheat monoculture had reduced the fertility of the soils calling for an increased application of chemical fertilizers which too had become scarce and more expensive owing to a combination of supply not keeping pace with demand and declining subsidies.

The seriousness of the economic aspects of the problem thus created can be illustrated with the comparative economics of the production of the popular Lok 1 variety of hybrid wheat in the free electricity and bigger fertilizer subsidy era in 1997 and the cost plus profit electricity charges and lower fertilizer subsidy regime now prevailing a decade later. This has been compiled from a survey conducted under this study and appears below in Table 7.

Table 7: Comparison of the Economics of Production of Lok 1 Wheat Variety

Break-up	***1997***	***2009***
Seed Cost	200 kg @Rs 8/kg= 1600	200 kg @Rs 15/kg = 3000
Sowing cost (land preparation+ first watering + sowing)	1500	3400
Phosphate + Potash Fertilizer	150 kg @Rs 3/kg= 300	200 kg @Rs8.75/kg= 1750
Urea Fertilizer	180 kg @Rs 2/kg= 360	240 kg @Rs6.04/kg= 1450
Watering	5 waterings@ Rs200/w= 1000	3 waterings @ Rs2500/w= 7500
Harvesting	1900	2200
Threshing	1200	2400
Total Cost /Ha	7860	21700
Output Value/Ha	5100kg @ Rs6.5/kg= 33150	3390kg @ Rs11/kg= 37290
Net Income/Ha	**25290**	**15590**

The crucial difference has been made by the reduction in output resulting from a lack of sufficient water. If two more waterings had been possible in 2007 then output would have been 5100 kgs per hectare as before and the net income per hectare would have been higher by about Rs 10000 bringing it at par on nominal terms with the earlier net income. However, even if the farmers are prepared to pay the higher charges there just isn't so much water any more because in the intervening decade the number of farmers sowing wheat has risen considerably reducing the availability of water per farmer.

This is in fact a nationwide phenomenon and there are many inefficiencies in this system of power and fertilizer subsidies (Bhatia, 2007). Supply of highly subsidized power provided at flat rates or free power tends to make the farmers wasteful in the use of electricity. Moreover, because it is difficult to keep track of the quantity of power supplied under a flat rate or free power system there are huge losses due to theft or illegal supply to sectors other than agriculture. Part of this loss has to be made up by cross subsidies from the industrial and commercial sector thus pushing up costs in that sector and through cascading in the economy as a whole apart from encouraging more theft. Most importantly the lack of regulation of groundwater usage that goes with this low cost supply of power disincentivizes the farmers from adopting land management and agricultural practices that conserve soil moisture and enhance artificial recharge which can in turn reduce their demand for energy (CGWB, 2008).

Seeking An Alternative

Towards bringing about a change in agriculture and water use an experiment was tried out as part of this study with a dryland wheat variety that requires just one or two waterings. A few farmers cultivated the dryland durrum wheat variety named Amrita (HI 1500) developed by the Wheat Research Centre of the Indian Council of Agricultural Research in Indore. This variety requires just one more watering after the first watering before sowing and can give yields of between 3000 and 3500 kgs per hectare at the maximum which is comparable with the yields of Lok 1 variety under three waterings. Moreover, this wheat requires no pesticide and can be grown with biofertilizers or organic compost. Since little or no watering is required the immense amount of labour involved is saved along with the cost of electricity or diesel for pumping of water. The results have been quite encouraging as is clear from Table 8 below.

Table 8: Economics of Production of Amrita Wheat Variety

	2009	
Seed Cost	100 kg @Rs 16.5/kg =	1650
Sowing cost (land preparation + first watering + sowing)		3400
Biofertilizer or Organic Compost		4000
Harvesting		2000
Threshing		2000
Total Cost /Ha		13050
Output Value/Ha	2680kg @ Rs11/kg =	29480
Net Income/Ha		**16430**

It is noteworthy that in all the locations where the seed was sown, the soil type was medium quality clayey soils and owing to lack of water only the first watering at sowing could take place. Despite this the crop came to fruition and the average yield was 2680 kg per hectare. Dryland wheat requires less seed as it has to be sown at a greater distance between plants. It requires less labour for harvesting and threshing and also obviously much less water. So in the end despite a lower production per hectare

than Lok 1 with three waterings turns out to be economically superior to it. The demonstration effect of this has been tremendous. More and more farmers are adopting this dry land variety.

This variety is known technically as durrum wheat as opposed to the other which is known as aestivium wheat. Durrum wheat has a higher content of proteins, vitamins and minerals and so is nutritionally superior to aestivium wheat also, thus enhancing food security.

This opens up a whole new vista for sustainable water use in Western Madhya Pradesh restricting ourselves for the time being to just the sphere of wheat production. The proportion of net irrigated area to net sown area in the region is 36 per cent. This irrigation coverage as shown has been achieved through an unsustainable withdrawal of groundwater facilitated by the supply of cheap electricity. This is bound to decline in future if ground water withdrawal continues at the same pace as the aquifers will gradually dry up. This will lead to a decline in wheat production further raising food prices. However, now the success of the Amrita variety has thrown up an alternative and so a combination of both kinds of wheat can be sown by the farmers to optimize both their economic gains and also address environmental concerns. We can visualize a simple linear programming model that could later be augmented into a more complex non-linear one with more crops and field and market conditions and then optimized to yield a better situation with regard to land and water use and food production as follows.

Let us assume that **P** is the total wheat production, **H** is the area under hybrid varieties such as Lok 1 which on an average yield 5000 kgs per hectare with six waterings including the sowing watering, **I** is the area under dryland varieties like Amrita which on an average yield 2500 kgs per hectare with just one watering and **A** is the total arable area. Let the sustainable amount of water that can be used up in a rabi season be **W** which will be much less than the amount of water that is now being utilized and the amount of water used up in one watering per hectare be **w.** Also, let the cost of production per hectare, including the cost of water, be **h** for the hybrid varieties and **i** for the dryland varieties and the price of wheat per kg is Rs 12. Let us also assume that there should be an economic constraint that the production process should yield the farmers at least a ten per cent return on their cost of production. Then we have the following linear optimization model -

Maximize $P = 5000 H + 2500I$, subject to

$H + I d \leq A$

$6H + I d \leq W/w$

$1.1(hH + iI) d \leq 12(5000H+2500I)$
which is equivalent to -

$(60000 - 1.1h)H + (30000 - 1.1i) I e \geq 0$

$H, I > 0$

H,I are the variables for this model while A, W/w, i, h are all constants that have to be determined in accordance with the local resource endowment situations and the market condition prevailing for a given agricultural season. However, W, w, h and i will vary with time and research and action can be initiated to increase W and reduce w, h and i and move towards a more sustainable regime overall.

This is of course a highly simplified model of the actual reality which consists of various other crops and soil, water and market conditions. But it serves to illustrate the fact that it is possible to break out of the present unsustainable model of development based only on hybrid and water-intensive seeds. There are other environmental benefits of adopting this model like the lesser use of artificial energy, chemical fertilizers and pesticides which will all contribute to mitigating climate change. There is also the social benefit of the greater use of human labour in natural resource conservation work which will address the problem of under employment and surplus of labour in the current rural economy.

At present the rural economy is geared towards maximization of crop production but what is required is the maximization of bio-mass production with optimum use of natural and human resources. Thus, a more comprehensive version of the above alternative modelling based on actual experimentation on the ground can provide concrete pointers to the areas in which interventions are needed in agriculture -

- Farms have to be assessed for their soil quality and suitability for various kinds of crops and research, credit and marketing support provided for cultivating them. All of these are crucial as without a reorientation at the policy level it is very difficult to initiate changes in cropping practices at the ground level. Currently there is a woeful lack of data, research, credit and marketing support with regard to water conservative

crops in the basin in particular and the country as a whole in general.

- There is need for calculating the "virtual water" embedded in a particular crop being produced in an area (Hoekstra & Chapagain, 2007). Even though there are some problems with the calculation of virtual water at the moment these can be overcome to reveal a true picture of the water embedded in different types of crops. This can be used as an advocacy tool to convince people to change consumption patterns towards lesser virtual water crops so that the demand pattern for crops also changes and it becomes easier to ensure more sustainable water use in agriculture.
- Measures have to be taken to increase the sustainable water availability **W** through soil and water conservation and afforestation and reduce **w** through greater reliance on the use of in situ soil moisture. The NREGS provides the best instrument for ensuring this. So steps have to be taken to improve the functioning of this scheme as detailed later.
- Biomass-based local farm manuring and energy production has to be encouraged to reduce fertilizer application, enhancement of soil quality, soil depth, water retention and use of fossil fuel-based energy. In the initial stages this too needs to be provided grant support as a considerable amount of labour has to be expended in this activity. This too could be included under the NREGS.
- All of the above have to be combined in an integrated plan at the sub-basin level in order to optimize sustainable resource use while at the same time ensuring a decent livelihood for the people. Such plans have been drawn up for specific basins (SOPPECOM & VIKSAT, 2003) but they have not been implemented and so there is a lack of ground level validation of these plans. Primarily because as stated in the report it involves a redirection of subsidies and grants from the presently prevailing system of agriculture to the proposed newer system. So there is a need for the implementation of such plans on a pilot basis with grant support and then wider policy level changes once these plans have been locally validated.
- Water, in the short term, is a public good in the sense that it is a non-rival because consumption by one person does not reduce the possibility of consumption by another person and it is also not possible to exclude people from using it. That is why the market fails when it comes to the allocation of this resource. There is an over exploitation in the long-term as has happened not only in the Man basin but all over India. The profligate use of water for short-term gains in agricultural productivity has jeopardized the long-term environmental and economic sustainability of agriculture, natural resources and energy production. There is thus a need for water governance to ensure either through regulation, assigning of property rights, imposition of taxes or communitarian sharing that this vital resource is properly utilized.

Book Review

Public Private Partnerships in Water Sector: Partnerships or Privatization? By Gaurav Dwivedi, Manthan Adhyayan Kendra, January 2010

This booklet delves into the idea and practice of Public Private Partnership (PPP) particularly in the water sector in the context of India's present socio-economic condition and the general governance environment. It explains how the idea of PPP was conceived to address the limitations of privatization, supposedly a cure-all 'solution' for public sector ills as viewed primarily in terms of efficiency and financial sustainability. Essentially PPP in substance turns out to be the same as privatization with a difference that risks are covered by the public in various forms. It calls into question the new meaning given to the term 'partnership' and also the reasoning that informs the 'solution'. It surveys policy/ programme documents and guidelines issued by various governments including Government of India

(GoI), multilateral development agencies and the international financial institutions (IFIs), the main proponents of PPP, to look at the assumptions made while theorizing the concept. It highlights the complexity of PPP arrangements and various contradictions in PPP theory and practice. There is every likelihood that the projected benefits of PPP may not materialize eventually leading to distressing conditions in different countries, especially the underdeveloped, including India. The booklet quotes various empirical studies carried out at both national and international levels, audit and evaluation reports, newspaper reports and Manthan's own research providing evidence in support of the contentions made. It raises a serious question about the mechanism followed for taking a blanket policy/programme decision on issues of such import without involving the affected population and projecting the same as the only solution. Various alternatives tried in various locations in different countries, the learning from which could have helped work out better alternative solutions, are also briefly described.

Privatization of the water sector was tried in the 1990s in the wake of IFIs and governments promoting privatization models for infrastructural development and service delivery presumably for improving urban infrastructure, service quality, lower tariffs and bringing in new investments. The period witnessed public protests, social unrest and campaigns against privatization in the water sector. There were huge losses to private companies, and they needed public sector support to run their businesses and earn profits. Governments on the other hand started displaying their lack of trust in reviving the public sector and their inability to mobilize the required huge amounts for overhauling infrastructure and improving service delivery, which became necessary for GDP growth. The PPP model emerged as an alternative to exclusive private sector participation. After analyzing the use of the term PPP from various studies and government documents, the booklet concludes, "despite the rhetoric for popular consumption which makes PPPs look more community-oriented, accountable, public-sector controlled and transparent, the terms 'privatization' and 'PPP' remain same on the legal, operational and structural levels." In India there are a number of ongoing PPP projects related to the water sector. The PPP model for project implementation is looked upon as one of the major reforms for improving public sector water services.

The booklet thoroughly analyses the arguments given in favor of PPPs - (1) PPPs are cheaper; (2) Private Corporations are more efficient; (3) PPPs bring in private investments thus freeing public resources for other policy priorities for the government and (4) PPPs are in-budget and on-time. The first argument of PPP as a cheaper option for bringing in new private investments, thus allowing the governments to save money may not be true. It may turn out that PPPs are more expensive than traditional public procurement methods wherein contractors are appointed through tender processes or negotiations to build as per defined scope of works for a fixed price lump sum and, the client retains the responsibility for the design and the project team. The reasons for PPP being costly are, first, PPP follows a cumbersome procurement process involving a range of commercial practitioners and financial institutions, all of whom are likely to have their own legal and financial advisors and two, the higher cost of capital (borrowing) for the private sector as corporations are more likely to default, making corporate debt highly risky. The second argument that under PPP arrangement the private corporation would bring in efficiency in e design, construction and operation of public services and thus would help save cost leading to lower prices of services delivered is not backed by empirical evidence. Various studies including those from the World Bank, IMF and ADB show that there is not much difference in efficiency of public and private companies. Studies from the Trans National Institute (TNI) and Corporate Europe Observatory (CEO) show that other models adopted in various countries to improve water services like Public-Public Partnerships (PUPs) are better in providing services to people rather than PPPs. Private investors do not want to risk their investments and returns. In the absence of risks, say for instance in a cost plus approach to tariff setting, a private company has no incentives in improving services, reducing costs or being more productive. And in the case of risk, a private operator claims more incentives for

management of risks than the public sector does. To counter the third argument the booklet quotes David Hall of PSIRU, University of Greenwich, London thus, "...the 'budgetary constraints' on government borrowing are political decisions, not set in stone... The financial crisis of 2008 has shown how governments everywhere are increasing their spending and borrowing in order to support the financial sector and the economy in general. The scale of this is far greater than investments raised for public services through PPPs..." Also as against the claim made the booklet maintains "PPP projects show that public sector resources are not freed but are sucked into PPPs for private profits, due to private sector inefficiencies, unaccountability and risk averse behaviour. Projects like Tiruppur, Nagpur and Metro Manila Water Project prove this beyond doubt." Studies from the World Bank and Public-Private Infrastructure Advisory Facility (PPIAF) are quoted to corroborate the point. On the fourth "on-time" and "in-budget" claims the booklet states that projects under PPP fall behind on their commitments as these involve long tendering and negotiation periods even before the project is actually awarded and would eventually be included into the total project cost. Comparison of PPP projects with the public sector procurement contract is carried out in most of the developed world using "Value of Money" mechanism wherein two cost estimates – PPP and hypothetical Public Sector Comparator (PSC) – reflect two different ways of doing a project involving two different types of costs. Unfortunately no such mechanism is available in developing countries like India. But still the fact remains that in India there are many public sector companies like DMRC, NHPC, NTPC, BHEL and others, which have a strong reputation for executing projects well within the resources and deadlines. It is not only private companies that can provide the budget and time advantages, although they charge more for this.

The booklet further devotes a full section on operational issues like risk transfer from the public sector to the private operator and divisions of roles that PPPs ostensibly bring in and also the related issue of post-contractual changes. It raises a key question – can risks like commercial, financial, operational, construction and force majeure be really transferred to the private sector? The booklet argues, "...risk transfer under PPP projects is a tightrope walk for a government, since more of risk bearing on its part could lead to the private operator being totally risk free. And this will allow the private company to make excessive profits by pushing risks on the public. On the other hand, transferring more risks on the private operator could make the project costs go up or even render the project unviable." Further quoting Shripad Dharmadhikary on privatized hydro power projects it states, "When the project is carried out by a public sector company, the increased profits are at least presumably used in larger public interest. In case of private sector generation companies, this represents a clear case of the public bearing the risks, while the private sector walks away with the profits." Partnership ideally means similarity of goals, sharing of profits, losses and risks and a shared commitment for each other but in reality private partners would not take demand risks, financing risks, resource risks or risk of accountability towards residents. Out of the thirteen risks involved in PPPs tabulated for the water supply, irrigation and hydro power sectors only three i.e. design, construction and operation are borne by the private operator, all the rest fall on the public and are built into the project contracts as guarantees, incentives etc. In fact, PPP operators acknowledge public sector capabilities to take on larger and more risks and wish the public sector to take more risk so as to generate profits from providing services. There is a related issue of post-contractual changes that have been brought into PPP projects questioning the sanctity of competitive bidding.

The next two sections deal with governance and social obligation issues vis-à-vis PPP. The adoption of principles of good governance is a key to the success of PPPs. The booklet examines whether and how far these principles are followed in PPP projects under the heads – transparency and accountability, public participation and public policy, access to information, equity and social justice, and oversight and regulatory mechanisms. On transparency and accountability the booklet quotes a World Bank report of 2006 that says "Despite the fact that there are nearly 90 PPPs in India under construction and operation,

there is no publicly accessible data base providing even the most straightforward information on them." One has to access the data and information on public interest projects using the Right to Information (RTI) putting in a lot of effort and money. The secrecy maintained on the ground of projects' commercial aspects affects the very condition that keeps the basic democratic structure of society intact. The protection of commercial and trade secrets should not be at the expense of the people's right to have information on the matters that affect their lives. The booklet narrates Manthan's experience where it was unable to get answers to basic questions related to the actual average daily quantity of bulk water supplied in the case of the Tiruppur Water Supply and Sewerage Project (TWSSP) even after filing an application under RTI with New Tiruppur Area Development Corporation Limited (NTADCL) as the corporation maintained that it was not a public authority and didn't come under the purview of RTI Act. The decision-making structure and government terms and public policy regarding PPP projects are discussed under the head `public participation and public policy'. The decision-making structures ignore the need for public consultation and consent in spite of the fact that huge amounts of taxpayers' money is committed to the projects, as these structures are dominated by bureaucratic agencies and private corporations. Moreover, even much needed changes cannot be made in public policy if and when required without incurring a heavy loss as PPP contracts are usually for long terms of 20-30 years. On access to information the booklet shares the World Bank's observation that ground reality is different when one tries to access information on PPP projects in spite of "the enactment of the Right-to-Information Act (RTI) in 2005 which requires 'suo motu' ('on their own initiative') disclosures and foresees universal access to information wherever in the public interest". Further the Central Information Commission noted on the matter thus "...It would be vain to argue that functions which were earlier transparent when performed by Government exclusively should become opaque now that these are to be performed through PPP. This would amount to reversal of transparency and would be antithetical to public interest". On equality and social justice the booklet makes two points, one, with PPP the salaries and consultants, officials and lawyers of private companies increase leading to retrenchment of lower grade public sector employees, who are then again hired by private corporations at lower salaries without benefits. And two, with increase in user charges for the services delivered, access of marginalized sections to these services reduce. On credibility of oversight and regulatory mechanisms the booklet raises a crucial question – can regulatory agencies that are generally composed of public servants and retired bureaucrats be realistically expected to leash in the operations of private companies? The booklet cautions, "...in the complete absence of any credible regulatory mechanism, PPPs could be very risky, particularly when the public and public representatives have little role or control over these projects. However, even in cases where regulatory authorities do exist, the record does not seem to be impressive in protecting the socio-economic-environmental interests of the larger community." The booklet highlights the difference between ground reality and the GoI guidelines for sector reforms in the case of the water sector. It wonders why there is so much of hurry in accepting and implementing PPPs as the only and right option without the regulatory framework and mechanisms in place.

Under the section "Social Obligations and PPPs" the issue of impact of privatization in the water and sanitation sector on marginalized sections of the society has been taken up. The author maintains that water is a unique natural resource and from a social perspective essentially a form of public good that retains 'non-rival' and 'non-excludability' qualities. A water supply system, owing to very high initial fixed costs and very low probability of competition in the market, is a 'natural monopoly'. Since PPP projects provide private operators with a steady stream of guaranteed revenue and profits for longer periods through levying user charges for their services, the private sector usually focuses on the well-off segment of the society which is able to pay the charges. The marginalized and weaker sections are ignored as private corporations refuse to fulfill contractual obligations to provide essential services to the poor because of their low paying capacity. When the delivery of public services like water and sanitation follows the market principles of user-pay charges and full cost recovery it becomes contentious

and may turn out to be socially disruptive especially in a country like India with high income disparity across the society and a very low Human Development Index (HDI) ranking.

The next section outlines certain projects and policies that are promoting PPPs in India. The steps taken by GoI to promote PPPs include – establishing of a PPP cell in Department of Economic Affairs (DEA) in the Ministry of Finance; setting up the India Infrastructure Finance Company Limited (IIFCL) to facilitate access to long term resources; creating a Viability Gap Fund (VGF) with a current annual allocation of US $ 340 million; forming an inter-ministerial group to determine pre-qualification of bidders; preparing tool kits and model concession agreements by DEA; and establishing India Infrastructure Project Development Fund (IIPDF) for meeting the project development expenses. The World Bank through its multilateral funding mechanisms and the Asian Development Bank through its Technical Assistance projects are playing active roles in promoting PPPs in India, especially in the water sector.

Detailing of various aspects of PPP models has been done in the booklet to bring out the central issue of decision-making processes that lead to PPPs as a solution to the problems and issues in the water sector. It raises a question "...whether any thought was given to the alternative options before finalizing a PPP, whether there was any kind of alternative decision-making process available, whether such decision making processes were community-participatory and transparent in nature?" The booklet lists different alternative models and discusses with examples the major factors that are critical to performance in the water sector such as autonomy, financial independence, participatory management structures, participatory budgeting process, labour union participation, performance management etc. It concludes that certain principles like decentralization, autonomy, participation etc., will work in some places and not in others but we would still need spaces and structures for these processes. Also, some of the approaches like full-cost recovery, cross-subsidization, tariffs based on costs, and reduction in over-staffing are important to make water systems sustainable with improved services, but these should be seen in the context of private profits versus public good.

The booklet in the end draws attention to the issues that need to be explored, such as - the effect of PPPs on decision-making mechanisms and on the democratic structure of local bodies; the role of governments in promoting PPPs rather than initiating public sector reforms; the subsidies and financial assistance provided to private corporations by the government and IFIs; and the evaluation process of the options/ alternatives before selecting PPPs. The future course of action set out in the booklet is to look for an alternative beyond PPPs to provide equitable and sustainable water systems in the country. The six annexures attached to the booklet gives details on various aspects of PPPs. The booklet critically looks at the arguments given in favor of PPPs and patiently builds a strong case for a need to go beyond PPPs.

Hardeep Singh

River Water Sharing – Transboundary Conflict and Cooperation in India, Editors – N. Shantha Mohan, Sailen Routray, N. Sashikumar, Routeledge, New Delhi, 2010

Understanding the nature of conflict and cooperation in sharing of river water across boundaries – political, social, sectoral or individual is crucial to adopt a just approach towards resource management and use. These boundaries have meaning because the unities at higher level do not really efface the separate reality of lower levels till the level of individual lives. In his book ‘A Theory of Justice’, John Rawls writes "For us, the primary subject of justice is the basic structure of society, or more exactly, the way in which the major social institutions distribute fundamental rights and duties and

determine the division of advantages from social cooperation." Prolonged or repeated emergence of conflict means the incapacitation of social institutions.

The book under discussion is a follow up of a national consultation on 'Interstate Transboundary Water Sharing in India' held at National Institute of Advanced Studies, Bangalore on 26-27 June 2007. It is divided into four interconnected sections – Introduction; Institutional Framework; Historical and Technological Perspectives; and Negotiated Approaches and Alternative Paradigms. The three articles under section two are by R. Jeyaseelan, Ramaswamy R. Iyer and Narendar Pani. R. Jeyaseelan describes the Indian situation of water availability, Constitutional provisions with respect to water, integrated water resource development and management and the environmental aspects of water resource development. The article emphasizes the need to establish River Basin Organizations (RBOs) and informs the reader about their present status in India. Ramaswamy R. Iyer in his article notes that the root cause of conflicts is an unsustainable demand for water, and that interstate river water disputes are only a subset of a larger set of disputes over water resources. Before taking up the criticisms of the prevailing adjudication process, he explains the existing legal and policy framework. By and large, the principle adopted by the Tribunals set up under the Inter State Water Dispute (ISWD) Act is that of equitable apportionment. Under the Act it is not the people who are the disputing parties but the State Governments concerned. He agrees that a negotiated agreement is better than adjudication, delay at every stage in adjudication process is a serious problem, the proceedings are adversarial and divisive and there are no effective means of ensuring compliance. But the fault does not lie with the conflict-resolution mechanism which is in fact a necessary last-resort mechanism when everything else fails. As for delays, the author states that the problem is likely to be diminished after the amendments of 2002. On adversarial proceedings the author says that there is no law against a constructive, cooperative approach to adjudication. He suggests that instead of court style functioning, the Tribunals adopt a consultative, interactive approach involving those who have vital interests in the decision, namely the farmers, industrial establishments, municipalities and people in general. That leaves us with the problem of non-compliance. If a State Government refuses to obey the order of such a Tribunal nothing much can be done. The author considers two suggested legal reforms on the issue (a) bringing disputes within the Supreme Court's original jurisdiction on repealing the ISWD Act as suggested by the National Commission to Review the Working of the Constitution (and also by eminent lawyer Fali Nariman) (b) providing for an appeal to the Supreme Court. The author rejects (a) as it would put an enormous burden on the Supreme Court and nothing substantial would be gained by that, not even better compliance as is evident from the fact that a former Chief Minister of Karnataka was at one stage prepared to defy the Supreme Court and also that Punjab passed an Act terminating all past water accords, seeking to destroy in the process the very basis of certain directions of the Supreme Court. The author is in favour of (b) and has been recommending the same for several years. The reason provided is that it may assuage to some extent the sense of grievance felt by one or more parties and may in turn improve the prospect of compliance. Moreover, every case does go to the Supreme Court even now and the Court rarely refuses. Apart from procedural and operational aspects the author takes up three substantive issues – (1) Confining of ISWD Tribunals to the river in question and ignoring groundwater (2) Fragmentation of the river system that conflict resolution ends up in even if the principle of equitable apportionment for beneficial uses is properly and fairly applied (3) The conflicts that arise in the context of large projects. On ISWD Tribunals confining themselves to the river in question, the author maintains that the States in India and countries accept differential water endowment as a fact of nature and disputes whether between States or between countries do not arise over resource endowment as a whole but on rivers. The ISWD Act is about disputes over river waters, and the Tribunals set up under it are mandated to deal with the river in question and not with the respective overall water resource endowments of the States concerned. But still for equitable apportionment for beneficial uses one of the criteria as laid down in the Helsinki Rules is the availability of water from alternate sources, including groundwater, and also

the extent to which the area in question is dependent on the river that is in dispute. The author observes that ISWD Tribunals must take this into account. On fragmentation of river systems that conflict resolution ends up in, the author agrees that it would be better for all the riparian States to come together and jointly use the system in an integrated and holistic manner instead of getting a 'share' in river water and be left free to use it as they deem fit. But as this requires a degree of reasonableness, which is not always available, and if the best course is not feasible, it is better to settle for the second best. On conflicts in the context of large projects, the author explains that they arise because large projects tend to alter geography and hydrological regimes and involve issues of control, power and political relations, social justice and equity. The author ends the article by stating that agreements/ accords/ treaties and adjudications may temporarily bring peace but the conflict will erupt again unless we learn to re-define 'development'.

The article by Narendar Pani begins by referring to the Cauvery Water Disputes Tribunal (CWDT) before which the parties concerned placed documents and publications running into 50,000 pages in support of their respective claims. The States in dispute left no detail untouched. Appreciating the need for being sensitive to the details for effective dispute settlement, especially in view of the fact that each river and its basin has its unique history, that the stakeholders in the river can keep changing over time, and that stakes need not remain the same for the same group of individuals, the author cautions that yet there is the possibility of getting lost in the details. One may get narrowly stuck to the issues that attract the greatest debate and these are more likely to be such that elude agreement rendering the dispute all the more intractable. The author suggests that in such a situation it is worthwhile to take on board a larger view that could help bring in dimensions that offer more options in the negotiating process. He further explains that "as the potential benefits of cooperation between states increase, they would be less inclined to allow water-sharing disputes to prevent cooperation in other areas. And the benefit from a larger canvas need not be confined to areas of cooperation alone. There may also be negotiating benefits from linking disputes." The widening of the canvas cannot be indiscriminate linking of issues so as not to render the exercise counter productive. It involves carefully drawing fresh boundaries separating the issues that are relevant to river water disputes (intrinsic) from those which are not (extraneous). The author cautions against two temptations in deciding what are intrinsic. The first is the temptation to bring in extraneous considerations only because it is believed they will help ease pressures. The second and corresponding temptation is to leave out issues that are difficult to resolve. The experiences of river water disputes around the world would help us draw fresh boundaries. The author observes, "The diversity of these experiences is an in-built protection against a mechanical transfer of dispute resolution mechanisms from one basin to another. At the same time, the common features that can be seen despite this diversity would be useful pointers to the nature of river water disputes and their resolution. These pointers could help in putting together a framework for understanding the dynamics of river water disputes. This framework could then be adapted to deal with specifics of each dispute." Conflicts over water are caused by varied interests. The author takes the issue of water scarcity and shows how the particular arguments are generalized to conclude that conflicts over river waters are the result primarily, if not solely, of water scarcity. He cites two trends to counter the generalization. First, if scarcity were the only reason for river water disputes, the region of the greatest scarcity would also be the ones with the most intense water conflicts. But this is not the case. Second, and rather more important in some current contexts, measures to reduce scarcity may in fact create new conflicts. In India where two-thirds of its renewable water resources serves a third of the population, it becomes tempting to transfer water from the surplus to the deficit region. Just as scarcity can act as trigger to conflict, so can conflicting aspirations among different regions. The conflict could vary from sharing irrigation water, to effects of hydroelectric power generation or pollution, and can take place at various scales from between individual farmers to between groups of farmers or even sectors. The author refers to the study carried out by Aaron Wolf, Shira Yoffe and Mark Giordano on conflict and

cooperation over water in the second-half of the 20th century. The study covered 1831 events covering both conflicting and cooperative events, with cooperative events being more than twice as common as conflictive events. The author quotes an interesting hypothesis from their study, "The likelihood and intensity of dispute rises as the rate of change within a basin exceeds the institutional capacity to absorb that change". The author remarks that "This formulation focuses solely on what happens within a basin. But with economic integration, conditions affecting people within a basin, and therefore their dependence on the river itself, can be quite closely linked to what happens outside it". The availability of employment outside the basin could reduce the numbers of those dependent on the river for their livelihood. The author takes a broader view thus "The potential for conflict or cooperation centered around a river depends on the institutions being in tune with the changes taking place that directly or indirectly affect all those who have a stake in the river basin". The author describes how the variety of changes along the course of a river has the potential to generate the conflicts. For instance, the changes in political and economic relationships, which continually evolve and have an element of instability built into it, may lead to conflict. To make his point the author gives the case of the water rights of American Indian tribes. At times even a change in perception on security may lead to disputes as happened with the building of the Baglihar dam in Doda district of Jammu and Kashmir. Also, the changes in technology too could cause conflict-enhancing changes in the river basin. From the above it should not be concluded that changes necessarily lead to conflict, at times changes ease the conflict and provide opportunities to reduce pressure on rivers. The author cites the case of the Mekong River to support his point. After describing how changes along rivers provide both the potential for conflict and opportunities for cooperation, the author brings in the question of requisite characteristics of the institutions that would have the ability to tap opportunities in a way that can overcome conflicts. The author uses the term `institution' in a sense similar to that used by the philosopher John Rawls. The author, following John Rawls, differentiates between the institution as realized and the institution as an abstract object and finds the view of an institution being what it does than what is stated about it more appropriate in dealing with river basins. The author maintains that the precise features of the required institution would vary substantially as it has to be sensitive to the requirements of each river basin, but there would seem to be one fundamental characteristic that such an institution would need for it to be effective – the institution would require a large enough canvas to tap the opportunities available as well as to enable river-based initiatives to realize their full potential. The expansion of institutions to cover a larger geographical region than the basin can bring in people whose interest in the river basin itself may be secondary. In order to avoid such a situation the author suggests that the focus in the basin should be on the people of the basin rather than the basin as a geographical entity. Such a boundary will be defined not so much in geographical terms alone, but will also have different economic, social and cultural limits that would cover all the activities anywhere in the world - economic that can help or harm the basin and social and cultural activities that the river basin can relate to. Ideally, the political dimension would allow for the basin's interests to be protected and developed vis-à-vis other groups in the polity.

Section three of the book has two articles, one on the historical setting of the Kaveri by S. Settar and the other on the Cauvery Tribunal Award from the hydrological perspective by Rama Prasad. The article by S. Settar traces briefly the history of the Kaveri River from the ancient period as described in available Tamil and Kannada literature till date through the colonial and post-colonial periods. It describes the events leading to the 1892 Madras-Mysore Agreement and thereafter the 1924 Agreement with its main focus on the construction of the Krishnaraja Sagar and Mettur Dams. The Agreement was to be reviewed after 50 years in 1974. It describes how the sharing of waters became a major issue of conflict between the Tamil Nadu and Karnataka governments during the latter-half of the 20th century, and the early years of the 21st century. The article by Rama Prasad begins by presenting the highlights of the Cauvery Water DisputesTribunal Award – (1) the 50 per cent dependable annual yield in the

Cauvery at Lower Coleroon Anicut (LCA) is 740 TMC. (2) Out of the above yield, Karnataka can utilize 270 TMC, Kerala 30 TMC (out of which 21 TMC is in Kabini basin), Tamil Nadu 419 TMC and Pondicherry 7 TMC. (3) If the yield in any year is less than 740 TMC, the above shares are reduced proportionally. (4) Karnataka should release 192 TMC at its border with Tamil Nadu at Biligundlu. And (5) a regulatory authority should be set up to implement the Award. The author shows how the Cauvery Award has too many hydrological loose ends to be properly implemented. The author states that the Tribunal made allocations on the basis of the yield figures of 740 TMC at 50% dependability and 670 TMC at 75% dependability at LCA as provided by the Cauvery Fact Finding Committee (CFFC) set up in 1972. The CFFC considered the data only from 1934-35 up to 1971-72 although the flow at LCA was measured from 1900 onward. Ideally the available data for the longest possible period should have been taken to reduce the standard error (SE) as the SE of quantities derived from the data varies inversely as the square root of the length of record. The SE of 50% dependable flow on the basis of the record used by CFFC turns out to be 33 TMC, which is greater than the 30 TMC allocated to Kerala. Ideally, the SE should have been less than the smallest allocation unit i.e. 4 TMC for inevitable wastages. On the volume of water that Karnataka is supposed to release at the Tamil Nadu border, the author maintains that the hydrological or agro-meteorological basis for monthly break–up of releases has not been revealed making it unclear whether there is enough water to make monthly releases after Karnataka and Kerala have drawn their requirements. Moreover, the release of 192 TMC is to be made at the Karnataka-Tamil Nadu border if the yield at LCA is 740 TMC. The figure 740 TMC is assumed to be comprised of 483 TMC at the border (most of the water comes in the month of June-October) and 257 TMC (mainly in the months of August-January) below the border. The author explains that the yields in the two parts are not strongly correlated. Even when the total yield at LCA is 740 TMC, it may be the case that the yield at the border is less than 483 TMC. In such a case Karnataka cannot utilize 270 TMC and also release 192 TMC keeping in mind that 21 TMC is utilized in Kerala. Moreover, the tribunal has given the freedom to each state to utilize its allocation in any manner and anywhere it wants. Thus, although Kerala's allocation of 30 TMC has been calculated on the basis of 21 TMC in Kabini and 9 TMC in Bhavani and Pambar, it is free to utilize all 30 TMC in the Kabini basin. If Karnataka utilizes its 270 TMC, there will be only 183 TMC left at Biligundlu in a normal year, and 192 TMC cannot be released there. On proportional reduction of State shares if the yield is less than 740 TMC in any year, the author observes that the 'yield' refers to the flow which would have occurred at LCA had there been no utilization upstream – since there are utilizations upstream, the yield is calculated as the measured flow at LCA plus all the utilizations upstream. The utilizations upstream are either measured at several reservoir and anicut sites or estimated based on the respective command areas as is the case in thousands of tanks and dozens of anicuts amounting to more than 200 TMC. As for the measurement, it is done in very large number of cases by applying discharge formulae with uncalibrated coefficients or reading from unrevised stage-discharge tables. Errors pertaining to structures in existence during the period from 1934-35 to 1971-72 are built into the annual yield of 740 TMC. Any improvement or deterioration in the accuracy of measurement at these structures would lead to yield figures that cannot be compared with the benchmark 740 TMC. As for the estimation, the author says that it may be good enough to arrive at a rough estimate of average yield, but is not suitable for determining the share of basin states in a distress year. Because the actual yield cannot be determined accurately, there will be disputes in the regulatory body on an average at least once in two years, the basis of allocation being 50% dependable flow. Moreover, water utilization starts in June, but whether the yield is less than 740 TMC would be known only at the end of the following May. The Tribunal's order with regard to reservoir operation states that the reservoirs are to be operated on a 10-day basis and any deficit in 10-day flow has to be shared by all states. This is not possible in the absence of any benchmark to compare and say whether the yield in a particular 10-day period is in deficit or excess. The author estimates the return flow using different methods and dwells in detail on the issue of non-inclusion of return flow and also the availability of groundwater while making the decision on allocations.

Section four of the book contains three articles on negotiated approaches and alternate paradigms by Vijay Paranjpye, S. Janakrajan and Anitha Kurup. The major contention of Vijay Paranjpye's article as stated by him is that "the minimal level of societal awareness and involvement in the democratic process necessary for making the relevant policies and laws effective does not exist as yet in India. Therefore, it is necessary to work on these prerequisites in a conscious and purposive manner, rather than finding faults with the statutory processes." This necessitates (a) the creation of the necessary data base and framework for analyzing the physical, ecological, social and economic aspects of river basin (b) information dissemination, well-informed public debates through mass media or multi-stakeholder platforms (c) a culture of democratic participation capable of understanding and participating in public discussions on contentious issues related to the sharing of waters of inter-state rivers (d) negotiations between stakeholders and government authorities of two or more states on a common platform for arriving at solutions through discussions on possible trade-off between alternative solutions. At this stage, the prerequisites necessary for contentious issues are: administrative transparency, a sense of mutual accountability and trust, and respect and responsibility among the stakeholders, the authorities and the negotiators. It is only when society has gone through these stages and yet failed to arrive at water-sharing solutions that the matter should be taken to inter-state statutory arbitration. The author states that besides not taking people into confidence in the negotiation process, one of the major reasons for the failure of inter-state arbitration is the lack of integrative thinking among the parties concerned especially among the agencies in charge of development activities. The author sees the importance of two kinds of factors, one which he calls as subjective and relative such as the notion of justice and fair play that require broader principles and social processes to respond to, and the other he calls as objective parameters which are quantifiable and verifiable. The author says that though one would like to develop such parameters for resolving conflicts about water sharing, identifying the ones which will command social acceptance are difficult to come by. The author restricts his article to 'participatory processes' and 'principles' which could enable effective and timely resolution of water conflicts. The article by S. Janakarajan describes the necessity, conditions and processes involved in setting up a platform for multi-stakeholders' dialogue to complement existing measures of dispute resolution and water management. The article by Anitha Kurup while discussing Integrated Water Resource Management as an alternate paradigm emphasizes the socio-political character of water resource management, necessity to broad-base stakeholders to include the user community particularly women and the poor, and on the importance of the knowledge of indigenous systems.

The book covers the various aspects related to disputes arising from transboundary river water sharing. It gives a good overview of issues involved in water governance in India.

Hardeep Singh

Strengthening Integrated Water Resource Management Education In South Asia: Which Boundaries To Cross? March 2009, SaciWaters

This volume is compiled and edited by Peter P. Mollinga and is based on contributions of ten scholars as a part of the South Asia Consortium for Interdisciplinary Water Resources Studies' (SaciWaters) project 'Crossing Boundaries - Regional Capacity Building on IWRM and Gender & Water in South Asia'. The project looked at the state of the art of higher water resources education in four countries and five regions: Bangladesh, North India, South India, Nepal and Sri Lanka. The main report deals with whether South Asia's water resources higher education is responding to the Integrated Water Resources Management (IWRM) challenge and what can be done to strengthen and support that transformation. The challenges are of ecological sustainability, of secure livelihoods and eradication of poverty, and

of democratic governance. The study endeavors to advance ideas on facilitating reform of higher education in water resources.

The chapters by Peter Mollinga assess changes in South Asia's higher education in water resources during the period 2000-2008. Mollinga begins by noting that the public policy approaches to water resources management are shifting with changing social priorities from a supply enhancement perspective towards integrated, comprehensive and adaptive approaches but the process is not very well captured by the idea of a shift from one paradigm to another. Instead, it is much better understood as an ever-present contestation of multiple paradigms, with some more dominant in some periods of history and others in other periods. He also states that a change in perspective requires a change in knowledge systems built with a new perspective of human development with a pro-poor focus. The new initiatives in terms of new programmes and reorientation of existing programmes are addressing the ecological challenge while the challenge of livelihood security/poverty alleviation and democratic governance are being largely ignored. Gender and water too is not getting enough regard barring some isolated courses. While Mollinga concedes that there is a change in the mix of water resources education programmes since 2002, he still finds that water resources engineering and hydrology largely dominate. The policy sphere is unresponsive and whatever change has taken place is from the bottom, not from the top, that is, individual departments and universities are the innovators. The broader educational responses to the new challenges emerging are discussed in this chapter and the necessity of outscaling and upscaling of the new initiatives is emphasized. Even if such programmes can be created the question remains whether there is a demand for the new 'hybrid professional' with a broader interdisciplinary profile.

The regional studies examined curricula of selected educational institutions (re-visits of earlier institutions and selected new ones) to assess these aspects. The studies note the need to establish and maintain close links between research and education on one side and policy and practice on the other. The report observes that "academically, an entry-point for the operationalization of interdisciplinary education on water resources management is through the use of analytic approaches that link up the social and natural sciences. That is, technical/ ecological subjects are taught not only as courses separate from those on governance, management and public policy, but the linkages between the two are demonstrated".

The studies entailed documentation of the employability of graduates from the selected institutions, substantiated with data where possible. As regards demand the study found that these interdisciplinary professionals are still trying to carve out institutional spaces and their principal demand is from the development sector, which failed to compensate them in terms of salary level and job security. Demand from the government and corporate sector is nominal. Recruitment criteria in the government, particularly in the South India region, are still strongly focused on civil engineering qualifications, the entry requirement being a bachelors' degree in engineering - thus creating a disincentive for undertaking postgraduate studies. According to the study the way through the demand deadlock emerges gradually over a period of time when the government, civil society as well as corporate employers start seeing the benefits of a broader orientation and skill set. In Bangladesh there are concrete openings for employment of IWRM graduates in the government sector in some places. The South India region offers examples of establishment of Multi Disciplinary Project Units (MDPUs) for government projects of water resources development and management, as well as the invitation of Support Organisations (NGOs) to provide certain (non-technical) services in such projects. These provide opportunities for employment of interdisciplinary professionals and call for reshaping of the educational and recruitment approaches in the water resources sector. The Crossing Boundaries project partner institutes are undertaking liaisoning activities with regional employers through close interaction with potential employing agencies in the design and teaching phase of education programmes. These interactions help educators adapt to societal needs and demands. Peradeniya University, Sri Lanka as well as NEC, Nepal while formulating their IWRM programme, undertook a series of consultations, discussions, brainstorming, and validation with the stakeholders of

the water sector at various levels. This was assisted by the adoption of a national water resources policy which improved the prospects of IWRM education and the employability of its graduates.

The study suggests a broader network or partnership of IWRM-interested water resources education programmes/ institutes at South Asian national and South Asian regional level, across engineering, environmental science and social science/humanities programmes as a logical step to transform water resources education in South Asia. The need to learn lessons from other regional IWRM capacity building networks, particularly those in the South is also stressed. Resolute efforts to enhance gender balance in water resources education as well as 'open up' government employment for IWRM-trained water professionals are also suggested.

The study presents an in depth discussion and analysis of the need to integrate disciplinary perspectives in water resources education and make connections between academic knowledge and practice.

Amita Bhaduri

Consultation Report

Partners Consultation on the Water Governance Project, Amrawati, November 2009

A one-day long consultation was held on Water Governance (WG) on November 1, 2009 at Amrawati to discuss the findings emanating from the action research projects and capacity building exercises taken up at sub-basin and State level on the SDTT-SPWD programme on "Developing Practicable Scientific Approaches on Water Governance and Livelihoods and on Contributing to Policy Dialogue on Basin Issues". The consultation helped the partner agencies in the programme systematically review the various components of the project. This note captures the proceedings of the consultation in brief.

Speaking on the occasion, Hardeep Singh, SPWD, New Delhi highlighted the problems the water sector is riddled with such as: (a) poor performance of surface water systems and water management problems like efficiency, pollution, and wastage apart from groundwater depletion etc., and (b) water governance issues - institutional structures at different levels for decision making on water resource management and intra/ inter basin and sectoral allocation, water rights and water markets and human right to water. The action research projects aim to explore the possibilities of grounding the concept of Integrated Water Resource Management in view of the changing context as reflected partly in water acts/ policies and administration. A need to highlight aspects that would help crystallize the learning's from the ground level projects was stressed.

Srinivas Sajja of Center for World Solidarity (CWS), Hyderabad made a presentation on the AP State-level component of the WG project. Srinivas for the most part discussed the studies that have been completed or are ongoing under the project. He also discussed the capacity building programmes undertaken like the one on Water Governance at MYRADA – Hospet during Sep 22-25th 2009. Participants included heads of NGOs/ water activists from various parts of Andhra Pradesh. Theoretical sessions were interspersed with field visits. Under the project, Support Organization (SOs) meetings were also conducted at the State level in association with Freshwater Action Network-South Asia (FAN-SA). The meeting of SOs involved in the implementation of the externally aided 'Andhra Pradesh Community Based Tank Management Programme' (APCBTMP) was held in January 2009. About forty-eight SOs from twelve districts have participated in this workshop which was the first of its kind conducted at the state level.

SPWD made a presentation of its collaborative project with Krushi Samstha on "Basin Governance, Institutions and Livelihood Systems of the Poor: An Action Research Project in Bahuda Sub-basin in Pennar River Basin". The context of the Pennar basin was presented to cover aspects related to yield characteristics, the larger picture of intra- and inter-State water availability, water resource development during pre and post Independence periods, recent proposals on transfer of water to Pennar basin and resultant water conflicts. The study of these involved field visits combined with desk study of various kinds of documented literature accessed from (1) Central and State government websites like NWDA and CWC, (2) AP and Karnataka Government Irrigation/ WRD website, (3) Jalayagnam website (4) Survey of India/ NATMO maps (5) Reports/ Books/ Gazetteers etc., and (7) Analysis of articles focusing on water resource development in the Pennar basin appearing in national/ local newspapers. The basin characteristics described included rainfall, topography, availability of water, climate, vegetation, type of forests and its status etc. the flow diagram of Pennar river, the details of the drainages in the basin as well as the area under the catchments in the two states of AP and Karnataka were presented. The presentation then focused on water allocation, development and management issues.

The presentation also dealt with the procedures for clearance, scrutiny and approval of Water Resource Development projects. The role of the various agencies involved in development and allocation of water resources was discussed - Irrigation Department, Municipal Administration and Urban Development Dept/ Town Planning Department, Public Health Engineering Dept, Zilla Parishad, AP Industrial Infrastructure Corporation, AP Pollution Control Board, Urban and Rural Local Bodies, Groundwater Department, Rural Water Supply Department etc. The various approaches and rudimentary mechanisms for inter-sectoral water allocation along with the changes underway were discussed. Water law reforms under way in AP were discussed. Thereafter the activities undertaken under the project and the irrigation systems diagnostics were presented. ACWADAM's study on hydrogeological situation in the Bahuda Basin was discussed. Hydrological monitoring is being done at Musturu as suggested by ACWADAM under the SPWD-SDTT project. A study was also conducted on "Common Property Resources and Livestock in Bahuda River Basin" for the South Asia Pro Poor Livestock Policy Programme (SAPPLPP) as a part of the ongoing Pro Poor Livestock Policy Initiative.

SPWD made a presentation of its collaborative project with MARI on the action research project in Maneru sub-basin of Godavari river. The characteristics of the Godavari basin, especially the yield at 75 % dependability and the competitive claims over waters in the Godavari basin and Andhra Pradesh's stand were discussed. The GoI-appointed Krishna-Godavari Commission's findings, the 1975 agreement and the Godavari Water Dispute Tribunal award were also discussed. AP's share as per the award and the water resource development in the AP portion of the basin were discussed. The issue of irrigational disparity particularly to Telengana was highlighted. The case of the Babhali barrage which is expected to reduce the inflows to SRSP project was discussed. Interstate conflicts which are continuing in the Godavari basin were presented. The yield of Maneru as per GWDT award, the availability to AP and other characteristics like land holding distribution, land-use and cropping pattern were presented through charts and tables. The extent and issues related to exogenous water supply from Middle Godavari (G-5) and Lower Godavari (G-10) basins were presented with the help of schematic representation of basin flows. The issues related to irrigation in the basin and those related to drinking water supply in Warangal city were presented. Subsequently, issues related to basin management were discussed.

Suhas Paranjape, SOPPECOM presented on the Kukadi sub-basin and Maharashtra State Level Component of the project. He described the Kukadi Irrigation Project as one which includes five dams and explained the two levels of governance issues as – (a) Micro-level – at the level of village or minor and (b) Macro and Meso level issues – at the basin, sub-basin and project levels (for large and medium projects).

The micro-level issues which emerged from the focus group discussions in ten selected villages from the six talukas (Karmala taluka was left out) were discussed. The findings are: (i) skewed and inequitable water availability within the command, (ii) time between rotations is too high and crop requirement is not taken into account (iii) physical infrastructure is in serious disrepair: seepages are high, control is minimal (iv) most WUAs are not functioning (v) there is a close link between rehabilitation and WUA performance etc. The macro/ meso level issues were identified at two levels:

- One, procedural issues that basically accept main assumptions but suggest changes.
- Two, foundational issues, these basically question some of the underlying assumptions regarding macro/meso issues

On the issue of entitlements, Suhas said that figures for water availability are based on formula and data that deal mainly with virgin or natural condition flows. But there are two major factors that need to be taken into account: (i) Upstream development (extension of agriculture, growth of habitats and other land uses, watershed development, groundwater extraction, water storages development), and (ii) Climate change. The second part of Suhas's presentation was related to State-Level Networking in Maharashtra.

SPWD and Dharamitra made a presentation of their collaborative action research project in Waghadi sub-basin of Painganga Basin of Godavari River. The presentation covered (i) Aspects related to yield share and Maharashtra's case to GWDT pertaining to use of Painganga waters (ii) Water resource development in Waghadi sub-basin for various uses and the intersectoral allocation mechanisms devised on the ground (iii) The agrarian context of the basin (iv)The hydrological analysis exercise conducted and the problems emerging in them (v) The various alternatives considered for drinking water supply augmentation(vi) The problems related to coordination, and overlap of roles during development of the water resource and its allocation (vii) The legal framework for water resource management in the basin (viii) Issues related to Participatory Irrigation Management in the basin and (ix) The irrigation systems diagnostics of the Waghadi project.

TAAL made a presentation on the MP State Level project and especially their study on Water Governance in the Tawa Command. Amod Khanna and Chitra Khanna began with a historical account of the technical investigations which had been conducted for development of water resources of the Narmada basin in general and Tawa sub-basin in particular. The changes in cropping pattern from the designed cropping were highlighted. The institutions for water governance and their functioning were elaborated. The project's study in the three irrigation divisions of Tawa command was discussed. The various dimensions of water governance viz., decentralized decision making and participation of water users, equity in water distribution, efficiency in water distribution and use, sustainability of use and water and livelihood were discussed by TAAL during their presentation.

Rahul Banerjee of DHAS made a presentation titled "Neither Water Nor Governance: The Travails of Water Resource Management in the Man River Basin". He described the geographical characteristics of the Man basin: rainfall, elevation, rock type/ structure, soil etc. The catchment of the Man dam of 69000 ha falling in six blocks was delineated clearly showing the area falling in the three agro-ecoregions, namely: Nimar valley, Vindhyas and Malwa. Rahul stated that the most important technical information from a water governance point of view is that regarding the availability of water and its use. Rahul explained the complexities involved in water yield estimation. The methodology developed so far for assessing water resource use and availability is varied and still changing because it is difficult to quantify. The natural processes that govern the storage and flow of water and the social and economic factors that influence its use are not easily modeled through mathematical formulae and even if attempts have been made using partial differential equations in recent years an immense amount of reliable data

needs to be collected and analyzed to find solutions to them. So from the beginning empirical methods have been used which provide only a very rough estimate. Delving into the availability of data for the basin it became clear that very little quality data was available for a basin that spans a massive 150,000 hectares.

Since use of computer simulated models and a detailed primary investigation of soil, topographical and hydro-geological characteristics were beyond the scope of the present project, the focus in the Man basin study was not so much to estimate the water balance as to study the relationship between water availability and water use to see to what extent it is sustainable and if not then suggest measures for improvement. The water availability is more or less related to the rainfall in the area (over the period from 1987 to 2006) as per a table presented by Rahul. 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 than potential yields. Rahul then discussed the empirical formula which he used to estimate the comparative water use in agriculture in the basin for the years 1989-90 and 2005-06. An analysis of water use in agriculture was also presented. Rahul then explained the design of the dam and the reality now. He also presented economics of wheat production in the basin and how profitability had dropped during the period 1997 to 2007. The study had also looked at people's perceptions in the basin.

Amit Gaumat, Samavesh made a presentation on the progress of the project on Water Governance in Kalimachak sub-basin. The main focus of the project is on capacity and awareness building of people of the sub-basin given the fact that surface irrigation structures in this sub-basin have been introduced only recently. In the first phase, the focus was on gaining a better understanding of the water based practices with respect to their impact on livelihoods. The geographical and socio-economic characteristics of the sub-basin, livelihood options available to the people and water situation in the basin were described. Thereafter the key activities which had been undertaken in the period were discussed. Regular meetings and discussions have been conducted with different stakeholders such as government officials, NGOs personnel, members from village level community institutions, villagers and staff members. Field level staff are working as key links to spread awareness regarding government schemes as well as supporting villagers in raising their demands. WUA awareness building for Imlidhana project was conducted with support from Dharamitra. Discussions with dam affected families and fisheries department officials were held to understand the status and future plans regarding fisheries cooperatives. A study of the rehabilitation process at the Imlidhana dam site was conducted.

The consultation concluded with a short discussion on the presentations.

Policy Update

Standing Committee on "Interlinking of Rivers", MoWR, GoI, October 2008

The eleventh report of the Standing Committee on Water Resources (2008-2009) on the issue of "Interlinking of Rivers" (ILR) chaired by R. S. Rao was presented on October 2008. The Committee took up the subject for an in-depth study in 2004-05. The Committee came across divergent views being expressed in different fora by eminent persons and groups in the media as well as during the informal interactions it had with the representatives of State Governments of Maharashtra, Kerala, Tamil Nadu and Andhra Pradesh. Comments and memoranda were invited from individuals/associations/NGOs/experts interested in the subject. The Committee took oral evidence of the representatives of the Ministry of Water

Resources (MoWR), Central Water Commission (CWC) and National Water Development Agency (NWDA) in April 2008.

The report is organised into eight chapters. The first chapter "Introductory" gives a background of the initiation of proposals favouring ILR as an idea to equitably distribute and optimally utilize water from surplus river basin areas to deficit river basin areas in the country. The concept has been in practice in India for over five centuries and some examples from the 19th and 20th centuries are projects like Periyar, Parambikulam Aliyar, Kurnool-Cudappah Canal, Indus etc. The concept of Inter Basin Water Transfer (IBWT) was mooted by Dr. K.L. Rao in 1972 as 'National Water Grid' and by Captain Dastur in 1977 as 'Garland Canal'. Dr. K.L. Rao advocated one of the alignments for the Ganga-Cauvery link along with a few other links including the Brahmaputra and Ganga Link - partially by lift and partially by gravity. Captain Dastur put forward his proposal for Garland Canal, which mainly consisted of two canals - Himalayan and the Central Southern Garland Canal to be inter-connected at two points (Delhi and Patna) by huge pipelines. The proposal sought to store water of all tributaries/rivulets in canals at a constant elevation and their utilization through the two Garland Canals and involved transfer of water in both the directions. Both these schemes were examined by a group of experts from CWC, State Governments and Professors from IIT and University of Roorkee and were found to be technically unsound and economically prohibitive. MoWR in 1980 formulated the 'National Perspective Plan for Water Resources Development' in the country which envisaged transfer of water from surplus basins to deficit basins. The National Perspective Plan (NPP) comprised of two components, viz. (i) Peninsular Rivers Development, and (ii) Himalayan River Development. It envisaged additional benefits of 25 m.ha. of irrigation from surface water, 10 m.ha by increased use of ground water and generation of 34,000 MW of power apart from the benefits of flood control, navigation, water supply, fisheries, salinity and pollution control.

Chapter II of the report deals with the NWDA which was set up in 1982 and entrusted the task of further carrying out pre-feasibility/feasibility studies in respect of the components of NPP. The Committee reviewed the work done and role of NWDA, the efforts made by the Task Force on ILR, the cost and funding aspects of the ILR projects, the constitutional set up, the environmental and other related aspects including the views of the experts/NGOs/eminent individuals along with the views of State Governments. The NWDA after various studies identified 30 links under NPP for preparation of Feasibility Reports (FRs) – 16 links under the Peninsular Component of the plan and 14 links under the Himalayan Component. So far, NWDA has completed the feasibility reports in respect of 14 links under the Peninsular Component and 2 links (Indian Portion) under the Himalayan Component (Indian Portion). Surveys and investigations for the remaining links (Indian Portion) under both the Peninsular and Himalayan Component are under various stages of progress. NWDA has completed water balance studies of basins/sub-basins and at diversion points, toposheet studies of reservoirs and link alignments, storage capacity studies of reservoirs, pre-feasibility studies and feasibility studies towards the implementation of inter-linking of rivers in the country.

Many of the states did not agree to the proposals and problems cropped up related to water sharing. Getting clearance from MoEF was problematic. So was getting permission from neighbouring countries where the initial reaches of the Himalayan transfer component fell. Especially so, because the proposals had not been considered bilaterally. Efforts for consensus on the link proposals included setting up of a Consensus group headed by Chairman, CWC to convince about the feasibility of the proposals. Five links namely Ken-Betwa, Parbati-Kalisindh-Chambal, Par-Tapi-Narmada, Damanganga-Pinjal and Godavari (Polavaram)-Krishna (Vijayawada) have been identified as priority links for bringing consensus amongst the concerned States to take up the work of preparation of their Detailed Project Reports (DPRs). An assessment of ILR Programme has been carried out at the level of Secretary (WR) through detailed

discussions and interaction with various Stakeholders, officers of MoWR and other Central Depts., and State Governments in 2004.

Chapter III deals with the Task Force on ILR. It was set up by MOWR in 2002 in response to an interlocutory application (IA) on a writ petition praying for the need of setting of a High Powered Committee on river networking grid. The IA was treated as an independent PIL by the Supreme Court. The Task Force was to go into the modalities for bringing consensus on ILR among the States. The SC also observed that the link projects be completed within a reasonable time of not more than ten years (till 2016).

The Task Force was to provide guidance on norms of appraisal of individual projects in respect of economic viability, socio-economic impacts, environmental impacts and preparation of resettlement plans, devise a suitable mechanism for bringing about speedy consensus amongst the States, prioritize the different project components for preparation of DPRs and their implementation, propose a suitable organizational structure for implementing the project, consider various modalities for project funding and consider international aspects that may be involved in some project components etc. The Task Force prepared the milestone/ time table for achieving the goal of ILRs. Ten working groups were set up on various subjects viz., Technical Matters; Finance Matters; Environment, Ecology and related issues; Social issues; Legal (water law) Aspects; International Dimensions; Application of Remote Sensing Technologies; Communication & Coordination with NGO's; Executive & Implementation; Institutional Mechanism. The Task Force on ILRs submitted Action Plans I & II and completed its role, and was wound up by MoWR in December 2004. Action Plan I gave an outline of the time schedule for completion of FRs, DPRs, estimated costs, implementation schedule, concrete benefits of the project etc whereas Action Plan–II suggested alternative options for funding and execution of the project and methods for cost recovery etc. Study Groups were also formed for various other studies as also to allay apprehensions of the public at large on matters relating to ILR. Most of the States have shown dissatisfaction with the benefits that will accrue from the links under ILR or have shown preference for smaller links. On the basis of a report from IIM-Ahmedabad, a two- tier institutional/organizational setup has been suggested for the implementation of the programme on ILR along with a Council – "National River Water Development Council (NRWDC)" to act as the apex body of the proposed setup. The National Authority for Interlinking of Rivers (NAILR) has also been proposed as the first tier of the proposed two-tier organizational structure and the regional or branch offices or subsidiaries would act as "Link Instrument" and are proposed as the second tier of the organizational setup.

The Task Force got prepared Terms of Reference (TOR) for preparation of DPR through Engineers India Limited for providing guidance on norms of appraisal of individual projects. The Task Force has stated that the peninsular links are the right component to begin with. Top priority links identified by Task Force on Interlinking of Rivers are - Ken-Betwa link (UP and MP) and Parbati-Kalisindh-Chambal link – (MP and Rajasthan).

Chapter IV on "Economics of Inter Linking of Rivers" dealt with the cost and funding of the project. The Task Force had consulted ICICI for funding options and NCAER for studying the economic impacts of Inter Linking of Rivers Programme. ICICI had proposed that funding should be through Public, Public-Private and Private inputs. The NCAER, based on NWDA studies has stated that the cost of ILR Programme would be Rs.4.44 lakh crores which is 21-22% lower than the rough estimate of Rs.5.60 lakh crore and it would take nearly 35 to 40 years. However, with use of modern construction and Remote Sensing Techniques the programme at best could be completed in 25 years. The chapter also deals with rationalization of water use/ water use charges. However, since water is a State subject, cess/charges on use of water for irrigation and other purpose were being fixed by the State Government. At present there is no proposal in MoWR to levy charges on water uses to fund ILR.

Study by NCAER on ILR

The NCAER submitted a report of a study on the economic impact of ILR Programme in March 2004. According to the study, ILR will result in growth of the construction sector by 3.80 per cent and a total increase in employment in the economy by 4 per cent. ILR would increase food-grain production growth by additional 2 percentage points over the baseline scenario and would thus supplement overall economic growth by 0.37 percentage points. NCAER has estimated that the cost of ILR project would be Rs. 4,44,331 crore, which is 21-22% lower than the rough estimate of Rs. 5.60 lakh crore. NCAER is of the view that the programme would take nearly 35 – 40 years. However, with use of modern construction and Remote Sensing techniques, the programme at best could be completed in 25 years.

As per the NCAER study the ILR programme involves huge construction activity, comparable in scale to the Golden Quadrilateral project. The construction activities in the ILR would include dams, reservoirs and canals. The ILR programme will have both short and long term impacts on the economy. The short term impact of the link canal is in the form of increased employment opportunities and the growth of the services sector. Sectors supplying crucial inputs to the construction sector, such as cement, clay, iron and steel, will also grow. In the medium to long term, the major impact of link canals is through increased and assured irrigation. Although the major and direct gainers of the ILR programme will be agriculture and agriculture-dependent households, the entire economy will be benefited due to construction activities and increased agriculture production. The impact of the ILR programme on agriculture will be realized only when construction is completed, reservoirs filled and the water reaches the ultimate users for irrigation, drinking, industrial purposes and hydropower generation. Until construction is complete, the impact of the ILR programme will be through Government investment. This will have an impact on the industries supplying inputs for construction. There will also be an increase in employment and thus on demand for goods and services. According to NCAER studies on economic impact of the ILR programme, the programme will have a major impact on the rural area in general and the agriculture dependent households in particular. The rural household per capita income with ILR is expected to increase by 7.49 per cent as compared to the baseline growth without ILR scenario. Per capita household income of agricultural dependent households in rural areas is expected to go up by 13.2 percent. For non-agriculture dependent households per capita household income is expected to go up by 4.8 per cent in rural areas and 9.8 per cent in urban areas as compared to the baseline scenario.

Chapter V deals with the constitutional set-up and ILR, as water is a State subject. Entry 56 of the Union List in the Seventh Schedule of the Constitution gives ample powers to the Central Government to make laws to regulate the implementation of projects under ILR. Entry 56 under Article 246 states: "Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest." Also Entry 17 of the State List in the Seventh Schedule under Article 246 of the Constitution states that: "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of entry 56 of List I." The Parliament has enacted the Inter State Water Disputes Act, 1956 and the River Boards Act, 1956 empowering the Union to take executive action about the regulation of interstate basins. The latter has never been used in setting up of any River Board. The recently constituted Commission on Centre-State Relations while making recommendations shall have particular regard to the role, responsibility and jurisdiction of the Centre vis-à-vis States in the planning and implementation of the major projects like ILR.

Chapter VI deals with the consultative process of setting a Committee of environmentalists, social scientists and other experts on ILR. Experts have given various suggestions on TOR for preparation of DPR and modalities for preparation of DPR of the Ken – Betwa link. The experts stressed the environmental issues that need to be addressed while preparing the DPRs. Chapter VII dealt with the suggestions and opinions of experts, individuals and organizations. The Standing Committee on Water Resources received more than 900 memoranda from Experts/ Organizations/ Individuals on the subject of ILR Programme/ concept. Thirty of them were invited to give their views in support or against the ILR Programme. Though the chapter provides a descriptive note on the various views it falls short of covering the critical views on ILR in regard to deforestation, displacement and rehabilitation. The report also deals with the changed scenario of Global Warming and its effects and the need for appropriate adaptation measures to obviate the adverse fallout of ILR. The report's contention that controlled structures would fare better in the event of a post-climate change scenario is not established through the past experiences of managing floods in our country. Though ILR itself is at a conceptual stage, many of the alternatives suggested were rejected on the grounds of "not being rooted in the basic tenets of the temporal and spatial hydrology of the river basin", of being at a "conceptual stage", "technically unsound" and "incomplete". The report presents a gist of the proposals along with observations of MoWR viz., National Waterways Project by A.C. Kamaraj, Indian River Grid proposal by K.V. Rupchand, proposals of P.R. Janabandhu and S.D. Buddhisagar. The report ends with annexures covering memoranda from eminent people which raised issues on economic, legal, technical and social issues viz., rehabilitation and resettlement of project-affected people, ecological consequences, putting information in the public domain etc.

Report of the Task Force on formulating action plan for removal of arsenic contamination in West Bengal, Planning Commission, GoI, July 2007

The Planning Commission had constituted a Task Force in August, 2005, under the Chairmanship of Member (Environment & Forest), Planning Commission for formulating an Action Plan for removal of Arsenic Contamination in West Bengal. Purportedly, 79 Blocks in 8 different districts of West Bengal are severely affected due to drinking of water contaminated with arsenic (>0.05 mg/l). This is five times the WHO's permissible limit of 0.01 mg/l. The source of contamination is geological and the situation gets aggravated as major water demands of the affected districts are met from groundwater. According to the report "indiscriminate use of groundwater, rampant use of pesticides, fertilizers and consumption of fish which have ingested arsenic-contaminated water, malnutrition, poor socio-economic conditions, illiteracy, food habits and constant ingestion of contaminated water for prolonged periods have aggravated the problem". The report looks at the extent of the problem, its intake sources, and the technologies available. It subsequently identifies appropriate technologies, discusses operation and maintenance (O&M) issues and formulates an action plan. It then goes on to outline the various technologies based on various scientific principles, assesses them based on their scale of operation (domestic or community) on techno-economic considerations & infrastructure required and provides suggestions. Short, medium and long term measures are outlined for tackling the problem of arsenic contamination in drinking water supply in West Bengal.

The taskforce looked at the existing literature and patent documents on various processes of arsenic removal the world over and short listed processes specific to West Bengal apart from holding discussions with several scientists and innovators. The scientific principles followed in arsenic removal technologies for groundwater revolve around basic principles like coagulation/ co-precipitation, adsorption, sedimentation, ion exchange, membrane/ reverse osmosis, biological treatment/ oxidation etc. Technologies based on

coagulation/ co-precipitation/ adsorption entail pre-oxidation of trivalent As(III) to pentavalent As(V) the latter being less toxic and having better removal efficiency. The taskforce rules out ion exchange and reverse osmosis processes because of high costs and non-applicability in the context of West Bengal. The taskforce looked at some nine technologies for community level plants developed by various national and international agencies to suggest short-term remediation measures. These technologies have been compared with regard to their scale of operation, capital cost, process, media, capacity and cost.

The taskforce looked at three technologies for domestic scale namely, technology developed by School of Environmental Studies (SOES), Jadavpur University (Filter Tablet system), AIIH&PH and National Metallurgical Laboratory (NML), Jamshedpur. The report presents the relative merits and demerits of these and states that the NML's technology has some distinct advantages over the other two. For community level plants, new technologies like those developed and undergoing field trials like those by Central Glass & Ceramic Research Institute (CGCRI) using Ceramic Filter and Agharkar Research Institute are cited. Medium-term measures are recommended for promoting conjunctive use of ground and surface water and waste water recycling for use by communities for other purposes. Long-term measures suggested include tapping of surface water and shallow dug wells in West Bengal, which do not contain arsenic. The taskforce suggests that rainwater, surface water, flooded river basins, village ponds and dug wells available in the State be harnessed for drawing arsenic free drinking water. Central Ground Water Board, in a study, had observed that the arsenic contaminated aquifers lie within 20-80 m depth. So the task force suggests the prospect of tapping arsenic free aquifer at greater depths.

Summary of Recommendations –

- Change in IEC strategy needed.
- Arsenic contaminated water should not be used for drinking. Proper scientific study needs to be done to see if it can be used in cooking/ washing/ bathing/ irrigation.
- The issue of permissible limits of arsenic in vegetables/ fruits/ crops etc., needs to be studied.
- Treatment options for arsenic removal to be foolproof with zero environmental impact and in-built arrangement for sanitary disposal of arsenic bearing sludge.
- Different types of in situ effluent treatment need to be assessed for their impacts.
- To build in sustainability, water recharging component should be incorporated in the system.
- Best long term/medium term/techno-economically viable options need to be prescribed.
- Many technologies meant for removing arsenic also removed iron from the water. Therefore, stringent monitoring mechanism is required. It was also observed that presence of iron along with arsenic in drinking water improved the arsenic removal in co-precipitation process.
- Any arsenic removal package must comprise both the technology for sludge disposal as well as a package for technical education for the users and should also ensure a continuous supply of chemicals/ media etc. Further, supply of chemicals and salary of operating staff has to be ensured with community participation/contribution.
- For domestic removal units, all the three technologies - SOES, AIIH&PH and NML processes are workable.

- Treatment of arsenic affected water appears to be feasible only in areas where piped water supply cannot reach. Arsenic removal using different technologies will work only if the methodology is backed by ways and means to educate all affected villagers in the working of the plant.
- In some blocks, panchayats are drawing drinking water from the aquifer below 1000 ft level as upper layers are heavily contaminated either with arsenic or iron. Whether continuous withdrawal of water from the aquifer will lead to leaching of arsenic from the upper layers to the lower layers has to be examined. Leaching of arsenic through contaminated aquifers to arsenic-free aquifers can be prevented by putting a 'sanitary seal' across the dividing line between the two aquifers.
- The State has increasingly gone in for surface water. It may be safe to completely stop using affected groundwater. The State enjoys an average annual rainfall of about 1600 mm and rain water harvesting can be used as a local solution. The water bodies/ tanks can be put to good use for drawing drinking water without affecting pisciculture activities.
- GOI may provide a list of technology suppliers to the State and a suitable service provider to be selected by the State to set up, operate and maintain arsenic removal plants in affected areas. A MoU can be drawn up with the State Government. The service provider can mobilize funds for capital cost by approaching banks or venture capitalists. The taskforce recommends that the State should supply arsenic-affected water free of cost to the service provider and provide them with free electricity/electricity at nominal rates. The technology supplier can charge nominal fee for supplying technology to the service provider. The O & M cost can be borne by the service provider. The State Government can buy processed water from the service provider and supply it free of cost to villages. The service provider can operate the arsenic removal plant on a commercial basis.
- Standard methods need to be explained regarding safe disposal of sludge that comes out of the arsenic treatment plant at the community as well as district level. Central Pollution Control Board standards need to be clearly indicated in this regard. It may also be noted that although the contract is given to agency for installation, operation and maintenance and safe disposal of sludge but, in reality, once the arsenic contaminated sludge is taken away by the agency from the treatment site, one does not know whether the sludge is disposed off in a safe manner. This means that adequate follow up action should be taken up by the PHED/ Line Department regarding its safe disposal.
- The taskforce suggests awareness building measures like conducting of Sensitization Workshops at State, District, Block and Gram Panchayat levels by the PHED, imparting of training to local clubs, NGOs, etc., to enable them to develop skills to inculcate awareness on arsenic contamination, holding of cluster meetings in affected villages, distribution of posters and pamphlets, regular home visits by health workers to affected homes, making people aware of importance of water quality monitoring, etc. It is also essential to conduct arsenic detection tests on all private drinking water sources tapping water from shallow aquifers (20-80 m) depth and seal contaminated sources.

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