NEITHER WATER NOR GOVERNANCE
Water Mismanagement in the Narmada River Basin

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Introduction

Water governance in the Narmada River basin has been in the eye of a controversial storm from the time of independence. While initially the dispute had been between the riparian states over the apportionment of the use of the waters of the river for large dam centred canal irrigation and hydro-electric power development, later the dispute shifted to the appropriateness of this kind of development given the tremendous environmental and social costs associated with it (Paranjpye, 1990). This later problematisation of centralised water governance and people's mobilisation for a more localised, participatory and environmentally sustainable use of water resources has inspired a rich body of thought and action with regard to appropriate water governance not only in the basin but across the country and the world (Sangvai, 2002).

This treatise is in two sections. The first section begins by detailing the geographical characteristics and resource endowments of the river basin followed by a description of the status of agricultural and industrial development and their impact on the water quality. The dispute over river water sharing and its resolution is described next followed by details of some of the major projects under construction in the basin. The problematisation of centralised water governance by the Narmada Bachao Andolan and its culmination in the Supreme Court case is detailed thereafter. This is followed by a review of the various problems of large dam centred water resource development. Then the various traditional and modern

sustainable approaches to water resource use and governance in the basin are described.

The second section deals in detail with the situation of water management in the Man River basin which is a tributary of the Narmada River on which there is a big dam at Jirabad in Dhar district. This section begins with a detailed review of the current status of research with regard to water availability and use, the Adivasi predicament, the status of Panchayati Raj in the country and the gender situation in Western Madhya Pradesh. This is followed by a description of the Man River Basin. The quantitative estimation of the water use in the river basin follows. Then the details of the dam built on the river and its operation are detailed. Finally, there are the conclusions.

This treatise through a combination of primary and secondary research establishes that due to misgovernance of the natural resources of the Narmada River basin there is a lack of adequate water in the basin and the water scarcity is increasing continuously.

SECTION 1 : NARMADA RIVER BASIN

1. Geographical Characteristics

The water availability in a river basin is primarily determined by its geographical characteristics and this is especially so for the Narmada river which is the only perennial river that is not snow fed in India. The various geographical details of the Narmada basin have been described below.

1.1 Course

The Narmada is the longest west flowing river in India. It rises from a spring at a height of 1057m above MSL on the summit of Amarkantak Hill in Shahdol district of Madhya Pradesh in the Maikal hill range. This area also gives rise to a tributary of the Ganges river, the Son river, just a few kilometers away. The Narmada basin lies between east longitudes 72^0 32' to 81^0 45'and north latitudes $21^0$20' to $23^0$45'. The total length of the Narmada from its source to its outfall into the Gulf of Cambay in the Bharuch district of Gujarat is 1312 kms. The first 321 kilometres of its course winds among the Mandla Hills, which form the head of the Satpura Range till it reaches Jabalpur where it passes through the 'Marble Rocks' and enters the Narmada plains. The river runs another 745 kilometers through the plains before the Vindhyas and the Satpuras come close to the banks of the river restricting it to a narrow gorge that extends for 87 kilometers first forming the common boundary between Maharashtra and Madhya Pradesh and then between Maharashtra and

Gujarat. Thereafter it stretches for 159 km in the plains in Gujarat to its outfall into the sea (CWC, 2006).

1.2 Geology

The Narmada Valley is a rift valley situated between the Narmada North fault and the Narmada South fault. These in turn are part of the longer Narmada-Son Lineament which is an active fault zone and a distinguishing tectonic feature of central India. Extensive basaltic flows known as Deccan Traps have come out of these faults and underlie most of the basin. Apart from this there are some granite, and the Gondwana shale and sedimentary rocks in parts of the hills and plains and alluvial deposits near the river courses. A layered block called a graben has dropped down in the middle relative to the blocks on either side of the faults due to ancient spreading of the earth's crust. The Two faults parallel the river's course, and mark the boundary between the Narmada block and the Vindhya and Satpura blocks which have risen relative to the Narmada Graben. In between the two blocks there is an alluvial plains area of about 500 kms length and 35 - 45 kms width stretching from Jabalpur district to Barwani district which overlies the Deccan traps and and Gondwanas on both banks of the river.

1.3 Watershed

The Narmada watershed includes the northern slopes of the Satpuras, and the steep southern slope of the Vindhyas, but not the Malwa Plateau, the streams from which flow into the Ganges and Yamuna. According to the Narmada Control Authority (NCA Website) the river drains an area of 98,796 sq.kms. out of which nearly 86%

lies in Madhya Pradesh, 1% in Chhattisgarh, 2% in Maharashtra and 11% in Gujarat. There are 41 important tributaries of the Narmada River. The larger ones are Burhner , Banjar, Hiran, Tawa, Chhota Tawa, Orsang and Kundi which having catchment area of more than 3,500 sq.kms each. The remaining tributaries have catchment areas ranging from 500 to 2,500 sq.kms. The basin has an elongated shape with a maximum length of 953 Km. from east to west and a maximum width of 234 Km. from the north to south. The basin has five well defined physiographic zones. They are -

(i) the Upper hilly areas covering the distt. of Shahdol, Mandla, Durg, Balaghat and Seoni
(ii) the Upper Plains covering the districts of Jabalpur, Narsimhapur, Sagar, Damoh, Chhindwara, Hoshangabad, Betul, Raisen and Sehore
(iii) the middle plains covering the districts of East Nimar, part of west Nimar, Dewas, Indore and Dhar
(iv) the lower hilly areas covering Barwani and Jhabua in Madhya Pradesh, Nandurbar in Maharashtra and a part of Baroda and Narmada districts in Gujarat.
(v) the lower plains covering mainly the district of Bharuch in Gujarat.

The Central Groundwater Board (CGWB), however, has divided the basin into three sections - lower, middle and upper for their demarcation of watersheds. According to the CGWB Website the lower Narmada basin has a catchment area of 9750 sqkms and is mostly in Gujarat with small portions in Maharashtra and

Madhya Pradesh. The middle Narmada basin has a catchment area of 40699 sqkms wholly in Madhya Pradesh. The upper Narmada basin has a catchment area of 43129 sqkms mostly in Madhya Pradesh with a small section in Chhattisgarh. In this way the total area of the basin comes to only 93398 sqkms which is at variance with the estimate of the Narmada Control Authority. Similarly the Sardar Sarovar Narmada Nigam Limited (SSNNL Website) which administers the Sardar Sarovar Dam at Navagam in Gujarat has estimated the total catchment area of the Narmada basin to be 97410 sqkms. Thus there is a lack of agreement among the leading agencies concerned on the area of the basin.

1.4 Forests

On paper forests occupy 32% of the area of the basin covering 28300 sq. km. in Madhya Pradesh, 150 sq. km. in Chhattisgarh, 268 sq. km. in Maharashtra and 1085 sq. km in Gujarat. However most of this legally designated forest area is highly degraded and the actual dense forest cover by the Forest Survey of India estimates is only about 15%. The hilly regions of the upper basin extending upto the Tawa catchment are well forested with good crown cover of tropical moist species. The bulk of the commercial timber production of the Madhya Pradesh Forest Department is carried out in this region. The forests in the middle and lower basin which are of the tropical dry deciduous variety have been heavily denuded over the years with some of the best forests having been submerged by the reservoir of the Indira Sagar dam. Forests are practically non-existent in the parts of the basin in the states of Maharashtra and Gujarat where they

have been converted into agricultural and grazing lands. The major challenge to forest management in the basin is the pressure on the forests created by the livelihood needs of those residing in or near them, who are mainly adivasis with very little alternative livelihood sources. The major tree species are teak, salai, dhavra, saja, aonla, reunjha, moyan, anjan, rohan, tendu and mahua (MP Forest Department Website).

1.5 Climate

The tropic of Cancer crosses the Narmada Basin in the Upper plains area and most of the basin lies just below this line. The climate of the basin is humid and tropical, although at places extremes of heat and cold are often encountered. In the year, four distinct seasons occur in the basin. They are -

(i) Winter (November to February)
(ii) Summer (March to mid-June)
(iii) South west monsoon (mid-June to mid-September)
(iv)Post monsoon (mid-September to October)

In the cold weather, the mean annual temperature varies from 7.5^{o} C to 20^{o} C and in the hot weather from 30^{o}C to 42.5^{o}C. During the South west monsoon the temperature ranges from 27.5^{o} C to 30^{o} C. In the post monsoon season, the temperature ranges between 25^{o} C to 27.5^{o} C. Rain gauges were first established in 1867 in the Narmada basin. From the year 1891 published rainfall data are available. Thereafter, there has been a study growth of the rain gauge network in the basin. Nearly 60% of the total rainfall is received in the two months of July & August. Another thirty percent is received in the months of June, September and October. The rainfall is heavy in the upper

hilly and plains areas of the basin. It gradually decreases towards the lower plains and hilly areas and again increases towards the coast and south western portions. In the upper hilly areas, the annual rainfall is, in general, more than 1400 mm but it goes up to 1650 mm in some parts. In the upper plains from near Jabalpur to near the Punasa dam site, the annual rainfall decreases from 1400 mm to less than 1000 mm with the high rainfall zone around Pachmarhi in the Satpura Hills in Hoshangabad district where the annual rainfall exceeds 1800 mm (70"). In the lower plains the annual rainfall decreases rapidly from 1000 mm at the eastern end to less than 650 mm around Barwani, and this area represents the most arid part of the Narmada Basin in the lower hill areas. The annual rainfall again increases to a little over 750 mm in the hills in Gujarat and Maharashtra and 1000 mm in the coastal plains. The evaporation in the upper zone is 1 to 3 mm while that in the lower zone is 12 - 28 mm.

1.6 Soils

The soils in the upper hilly regions of the basin are mostly shallow red and yellow with low fertility. The upper Narmada plains are well suited for cultivation with deep black soils up to the East Nimar district. These soils are highly water retentive. Thereafter there are medium black soils in the West Nimar, Dewas and Barwani districts mixed with skeletal red and yellow soils. The lower hilly portions in Madhya Pradesh, Maharashtra and Gujarat have mostly shallow red and yellow and skeletal soils of low fertility. There are alluvial deposits on the banks of most of the major tributaries. The coastal plains in Gujarat are composed of alluvial clays with a layer of black soils.

2. Water Resources

The estimation of the water resources in a river basin is a complicated exercise dependent on prior estimation of rainfall, temperature, vegetation, land use, topography, geology and soil cover. Due to changes in these parameters over time because of natural and human factors the water availability too varies.

2.1 Surface Water

An initial effort at estimation of the surface flow in the river at Garureshwar just below the present Sardar Sarovar dam at Navagam in Gujarat was made by the Narmada Water Resources Development Committee headed by Dr A. N. Khosla which submitted its report in 1965. This committee worked on the basis of the actual run off data available from 1948 to 1962 and hindcasting of the rainfall data for earlier years from 1891 and arrived at an estimate of annual flow of 35.7 billion cubic meters (bcm) at seventyfive percent dependability. However, this estimate was challenged by the engineers of Madhya Pradesh and Maharashtra and finally after a long dispute the Narmada Water Disputes Tribunal arrived at a political settlment of the annual flow of the Narmada at Garureshwar at seventy five percent dependability as being 34.5 bcm in 1974. However the actual annual flow in the river at present at seventy five percent dependability is only 27.1 bcm. The maximum discharge of 60642 cumecs occurred at Garureshwar on 7.9.1994 while the minimum discharge at this point of 14.05 cumecs occurred on 3.6.1980. The monthly distributions of average daily flow per unit area of catchment intercepeted at this point in mm and the average daily sediment in

thousand metric tonnes are given in the table below. These values are for 2002 when the Indira Sagar and Sardar Sarovar dams had already been built on the river to a considerable extent. The maximum annual sediment load recorded at Garureshswar in for the year 1990-91 prior to the construction of the above dams when it was 51.54 million metric tonnes.

Table 1 : Flow per Unit Area & Sediment Load at Garureshwar on the Narmada River

	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Flow/ Area in mms	8.8	63.7	145.6	97.1	25.7	9.5	7.8	5.2	4.2	4.1	3.0	2.5
Sediment in '000 Ts	0.65	9.1	132.9	320.2	36.1	1.56	1.25	1.45	0.85	0.19	0.36	0.24

Source : CWC, 2006

2.2 Ground Water

The net groundwater availability in the basin is roughly about 8.5 bcm as calculated from the groundwater data available for the districts that comprise the basin (MPWRD Website). The groundwater yield depends on the underlying rock structure which as mentioned earlier consists of the following rock classes -

(i) Granite gneisses and meta-sedimentary rocks in the hilly upper watershed regions.

(ii) Gondwanas comprising sand stones, lime stones & marbles in the upper watersheds and also in the plains.
(iii) Basaltic Deccan Traps which cover most of the basin.
(iv) Quaternary alluvium along the river courses

The alluvial deposits form prolific aquifers where tubewells can yield in the range of 50-80m^3/hr. The yield of tubewells in sand stones of Gondwanas ranges between 20-30m^3/hr whereas in limestones of Gondwanas it varies between 50-80m3/hr. The yield of tubewells in basalts ranges between 20-30m^3/hr.

2.3 Water Use

The extensive use of water both suface and ground for the development of irrigation in the Narmada basin has taken place from the nineteen seventies onwards. Canal irrigation upto the year 2000 was mainly from small tanks and small dams as among the large and medium projects only the Matiyari, Tawa, Sukta and Barna dams had their command areas fully developed. A detailed discussion of the utilisation of surface water through large and medium dams follows later in the section on the exploitation of surface water in the Narmada basin. It is notable that despite the government stress on large and medium dam centred water resource development and utilisation it is electricity and diesel powered pumping of groundwater from tanks, streams, rivers and groundwater aquifers that has contributed much more to irrigation in the basin as can be seen from Table 2 below.

Table 2: Growth of Irrigated Area in the Narmada Basin in 000 hectares

Year	Canal Irrigated	Groundwater Irrigated
1969-70	111	181
1980-81	210	416
1988-89	388	702
1999-00	543	1054

Source : GoMP Agricultural Statistics quoted in Ranade, 2005.

The extent of groundwater development and its criticality with respect to availability is given across the six agro-ecological zones of the basin in Table 3 below.

Table 3: Groundwater Development and Criticality in the Narmada Basin

Agro-ecological Zone	Groundwater Development (%)	Criticality of Zone
Upper Hills	17	Safe
Upper Plains	100	Over-exploited
Middle Plains	30	Safe
Lower Plains	100	Over-exploited
Lower Hills	15	Safe
Coastal Plains	80	Critical

Source : Calculated from MP Water Resources Department Website district data.

The average consumption of domestic potable water in the basin is about 35 liters per capita per day as roughly calculated from CWC data which is well below the norm of 120 liters per capita per day. In this respect the most important project is that of drawing water from the Narmada near Mandleshwar, treating it to potable quality and then pumping it up to a height of 500 m. over 70 km. to the city of Indore through a pipeline which was implemented in the 1970s and later augmented once in the 1990s.. The Asian Development Bank has now sanctioned a loan of Rs 500 crores for further augmentation and renovation of this water supply system. This supply of water to Indore from a far away source much lower in elevation requires a lot of electrical energy in pumping and also involves considerable losses. The unit cost of water supplied is consequently very high and has to be subsidised by the government. The net result is that the running and maintenance of this water supply system has become economically unsustainable and with the phasing out of subsidies now the Indore Municipal Corporation has run up a debt of over a hundred crore rupees with the distribution company of the Madhya Pradesh State Electricity Board.

3. Other Resources

3.1 Mineral Resources

The basin has mineral deposits of good economic value. There is manganese ore in Dindori district in the upper hilly region of the basin while Mandla district has dolomite deposits. Lower down Jabalpur has coal and ochre deposits. There are limestone deposits in Narsimhpur and Hoshangabad district in the middle plains and dolomite in Harda district. There are very good deposits of coal in Betul district. There are pyrophyllite and diaspore deposits in Dewas district further down. There are considerable limestone, calcite and dolomite deposits in the lower plains and hills in Khargone, Khandwa, Dhar, Barwani and Jhabua districts. The only flourspar deposits in the country are to be found in Vadodara district in Gujarat. While the coastal region near Ankleshwar in Bharuch district has good deposits of crude oil.

3.2 Human Resources

The average population density in the basin is about 195 persons per square kilometer and it is mostly rural with the rate of urbanisation being only 20%. There are only two cities with population above one million and these are Jabalpur in Madhya Pradesh and Bharuch in Gujarat. There are four towns with population of around one lakh and these are Khargone, Khandwa, Hoshangabad and Betul. The work participation rate of the whole population is 45% with 42% of the workers being cultivators and another 34% being agricultural labourers thus underlining the predominantly rural and agricultural nature of the

workforce. The literacy rate is quite high at about 62% while the life expectancy at birth is 65 years indicating that the population is fairly well educated and healthy. The proportion of scheduled castes is about 11% but they own only about 5% of the cultivable land. The proportion of scheduled tribes is quite high at about 40% and they reside mostly in the hilly and forested areas in the upper watersheds of the basin. Their share of the cultivable land is only 32% and most of it is of poor quality (MPHDR, 2002).

4. Agriculture

The net sown area in the basin is about 45% of the total area and the average cropping intensity varies across the basin with the average being 135%. The average cultivable landholding size is 1.1 hectares and the land distribution is skewed towards large landholders in the plains regions. The distribution of net sown area and net irrigated area across the three states of Madhya Pradesh, Maharashtra and Gujarat are given in Table 4 below. This clearly brings out the preponderance of groundwater irrigation over canal irrigation in the basin.

Table 4: Net Sown Area and Irrigated Area in the Narmada Basin in sq. kms. (2000)

	Net Sown Area	Irrigated Area						% age Irr. Area
		Canals	Tanks	Tube wells	Other Wells	Other Sources	Total	
M. P.	38527	3867	387	2624	5110	1740	13728	35.6
Maharashtra	884	64	-	-	120	-	184	20.8
Gujarat	5622	414	18	647	1137	18	2234	39.7

Source : CWC, 2006

There are six distinct agro-ecological zones in the basin with diverse agricultural characteristics as follows -

(i) The upper hilly region covering Mandla, Dindori and Balaghat districts which is predominantly a rice growing zone with some wheat, pulses and minor cereals. The productivity in this region is low because of poor soil quality and non-development of irrigation facilities.

(ii) The upper plain covering Jabalpur and Narsinghpur districts which is primarily a rice/wheat double crop zone with some pulses and minor cereals. The productivity is high in this region because of good soil quality and a fair development of irrigation facilities.

(iii) The middle plain covering Hoshangabad, Sehore, Harda and Raisen districts which is primarily a soyabean/wheat double crop zone with some pulses and minor cereals. The productivity in this zone is high because of good soil quality and extensive irrigation development.

(iv) The lower plain coverning Khandwa, Dewas, Khargone, Dhar and Barwani districts which is primarily a Cotton, Jowar, Soyabean and Wheat multiple crop zone with some pulses and minor cereals. The productivity is high in this region because of good soil quality and extensive irrigation development.

(v) The lower hills covering the districts of Barwani and Jhabua in Madhya Pradesh, Nandurbar in Maharashtra and Vadodara and Narmada in Gujarat which is mainly a Jowar and Makka zone with some soyabean, wheat and minor cereals and

pulses. The productivity is low as the soil quality is poor and due to the hilly terrain not much irrigation is possible.

(vi) The coastal plain covering the Bharuch district of Gujarat which is primarily a paddy, jowar, groundnut and cotton multiple crop zone with some wheat and minor cereals and pulses.

The farmers in the Narmada basin mostly cultivate small plots of land on terrain and soils that are unsuitable for flood irrigation and they have traditionally been driven by the desire to produce for subsistence rather than for profit. They had over thousands of years developed a system of agriculture that made the most of the locally available resources in terms of seeds, organic fertilisers, soil moisture and natural pest management. This led Sir Albert Howard, the pioneer of modern organic farming who did most of his work in Indore, situated on the edge of the Basin to remark some sixty years ago, "What is happening today in the small fields ... took place many centuries ago. These agricultural practices have passed the supreme test, they are as permanent as those of the primeval forest, of the prairie, or of the ocean" (Howard, 1940). The clever use of rotation of a bewildering variety of crops ensured that despite occasional drought some part of the harvest was always saved. Famines occurred not because of the failure of agriculture but because of socio-economic factors such as excessive levies by kings and colonial rulers or due to usury and hoarding by sahukars (Patnaik, 1991). Indeed the levying of excessive taxes and usury have been a severe constraining factor on the development of agriculture all over the world from ancient times and in most of the Narmada basin this was intensified greatly

because the usurious practices of the sahukars or moneylenders was supported by the British colonialists.

Thus what was necessary after independence was to remove the obstacles in the path of development of this traditional agriculture being practised in the basin and strengthen it with further research, extensive land reforms, localised water resource development, cheap institutionalised credit and market support. But this did not happen and agriculture, especially in the dryland areas in Madhya Pradesh gradually became moribund (Vijayshankar, 2005). This was because the new model of industrialised agriculture that was developed in the west since the nineteen thirties in which hybrid seeds, fertilisers, pesticides, big dam irrigation and machines were used to ramp up agricultural production with huge state subsidies eventually benefited the corporations which not only supplied these inputs but also owned most of the farms and traded in the outputs. So farm gate prices remained low leaving the actual small farmers who had always struggled against usury no alternative but to trod the path of tremendous destitution. Post World War II the excess production of fertilisers, pesticides, tractors and trucks arising from the reorientation of the war time production of plants from explosives and armoured vehicles necessitated the replication of the western agricultural system worldwide (Wessel & Hantman, 1983).

So, at the behest of the research foundations set up by American multinational corporations, with financial support provided by the World Bank and the money from the exports of American wheat to India which were

recycled for this purpose, the western agricultural pattern was promoted with the introduction of foreign hybrid varieties of wheat and rice as green revolution agriculture in the late nineteen sixties and early nineteen seventies in the basin. Simultaneously soyabean was also introduced so as to provide feed for the burgeoning cattle industry in America. Soyabean has had the effect of displacing traditional kharif food crops like sorghum, maize, millets, pulses, gram, sesame and groundnut. Consequently, the poorer farmers and the agricultural labourers have lost a cheap source of food and have now to buy their food from the market which has led to a rise in malnutrition.

This form of agriculture has now become problematical throughout the world. The main problem with artificial input agriculture is that there is a natural limit to the artificial inputs that the soil can take and so the amount of fertilisers, pesticides and water to be applied goes on increasing while the yields go on falling and sometimes the crop fails altogether. Consequently, the economic costs go on increasing while the realisation of the value of agricultural products in the market does not keep pace (Rahul & Nellithanam, 1998). Inevitably this has led to the farmers falling into the clutches of sahukars and spiralling debt.

The most important consequence arising from the adoption of this agriculture has been in the utilisation of water resources in the basin. The stress on production of high water demanding crops like hybrid rice, wheat and sugarcane has led to the concentration of financial resources on mega dam projects by the government on the one hand and the mining of ground water by private

farmers through the use of motorised borewell pumps on the other. There has thus been an increasing scarcity of water in the basin. Most of the water needed for irrigation in the basin as we have seen is being provided by groundwater extraction and this has led to a situation of "water mining" wherein water collected in the deep confined aquifers over hundreds of thousands of years has been used up in the space of a decade and most parts of the plains are facing a ground water drought from the nineteen nineties onwards (CGWB, 1995). Since then there has been less and less ground water available for not only irrigation but also for drinking and the cost of its extraction is continually going up. This collapse of agriculture in the basin has created a parallel problem of massive seasonal or permanent migration from the basin to areas outside it which offer better employment opportunities due to industrial development (Mosse et al, 2002). Within the basin as will be detailed in the section on industries there are only two important industrial centres. However, this migration is grossly under reported in the census data and there are no studies specifically on outward migration from the basin.

5. Industry

Industrial development has not taken place in the basin as there are only two major industrial centres at Jabalpur and Bharuch. The major industry in Jabalpur is the ordnance factory of the Defence Ministry which is a century old establishment involved in manufacture of arms, ammunition and vehicles for the army. Apart from this there are timber based industries such as sawmills and furniture establishments. There are also units producing telephone parts, electrical goods and glassware. It is also a major centre for the manufacture of bidis. The major industrial unit in Bharuch is a chemical and fertiliser plant of the Gujarat Narmada Valley Fertiliser Company. Apart from this there are many other chemical and petro-chemical plants in the many industrial areas in Bharuch, Ankleshwar and Dahej. There is also a unit of the Oil and Natural Gas Corporation producing crude oil. In addition to this there is a coal based thermal power plant in Sarni in Betul district of Madhya Pradesh and a Security Paper Mill of the Finance Ministry in Hoshangabad and some textile mills in Khargone and Khandwa. These two districts also have a few sugar mills.

6. Water Quality

The lesser industrial development in the Narmada basin has meant that the problem of water pollution is considerably less in the river. The river has an average dissolved oxygen level of about 7 - 8 mg/litre throughout which is comfortably higher than the safe limit of 5mg/ litre. The river water is slightly alkaline with the average pH level also hovering between the healthy 7 and 8 range though it is slightly on the higher side in Gujarat. The conductivity ranges from 190 mho/cm in the upper hilly region to 1746 mho/cm in the Bharuch area where industrial activity is high. The Total Coliform Count in the river ranges from 3-2400 MPN/100ml whereas the Faecal Coliform count varies from 2-210 MPN/100ml indicates relatively low level of pollution from human waste. The average Biochemical Oxygen Demand (B.O.D.) levels range from a low of 0.9 mg/litre at Amarkantak to a high of 4.5 mg/litre at Bharuch and Hoshangabad and generally about 1.3 elsewhere. Thus the river has an unacceptable B.O.D only near the urban conglomerations. Similarly the Total Suspended Solids (T.S.S.) are high at 14 mg/litre at Bharuch in the winter when the flow is clear elsewhere in the river. There are also concerns about the groundwater quality in Bharuch with the chemical units there pumping their effluents into the aquifers leading to heavy pollution of groundwater. Tests have revealed that the mercury levels in the groundwater near the Ankleshwar Industrial Estate are more than 100 times the admissible levels. This has been compounded by saline ingress from the sea due to heavy drawals of groundwater in the area. Throughout the plains areas of the basin there is the problem of chemical

residues from agriculture entering the groundwater and this is reflected in the fact that about 40% of the ground water sample collection sites of the Central Ground Water Board in the plains areas of the basin where modern agriculture is practised reported nitrate levels in excess of 100 mg/litre with some sites having levels higher than 300 mg/litre. Some areas in Jhabua and Dhar district where there are fluoride rocks in the aquifers have a high flouride content in the groundwater leading to the prevalence of fluorosis among the population that uses this groundwater. Some steps have been taken by the government to provide alternate treated water to these areas. (CWC, 2006)

7. Initial Plans for Surface Water Exploitation in the Narmada Basin

The Narmada basin along with other parts of central and western India experienced severe drought conditions in the last decade of the nineteenth century and this led the then British Governor General to appoint a Famine Commission in 1901 to study the possibilities of irrigation in the Narmada Basin and in Gujarat by construction of dams (Paranjpye op cit). The commission in its report unequivocally stated that surface irrigation would be counter productive in the mostly deep black soils of the Narmada basin and also in Gujarat. The report mentioned that there were various ingenious systems in place throughout the basin for the conservation of soil moisture in clayey black soils for the cultivation of dry land wheat in the rabi season and it was inadvisable to introduce flood irrigation that would result in waterlogging and salinity and bring down agricultural production instead of increasing it. This led to the shelving of any plans for dam building in the basin till almost the end of British rule.

The governments of the Central Provinces and Berar and Bombay presidencies requested the Central Waterways, Irrigation and Navigation Commission (CWINC) to take up investigations on the Narmada river system with respect to the possibilities of flood control, irrigation, power and navigation. The CWINC recommended that preliminary investigations should be taken up at seven different sites which were ideal for the construction of storage reservoirs on the river. In 1948 a three member ad hoc committee appointed by the Ministry of Power to go into these recommendations headed by the then chairman

of the CWINC Dr A. N. Khosla suggested that given the paucity of resources detailed investigations should be conducted at only the four sites in Bharuch district, Punasa in Khandwa disrtict, Tawa in Hoshangabad district and Bargi in Jabalpur district. The investigations were taken up and after the CWINC was renamed the Central Water and Power Commission (CWPC) in 1955 the detailed project reports of all the four projects were finally ready by 1963. The CWPC also carried out a study of the hydroelectric potential of the basin in 1955 and identified 16 sites which could generate upto 1300 MW of electricity.

A meeting of the representatives of the Bombay and Madhya Pradesh states was held in 1957 where the chairman of the CWPC informed them of the potentialities of the Narmada basin. It was decided at this meeting to study a few more sites than those mentioned above and the cost of the investigations was to be borne equally by both the states. While conducting these further investigations it came to light that the site at Navagam in the present Narmada district of Gujarat which had exposed rock from the river bed which could provide lateral supports for the construction of a high dam. On the basis of this the CWPC submitted a report to the Bombay government for the construction of a dam at Navagam in two stages. The first stage would have a full reservoir level (FRL) of 48.8 meters with a provision for later enhancement of the FRL to 91.4 meters. A panel of consultants appointed by the Ministry of Power and Irrigation to review this proposal recommended that the dam should be built at one go upto an FRL of 97.5 meters and a high level canal would make it possible to extend

irrigation upto Saurashtra and Kacch. Notably unlike in British times in all these deliberations the suitability of irrigation in black cotton soils was not investigated at all. Thus the approach to water resource utilisation was not related to the local specificities prevailing in the basin but to the general nationwide thrust for the building of large dams. On May 1st 1960 the new state of Gujarat was formed and it gave its approval to this enhanced height of the project and subsequently in April 1961 the then Prime Minister Jawaharlal Nehru inaugurated it thus starting off the process of dam building for the purpose of large scale utilisation of its waters on the river Narmada.

The proposal to irrigate Saurashtra and Kacch needed substantiation as to whether there was enough water available in the river at Navagam for this to be possible. The Gujarat government itself conducted a study and also contracted the Survey of India to do another to investigate the water availability from the free draining catchment of the river between Navagam and Punasa. On the basis of these studies the Gujarat government proposed that the dam height at Navagam should be enhanced to an FRL of 140.2 meters for full utilisation of the untapped flow below Punasa.

Subsequent to this a meeting was held in November 1963 in Bhopal in which the Union Power Minister Dr. K. L. Rao and the Chief Ministers of Gujarat and Madhya Pradesh participated and it was supposedly agreed that -

1. The FRL of the Navagam dam in Gujarat would be 129.6 meters and all the benefits would be enjoyed by Gujarat.

2. The FRL of the Punasa dam in Madhya Pradesh would be 259.1 meters and the cost and power benefits should be shared between Gujarat and Madhya Pradesh in the ratio of 1:2. Maharashtra would provide a loan to the extent of one third of the cost of the Punasa dam and would in return be entitled to half of Madhya Pradesh's share of the electricity for a period of 25 years.
3. The FRL of the Bargi dam in Madhya Pradesh would be 416.2 meters and it was to be implemented totally by Madhya Pradesh with loans of Rs 10 crore being provided by Gujarat and Maharashtra.

However later the Chief Minister of Madhya Pradesh retracted from this agreement and reiterated that the height of the Navagam dam should be restricted to an FRL of 49.4 meters which was the bedlevel of the river at the Gujarat - Madhya Pradesh border. This led to the beginning of a bitter dispute over the use of the surface flows of the Narmada river.

8. The Inter-State Dispute over sharing of Narmada Waters and its Initial Resolution

The Union government constituted the Narmada Water Resources Development Committee under the chairmanship of Dr. A. N. Khosla in 1964 to resolve the dispute between the states over the sharing of the benefits of the utilisation of Narmada waters. This committee was given the responsibility of preparing a Master Plan for the optimum and integrated use of the flow of the Narmada river and drawing up a phase wise timeline for its implementation with special reference to the details of the dam at Navagam. While this committee was deliberating on the various issues before it the governments of Madhya Pradesh and Maharashtra entered into an agreement in 1965 for the construction of a dam on the Narmada river at Jalsindhi just before the Gujarat border sharing the costs and benefits associated with the project. After this the Khosla Committee came out with its report recommending 13 major projects in the basin on the Narmada and its major tributaries namely Rosra, Basanta, Burhner, Bargi, Chinki, Sitarewa, Barna, Hoshangabad, Tawa, Kolar, Punasa, Omkareshwar and Navagam.

Regarding the Navagam dam itself the Khosla committee recommended an FRL of 152.4 meters, the full supply level for the irrigation canal as RL 91.5 meters and the total installed capacity at the river bed powerhouse as 1400 MW. The committee also for the first time included Rajasthan in the share of irrigation benefits. As before the Khosla committee did not go into the suitability of flood irrigation in black soil areas and the added measures

needed to be taken in terms of lining of canals and construction of proper drainage channels to ensure that waterlogging and salinity did not occur. It also downplayed the environmental and social costs of the submergence of the gorge that begins at Harinphal at the point where the river becomes the boundary between the states of Maharashtra and Madhya Pradesh and the dam site at Navagam thus undervaluing the forests and the adivasis living in them. The main thrust of the committee was to ensure that most of the water in the river was used up for irrigation and power generation irrespective of the social and environmental costs involved.

While Gujarat accepted the Khosla committee's reccomendations Madhya Pradesh and Maharashtra rejected them. The Madhya Pradesh government came up with the alternative idea of diverting the waters of the Narmada into the Ganges basin rather than their diversion into central and north Gujarat. Maharashtra was interested in the construction of a dam higher up so that it could get greater benefit from power generation. Several meetings between the Chief Ministers of the three states remained inconclusive and finally in 1968 the Gujarat government petitioned the Union government to appoint a tribunal invoking the Inter-State Water Disputes Act of 1956 (ISWDA). The tribunal was constituted in 1969 and the dispute over the apportionment of the waters of the river Narmada between the states of Gujarat, Rajasthan, Madhya Pradesh and Maharashtra and the height of the Navagam dam were placed before it for resolution.

The constitution of the Narmada Water Disputes Tribunal (NWDT) was challenged as ultra vires of the Inter-State

Water Disputes Act by the government of Madhya Pradesh in 1969 first before the tribunal itself and then when this challenge was dismissed by the tribunal the government of Madhya Pradesh went to the Supreme Court and obtained a stay in 1972. Subsequent to this the Chief Ministers of the four states decided on trying for an agreement out of court with the assistance of the Prime Minister of India and after several parleys came to the agreement in 1974 that the yield of the river available at Navagam should be taken as 34.5 billion cubic meters at seventyfive percent dependability. Of this 0.31 bcm was to be allotted to Maharashtra and 0.62 bcm to Rajasthan. So the NWDT was left with adjudication on the apportionment of the remaining 33.57 bcm of water between the states of Gujarat and Madhya Pradesh and the benefits of the hydel power generated. Thus this political settlement estimated the annual yield of the Narmada at Navagam at seventyfive percent dependability at a value well above the assessment by the NWDT's own technical experts of 27.4 bcm. The tribunal finally passed its orders in 1978 resolving all the contentious issues before it.

9. The Narmada Water Disputes Tribunal Award

The basic design data of yield of the Narmada river at Navagam was flawed as mentioned above because it was based on arbitrary assumptions for the values of the surface runoff, evaporation losses at reservoirs, return flow from upstream storages and from the groundwater aquifers and the carryover storages without doing any detailed sampling and simulation studies to properly estimate these values. This arbitrariness plagued the estimation of other variables also that were used to decide the apportionment of waters between the states of Gujarat and Madhya Pradesh and the heights of the Sardar Sarovar dam at Navagam and the Indira Sagar dam at Punasa leading to the overdesign of the height of both dams and the consequent greater costs - economic, environmental and social. The broad contours of this design fiasco is detailed here. The ISWDA does not specify the principles based on which a tribunal constituted under it shall adjudicate on the apportionment of the waters of a river between the disputant states and so the NWDT relied on the Helsinki Rules on the Use of Waters of International Rivers that were framed by the International Law Association in 1966 as this customary international law also governed the use of waters of a river basin that spans more than one sub-national province. According to the Helsinki Rules (ILA Website) the principles on which the water resources of a basin are to be reasonably and equitably shared are as follows

1. The relevant factors to be considered include, but are not limited to:

a. Geographic, hydrographic, hydrological, hydrogeological, climatic, ecological, and other natural features;
b. The social and economic needs of the basin States concerned;
c. The population dependent on the waters of the international drainage basin in each basin State;
d. The effects of the use or uses of the waters of the international drainage basin in one basin State upon other basin States;
e. Existing and potential uses of the waters of the international drainage basin;
f. Conservation, protection, development, and economy of use of the water resources of the international drainage basin and the costs of measures taken to achieve these purposes;
g. The availability of alternatives, of comparable value, to the particular planned or existing use;
h. The sustainability of proposed or existing uses; and
i. The minimization of environmental harm.

2. The weight of each factor is to be determined by its importance in comparison with other factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together for reaching a conclusion.

The NWDT rejected the Madhya Pradesh government's claim that the apportionment of waters should be made

only on the basis of the first factor according to which Madhya Pradesh's contribution to the drainage area was 88% and its contribution to the flow at 75% dependability was 91%. The tribunal instead laid more stress on the second and third factors relating to social and economic needs and the dependent population of the basin states. Consequently, the tribunal entered into an exercise of estimating the cultivable command areas (CCA) for arriving at the irrigation needs, the conveyance losses in taking the water from the dam to the fields and the civic and industrial needs. While estimating the cultivable command area in Gujarat the tribunal subtracted the contribution to this from the Mahi command but did not take into consideration the area already under groundwater irrigation. Nor did it apply its mind to the fact that surface water irrigation in the deep black cotton soils would lead to the problem of waterlogging and salinity which could only be resolved through the complete lining of canals, conjunctive pumping out of ground water and the laying of appropriate drainage channels at a huge extra cost which would be economically and also physically unfeasible. This has been proved with the occurrence of waterlogging and salination in vast areas of the country due to canal irrigation and especially so in the command of the Ukai dam.

Moreover, the laying of drainage channels would also mean that more of the rainfall would be drained away rather than being recharged into the soil. So, in years of drought when there would be less water for irrigation available from the dam the ground water would also be less because of less recharge leading to a severe water

crisis instead of an improvement due to the dam. Not only this the NWDT calculated a high conveyance loss of 50% from the dam to the fields to allow for seepage from the canals thus further inflating the water demand. This wrong logic was applied to the calculation of culturable command area for Madhya Pradesh also. Thus the NWDT arrived at a much higher cultivable command area for surface irrigation from dams for the basin than is practically and economically feasible with 120.3 lakh hectares for Gujarat and 254.6 lakh hectares for Madhya Pradesh. These areas were then multiplied by a delta factor for the amount of water required for surface flood irrigation to arrive at an irrigation water requirement of 13.1 bcm for Gujarat and 22.1 bcm for Madhya Pradesh which was more than the 33.6 bcm of water agreed on for apportionment between the two states! Adding the empirical estimates for civic and industrial water use and also giving some consideration to the greater drainage contribution of Madhya Pradesh the NWDT finally apportioned 22.5 bcm of water to that state and 11.1 bcm to Gujarat.

Similarly, the determination of the height of the Navagam dam too was based on considerations that had little to do with reasonable use. The first basic parameter was that Rajasthan had to be supplied with 0.62 bcm of water through canal gravity flow. This would require a Full Supply Level (FSL) at the canal head of 91.5 meters so as to provide enough head and gradient for ensuring that water reached Rajasthan. Madhya Pradesh and Maharashtra argued that just to supply water to Rajasthan the height of the dam should not be increased and instead Gujarat should be given Rajasthan's supply of water and

asked to supply the same amount to Rajasthan from the Kadana river basin in north Gujarat. However, this proposal was rejected by the tribunal. The dead storage level at the dam was settled at 93.6 meters to take care of the losses in the canal head regulator and the transport of water from the dam to the canal head. The live storage level required above this for the supply of 11.7 bcm to Gujarat and Rajasthan was 132.9 meters. However, since Madhya Pradesh had earlier made a submission that it wanted to build a dam just inside its territory to a level of 141.8 meters to exploit the hydro-electric power potential the Full Reservoir Level (FRL) of the dam was settled at 138.7 meters and the Maximum Water Level (MWL) with the provision of a flood cushion was fixed at 140.2 meters. The full use of this heightened reservoir capacity could only be made with the help of regulated releases of 10 bcm from the Indira Sagar dam at Punasa and orders were given to this effect by the tribunal. However, no consideration was given to the fact that given the much lesser actual flow of the river and also the lesser return flow due to heightened groundwater extraction in the basin there was little possibility of such regular releases being made and so the water level in the dam would very quickly fall well below the FRL subsequent to the monsoon months when the flow would be reduced and the offtake of the canal would begin.

The NWDT also did not assess and deliberate on the various environmental consequences of building big dams beginning with the problems arising from submergence of forests and the denudation of the catchment to the changes that would be wrought on the environment of the river downstream of the dam. Nor did the NWDT take into

consideration the effects of increased ground water exploitation in the basin on the return flow from the aquifers into the rivers. Thus the NWDT in its deliberations and in giving its final order totally ignored the several other factors in the Helsinki Rules relating to the effects of the use or uses of the waters in one basin state upon other basin states, existing and potential uses of the waters of the basin, conservation, protection, development, and economy of use of the water resources of the basin and the costs of measures that have to be taken to achieve these purposes, the availability of alternatives, of comparable value, to the particular planned or existing use, the sustainability of proposed or existing uses and the minimization of environmental harm. These principles in the Helsinki Rules have later been endorsed by the United Nations Convention on the Law of the Non-navigational uses of International Watercourses that was adopted by the General Assembly in 1997 (UN Treaty Website).

10. The Sardar Sarovar Project

The thirtieth and terminal large dam[1] on the Narmada river, Sardar Sarovar at Navagam, has a reservoir length behind it of 214 Km with an average width of 1.77Km. In terms of the volume of concrete involved for gravity dams, this dam will be ranking as the second largest in the world with an aggregate volume of 6.82 million cu.m. Its spillway discharging capacity is 87,000 cumecs. The chute spillway radial gates are 7 in number and of size 18.3 m x 18.3 m and the service spillway has 23 radial gates of size 18.3 m x 16.8 m which are to be used to handle the design flood flow. Another set of 4 permanent river sluices are provided at RL 53.0 m. The design of the dam allows for a horizontal seismic coefficient of 0.125g and it also covers an additional risk due to reservoir induced seismicity. The FRL of the Sardar Sarovar Dam is fixed at RL 138.68 m. The Maximum Water Level is 140.21 metres while MDDL is 110.64 m. The normal tail water level is 25.91 m. (NCA Website)

The gross storage capacity of the reservoir is 9.5 bcm while the live storage capacity is 5.8 bcm. The dead storage capacity below minimum draw down level is 3.7 bcm. The annual evaporation loss is 0.616 bcm. The submergence at Full Reservoir Level (FRL) is 37,690 ha. which comprises 11,279 ha. agricultural land, 13,542 ha. forests and 12,869 ha. river bed and waste land. In all 245 villages of the three states viz. 193 Villages of Madhya Pradesh, 33 villages of Maharashtra and 19 villages of

[1] When the height of a dam from bed level to maximum water level is more than 30 m it is considered to be a large dam and for a height between 30 and 10 m it is a medium dam.

Gujarat are affected. Only 3 villages of Gujarat are fully affected, while the remaining 242 villages are partly affected. In Madhya Pradesh, out of 193 villages, more than 10% agricultural land will be submerged only in 79 villages, in 89 villages less than 10% agricultural land or only houses will be submerged under FRL, due to back water of 1 in 100 years flood. In 25 villages, only Government waste land will be submerged. The project envisages irrigation to 17.92 lakh ha land of Gujarat covering 3360 villages of 62 talukas in 14 districts.

The Narmada Main Canal, which is a contour canal, is the biggest lined irrigation canal in the world. It is about 458 km. long up to Gujarat -Rajasthan border having discharging capacity 1133 cumecs at its head tapering to 71 cumecs at the Gujarat - Rajasthan border. The canal will extend a further 84 km. in Rajasthan to irrigate areas in Barmer and Jalore districts of Rajasthan. The cross section of the canal at its head is 73.1m x 7.6m (Bed width x Full supply depth) with 2:1 inner side slope having canal velocity at head as 1.69 m/sec. The entire length of the Main Canal is proposed to be lined with in-situ plain cement concrete to minimize seepage losses, to allow higher velocities and control water logging problems in the command in future. In all, there are 593 Structures on the Narmada Main canal. Out of this 320 structures are cross drainage structures, comprising of 5 Aqueducts, 15 canal syphons, 177 drainage syphons, 26 canal crossing and one super passage. There are 96 regulating structures comprising 1 main head regulator, 44 branch head regulators, 38 cross regulators and 13 escapes. There are a total of 273 road bridges. Narmada Main Canal has been completed up to 357 km. and water has flown through it.

There are thirtyeight (38) branch canals proposed for off taking from Narmada Main Canal as given in the table below -

Table 5: Branch Canals of Sardar Sarovar Project

Sr. No.	Name of Canal	NMC Chainage (km)	Sr. No.	Name of Canal	Chainage of NMC (km)	Sr. No.	Name of Canal	Chainage of NMC (km)
1	Wadia	9.931	16	Sanali	171.961	31	Amarapura	354.000
2	Tilakwada	17.871	17	Mehmdabad	187.074	32	Radhanpur	374.486
3	Mandwa	25.263	18	Ghodasar	202.368	33	Kachchh	385.814
4	Bhilodia	32.694	19	Vehlal	212.546	34	Vejpur	405.722
5	Timbi	38.523	20	Daskroi	223.667	35	Madka	417.792
6	Sankheda	45.109	21	Dholka	246.286	36	Malsan	423.732
7	Miyagam	62.916	22	Sanand	258.632	37	Dhima	438.552
8	Gojali	70.236	23	Saurashtra	263.200	38	Godasisar	453.837
9	Vadodara	81.834	24	Viramgam-I	267.063			
10	Dena	88.770	25	Viramgam-II	277.166			

Sr. No.	Name of Canal	NMC Chainage (km)	Sr. No.	Name of Canal	Chainage of NMC (km)	Sr. No.	Name of Canal	Chainage of NMC (km)
11	Dumad	100.026	26	Goriya	290.605			
12	Sakarda	102.953	27	Kharaghoda	292.398			
13	Zumkha	106.905	28	Zinzuwada	301.041			
14	Nahra	111.645	29	Bolera	326.389			
15	Desar	126.645	30	Rajpura	344.772			

The project aims at supplying 3571 million litres per day (MLD) of drinking water (2900 MLD for domestic consumption and 671 MLD for industrial consumption) to 8215 villages & 135 towns in Gujarat which are presently suffering from acute shortage of water. Also, the project aims to provide drinking water facilities to a population of about 13.71 lakh in 1107 villages and the two towns of Jalore and Barmer in Rajasthan. There are two power houses for the Sardar Sarovar Project (SSP). There is 1200 MW of installed capacity at the river bed power house, which is fitted with reversible turbines that can act as pumps to pump up the water back into the reservoir with the surplus electricity produced at off peak hours so as to be able to reproduce this electricity during peak hours. The installed capacity is 250 MW at the canal head power house.

11. The Narmada Basin Master Plan in Madhya Pradesh

The Madhya Pradesh government formulated a master plan for the development of the water resources in the Narmada basin in 1972 on the basis of the assumption that the yield of the Narmada at Garudeshwar at 75% dependability would be 34.5 bcm and the Madhya Pradesh share of this would be around 29.7 bcm (NVDA Website). Typically, this master plan concentrated only on the construction aspects of the dams and canals without taking into consideration the tremendous environmental and social costs associated with them. In an absurd denoument the design parameters of the dams were not modified after the NWDT awarded a lesser amount of 22.5 bcm to Madhya Pradesh, only the amount of water to be utilised was reduced for the various projects as under -

Table 6 : Details of Projects to be Undertaken

Sno.	Category	Area to be irrigated (Lakh Ha.)	Water use (bcm)
1	29 Major Projects	14.15	14.0
2	135 Medium Projects	6.7	3.55
3	3000 Minor Projects	6.7	3.1
4	Total	**27.55**	**20.65**
5	Domestic & Industrial use	-	1.85
6	**Grand Total**	**27.55**	**22.5**

Source: NVDA Website for this and the following tables

The estimated costs and the benefits in terms of irrigation potential to be created and hydel power to be generated of the 29 major projects that are to be constructed are as follows -

Table 7: DETAILS OF PROJECTS

Sl. No.	Name of Project	Estimated cost (Rs. In crores)	Irrigation potential (Lakh ha.)	Hydel Power (installed capacity MW)
1	Matiyari (Dhoba Toria)	30	0.1011	
2	Barna	18.9	0.548	
3	Tawa	113	2.469	
4	Kolar	120	0.451	
5	Sukta	12.6	0.166	
6	Bargi (R.A.B.S.)	2120.84	4.02	R.B.P.H. 90 M.W. (2 x 45 MW), C.H.P.H. 15 MW (2 x 7.5)
7	Indira Sagar	5000.00	1.2300	1000 MW(8 x 125 MW)
8	Omkareshwar	1784.29	1.4700	520 MW (8 x 45 MW)
9	Maheshwar	1570.00	----	400 MW
10	Man	140.00	0.15	----
11	Jobat(Chandra Shekhar Azad)	117.45	0.0985	----

Table 8 : PROJECTS PROPOSED IN THE SECOND PHASE

Sl. No.	Name of Project	Estimated cost	Irrigation Potential (Lakh ha.)	Hydel Power installed capacity(MW)
12	Upper Narmada	211.92	0.1862	
13	Raghavpur	26.64	----	20 MW
14	Rosra	32.00	----	35 MW
15	Basania (Shingarpur)	165.72	----	60 MW
16	Upper Burhner	56.8	0.0942	
17	Halone	160	0.1173	
18	Ataria	30.16	0.1295	
19	Chinki	76.57	0.7082	
20	Sher	93.23	0.6476	
21	Machhrewa			
22	Sakkar			
23	Sita Rewa	4.00		15 MW
24	Dudhi	42.36	0.5060	
25	Morand	64.10	0.5220	
26	Ganjal			
27	Punasa Lift	672.98	0.2560	
28	Upper Beda	89.17	0.0990	
29	Lower GOI	164.45	0.1370	

12. The Indira Sagar Project

The catchment area of the Indira Sagar dam is 61,642 sq k.m. with an average rainfall of 1288 mm. Thus, the estimated yield at 75% dependability is 26.5 bcm giving a stanard flood outflow of 65,670 cumecs and a probable maximum flood outflow of 83,534 cumecs. On the basis of these design parameters the FRL of the dam has been fixed at 263.4 m and the MWL at 263.4 m while the MDDL is 243.2 m and the crest level of the spillway is 245.1 m. The water spread area at FRL is 913.5 sq. km. with a gross storage of 12.2 bcm, a live storage of 9.8 bcm and a dead storage of 2.4 bcm. The total length of the dam is 653 m with an overflow length of 495 m and a non-overflow portion of 158 m. The maximum height of the dam is 92 m. There is also a saddle earth dam 815 m long with a height of 10.7 m. There are 20 radial crest gates with length of 20 m and height of 17 m. A total of 249 villages are to be submerged of which 69 totally and 180 partially with cultivated area of 44,363 ha, other land of 5565 ha and forest land of 41,348 ha. A 3.7 km long and 8.2 m dia tunnel with a discharge of 180 cumecs is to connect the reservoir to the main irrigation canal on the left bank. The main irrigation canal is to be 248.7 kms long with a head discharge of 160 cumecs. The Indira Sagar Project has an installed power capacity of 1000 MW, with annual energy generation of 2698 Million Units in Stage - I, 1850 Million Units in Stage - II and 1515 Million Units in Stage - III and annual irrigation of 2.65 lakh ha. on a Cultivable Command Area (CCA) of 1.23 lakh ha.

As mentioned earlier the design of this and the other major dams was not altered even though the actual yield of the river had gone down from that estimated earlier. Thus the possibility of achieving substantial reductions in the social and environmental costs which were grossly under estimated when calculating the cost of the project were foregone. Such a redesign would have involved the exploration of alternative methods of conserving and using water and a more reasonable and equitable distribution of costs and benefits. As a consultant of the World Bank sent to assess the Indira Sagar Project for loan support has stated - "... the analytical methodology used in sizing reservoirs and power stations was empirical rahter than based on latest techniques. Similarly, little scientific analysis was made of the complex hydrology of the river system. The 1972 Master Plan was prepared against a background of riparian conflicts - with the objective to demonstrate the greatest potential for irrigation development in order to justify the greatest possible allocation of water. However .... the Tribunal allocated to Madhya Pradesh less than three quarters of the water claimed by the states. Thus, the Tribunal's award necessitates a careful reassessment of the Master Plan to ensure that the water is put to the 'best' use from both an economic and social point of view." (Ljung, 1983, p. 8). So far only the dam, powerhouse, diversion tunnel and the canal head structures have been completed and so electricity is being generated but no irrigation benefits have accrued. The amount spent so far is about Rs 5500 crores.

13. Details of Some Other Projects

The Bargi dam has been built on the Narmada river in Jabalpur district and has a catchment area of 14556 sq kms with a 75% dependable yield of 5.4 bcm. The FRL of the dam is 422.8 m and the MWL is 425.7 m while the MDDL is 403.6 m. The gross storage is 3.92 bcm with 3.18 bcm of live storage and 0.74 bcm of dead storage. The reservoir has submerged an area of 26,797 ha covering 162 villages. The length of the masonry dam is 827 m while its maximum height is 69.8 m and the length of the earthen dam is 4530 m. The design length of the left bank canal is 137.2 km with a head discharge of 124.6 cumecs and a full supply level head of 404.1 m. The cultivable command area is 2.19 lakh ha and the gross command area is 2.57 lakh ha. The installed capacity of the powerhouse at the toe of the dam is 90 MW and that of the canal head powerhouse is 15 MW. The main canal is still under construction and the total amount spent so far has crossed Rs 800 crores.

The first major dam to be completed in the basin in 1975 was the Tawa dam situated at the confluence of the Tawa and Denwa rivers in Hoshangabad district. The head works comprise an earthen dam of average height 22.5 m and masonry dam of 57.9 m height with a central masonry spillway having 13 radial gates each of size 15.24 m x 12.192 m at the spillway crest at an R.L. 343.2 m. The M.W.L. of the dam is 356.7 m. The FRL is 355.4 m. The catchment area is about 6000 sq kms. The reservoir area is 20,050 ha. at FRL covering 44 villages. The right bank canal has a culturable command area of 98079 ha and a gross command area of 11878 ha. The Left Bank

irrigation canal has culturable command area 1,86,162 ha and a gross command area of 2,56,904 ha. The cost of the dam and canal system was Rs 150 crores upto 1998. The installed capacity of the left bank canal head powerhouse is 13.5 MW established at a cost of Rs 74 crores in 1998.

The Man dam has been constructed at village Jeerabad of Manawar Tehsil of District Dhar. The dam has an FRL of 297.7 m. The maximum height of the masonry dam above river bed level is 52.4 m, in the overflow section the height is 44.09 m and the earth dam is 33.9 m high. The MWL is 300.4 m and the MDDL is 278.7 m. The full reservoir capacity is 0.145 bcm, the live storage is 0.128 bcm and the dead storage is 0.017 bcm. The canal outlet Level is 277 m with the L.B.C. flow being 3.34 cumecs and the R.B.C. flow being 8.28 cumecs. The length of the Right Bank Canal is designed to be 11.64 m and of the left Bank canal 10.02 m. The Culturable Command Area of the Project will be 15,000 hectares with proposed annual irrigation going upto 19,200 ha and it covers 48 villages. The catchment upto dam site is 690 sq. km. The Project has no power potential. The reservoir submergence is 1094.9 ha covering a total of 17 villages. The dam was completed in 2004 and the canal system is still under construction. The cost so far has been Rs 160 crore. The Jobat project is a 38.6 m. high and 452.5m long composite gravity dam near village Baskal, in Jhabua district on the river Hathni, a tributary of the river Narmada. The Project will provide irrigation of 9848 ha. benefiting 27 villages. The estimated cost of project is about Rs.117.45 crores. Submergence will partially affect 13 villages and 1310 ha. of land which includes about 123.32 ha. of forest land. The construction of the dam is still in progress.

There are two dams on the Narmada river downstream of Indira Sagar dam that are to take advantage of the regulated releases from the latter for the SSP to generate electricity and also irrigate agricultural land. The Omkareshwar project envisages construction of a 73.12 m high and 949 m long concrete dam with gated spillway, to irrigate 1.468 lakh ha of culturable command area through a 142 km long left bank canal and a 64 km long right bank canal with another 83 km of lift canal. A river bed power house of 520 M.W. installed capacity (8x65 MW) has been built on the right bank. The reservoir has 0.3 bcm live storage capacity and the submergence will affect 30 villages spread over 5829 ha forest land, 4059 ha and of private and revenue lands. Compensatory Afforestation in 11660 ha and Catchment Area Treatment in 79,886 ha has to be done. The cost of the project is about Rs 3000 crores. The Maheshwar project is solely a hydel project located about 40 km downstream of the Omkareshwar project near Mandleshwar town in Khargone district and envisages construction of a 35 M high concrete dam with 670 M long spillway having earthen flanks on the left and right banks of lengths 1573 M and 464 M respectively and a surface power house of 400 MW (10x40 MW) on the right bank. Similar to the SSP and the ISP the design and implementation of these projects too have been fraught with various inconsistencies leading to many problems as will be discussed later.

14. Initial Problems with the Implementation of Narmada Basin Development Plans

Given the fact that the environmental and social costs associated with large dam centric utilisation of river waters and the history of governmental apathy and inefficiency in mitigating these costs it is not surprising that such development in the Narmada basin came up against opposition right from the beginning. Immediately after the NWDT award in 1978 there was a "Nimar Bachao Andolan" in the lower plains in the Nimar region consisting of the districts of Khargone and Dhar against the submergence of fertile land there due to the enhanced height of the Sardar Sarovar dam. The Gujarat government had applied to the World Bank for a loan to facilitate the construction of the SSP and the first reconnaisance mission in its report recommended that certain impact assessment studies should be first carried out before proceeding with the construction of the dam. This delayed matters till 1980 when the Environment Protection Act was passed by parliament which made it mandatory to get permission from the Ministry of Environment and Forests (MoEF) for diversion of forest land for non-forest use. An Environmental Impact Assessment (EIA) of a project detailing the various impacts and the remedial measures necessary and their costs was mandatory for obtaining permission from the MoEF. This procedure for impact assessment also included a provision for public hearings in the project area in which the affected people could register their views. In accordance with the orders of the NWDT the Narmada Control Authority (NCA) was also set up in 1980 to

ensure the implementation of its award and also to oversee the proper measurement and development of water resources in the basin. This authority was to be headed by the secretary of the Water Resources Ministry and have as its members secretaries from the Power, Environment and Forest and Welfare and also the chief secretaries of the four states of Gujarat, Rajasthan, Maharashtra and Madhya Pradesh. This authority has subgroups dealing with the issues of environment, resettlement and rehabilitation, power, hydrometrology and implementation and regulation and so all works in and management of the Narmad basin are first discussed and approved here.

This effectively meant that the work could not start on the two main dams SSP and NSP without all the studies and permissions in place. While deliberations were going on at the governmental and World Bank level the project affected persons in Gujarat first began to protest under the leadership of the Chhatra Yuva Sangharsh Vahini regarding the provision of poor resettlement and rehabilitation. They made the provisions of the NWDT with regard to resettlement and rehabilitation their main agitational plank. The NWDT had made what were till then the most progressive provisions for rehabilitation and resettlement. Since most of the displacement due to the SSP was to take place in Madhya Pradesh and Maharashtra these states had fought hard for good rehabilitation and resettlement provisions for the oustees and this demands had been upheld by the NWDT. This movement for proper rehabilitation picked up steam in Maharashtra and Madhya Pradesh also from 1985 onwards and very soon the Narmada Bachao Andolan

(NBA) was born which did not restrict itself just to the issue of rehabilitation but raised other issues related to the inflated claims of flow and the over design of dams, canal systems and command areas, waterlogging and salinity, siltation and the effects of seismicity and reservoir induced seismicity due to the active basin fault lineament.

The World Bank came out with a Staff Appraisal Report in 1985 (World Bank, 1985) which stressed on the conduct of environment impact assessment studies and provision of proper rehabilitation and resettlement to the oustees recommending that even landless people and encroachers on forest land should be given land and other facilities in compensation on par with the landed oustees. The loan that was sanctioned by the World Bank for the SSP in 1986 had a special component just for rehabilitation and resettlement. However, the Ministry of Environment and Forests came out with a note in the same year that stated that the environment impact assessment for the SSP and the ISP were not complete and problems arising from improper environmental treatment would be quite severe. Apart from this enough land had also not been identified for the rehabilitation of the oustees and so there was a case for reducing the height of these dams to minimise the environmental and social costs.

The Ministry of Water Resources while agreeing with this assessment at the same time stressed that since the governments of Gujarat and Madhya Pradesh were keen to go ahead with the projects they should be given a green signal. Succumbing to political pressure at the highest level the Ministry of Environment and Forests finally gave a conditional sanction to both the projects in 1987

stipulating that appropriate catchment treatment and compensatory afforestation would be undertaken and rehabilitation and resettlement done properly. the department agreed to the release of forest lands for the purpose. This finally paved the way for the work on both the projects to start in full swing. However, the World Bank sent a letter to the Union Government pointing out the shortcomings of the existing rehabilitation and resettlement provisions and the environment treatment works and stressing that these lacunae needed to be removed.

15. The Struggle between Two Opposing Views on Water Resource Management

Prior to the large dams on the Narmada River all such mega projects, beginning with the Bhakra-Nangal project on the river Sutlej in the 1950s, had witnessed the downplaying of the immense environmental and social costs associated with them leading to deleterious impacts in these spheres. Moreover, the claims of command area development too had been belied and so the actual irrigated area was far below that initially claimed at the planning stage. Over and above this the area actually irrigated had become plagued with waterlogging and salinity due to excessive flood irrigation and seepage from the canals and channels. Thus, the NWDT award in favour of proper rehabilitation and resettlement whose implementation was to be monitored by the NCA was a pioneering progressive step towards people centred water governance in India. Similarly, the mandatory requirement of EIAs and conduct of public hearings among the affected people for getting sanction from the MoEF for such projects was also a progressive step towards such people centred governance. Thus, the bypassing of these two legal provisions by the government which is supposed to be the upholder of the rule of law in a liberal democratic state was a gross violation of the fundamental right of the common people to decide on an appropriate mode of water resource development.

This unjust decision of the government led to the escalation of the opposition to large dam building not only in the Narmada basin but all over the country under the

aegis of the NBA giving rise to the powerful voicing of an alternative people centred perspective on water resource management for "reasonable and equitable" use of the waters of a river basin in line with the provisions of the UN Convention on Non-navigational uses of International Watercourses. The struggle involved not just the affected people in the Narmada valley but also others across the country and the world in a never before seen mobilisation that used the techniques of mass action, legal action, lobbying and media advocacy to put forward its alternative views on people centred water resource management. The movement was so universal that it included even people in Gujarat. The movement included those who had been displaced by the establishment of the colony at Kevadia village near Navagam in 1961 but were not considered as project affected persons (PAP) eligible for rehabilitation under the NWDT award, those who were to lose their land in the massive canal network but had not been considered to be PAPs, those of the PAPs who had been rehabilitated on land unsuitable for cultivation and those in Kachh and Saurashtra who were convinced by the NBA's critique that showed that water would actually either not flow or flow in much lesser quantities to that region belying the claims of the government (Sangvai, op cit).

This mass mobilisation by the NBA reached its peak during the Sangharsh Yatra from Barwani to the dam site of the SSP in January 1991 which was stopped at the Gujarat - Madhya Pradesh border by the Gujarat Government. After a twenty one day hunger strike by five activists the dharna at the border was withdrawn on the assurance given by the World Bank of instituting a first

time ever independent review of its funding of the Sardar Sarovar Project. The NBA also made the public assertion at this point that given the apathy of elected governments towards the problems of the people it would henceforth work for the establishment of a people's government with the slogan of "Hamara Gaon Mein Hamara Raj" which specifically included local area watershed development as an alternative to large river basin and inter-basin projects. This was a very significant statement at the time as it anticipated the pathbreaking 73rd Constitutional Amendment of 1993 making Panchayati Raj a mandatory third tier of governance throughout the country. After this directly as a consequence of the pressure created by the agitation of the NBA the governments of Maharashtra, Madhya Pradesh and Gujarat stepped up their rehabilitation activities in accordance with the provisions of the NWDT award and the World Bank stipulations and so a major portion of the oustees chose to accept the better rehabilitation on offer and disassociate themselves from the NBA. Consequently, the work on the projects in the Narmada valley proceeded apace despite the NBA's opposition.

16. The Report of the Independent Review Committee of the World Bank

The World Bank Independent Review team led by Bradford Morse conducted a thorough review of the Sardar Sarovar Project and came out with a report in 1992 that was critical of the SSP (Morse, 1992). This criticism is important as it is in line with the provisions of the Helsinki Rules and the UN Convention on International Watercourses and is given in detail here as it brings out clearly the fundamental social and environmental problems with the planning and implementation of such mega projects. The main points of criticism are -

i The World Bank and the Indian Government both failed to carry out adequate assessments of human impacts of the Sardar Sarovar Projects and the difficulties in implementation have their origin in this failure.

ii There was virtually no basis, in 1985, on which to determine what the impacts leading to an inadequate understanding of the nature and scale of resettlement.

iii This inadequate understanding was compounded by a failure to consult the people potentially to be affected and this had resulted in opposition to the Projects, on the part of potentially affected people, supported by activists. Also adequate account was not taken of the fact that a large proportion of those at risk from the development of the Sardar Sarovar Projects are tribal people. In addition, the overarching principle embodied in the 1985

credit and loan agreements by which resettlement and rehabilitation were to be judged, namely that oustees improve or at least regain their standard of living as quickly as possible, was not consistently advanced or insisted upon with sufficient force or commitment.

iv The effects of the Projects on people living downstream of the dam was not taken into account. These effects should also be mitigated.

v The distinction between "landed" and "landless" oustees failed to recognize the realities of life in the submergence villages and the rights of encroachers, mostly tribals, were not acknowledged.

vi The people of the six villages affected by construction and development of Kevadia Colony were not appropriately and adequately compensated.

vii Relocation and resettlement of the people of the rock-filled dyke villages was implemented in a way that was far from satisfactory.

viii Those affected by construction of the canal and irrigation system should be entitled to resettlement benefits at par with those being affected due to reservoir submergence.

ix The policies of the riparian states failed to anticipate the needs of major sons, and adopted what we regard as an unduly restrictive interpretation of the Tribunal award's provision for major sons. Maharashtra and Madhya Pradesh continue to maintain this interpretation

and provide inadequate benefits to major sons of landed families. In 1987-88 the Government of Gujarat expanded its resettlement and rehabilitation policies to provide two hectares of irrigable land to all oustees, including the landless, encroachers, and major sons. This represented a policy package that came nearer than any thus far set out anywhere in India to establishing a basis for successful resettlement. Despite Gujarat's improved policy, Maharashtra and Madhya Pradesh continued to limit the provision of two hectares of land to "landed" oustees. This means encroachers and major sons (including the major sons of landed oustees) are not entitled to benefits in their own states that meet the overarching principles of resettlement and rehabilitation. The proportion of oustees thus vulnerable to a reduced standard of living is at least 6o per cent.

x The disparity between Gujarat's policy and the policies of Maharashtra and Madhya Pradesh has meant that oustees' right to choose between relocation in Gujarat and their own state has been rendered meaningless.

xi Implementation of resettlement in Madhya Pradesh has been limited by policy deficiencies, inadequate institutional commitment, continuing failure of consultation, and limited availability of suitable resettlement land. This state of affairs in Madhya Pradesh has produced a situation in which, even if Madhya Pradesh were to adopt a

policy with benefits equal to Gujarat's, such a policy could not now be implemented, given the time necessary to meet the requirements of the Sardar Sarovar Projects.

xii Resettlement of oustees in Gujarat has entailed a scattering of families and villages among many different sites. This is in part a result of choices made by oustees. It is also a result of inadequate land at resettlement sites to accommodate all oustees who wish to have land there. This has contributed to some separation of families, especially in the case of oustees from the rock filled dyke villages. Gujarat is unlikely to be able to resettle a large proportion of oustees from Maharashtra and Madhya Pradesh. Even if land were available for relocation sites, resettlement and rehabilitation at these sites presents major problems.

xiii Measures to anticipate and mitigate environmental impact were not properly considered in the design of the Projects because of a lack of basic data and consultation with the affected people.

xiv The World Bank's appraisal took no account of the fact that environmental clearance in India was not forthcoming in 1983 from the Ministry of Environment and Forests because of insufficient information.

xv Under the 1985 credit and loan agreements, the World Bank required an environmental workplan to be developed by the end of 1985, later extended to 1989. It is still not available,

resulting in a disjointed, piecemeal approach to environmental planning that is both inefficient and ineffective. In 1987 India's environmental clearance for the Projects was given, despite the fact that the information required prior to the Projects' clearance was unavailable. In order to overcome this deficiency, studies were to be conducted pari passu with construction. The clearance was conditional on completion of these basic studies by 1989. Most remain to be completed. The pari passu policy greatly undermines the prospects for achieving environmental protection.

xvi Significant discrepancies in the hydrological data and analyses indicate that the Sardar Sarovar Projects will not perform as planned either with or without the upstream Narmada Sagar Projects. A realistic operational analysis of the Projects upon which to base an impact assessment has not been done.

xvii The cumulative impacts of the Sardar Sarovar Projects together with the related upstream developments, especially the Narmada Sagar Projects, are very likely to be far reaching, yet they have not been studied.

xviii The afforestation and catchment area treatment programs proposed upstream are unlikely to succeed within the timetable of the Projects because of the lack of consultation with, and participation of, villagers in the affected areas. The compensatory afforestation approach being taken by Gujarat in Kutchch, if

continued, will lead to a steady decline in the quality of forests. The practice of replanting marginal forest lands in substitution for better lands that will be submerged, means that the forests will be diminished in value.

xix The impact associated with the backwater effect of sedimentation in the upper reaches of the reservoir has not been considered. Our assessment has concluded that it will be significant.

xx The downstream ecological implications of dam construction have not been considered. Important but limited data have only recently begun to be collected. The downstream impacts are likely to be significant, including severe losses to, if not the elimination of, the last important hilsa fishery in western India.

xxi There has been no comprehensive environmental assessment of the canal and water delivery system in the command area. Information gathered leads to the conclusion that there will be serious problems with waterlogging and salinity. Many of the assumptions used in project design and for the development of mitigative measures are suspect.

xxii Despite the stated priority of delivery of drinking water, there were no plans available for review.

xxiii The existing threat from malaria within the command area is serious. The Projects have been designed and executed without

appropriate safeguards to reduce the likelihood of the spread of malaria will have serious consequences in the future.

xxiv The newly proposed Narmada Basin Development Project, although it appears to address some of the problems highlighted in our review, fails to address key issues, delineated above. The Basin Development Project adopts a piecemeal approach, falling far short of that needed for proper basin development. The implications of Narmada Sagar for basin development are overlooked.

Later developments have shown that these criticisms have been borne out not only for the SSP but also for the ISP and the many other large dams under construction in the Narmada basin as will become clear by and by. Intense international pressure brought on the World Bank by environmental, human rights and tribal rights groups around the world led to its withdrawing from funding the SSP and rejecting the pending proposal for funding of the NSP in a pyrrhic victory for the NBA.

17. The Battle in the Supreme Court

Seeing no other alternative the NBA filed a writ petition in the Supreme Court in 1994 arguing that the fundamental right of the oustees especially the tribals was being denied by the SSP which was not in the public interest as it was not only incapable of providing proper rehabilitation and resettlement but it would also cause considerable environmental harm through waterlogging, forest submergence (not totally compensable by compensatory afforestation), siltation (not totally preventable by catchment treatment), estuarine saline ingress, estuarine fisheries destruction and spreading of malaria epidemics. The project would also not fulfil its claims of irrigation development, drinking water supply and power generation and so the project should be scrapped. Apart from this the provisions of the Constitution of India regarding the governance of tribal areas falling under the Fifth Schedule and the provisions of the International Labour Organisation Convention no 169 of 1989 on Indigenous and Tribal Peoples were also relied on by the NBA. The Supreme Court granted a stay on the construction of the SSP until the issues raised by the NBA were adjudicated on and so the work on the dam temporarily came to a halt.

After four long years of arguments and deliberations the Supreme Court pronounced its judgment in 1998. The court held that it had basically been petitioned to decide whether the policy decision taken by the government in 1987 in the face of pending environmental clearances of going ahead with the SSP was good or bad and it decided that while the decision was a hard one it was good and so

the SSP could not be scrapped. Generally the Supreme Court went along with the government's assessment that the SSP would solve the problem of scarcity of water,both for irrigation and drinking purposes, and of power as would the other dams on the Narmada and averred that in the post-independence period dams had helped in overcoming the food shortage in the country. On the contentious points of rehabilitation and resettlement and environmental mitigation the court held that these and the studies and impact assessments which would form their basis could be done pari passu with the building of the dam. The court refused to consider the Morse Committee report since the government had refused to accept it and stated that there was no reason to doubt the veracity of the government's own assessment in this regard. The court also felt that the NWDT had made adequate provisions for rehabilitation and resettlement of the oustees and that the institution of the NCA set up in accordance with its order was quite capable of looking into all the outstanding issues with regard to environmental and social concerns. Moreover, the court also noted that a Grievance Redressal Authority had been set up to look into complaints regarding rehabilitation and this institution would provide relief when approached. Thus the court felt that there was no need to approach it again on these matters as there was a competent institutional setup in place to take care of complaints.

The Supreme Court thus through this judgment laid down some crucial postulates regarding governance in the water sector in the Narmada basin in particular and in India in general as follows -

i The government and its agencies know best regarding the "reasonable and equitable" use of water resources and any citizens or groups of citizens challenging the government's understanding cannot claim any authenticity for their reasoning.

ii The government and its agencies have to be trusted when they affirm that they will carry out the studies and activities required to offset negative environmental and social impacts resulting from a particular mode of water resource utilisation.

iii That tribals would benefit from being displaced by mega projects as they would then move out of the remote forested corners in which they reside and become part of the mainstream economy and society.

The reality since the handing down of this judgment, however, has belied these postulates. Neither the environmental mitigation activities nor the rehabilitation and resettlement has taken place in accordance with the guidelines in the SSP and so even a decade after the dam is still incomplete as the NBA has continually appealed to the NCA and also petitioned the Supreme Court again complaining about this and had the work of the dam stopped. This laxity with regard to environmental mitigation and rehabilitation has been in evidence in the other projects in the basin too - Bargi, Indira Sagar, Omkareshwar, Maheshwar, Maan, Upper Beda, Goi, Jobat and Tawa. In these projects too the NBA and its associate organisations have undertaken both mass action and legal action in the High and Supreme Courts against

the gross violations by the government and its agencies of the NWDT award for rehabilitation and the minimum environmental standards. The employees of the government agencies have instead indulged in gross irregularities in the disbursal of cash compensation in lieu of land which is prohibited by the NWDT award. This has adversely affected the tribals the most because they have in most cases been left without productive assets and forced to make do as best they can with meagre cash compensation in the modern market economy in which they are weak players belying the expectation of the Supreme Court that they will benefit from displacement and rehabilitation. Despite this sordid state of affairs, the Supreme Court refuses to review the dam centric water resource management paradigm of the government.

18. Problems of Large Dam Centric Water Resource Development in the Basin

The problems of large dams are many. Arising from their design and implementation having either ignored outright or grossly under estimated the social and environmental costs. They span the areas of rehabilitation and resettlement, canal system and command area development, compensatory afforestation and catchment area treatment and the sequestration of ecological niches and are described below in detail.

18.1 Rehabilitation and Resettlement

Involuntary displacement has been a constant phenomenon in the Indian sub-continent from the time of the British. The major legal instrument used by the British for this purpose was the Land Acquisition Act of 1894 (LAA) which continues to be the law in this regard to this day. This law just compensates the owner of land in cash at the value of land recorded in registered land sales and does not concern itself with other social and environmental losses suffered by the land owners. The legal process too is so complicated that poor people and especially tribals cannot hope to secure justice. The divide and rule policies of the British also led to the occurrence of possibly the single biggest displacement at one go in the world of millions of people at the time of partition of the Indian sub-continent into Pakistan and India in 1947. A Department for Rehabilitation was set up then to deal with this traumatic experience. However, this department did not concern itself with an equally traumatic process of displacement that began with the acquisition of land for

development projects on a large scale after independence and was wound up in 1960. There is yet no law or department specifically dealing with rehabilitation and resettlement even though one has now been tabled in Parliament for enactment. Especially large in number were those displaced due to the construction of large dams and among them the proportion of tribals is the largest. The colonial LAA was used to compensate the oustees with paltry cash compensation and sometimes not even that. There are no firm estimates but the government records themselves show that 75% of those displaced due to development projects have not been properly rehabilitated and these millions of people have suffered immensely as a consequence.

This was the sorry backdrop for the deliberations of the NWDT with regard to the provisions for resettlement and rehabilitation. The governments of Maharashtra and Madhya Pradesh lobbied hard for good provisions to be made for the people being displaced from their states as the costs would have to be borne by the government of Gujarat. Ultimately as a result for the first time in India very progressive provisions were made in the NWDT award for the rehabilitation and resettlement of the oustees as follows (Shelat, undated) -

i The main principle of the resettlement policy should be that the project-affected families improve or at least regain their standard of living they were enjoying prior to displacement.
ii The affected people should be relocated as village units, village section or families in accordance with their preference.

iii The affected people should be integrated with host community, village where they have settled.
iv The affected people should be provided appropriate compensation, adequate social and physical rehabilitation, infrastructure including community services and facilities.
v There should be active participation of the affected people in planning of their resettlement and rehabilitation.

As mentioned earlier mass mobilisation first by the Chhatra Yuva Sangharsh Vahini and then by the NBA ensured that these provisions did not remain just on paper but were actually implemented on the ground by the governments of Gujarat and Maharashtra and the detailed arrangements that have been made are listed below as the best example of rehabilitation and resettlement in this country achieved through mass mobilisation -

i Full compensation for the submerging agricultural land as per the provision of the Land Acquisition Act 1894, or land for land as desired by the oustee.
ii Full compensation for existing house going under submergence.Dismantled components of the house and household kits to be transported free of cost to the new habitat.
iii Each family will get 2 ha of irrigable land whether it is landowner or agricultural landless labourer. Even encroacher on government and forestland will get this benefit.
iv Every major son of the landless oustees, agricultural labourers, encroachers, co-sharers

who had attained the age of 18 years would be treated as a separate families and entitled to get 2 hectares of land.

v Every displaced family will be provided residential plot of 500 sq m Free of cost.

vi Facility for temporary sheltered accommodation at new village site.

vii For construction of plinth of houses, grant up to Rs. 10,000 to affected family, above plinth may be built by the oustee.

viii Rs. 2,000 for the purchase of new roof tiles instead of transporting the old tiles at new sites.

ix A core house of 45 sq m at the cost of Rs.45,000 in lieu of tin shed, plinth and roof tiles will be provided free of cost.

x Every displaced family is paid subsistence allowance of Rs.4,500 for the year. The amount is paid in three instalments.

xi Resettlement grant of Rs.750 plus escalation in consumer price index at 8% from January 1980. This is given in bulk after people permanently shift to the new site.

xii Rs. 700 grant for purchase of productive assets such as bullocks, cows, sewing machine, trade tools, agricultural implements.

xiii To make the land fit for cultivation and derive full potential, the land is either ploughed or a grant of maximum Rs.600 is given for ploughing the fields.

xiv To derive the benefit of 100% electrification, the affected people are given assistance for

electrification in their new house and huts in the farms free of cost.

xv Appointment of Grievance Redressal Authority for any complaints regarding land, resettlement and rehabilitation.

xvi Civic amenities such as, primary school, health centre in each new habitat, percolation tank, drinking water well, vocational training centre, approach roads, internal roads, seed store for 500 families, children's play ground are to be provided at the new habitat.

xvii All displaced people are covered by insurance: huts and dwelling for Rs. 5,000; contents including own belonging for Rs. 1,000; death for Rs. 6,000; loss of use of two limbs or two eyes or one limb and one eye for Rs. 6,000; loss of use of one limb or one eye for Rs.3,000; permanent total disablement from injuries other than above for Rs. 6,000.

The implementation of these provisions which are exemplary and are majorly deficient only in respect of being gender insensitive has been fairly good in Gujarat and Maharashtra. Even so those affected by the canal network and also by the creation of the colony at Kevadia have been given only cash compensation as the Supreme Court decreed that they did not qualify for rehabilitation under the provisions of the NWDT award. The imlementation of the NWDT award, however, has meant that the project cost of SSP has shot up tremendously as a consequence. This escalation of project cost that results from providing proper rehabilitation has been the key deciding factor behind the government of Madhya

Pradesh not only pushing the oustees of SSP to go to Gujarat for rehabilitation but also not providing anything but cash compensation to those who did not do so. Apart from some of the tribal population in Jhabua, Dhar and Badwani districts most oustees from Madhya Pradesh have stayed on there and so have been given cash compensation in total disregard of the NWDT award. Over and above this there have been gross financial irregularities in the disbursement of this compensation which have continued despite the repeated agitations of the NBA (NBA Website).

Similarly in the ISP, Man and Jobat projects too the Madhya Pradesh government and the implementing agencies - the Narmada Hydroelectric Development Corporation in the first case and the Narmada Valley Development Authority in the latter have tried to ignore legitimate claimants for rehabilitation and give only paltry cash compensation to those identified without any proper provision of support facilities. In the case of the ISP the dam has been built and the NBA could intervene only after the fact through a writ petition in the Madhya Pradesh High Court and so the most it could do was ensure that proper identification of oustees did take place and that they were given adequate cash compensation. In the case of the oustees of the Man and Jobat projects despite agitations on their part they finally had to settle with only cash compensation.

The battle of the oustees of the Omkareshwar Project which too has been fully constructed is still pending in the High Court of Madhya Pradesh. The High Court has stayed the closure of the gates to the Full Reservoir Level

until the issues regarding the rehabilitation of the oustees are not fully decided by it. Thus here there is a possibility of the NWDT award being fully implemented once again. The work on the Maheshwar project is totally at a standstill because the implementing agency Sri Maheshwar Hydroelectric Power Company has violated the conditions of the environmental sanction given to the project by not preparing a comprehensive rehabilitation and resettlement plan in accordance with the provisions of the NWDT award. Moreover this private company has also indulged in various financial irregularities for which it has been implicated in court cases by several government agencies. A detailed analysis of the economics of the power to be generated by this project has shown that it is extremely uneconomical.

The plight of the oustees of the projects in the basin which came up before the NWDT award is nothing but pitiful. Thus the oustees of the Barna, Sukta, Bargi and Tawa dams were given paltry cash compensation and left to their own devices. The oustees of the Bargi and Tawa dams later agitated under the aegis of the NBA and the Samajwadi Jan Parishad for the right to form fishing cooperatives and exploit the fishing potential of the reservoirs created by these dams by submerging their lands. But this too is a tenuous concession that is under threat of being revoked by the government all the time. One other aspect of displacement in all the dams in the Narmada basin has been the under-estimation of the backwater effect that arises due to the flowing water being obstructed by the dam as a result of which the submergence area increases over and above that caused by MWL filling. Thus in all the dams the number of

project affected persons has tended to be more than that decided on the the government.

Thus there has clearly been a major governance failure with regard to rehabilitation and resettlement of oustees, a substantial proportion of whom are tribals, of the many dam projects in the basin. Only by continuously going to the courts for redressal has the NBA succeeded to some extent in ensuring proper rehabilitation in some cases but the government of Madhya Pradesh in particular has been reluctant on its own to do so. This despite the fact that it has enacted a law for this purpose - Madhya Pradesh Pariyojna ke Karan Visthapit Vyakti (Punasthapan) Adhiniyam, 1985.

More importantly since a major proportion of the oustees are tribals residing in scheduled areas notified under the provisions of the Fifth Schedule of the Constitution of India this failure to hold consultations with the the tribal oustees by the Government is also a violation of their constitutional entitlements. With the enactment of the Panchayat Extension to Scheduled Areas Act 1996 it has now become mandatory to take the permission of the Gram Sabha before implementing any project in a scheduled area. However, this provision has been violated continuously in the case of the tribal oustees of the Man, Indira Sagar and Omkareshwar dams.

18.2 Canal System and Command Area Development

The actual realisation of the claimed irrigation potential by dam projects depends crucially on the completion of the construction of the canal system and the subsequent development of the command area beyond the canal

system so as to prevent waterlogging and salinity, optimise water utilisation and maintain water quality. All these objectives require the development of the command area through levelling, grading and provision of sufficient drainage, both surface and sub-surface as well as pollution control measures especially against the fertilisers and pesticides run-off. On-farm development works also have to be detailed and implemented. Thus a command area development plan has to be worked out to fully utilise the irrigation potential. However, this has never been done effectively in all the major and medium projects constructed in the country and so right from the late 1960s several committees and commissions have noted that the claimed irrigation potential of the projects has not been even minimally realised (Upadhyay, 2004). What has happened is that investments have continually been made in the building of newer and newer dams while funds have been withheld from command area development. Consequently over the period from 1991-2004 despite an investment of Rs 99610 crores in major and medium irrigation projects the area under canal irrigation actually went down by a massive 3.18 million ha (Thakkar & Chandra, 2007). Similarly while the potential for canal irrigation created in the Narmada basin in Madhya Pradesh is around 318000 ha the actual irrigation was only 55915 ha (MPWRD Website). The SSP itself had reported command area development in only 279,308 ha by 2007 and an irrigation of 1.08 lakh ha (SANDRP, 2007). Thus even though almost 6 bcm of water flows through the canals most of this water is allowed to flow in intervening rivers like Sabarmati and used to fill tanks instead of being used for irrigation. Moreover due to gross

mismanagement and financial irregularities the drinking water supply could also be made only intermittently in 2044 villages and 57 towns, less than half the planned number.

The irrigation has not yet begun in ISP, Omkareshwar and Bargi projects because the canal systems are not in place. In Man project only about 15% irrigation is taking place because the main canals are leaking profusely and are incapable of taking the design flow. In the Tawa project there is a serious problem of waterlogging and salinity. The seepage from the canals was much more than had been expected. Thus additional investments had to be made in lining the channels and also in land levelling and drainage works. While the former was carried out by the government the latter had to be done by the farmers themselves and this they could not do due to lack of funds. Not surprisingly the actual irrigation is much less than the potential that has been created. In all these projects in Madhya Pradesh despite there being a law to this effect no participatory irrigation management is being practised.

The SSP, however, had originally planned to overcome the problems of command area development by participatory irrigation management through the formation of water user associations (WUA) for the mobilisation of farmers to carry out earth levelling, drainage and field channel works beyond the lined minors which would reach every village in the command. This was supposed to be the key to ensuring that problems like waterlogging, salinity and pollution of groundwater did not take place and that the water was equitably distributed among the farmers. However, even though by 2004 as

many as 1145 WUAs had been registered none of them had carried out the field distribution and drainage works and so water was being drawn with the use of diesel or electric pumps or siphoning from the minors leading to inequality in the distribution of waters and also in harmful effects on the soil. Consequently instead of supplying water to the first phase command areas in Narmada, Bharuch and Vadodara districts the Gujarat government is now proposing to carry the water to North Gujarat to recharge the depleted ground water aquifers there. The estimated cost of the SSP has now ballooned to well over Rs 50000 crores. Thus like in other projects earlier, the irrigation projects in the Narmada basin too are not going to be able to actualise the potential for canal irrigation that has been created by damming the rivers at such exorbitant costs. Moreover, there is the question of the unutilisation of the storage capacities created because of the lower flow in the river and also the recently established fact that large dam reservoirs are a significant contributor to global warming through generation of methane gas.

18.3 Compensatory Afforestation and Catchment Area Treatment

Another two important areas of work in a dam project that are crucial to its sustainability and life is that of compensatory afforestation and catchment area treatment which go hand in hand. Unless these activities are done in a planned manner with massive people's participation the amount of soil erosion will continually increase in the catchment leading to a rapid rate of siltation of the dams. Even though on paper compensatory afforestation and catchment area treatment have been completed in reality

this has not been effective. For both these activities to be successful the people residing in the catchment have to be involved in the work and the level of investment and planning has to be much higher than actually done.

Good catchment area treatment and compensatory afforestation require the prior demarcation of critically degraded areas on the basis of aerial photgraphs, satellite imagery and ground checks. Creation of a chain of nurseries of suitable species for biological treatment of the area is another important requirement. Finally a phased action programme for biological and engineering treatment of the degraded catchment area with informed participation of the residents of the area is a must. Only such a thorough exercise can both reduce silt load and maintain ecological balance in the catchment area of dams. The interpretation of the aerial photographs and satellite imagery followed by ground truth checks, detailed land and soil surveys and geo-morphological studies to suggest the engineering and biological treatment for the eroded areas have never been undertaken. Moreover the poor rehabilitation of the oustees has not only forced them to encroach on forest and revenue lands near the reservoirs of the dams for their livelihoods but also made them engage in draw down agriculture in the reservoir itself in the summer months.

The net result of all this is that the soil erosion rate is not controlled and so siltation is a big problem that is reducing the life of all the dams much faster than expected. Over and above this there is continuous land use change in the catchment area which leads to more runoff. There are

neither any ongoing studies of these landuse changes nor any plans to reverse them.

18.4 Creation of Ecological Niches

Finally, there is the problem of creating ecological niches where the wildlife displaced from the reservoirs will be accommodated. This involves further displacement of people, adivasis in most cases, once again without proper rehabilitation and resettlement under the provisions of the Indian Wild Life Act 1972. There are more than ten such new sanctuaries and national parks planned in the Narmada basin.

The most tragic plight in this regard, however, is that of the oustees of the Tawa Dam which displaced the tribals of 44 villages. They were paid paltry compensation of Rs 100 to 500 per hectare at the time of their first displacement in the 1970s. They settled on forest and government land near the reservoir. They were then evicted once again as a proof range meant for the purpose of testing military weapons was set up there. They then once again settled in the forests and had to bear the continous harassment of the forest department which intensified when the Satpura National Park was set up in 1981. Finally, the people organized themselves and founded Kisan Adivasi Sangathan in 1985. Since then people have raised their voice and have protested through rallies, demonstrations, dharnas and foot marches and road blockades. Following this the government finally decided to hand over the contract for fishing in the Tawa reservoir to a cooperative federation of the displaced people and this has been running successfully since then.

However, later the government combined three protected areas for wildlife conservation in the vicinity of the Tawa reservoir - Satpura National Park, Bori Wildlife Sanctuary, and Pachmarhi Wildlife Sanctuary and formed the Satpura Tiger Reserve, to be managed under the Project Tiger. These protected areas are not only home to the tiger but several villages are also located inside these forests. There are 8 villages in the Satpura National Park, 17 inside the Bori Wildlife Sanctuary, and another 50 villages within the boundaries of Pachmarhi Wildlife Sanctuary. In addition to these 75 villages, there are 50 villages located close to the boundaries of these protected areas where people regularly make use of these forests. In recent years the use of the forest by these villagers has been severely restricted and local people are not allowed to work for their subsistence by harvesting and selling products such as honey, broom, ropes made with bhabhar grass, tendu leaves, mahua seeds and flowers, and other forest produce. Grazing of cattle in the forest and harvesting of fodder and fuel-wood has been banned in these forest areas. This has led to a severe crisis of hunger and starvation.

The Tawa reservoir has also been included within the boundaries of the Satpura Tiger Reserve. People displaced at the time of construction of Tawa dam had resettled themselves along the banks of Tawa reservoir and now earn their livelihoods by catching fish in the reservoir and doing draw-down cultivation in the submergence area after the reservoir waters recede. However Satpura Tiger Reserve authorities are trying to ban even these subsistence activities, which means that tribals of these 50

villages may be displaced again and their lives and livelihoods may be devastated once again.

18.5 Elitist Water Governance

The World Bank, which has been a major funder of dams worldwide, was forced by public criticism arising from the fiasco of its funding of the Sardar Sarovar Dam to constitute a World Commission on Dams to review the performance of big dams, which submitted a comprehensive report (WCD, 2000). The report brings out the fact that the benefits in terms of irrigation and power gained from big dam construction have gone to the larger farmers or agricultural corporations generally and that the small and landless farmers have been left literally high and dry. Specifically throughout the Narmada basin the lack of command area and canal system development in the many dam projects that have been implemented has meant that farmers with motors situated near the canals have cornered all the benefits.

The more harmful aspect from the point of view of water governance is that the rationale of water resource management has shifted away from water per se to the building of large dams and the tremendous benefits that such gigantic construction works convey to the industrial elites at the expense of the common tax payer. The proper way to go about managing the surface and sub-surface water flows in a river basin is to start from the ridges of the topmost micro-watersheds that constitute the catchment of the river and then work down to the river itself. It is economically much cheaper and environmentally much safer to do this and big dams

should only be built to service the needs that cannot be met through in situ water conservation and extraction. However, since this decentralised water management requires very simple technology that has been around for thousands of years from the time of the ancient Harappan civilisation (Agrawal & Narain, 1997) it does not appeal to the planners, engineers and politicians and so there is little consultation with the people either in the command areas or in the catchment areas of dams before they are designed. There has thus been a lack of equity in both the distribution of benefits and costs of large dam construction with the poor having lost out on both counts.

19. Sustainable Water Management

The areas in the Narmada basin with less than 5% slope which are eminently suitable for extensive canal irrigation from major or medium dams cover only about 20% of the total cultivable land. Indeed, the Man and Jobat dams have been built in areas whose commands are highly unsuitable for canal irrigation due to the terrain and the soil structure. In the case of the SSP which envisages inter-basin transfer also, the command is situated in plains areas as it is in the case of the ISP. Thus, the substantial upper watershed regions having greater slope will always remain without irrigation if nothing other than large and medium sized dam based irrigation projects are implemented. Thus, even if the tremendous problems associated with dam centred water resource development detailed above are ignored even theoretically such development cannot address the water needs of the more numerous population residing in the upper watersheds of the basin. Apart from this there is the problem of the collapse of external input flood irrigation based agriculture that has been mentioned earlier. Thus, there is a need to invest more on techniques for conserving soil moisture and for augmenting the groundwater aquifers which are natural reservoirs available free of cost. Some of the sustainable projects that have been implemented in the basin are given below.

19.1 Watershed Development

Centralised planning for the agricultural sector after independence and especially since the decade of the 1960s in the Narmada basin based on subsidised supply of inputs like water, power, hybrid seeds and chemical fertilisers has not only been environmentally harmful but has also

led to the near total neglect of the tribal dominated dry land areas that constitute most of the basin (Shah et al, 1998). This led to the initiation in the beginning of the decade of the 1990s of watershed development through the "ridge to valley" approach as opposed to the treatment of land in isolated areas with the active involvement of the beneficiaries in planning, implementation and post project maintenance of the created structures as an ameliorative measure (Shah, 1993, GOI, 1994). The Government of Madhya Pradesh initiated the ambitious Rajiv Gandhi Watershed Development Mission (RGWM) in 1994 incorporating these new ideas by pooling all the funds being made available to it by the Government of India for poverty alleviation and treatment of drought prone areas under various schemes. This increased stress on watershed development arose because most of the terrain was undulating and due to the underlying basaltic rock structure water storage in the natural system was low. Apart from the government many NGOs too began to implement watershed development programmes along these lines. The obvious positive impact of the RGWM on the water availability in the upper watershed villages in the districts of the basin in which it has been implemented can be gauged from the table below -

Table 9 : Changes in Water Availability due to Watershed Development (%)

District	Increase in No. of wells with year round water	Increase in No. of tubewells with year round water	Increase in Kharif Irrigated Area	Increase in Rabi Irrigated Area	Increase in Summer Irrigated Area
Barwani	84	0	35	71	0
Balaghat	1220	393	85	117	100
Betul	174	140	74	68	18
Dewas	74	87	13	31	457
Dhar	45	81	24	27	50
Dindori	129	71	4	75	16
Hoshangabad	444	191	29	29	22
Jabalpur	49	106	46	88	287
Jhabua	103	80	19	115	252
Khandwa	83	111	621	40	116
Khargone	48	33	24	64	63
Mandla	98	100	26	159	100
Narsinghpur	387	342	64	44	271

District	Increase in No. of wells with year round water	Increase in No. of tubewells with year round water	Increase in Kharif Irrigated Area	Increase in Rabi Irrigated Area	Increase in Summer Irrigated Area
Raisen	120	112	41	19	26
Sehore	166	201	90	146	166
Shahdol	33	22	97	145	171

Source: RGWM Website

Similarly, in Gujarat too in 2005-06 the irrigation achieved through small water conservation programmes was 3.5 lakh ha. as compared to only 1.08 lakh ha. by the SSP. The increased return flow in streams and rivers from the recharged groundwater aquifers can then be utilised through a combination of check dams and lift irrigation. Consequently, given the increasing importance of local area conservation and harvesting of water resources the World Commission on Dams in its report has recommended that in future people's participation in processes of water resource governance should be made mandatory so that more effective and less harmful solutions to the problems of water resource management can be worked out. After all the investment required in comprehensive watershed development is only around Rs 12000 per ha as opposed to the lakhs of rupees required

for large dam construction and the benefits are immense as detailed below -

i Recharge of the natural storage provided by the groundwater aquifers.

ii Conservation of soils and soil moisture.

iii Conservation of forest, common land and agricultural biodiversity.

iv Greater irrigation coverage.

v Generation of energy through biomass production.

vi Mitigation of climate change effects through greater forest cover.

vii The greater flow that results in the hilly streams can be harnessed for micro-hydel power generation for cheap distribution in remote rural areas.

Unfortunately, the fatal fascination with big dams means that most of the investments are directed towards their construction and very little for watershed development.

19.2 Combination of Endogenous and Exogenous water

Arid and semi-arid areas may not always be able to fulfil their water needs from the maximum utilisation of the water available endogenously because it is insufficient. In such cases introduction of water exogenously from another basin may be necessary. This has been the practice in Tamil Nadu where rain fed tanks are replenished with canal waters once they run dry. This principle along with that of the conjunctive use of surface

and groundwater has been relied on to devise an alternative plan for the harnessing of the waters of the Narmada for the benefit of Gujarat which would ensure full utilisation of the 11 bcm of water allocated to Gujarat with much greater irrigation and environmental benefits at much lesser economic, environmetal and social costs through the use of local dispersed surface storage and the storage in groundwater aquifers instead of one large storage at the dam (Joy & Paranjape, 2006). In addition, there are provisions for local participation in biomass generation through equitable distribution of water both upstream and downstream ensuring sustainability and equity in resource use. The comparison of the actual and alternative plans are given in the table below -

Table 10: Comparison of Alternative Plan with the Current Plan of SSP

Item	**Alternative Plan**	**Current Plan**
MWL at SS dam	107 m	140 m
Total submergence	10,800 ha	36,000 ha
Displacement	Drastic Reduction in displacement	1.5 lakh people displaced
Rehabilitation	Within the same area with assured share of Narmada water	Uprooted, rehabilitation in new area

Item	Alternative Plan	Current Plan
Upstream service area	More than 1 lakh ha	Nil
Total Gujarat service area	41 lakh ha	18 lakh ha
Saurashtra	13.1 lakh ha (32%)	3.9 lakh ha (22%)
Kutch	4.0 lakh ha (10 %)	0.4 lakh ha (2%)
North Gujarat	14.7 lakh ha (36 %)	3.1 lakh ha (17 %)
Rest of Gujarat	8.9 lakh ha (22 %)	10.6 lakh ha (59 %)
New Power Generation	850 MW	1,400 MW
New Energy Generation	2,600 MU	3,600 MU
Energy Consumed in the project	1,646 MU	1,138 MU
Peak load capacity	1,200 MW	1,400 MW
Gas-solar hybrid generation out of saving	200 MW (1750 MU)	Nil
Surplus energy	At least 4,410 MU (26.3 MT produced as biomass)	Nil

Item	Alternative Plan	Current Plan
Equitable water distribution and sustainable development	Basic issue	Not planned
Total cost (Rs crore)	12,920	13,000
Expenses on employment and services (Rs crore)	3,620	Negligible
Loss of Forest	3,000 ha by submergence and 10,000 ha low grade forest for rehabilitation	13,700 ha substantial prime quality forest
Cost recovery	Based on distinction between basic and economic service	No such plan
Gujarat's total share of Narmada water	11 bcm	11 bcm
Permanent vegetative cover in service area	11 lakh ha (23,000 ha in upstream contiguous to forest area)	No provision

Source : Joy & Paranjape, 2006.

This alternative plan is in consonance with the provisions of the Helsinki Rules for "reasonable and equitable" utilisation of the waters in a basin and also their sustainable and conjunctive use. This plan also conforms to the provisions of the UN Convention on Non-navigable Uses of International Watercourses. Such plans can also be developed for the other Major dams in the basin leading to a much better participatory regime of water governance.

19.3 Traditional Water Harvesting Systems

The Narmada basin has traditionally been home to very wise and ingenious water harvesting systems. The upper basin areas around Jabalpur, Narsinghpur and Hoshangabad had the "haveli" system. In this the fields with deep black soils were bunded and kept immersed in water throughout the monsoons. This led to good recharging of the aquifer and also the rotting of all the weeds. At the end of the monsoons the water was slowly drained and then when the fields had just the right moisture, they were sown with indigenous dry land varieties of wheat. This area had the highest productivity of indigenous wheat varieties in the whole of the country in the 1950s. However, with the introduction of soyabean as a kharif crop this practice died as farmers began to take a kharif crop and then use irrigation with pumped ground water or water from the Tawa dam for the rabi wheat crop. Consequently the haveli system has become moribund in most areas (Agrawal & Narain, op cit).

In the lower hilly tracts of the basin in Khargone, Barwani, Dhar, Jhabua, Nandurbar and Vadodara districts the Bhil adivasis have a system of water harvesting called

the "paat" (Rahul, 1996). In this, hilly streams are bunded with rocks, stones and muds to form a weir and then the water is diverted into channels which have a much lesser gradient than the stream bed. So, after a distance downstream these channels are able to reach the fields on the high banks of the streams and irrigate them. Since maintaining the bunds on the streams and the channels which are over a few kilometers long and have to be carried across intervening gullies requires a lot of labour the paat systems are normally maintained by the communities and are a participatory irrigation system. Since this sytem requires only labour which is in abundance among the Bhils it is still very popular as irrigation with electric and diesel pumps has become extremely uncertain and expensive these days.

19.4 Micro Hydel Systems

The hilly portions of the basin with fast running streams offer considerable scope for micro-hydel power generation. However, even though policies are in place in this regard in all the states of the basin little has been done to actualise this on the ground. The NBA has implemented one such project on a tributary of the Narmada, the Udai river, in Nandurbar district in Maharashtra at Bilgaon village. Designed by the People's School of Energy of Kerala, the hydel project taps the power potential of a natural waterfall. The 15 kW of electricity produced is adequate to light all 12 hamlets that fall within 4 kms of this tribal village. A two-metre high check dam stores 15 lakh litres of water, which is channelled into a smaller tank capable of storing 30,000 litres. Water flows at the rate of 400 litres a second from a height of 8 m to drive a

turbine. This, in turn, drives a generator at the rate of 1,500 rotations per minute (rpm) giving Bilgaon its electricity. In the months when the river Udai is in full flow, the village would have electricity round the clock. When there is less water, there are four hours of supply only in the evening (Bavadam, 2003).

19.5 Summary

We unequivocally arrive at the conclusion that there has been a serious governance failure in the Narmada basin regarding the proper utilisation of its water resources. The basic assumption that big dam projects are indispensable for irrigation and power development has led to the ignoring of the tremendous environmental and social costs associated with such projects and a violation of the basic principle of "reasonable and equitable" utilisation of water as mandated by international covenants on the use of river waters. The inability to fulfil the need for irrigation through dam projects has on the one hand led to the excessive exploitation of ground water aquifers and also to a lesser recharge of groundwater and leading to reduced surface flow and greater siltation due to a paucity of funds for soil and water conservation measures. The various mass organisations and NGOs led by the Narmada Bachao Andolan have continually agitated for people centred water governance in the basin so far with only partial success. This has led to the development of alternative approaches for a better participatory and sustainable water governance in the basin at both the theoretical and practical levels but they are not being replicated on a large scale. The basic reason is the lack of funds and political will.

SECTION 2 : MAN RIVER BASIN

20. Overview

The increasing unsustainability of natural resource use, especially of renewable common property resources like forests, land and water, has become a serious problem all over the world and especially so in developing countries where the number of poor people dependent directly on these resources for their livelihoods is much higher in number (Dasgupta & Maler 1991). Specifically in the Indian context due to the skewed distribution of property rights that prevails currently, the demographically numerous rural poor are mostly either in marginal control of these vital resources or have no access to them. This means that they have no incentive to gainfully use the other important resource, their abundant labour power, to conserve and develop these natural resources for ensuring sustainable livelihoods that can assure the fulfillment of their basic economic and social needs while simultaenously ensuring ecological sustainability. Moreover, imperfect functioning of markets combined with faulty government regulation has meant that equity and sustainability considerations have been further sidelined (Beardsley, Davis and Hersh, 1997). This has led to a retrogressive deterioration in both the stock and

flow of natural resources and the quality of human resources causing the rural economy and culture to fall into crisis all over the country (Dasgupta, 1993).

20.1 Unsustainability of Resource Use

The problem of unsustainability of renewable natural resource use is particularly acute in areas where Adivasis or tribes people reside and there are considerable natural resource bases. Traditionally the Adivasis had tightly knit communitarian systems of natural resource management that have ensured sustainable use albeit at subsistence levels but due to the inroads of the modern market and State systems these communitarian systems of the Adivasis have decayed leading to unsustainability of resource use (Banerjee, 2003).

Sharma has established from a qualitative analysis of tribal development policies within the larger area of scholarship of the predicament of the Adivasis in India that the institutions set up under the provisions of the Constitution of India and the various laws enacted from time to time for the protection of the adivasis traditional communitarian and natural resource friendly lifestyle have not functioned properly primarily due to the wrong development policies adopted by the State which have tended to strengthen rather than weaken the political and economic power of the non-Adivasis vis-a-vis the Adivasis (Sharma, 2001). Planned development in

Adivasi areas of Madhya Pradesh after independence has followed this path that is unfriendly to the tribes people -

"top priority has been given to a programme of rapid industrialisation and extension of means of communication to the most interior regions in the state. Our firm view is that the development of land and agriculture alone will not be adequate for the rehabilitation of the tribal communities. Agricultural land is insufficient and cannot serve the needs of even half the tribal population of the state. Fortunately, the tribal areas of the state are rich in industrial and power potential. There is no reason why in the wider interest of the nation and in the long-term interest of the tribals themselves, industries should not be developed and localised in tribal areas" (NCAER, 1963:vi).

In reality this kind of development has led to a devastation of the resource bases and livelihoods of the Adivasis in Madhya Pradesh (Banerjee, 2008). Thus, the broad research problem that has been studied here is the sustainability or otherwise of natural resource use in Adivasi Areas in Madhya Pradesh.

The factors that determine the sustainability of resource use are highly location specific (Marten, 2001). It is only through information collected through multidisciplinary micro-studies that programmes for sustainable resource use can be planned and implemented. There is, thus, a need to study rigorously in a multi-disciplinary mode

using sociological, ecological and economic tools, the sustainability of natural resource use with regard to specific areas and specific population groups who have suffered most from the prevailing patterns of resource use. This will enable better development planning for these areas and groups, ensuring environmental and economic sustainability in general. The Bhil Adivasis of Western Madhya Pradesh are such a group. There have not been so far many such multi-disciplinary sustainability micro-studies of natural resource use of the Bhil Adivasis. However, since natural resources constitute a vast field of study and since from the point of view of the lives and livelihoods of the Bhils, water is the most important natural resource on which the use of other resources hinges, the Bhil Adivasi populated catchment area of a big dam built at Jirabad in Dhar district of Madhya Pradesh on the River Man, which is a tributary of the River Narmada has been detailed here.

20.2 Definition of Terms

The term **sustainable development** was first defined by the report of the World Commission on Environment and Development in 1987 as follows -

"Sustainable Development is development that meets the needs of the present without compromising the ability of the sfuture generations to meet their own needs" (WCED, 1987). The report goes on to say -

"In essence, sustainable development is a process of change, in which exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations."

Thereafter, there have been various interpretations and modifications of this catchall definition with a debate raging among neo classical economists regarding the extent of substitutability of human made capital for natural resource capital (Dasgupta, 2001). Another major criticism is that while this definition stresses on the maintenance of inter-generational equity it is silent about the deep levels of current inequality across and within countries which is the primary cause of natural resource degradation (Miller, 2005). Taking these into consideration Kadekodi has pinpointed the various aspects of sustainable development to be efficiency of resource use, equity of distribution, proper valuation of resources, estimation of resource stock and environmental resilience of resource use so as to ensure the continued availability of resources into the future (Kadekodi, 2001).

People who have traditionally lived in small communities with strong kinship ties at subsistence levels in close proximity with nature in relatively egalitarian and non-hierarchical settings are generally referred to as **tribes** (Fried, 1975). After independence the new Indian

Constitution adopted in 1950 incorporated special provisions for the protection and development of the tribes and they were named as Scheduled Tribes and the tribes so identified were notified by an order of the President of India in a special Schedule (GoI, 1950). However, there is criticism of the use of the word tribe in post colonial countries and among the American Indians in the United States of America because of the pejorative and condescending connotation given to the term by colonial anthropologists and administrators (June, 1968). The term **Indigenous Peoples** is instead favoured around the world by tribal people and has come to be accepted by the United Nations also as signifying that these people used to live in their territories before they were colonised (Erni, 2007). Many tribal activists in India claim that they too are the indigenous people of this country and use the vernacular term **Adivasi**, which is roughly equivalent to the term indigenous people, to describe themselves. The Indian Government, however, resisted this classification for a long time but finally signed the United Nations Declaration of the Rights of Indigenous Peoples in 2007. Therefore, in this study the term Adivasis has been used to refer to tribes.

21. Details of Western Madhya Pradesh

The Man River basin is 145,000 hectares in size and there is a big dam on the Man River at Jirabad which has led to a drastic difference between the water availability and use upstream and downstream of it. Therefore, in the present study the catchment area of the Man River dam covering 69,000 hectares has been chosen as the study area. The study area has two distinct agro-ecological zones namely the Malwa Plateau and the Vindhya Hills with the concentration of Bhil Adivasis being higher in the latter region.

21.1 Agriculture in a Naturally Water Scarce Region

The western Madhya Pradesh region, where the Bhil Adivasis reside is a naturally water scarce region like most of India other than the Indo-Gangetic and Brahmaputra plains (Kumar et al, 2008). This is due to four characteristics that are peculiar to it -

1. The average annual rainfall is low being around 700mm with the number of rainy days being around 50.
2. The soil is mostly clayey and so infiltration of rain water into the ground is low. Moreover such soils tend to get waterlogged if subjected to flood irrigation.
3. The underlying rocks are basaltic and sedimentary having low porosity and permeability and so their

capacity to store water in underground aquifers is limited.

4. The average evapo-transpiration rate for the area is very high at about 2100 mm and so a considerable amount of the rainfall evaporates immediately. In the dry periods the moisture retained in the soil gets evaporated. A large amount of the water stored in surface storages big and small too evaporates.

Agriculture constitutes the largest use of water in the region and also provides the livelihoods of the majority of the population. Thus, it will be necessary to dwell on the development of agriculture to understand water use and the livelihood situation of the people. Under centralised planning for the agricultural sector after independence and especially since the decade of the 1960s, an agricultural regime was promoted that ensured higher productivity in the plains areas upto the decade of the 1990s based on subsidised supply of external inputs like water, power, hybrid seeds, chemical fertilisers and pesticides (Rahul & Nellithanam, 1998). Rahul and Nellithanam have gone on to say that while this initially increased yields and production phenomenally in the plains it also meant the neglect of the more widespread dryland agriculture in the hilly upper watersheds which are mostly inhabited by the Bhil tribals. With regard to water use this has meant the over exploitation of ground water aquifers and the near total neglect of soil and water conservation measures in the upper watersheds (CGWB,

2012). Consequently, the lack of adequate soil moisture is the major constraint on agricultural productivity in these dry land areas (Benites and Castellanos, 2003). The large scale deforestation that was also a feature of this era aggravated soil erosion and reduced recharge and availability of natural manure (Gadgil, 1990).

Thus, the proper conservation and equitable utilisation of water is the most important determinant of agriculture in dryland areas and the key to the environment and economy of western Madhya Pradesh (Shah et al, 1998). The vast majority of farmers in western Madhya Pradesh cultivate small plots of land on terrain that is unsuitable for flood irrigation and they have traditionally been driven by the desire to produce for subsistence rather than for profit. Vijayshankar has outlined the policy changes necessary for a revival of agriculture in Madhya Pradesh through a system that makes the most of the locally available resources in terms of seeds, organic fertilisers, in situ soil moisture and natural pest management which are more cost effective in the case of dry land varieties. (Vijayshankar, 2005).

21.2 Watershed Development

Given these problems arising out of the neglect of dry land agriculture, forest conservation and small scale water harvesting and recharge, scholars and practitioners of development began trying to find solutions (TWN, 1990). This led to the adoption of Watershed Development

(Vaidyanathan, 1991) and Joint Forest Management (Poffenburger and McGean, 1996) at the grassroots level in the decade of the 1980s. Chambers drew the attention of development practitioners to the woeful lack of involvement of the people themselves in planning and implementation and suggested new methodologies that involved the participation of the beneficiaries to correct this serious anomaly (Chambers, 1983). Later there was a rethinking in the beginning of the decade of the 1990s all over the country with regard to the implementation of watershed development in a haphazard manner that prevented lasting benefits from accruing. This led to the "ridge to valley" approach wherein a watershed was treated with soil and water conservation work beginning with the ridge line and going down to the drainage line as opposed to the treatment of isolated areas. This was done with the active involvement of the beneficiaries in planning, implementation and post project maintenance of the created structures (Shah, 1993, GOI, 2006).

The best example of this is the watershed development work done in the Arvari River basin in Alwar district in Rajasthan by Tarun Bharat Sangh. The organisation built 238 water harvesting structures, mostly the traditional johads, in the river basin by 1997 and this led to the river becoming perennial (CSE, 1997). These structures were tested for their engineering soundness in the monsoons of 1995 and 1996 when they withstood the heavy rains but the standard structures built by the Government

departments were washed away. The ground water level which had earlier gone down to 70 meters rose to 7 meters due to the heightened recharge. By 1998 the organisation had constructed 2500 johads in 500 villages in Alwar district at an expenditure of Rs 15 crores with as much as 73 per cent being contributed by the people themselves and all this has led to a doubling of the productivity of the kharif crops like wheat and maize (Sharma 2002).

The Government of Madhya Pradesh initiated the ambitious Rajiv Gandhi Watershed Development Mission (RGWM) in 1994 incorporating these new ideas by pooling all the funds being made available to it by the Government of India for poverty alleviation and treatment of drought prone areas under various schemes. This increased stress on watershed development on the part of the Government of Madhya Pradesh came from the realisation that since the state is situated across a drainage divide involving as many as six river basins, the terrain is undulating and is underlain by hard rock and so water storage in the natural system is low. Moreover the state has only a limited share in the river waters because it lies on the upper catchment of the six basins as noted in the review of the programme done by TARU (RGWM/TARU 2001). However, the review also noted several problems in the implementation of the programme notably that of a lack of adequate people's involvement and empowerment. Watershed development, implemented in small watersheds in dry hard rock areas with relatively high

population density, has limited scope for ensuring sustainable livelihoods even with the best community mobilisation (Kumar et al, 2008).

Thus, there is a need to undertake planning and implementation of water resource management of a larger unit that can provide a big enough base for integrated resource conservation and use and the initiation of non-farm value addition activities to capitalise on the higher bio-mass production arising from conservation efforts. The National Water Policy 2002 also lays stress on such holistic and aggregative water resource management (GOI, 2002). Moreover, Kerr has pointed out the problem of externalities within and without the small watersheds arising from larger societal and agro-ecological considerations (Kerr, 2002). This is in fact the most important criticism of local area watershed development. Even very successful communitarian watershed development efforts, like in Alwar by the Tarun Bharat Sangh, while they have increased yields from a previously low level have nevertheless not been able to increase agricultural yields substantially above the Indian average. Even this has been done by adversely affecting downstream water availability (Sharma, 2002). Another major concern is that the vast majority of the poor in India live at subsistence levels, with high population density and inequitable access to resources and this is incompatible with the achievement of overall human development within small micro watersheds. Thus, even

if successful implementation of micro level watershed development may ensure better management of natural resources this might still not ensure sustainable livelihoods for the majority (Banerjee, 2009).

Scholars have also noted the problems arising out of the mismanagement of dam irrigation on the one hand and the consequent over dependence on ground water for irrigation purposes on the other (Dharmadhikary, 2005). The biggest problem is that the canal networks in most cases are not completed or even if they are they are not lined properly and so there is either much less water available for irrigation or much heavier losses through seepage than were designed at the time of construction. There has been a tendency among water resource managers to just build the walls of the dams and not pay enough attention to building and maintaining the canal network. An assessment shows that in the fifteen year period from 1992 to 2007 there was no net addition to the canal irrigated area despite an expenditure of Rs 142000 crores on major and medium irrigation projects in this period (Thakkar, 2010).

This has led to a serious crisis of over exploitation of groundwater in large areas of the country (Chatterjee & Purohit, 2009). In fact even in Punjab which is well served by irrigation canals from the dams on the Sutlej, Beas and Ravi Rivers, the proportion of irrigation from ground water is as high as 75 per cent while in Haryana it is 50

per cent. This increasing dependence on ground water has resulted in an increasing inequity in water usage among the rich and the poor arising from the creation of water markets (Prasad, 2002). It is not viable for poor marginal farmers to sink deep tubewells to access the confined aquifers. So they have to either buy water from rich farmers or lease out their land to them. In both instances the poor farmers lose a substantial proportion of the earnings that would have been possible if they had access to much cheaper canal irrigation or irrigation from in situ water harvesting structures and increased soil moisture due to water harvesting.

Concerns such as the above have led to the conceptualisation of participatory integrated resource planning for the empowerment of the poor and management of natural resources for ensuring sustainable livelihoods (Chambers et al, 1989). This important aspect of people's participation in design and implementation of programmes has been incorporated into the Watershed Plus strategy from 2004 onwards that lays stress on training and motivation for project beneficiaries so that they can own and maintain the structures and water harvesting systems that are put in place (Joy et al 2006)

22. Integrated Water Resource Management

Thus, the need arose for considering bigger planning units than watersheds which would allow for diversification of livelihoods, equitable access, wider political mobilisation and provide opportunities for optimal cross watershed sharing of natural resources while at the same time avoid the pitfalls of mismanagement and under implementation that have plagued big dam centred canal irrigation projects. This led to the evolution of the concept of Integrated Water Resource Management (IWRM) which has been defined as (GWP, 2000) -

" A process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

Once a larger unit than a watershed is considered for water resource management immediately the question of water governance assumes paramount importance. Given a situation in which water resources are becoming increasingly scarce and the failure of the market and centralised regulatory mechanisms to ensure equitable and sustainable use of this scarce resource, the issue of decentralised people's governance and the institutional mechanism through which this is to be achieved comes to the fore. Presently at the behest of the international funding agencies which are more concerned with cost

recovery of water distribution systems of big dam projects, the push is for participatory irrigation management and many State Governments have faithfully passed legislation in this regard (MoWR, 2012). However, for true water governance, the complete harnessing of water resources and their use has to be considered from the poor people's point of view and this means the evolution of people's institutions and practices rather than the adoption of handed down agenda (Hamada and Samad, 2011).

22.1 The Conceptual Details

The idea of having a holistic conception of water management had been there for quite some time but gained a formal definition in the Agenda 21 adopted at the conclusion of the World Environment Conference in Rio - de - Janeiro in 1992 (UNCED. The concepts of River Basin Management and Integrated Water Resource Management for a more holistic planning of water resources came into vogue and a Global Water Partnership of water management institutions was established to push these ideas for adoption in the water sector on a wider scale. In its scope it is far reaching because it encompasses the study of and subsequent action in the spheres of -

i. Water sources - surface and underground
ii. Distribution of water - seasonal and geographical

iii. Users - terrestrial and aquatic plants and animals, micro-organisms and humans
iv. Human Uses - domestic, agricultural, industrial, sanitational, hydroelectrical, navigational and recreational
v. Upstream - Downstream linkages
vi. Land, Vegetation and Water interactions
vii. Economy, Society and Ecology interfaces
viii. Institutions - informal rules, culture, civil society organisations, governance systems.

Thus, even though IWRM speaks of a holistic approach it is highly ambitious in scope and very difficult to put into practice.

22.2 Critique and Development of the Concept

Scholars and practitioners have criticised this concept for being narrowly underpinned by neo-liberal principles propagated by international development institutions, dominated by technical and managerial concerns and concentrating on the marketability of water while neglecting the equity of distribution and the politics associated with it serving only to legitimise the prevailing governance mechanisms and so questioned its applicability in third world countries like India (Jairath & Ballabh, 2008). Subsequently, there is an ongoing attempt to redefine and reformulate the concept to make it suitable to the management of natural resources and sustainable development in Indian conditions (Shah & Prakash, 2007). Mollinga treats it as a boundary concept which is

still evolving out of the negotiations regarding its meaning and actual practice between different stakeholders (Mollinga, 2006). Thus, a modified IWRM framework with adequate attention to the pro-people social and political aspects of water use can ensure sustainability of its use as a framework of study and practice at the sub-basin level and then this can be aggregated for macro-level sustainability in large River basins. The National Water Policy of 2002 also lays stress on IWRM (Section 3.3, GOI, 2002) -

"Water resources development and management will have to be planned for a hydrological unit such as drainage basin as a whole or for a sub-basin, multi-sectorally, taking into account surface and groundwater for sustainable use incorporating quantity and quality aspects as well as environmental considerations".

Even though the statement above does not explicitly mention it, people's informed involvement at the grassroots in such planning is most essential for its success. Conservation of water, soil and forests and the promotion of organic agriculture and associated non-farm localised industry have together become the most successful mode of ensuring sustainable development in hilly dry land and hard rock areas which are physically water scarce as exemplified by Hiware Bazaar Panchayat in Maharashtra among others where a denuded environment has been regenerated through protection and

water and soil conservation measures to boost both natural resource availability and agricultural production sustainably(Sakhuja, 2008). This also ensures that the global problem of climate change arising from deforestation, soil loss and increasing use of energy in agriculture is addressed effectively through in situ natural resource conservation and augmentation of agriculture (IISD et al, 2003).

The challenge is to replicate small scale local successes at a larger level. Given the present acute scarcity of water, its management can no more be left to individual vagaries or market forces and so over the past two decades since the United Nations Environment Conference in Rio - de - Janeiro in 1992, the role of the State and communitarian governance of water resources has come to be emphasised. In this regard the underlining of the importance of community institutions and the deliniation of the principles for their functioning that allow them to conserve common property resources and use them sustainably, has been the major contribution of Ostrom and it applies especially to Adivasi communities who have traditionally had such institutions (Ostrom, 2001).

23. Adivasi Water Management Practices

The Bhil Adivasis have had very robust local water use systems which are still extant despite the spread of diesel and electricity powered irrigation systems (Rahul, 1996). Thus, it is relevant to dwell on the sustainabile water use practices in Bhil Adivasi areas in the present context of achieving overall sustainability of water use.

In the remote villages of Western Madhya Pradesh, including the study area a water use system is in place that at first glance appears to make water scale steep hills to irrigate fields. This seeming defiance of the law of gravity is a system devised by Bhil tribals which takes advantage of the peculiarities of the hilly terrain to divert water from swiftly flowing hilly streams into irrigation channels called paats. The paats work on the principle of differential gradient. While the stream bed itself has a steep gradient, it is bunded with stones and mud at an upstream point well above the farms in the village to construct a diversion weir. The paat channel that is taken off from the weir along the side of the stream has a much lower gradient and so gradually it gains in elevation with respect to the stream bed as the stream progresses downstream. The crucial knowledge input here is to decide the exact point upstream from the farms where to build the diversion weir and draw the channel so that it reaches the farms. The Adivasis pinpoint this location

without the use of any measuring instruments and that is their great achievement.

Within a period of four decades, the Bhils have developed and refined the paat system, a practical and ecologically sound method of water management. The development of this technique could be seen as the Bhil Adivasi retort to the State's destructive practices which have ravaged the region's environment. The people of Bhitada village in Alirajpur district (located at the confluence of Kari, a stream, and the river Narmada), have developed this unique system to possibly its best form. Even though the bed of the Kari, at its confluence with the Narmada is positioned about 20 meters below the farms on its banks, the fields are lush green with maize and gram, grown with water brought by a four km long paat from a point upstream whose elevation is higher than that of the fields.

After harvesting the kharif crop of bajra (millet) and maize, one member from each family is spared to join others in the repair of the water channel and construction of the diversion bund. The process is quite a laborious one. The diversion bund across the stream is constructed by piling up stones and then lining them with teak leaves and mud, to make them leak-proof. The paat channel has to steer through the nullahs (deep ditches) that join the stream, before reaching the fields. Stone aqueducts are built to span these nullahs in a manner similar to the diversion bunds. Particularly skillful

is the manner in which the narrow channels have been cut in the face of the sheer stone cliffs. The villagers irrigate their fields by turns. The channel requires constant maintenance and it is the duty of the family irrigating its fields on a certain day, to take care of the paat for that day. It takes about two weeks to get the paat flowing and the winter crop is sown in early November. Thus, this is a communitarian effort that binds the whole village together while at the same time conserving the environment.

24. Gender Situation

Bhil Adivasi women have a low status in their society. Relegated to a position of subordination from the moment of birth, girls eat last and least, are over-worked and under-educated and have to bear children from an early age. They receive inadequate medical treatment when ill and are often passed over for immunisation. Despite the biologically proven fact that women have a longer lifespan than men, in reality, the reverse is true in Bhil tribal areas where more girls are likely to die than boys leading to a sex ratio skewed against women in the population. Adult women lack property rights and control over economic resources, which contributes to the general preference for a male offspring as an insurance against old age incapability. This in turn results in women having to go through the rigours of repeated pregnancies and childbirths to produce sufficient male children that can survive through to adulthood overcoming the uncertainties of an insecure childhood. Malnutrition, lack of sexual hygiene, repeated pregnancies and overwork lead to most rural women being anaemic and so prone to other diseases in general (Mehta & Abouzahr, 1993)

The prevailing pattern of development has been particularly harsh on Bhil tribal women. Destruction of resource bases has led to the workload increasing with a corresponding decrease in nutritional levels of the food intake. The introduction of artificial input mechanised

agriculture has deprived women of the little control that they had over production processes in traditional agriculture and further reinforced patriarchal power relations. Forced migration either temporary or permanent, which has become a common phenomenon in Bhil tribal areas, has exposed women to sexual violence in unfamiliar surroundings. The loss of traditional livelihoods has been accompanied by the induction of women into low-paid jobs in the informal sector in urban areas where the work environment is unhealthy and the workload high. The general level of violence against women has gone up both within and without the home (Duvvury, 1994).

Last but in no way the least harmful have been the government's health and population control policies. Primary health care has received short shrift both in terms of financial outlays and in terms of the introduction of participative health care systems. Thus apart from the foreign funded immunisation campaigns like the Pulse Polio programme mentioned above, rural populations rarely ever receive any effective healthcare from government health services (Bose & Desai, 1983). Consequently for the poor Bhil tribals, infant mortality levels are still dangerously high as are maternal mortality and morbidity levels (IIPS, 2003). Again spurred on by the neo-Malthusian myth that population growth is responsible for poverty the government had launched an aggressive population control programme in the 1970s,

which targeted women for sterilisations and the use of various unsafe and unhealthy contraception measures (Mamdani, 1973). Even though with the introduction of the sterilisation target free reproductive health approach from 1996 onwards there had ostensibly been a so called paradigm shift at the policy level in population control and maternal and child health care, the ground reality in rural areas had remained much the same as before (Rahul, 1997c). The Bhil women are burdened by the multiple oppressions enumerated above and are subservient to men. An intimidating culture of silence prevents women from articulating their problems or participating in social and economic life in a big way (Dixon-Mueller & Wasserheit, 1991).

25. Details of Man River Basin

The IWRM framework which has been adopted for this study stipulates, as mentioned earlier, that the sub-basin to be studied should be bigger than a watershed and smaller than a large river so as to overcome the limitations of small watersheds and do away with the errors arising out of the generalisations of large river basins. Thus, the target study area has to be a basin of between 50,000 to a 100,000 hectares. Moreover, there has to be a sizeable Adivasi population in the basin so as to study their water use and perceptions about its sustainability.

The World Bank funded Water Sector Development Programme in Madhya Pradesh (World Bank, 2004) has already been looking into the issue of sustainability of water use in the rest of the river basins in the State other than the Narmada River basin. Consequently, the Man River sub-basin in the Narmada River basin was chosen because of the following unique characteristics which made it suitable for this study -

- The basin spans the three distinct agro-ecological zones of the Malwa plateau, Vindhya hills and the Nimar plains.
- There is a serious problem of over extraction of ground water in the basin arising mainly from the cultivation of high yielding varieties of wheat.

- There is a large dam in the basin affecting water use drastically in the catchment and command areas.
- There is a significant Bhil Adivasi population in the basin which is mostly dependent on subsistence agriculture on small farm plots and its proportions in the different agro-ecological zones is different thus providing an opportunity to segregate tribal and non-tribal resource use.
- Considerable soil and water conservation work has taken place in the basin but its impact has not been as expected.
- The basin has some reserved forest area which is mostly degraded as there is not much communitarian protection going on.

The Man basin in totality spans an area of 145,000 hectares with five main tributaries and is much too big for the purposes of this study. Moreover, due to the construction of the big irrigation dam at Jirabad on the Man River, the downstream section has a distinctly different water availability and use pattern from the upstream section. This is not just because of the change brought about by the dam which has started operating from 2005 but also because the command area is a relatively fertile clayey soil area in the Nimar Plains agro-ecological zone which is hydro-geologically distinct from the catchment area which has basaltic and metamorphic

rocks overlain mostly with thin lateritic soils in the Vindhya Hills region and deep clayey soils in the Malwa Plateau region. The Malwa Plateau region has a larger proportion of non-Adivasis as compared to the Vindhya Hills region which is mostly populated by the Bhil tribals. Therefore, for the present research, the upstream portion of the river consisting of the catchment area of the Man dam has been studied in detail. This covers an area of 69,000 hectares and so fits the size limits for a manageable study unit under IWRM.

The Man River rises in Lunehra village in a tank called Man Sarovar on the Malwa Plateau and then flows for about 12 kms eastwards before plunging down the hilly escarpment of the Vindhya range for 35 kms upto the Man dam at Jirabad. Thereafter it flows for a further 44 kms through the Nimar plains to its confluence with the Narmada at Kothra village. The Map of the basin showing the three distinct agro-ecological zones, the tributary rivers, the reserved forest area, the Man dam location and the two main towns is given in the figure below.

Fig. 1: Map of Man River Basin with Rivers and Agro-Ecological Zones (AEZ)

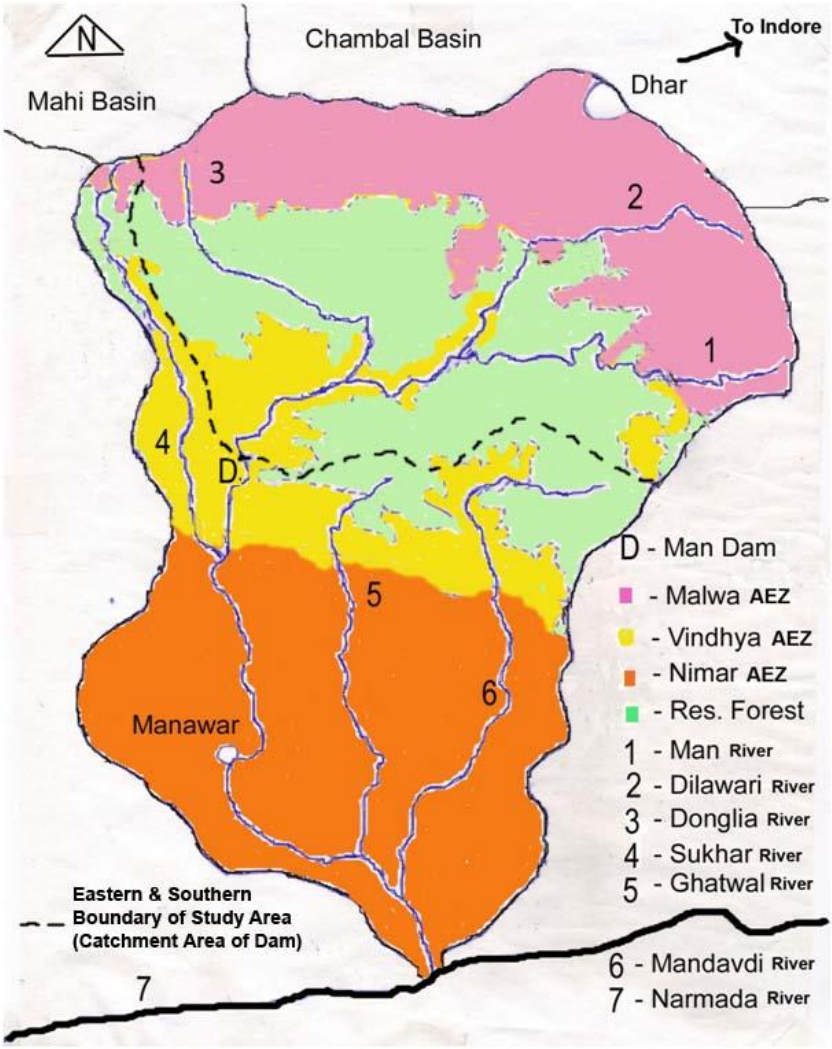


Table 11. Geographical Characteristics of Man River Basin

	Malwa	Vindhyas	Nimar
Mid Latitude	$22^0$35	$22^0$25	$22^0$1
Mid Longitude.	$75^0$08	$75^0$08	$75^0$08
Ht. above MSL	560 m	450 m	220 m
Rock Structure	Basalt	Granite & Sandstone	Granite
Soil	Clay & Sandy loam	Sandy loam & Alluvium	Clay, Sandy Loam & Alluvium
Rainfall	913 mm	738 mm	711 mm
Avg. PET	2100 mm		

Source: District Statistical Handbook 2009, Dhar.

The geographical characteristics of the Basin have been summarised in Table 11. There is a steep drop from the Malwa plateau to the Nimar plains in the form of spurs of the Vindhya range of about 340 meters. The Malwa plateau agro-ecological zone, which extends about 10 kms at the top of the basin is underlain with basaltic rocks known locally as the Deccan Traps. These rocks are of

low porosity and permeability and have water retention capacity only in the fractures and faults. The Vindhyas agro-ecological zone, extending about 10 to 20 kms in the centre of the basin, is made up of granite and sandstone which have a slightly better water retention and permeability. There are some degraded forests in the region even though the notified Reserved Forest Area occupies a considerable area of this zone. The Nimar region, extending about 15 kms at the bottom of the basin, is underlain with granite. The soil is mostly a rich black cotton clay in the Malwa region with some lateritic sandy loam while in the Vindhya region it is mostly sandy loam with some deposits of black cotton and alluvial soils in the valley of the Man River just above the Dam at Jirabad.

The Nimar agro-ecological zone has an equal mixture of black cotton clay and sandy loam soils with some deposits of alluvial soils along the river valleys. The rainfall is fairly heavy on the Malwa Plateau and most of this water flows down into the dam. However, the rainfall occurs mainly in the monsoon months of mid June to mid September and the number of rainy days is on an average only 50. The average potential evapotranspiration rate for the area is high at about 2100 mm. Consequently the soil moisture zone remains completely dry for about 90 days in the summer period. The whole basin has been classified on the Thornthwaite system of climate classification as a transitional ecosystem of moist semi-arid and dry sub-humid type with an index (-)41.9 (Tamgadge et al, 2001).

The contribution of the sub basins to the area of the Man basin are given in Table 12. The Vindhyas region contributes the most to the flow in the basin and its topography being hilly and covered mostly with degraded forests and cultivated land, the water runoff and sediment load are both high. The 69000 ha catchment area of the Man dam is constituted by the Donglia, Dilawari and Man river catchments.

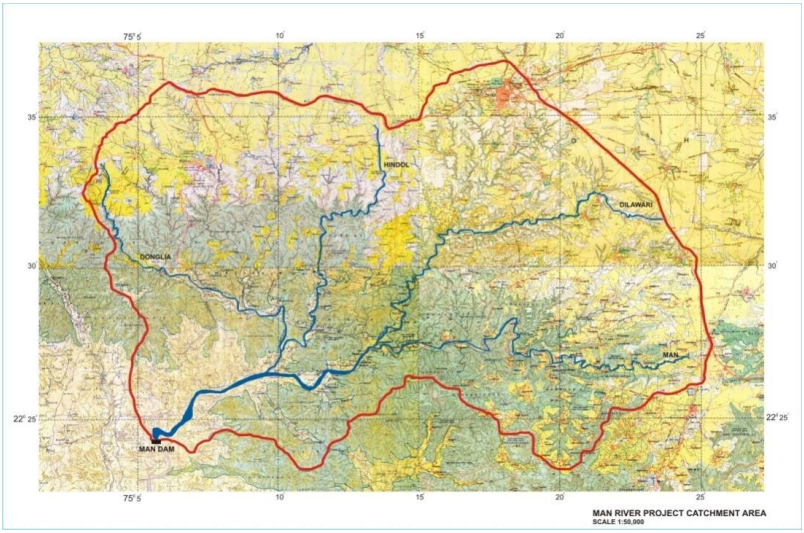
Table 12: The Sub Basins of Man River Basin in Ha.

	Malwa	Vindhyas	Nimar	Total
Man	6900	23600	29000	59500
Dilawari	11300	4500	-	15800
Donglia	7400	15300	-	22700
Sukhar	2100	8200	400	10700
Ghatwal	-	3600	10300	13900
Mandavdi	-	10400	12000	22400
Total	27700	65600	51700	145000

Source: Calcutaltion from Survey of India Toposheets.

The map detailing the catchment area of the dam is shown in Fig. 2 below.

Fig 2: Man Basin Showing Catchment area of Man Dam at Jirabad



26. Methodology of Quantitative Estimation of Water Availability and Use and its Sustainability.

The standard methodology for assessing water availability and use is to construct a water balance estimation model specific to the area under study. The water balance model is based on a study of the surface and groundwater hydrology of the basin. The concentration of hydrological studies in India have 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). Moreover, accurate estimation of water balance requires the collection of a huge amount of data over long periods of time at various locations in the basin which is an expensive proposition. Thus, various empirical formulae have been derived that give a very rough idea of the runoff in large river basins like that of the Narmada River. 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% (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 were no data available from the basin regarding runoff, river flow, natural recharge and return flow from ground water aquifers. The design was done on the basis of the results of a linear regression equation set up between the rainfall and flow data for the Narmada River basin between Mortakka and Garureshwar flow gauging stations, upstream and downstream of the Man River basin, which are more than a hundred and fifty kilometers apart. Such a big approximation led to the over estimation of the flow in the Man River and a consequent over design of the dam.

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 River basin.

On the other hand there have been another set of hydrological studies that have been 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 the following parameters (SOPPECOM, 2007) –

a) The infiltration of rainfall into the soil,

b) The surface runoff of the rainfall minus this infiltration,

c) The storage of water in the soil and the underground aquifers,

d) The evapotranspiration that takes place from the soil and the plant growth,

e) The return flow from the underground aquifers into the streams

However, these kinds of empirical models were found to be inappropriate for the present study for the following reasons -

1. The study area is very large in size and spans two 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 that govern runoff and evapotranspiration across the study area.

Moreover, without a detailed study of the underlying rock characteristics no worthwhile estimate of the infiltration or return flow could possibly be made.

2. There are innumerable big and small water retaining structures in the study area and most of them do not have their dimensions formally recorded. 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 study area.

3. Proper measurement of flow over the dam and the utilisation of the capacity of the reservoir is not being done by the Narmada Valley Development Authority (NVDA) as only the level of the water at the dam is being measured once daily. Moreover, in the Rabi season there is considerable drawal of water through lift irrigation from the reservoir. There is thus no possibility of getting a reliable estimate of the flow at the dam in Jirabad.

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 the latter is sustainable. The water availability is more or less related to the rainfall in the area which is below the average values in most years. This is when the kharif crop is under water stress leading to lower than potential yields.

Therefore, what is more of a concern is the availability and use of water for the irrigated crops in the rabi season which constitutes the highest drawal of water. What has been attempted here is an estimation of the average amount of water used in agriculture in the catchment of the Man dam which is the study area. 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 under the aegis of the Food and Agriculture Organisation as given below -

$Q = 1/I.E.\{ \sum A_i (kc_i \sum ET_o)\}$, where
Q = Total water needed for irrigation
I.E. = The Irrigation Efficiency given by the ratio of the water actually evapotranspirated by the crop and the total water needed to flood the field. This ratio is assumed to be 60% 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 determined from experimental plots.
ETo = The daily Evapotranspiration rate for a crop which varies during the different periods of its growth.

This formula gives the water demand for a crop that is cultivated under ideal conditions of soil, water availability and other inputs like seeds, fertilisers and pesticides. Therefore, the value derived from this formula has to be corrected for actual conditions prevailing in a study area. The evapotranspiration 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 puposes of this estimation the Indian Meteorological Department (http://indiawaterportal.org/metdata) data have been relied on for evapotranspiration and the FAO standard data (Doorenbos et al, op cit) for crop coefficients.

The daily values of "Q" or water usage have been summed up over 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, soybean, groundnut, redgram and blackgram and the main rabi season crops of wheat, gram, red gram and cotton (red gram and cotton are sown in the summer or kharif season but continue into the rabi season when they are harvested so their growing period has been divided into both the seasons). The

average "kc" values for the crop coefficients have been calculated on the basis of Food and Agriculture Organisation guidelines (Doorenbos et al, op cit). This estimation has given the water usage for agriculture. The total precipitation over the whole area has also be calculated and the water usage has then been compared to find out the sustainability of use.

Ideally this should be done for each and every farm plot as the parameters vary considerably across farm plots. In a small watershed of about 1000 Ha or so the detailed data collection required from each farm plot and subsequent rigorous estimation exercise can be done easily. However, since our estimation has to be done over an area of 69,000 Ha spanning the entire catchment of the Man dam consisting of 98,317 registered landholders owning cumulatively close to 500,000 different farm plots such a detailed procedure is beyond the scope of this research.

Instead, the estimation has been done with the village as the smallest unit. For this the land use, cropping pattern and irrigation details compiled by the Patwari or revenue official for each of the 228 villages falling in the catchment of the Man dam and the rainfall recorded in the nearby tehsil headquarters have been collected from the Department of Land Records. The Soil Resources Atlas of Dhar district published by the National Bureau of Soil Survey and Land Use Planning has been referred to for the soil details. The underlying geological characteristics

of the aquifers and the groundwater level data have been collected from the Central Groundwater Board regional office in Bhopal. Apart from this the data regarding average yields of various crops in the different tehsils has been collected from the Department of Agriculture. This empirical exercise will help us to put a number to the amount of water being used in agriculture in the study area and so enable us to quantify the water usage and compare it with the total precipitation and determine its sustainability.

27. Details of the Man Dam

The Dam on the Man River was built with the objective of providing irrigation to an area predominantly populated by Adivasis practising dry land agriculture and so improving their livelihoods. The important design data as per the Detailed Project Report (DPR) of the Man Dam prepared by the Government of Madhya Pradesh regarding are given in Table 13 below.

Table 13: Design Data of Man Dam

Particular	Quantity
Total Catchment Area	69000 Ha.
Free Catchment	57680 Ha.
Command Area	15000 Ha., 48 villages
Height of Dam	53 m.
Max.Ht. Level	301 m
Full Reservoir Level	297.65 m
Dead Storage Level	273.0 m
Canal outlet Level	277 m
Full Reservoir Capacity	14503 Ha. m
Utilisable Capacity	12787 Ha.m
Dead Storage	1716 Ha.m
Full Reservoir Area	1094 Ha
Minimum Reservoir Area	283 Ha.
Total Submergence Area	1169 Ha of which - Res. Forest - 5 Ha

Particular	Quantity
	Agri. Land - 783 Ha Waste Land - 381 Ha
Submergence villages	17
Number of Affected Households	993
R.B.Canal Flow	4.23 cumecs
L.B.Canal Flow	6.26 cumecs
R.B. Canal Length	11.64 kms
L.B. Canal Length	10.02 kms
R.B. Culturable Command Area	6053 Ha (27 villages)
L.B. Culturable Command Area	8947 Ha (21 villages)

Source: Detailed Project Report of Man Dam, GOMP.

There have been serious problems with rehabilitation of project-affected persons. When the dam was first designed in 1982 the DPR provided for Rs 1.2 crores for compensation, rehabilitation and resettlement of only 560 households in 16 villages (DPR, 90). This was calculated on the basis of Rs 4000 per household for rehabilitation and Rs 4000 per Ha of land to be submerged. This despite the fact that the provisions of the Narmada Water Disputes Tribunal Award mandatorily require each adult male member of each affected household to be given a minimum of 2 Ha of irrigable land and other living,

education and health amenities. Eventually very few people have been rehabilitated after the construction of the dam. Those few who were rehabilitated in Kesur village in Dhar district in the Chambal basin were given less than the stipulated amount of land. Consequently from 2000 onwards, there was a militant mass movement against the construction of the dam by the oustees under the banner of the Narmada Bachao Andolan (IPT, 2002). Even though this protest movement of the dam affected was eventually crushed through state repression and the dam built, nevertheless it has had some serious negative repercussions on the dam and its viability.

Owing to inadequate rehabilitation many of the oustees have remained in the catchment area. They survive somehow on their unsubmerged land in the monsoons and then as the water in the dam recedes down with the release of canal water they begin practising drawdown agriculture on their submerged lands.

There is mention in the DPR that extensive soil conservation and afforestation work needs to be carried out in the catchment area to ensure that the post monsoon flow into the reservoir is augmented and also to reduce the silt load. However, there is no provision in the budget for these activities and so none have been carried out specific to the dam. There has been work done in soil conservation and small water structures through the Rajeev Gandhi Watershed Mission and by various other agencies.

However, these have only intercepted more of the monsoon flow and have not really done much soil conservation. The forest area of 8778 Ha is of moderate crown cover only on the slopes on both sides of the Manawar to Amjhera road covering an area of about a 1000 Ha, otherwise it is all degraded forest. Thus, there is need for intensive community based afforestation but not much has been done in this respect.

Instead, there is considerable agricultural activity in the vicinity of the reservoir and inside it leading to higher silt load. Obviously due to the continued presence of the inadequately compensated and rehabilitated oustees, afforestation of all the land on the rim of the reservoir to establish a green belt as stipulated in the environmental clearance given by the Ministry of Environment and Forests has not been done. The Narmada Bachao Andolan conducted an unsuccessful mass struggle for justice to prevent the dam from being built without proper rehabilitation. Later the NBA fought the case in the High Court of Madhya Pradesh and won a judgment that all adult sons of oustees should also be given two hectares of irrigated land. This further complicates matters for proper planning and implementation of water resource management in the basin as now there is a legal sanction for the oustees to continue to live in the basin until they get proper rehabilitation. Thus, the problems for sustainability of water use arising from improper

implementation of catchment area management are as follows -

1. Higher population load of unrehabilitated oustees on the fringes of the reservoir leading to lesser greening of its rim against what was envisaged in the design.
2. Practice of drawdown and lift agriculture leading to higher silt load in the reservoir.
3. Greater soil erosion due to a lack of soil and water conservation measures.

28. Quantitative Estimation of Sustainability of Water Use

The empirical formula for estimation of agricultural water use as mentioned earlier in the methodology section is -

$Q = (1/I.E.)\{ (\sum A_{ix}) (kc_i \sum ET_o)\}$, where
Q = Total water needed for irrigation
I.E. = The Irrigation Efficiency given by the ratio of the water actually evapotranspirated by the crop and the total water needed to flood the field. This ratio is assumed to be 60% 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 Evapotranspiration rate for a theoretical crop during the different periods

The above water demand formula is for maximum yield of crops which is defined as (Doorenbos et al, op cit) -

"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".

However, the reality in the basin is that the average yields are much lower than the maximum yields for the major crops as shown in Table 15 below.

Table 15: Average Yields of Crops in Man Basin and their Maximum Yields (kgs/ha)

	Sorghum	Maize	Paddy	Soybean	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

Source: District Statistical Handbood and Ministry of Agriculture, Government of India

Clearly the average yields in the basin taking into consideration all crops is only about 40 % of the maximum yields and so the water demand in the formula above will have to be scaled down. A 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, op cit) 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 level and extent of soil degradation is quite high in the whole basin with a considerable amount of the land having become unreclaimable 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.

Therefore, both lower than optimum water availability and poor soil quality are together responsible for the lower yields in the study area. Consequently the maximum water demand for the crops has to be scaled down by about 30% assuming that the other 30% deficit in the yield is due to the poor quality of soil and its low depth and other factors that determine maximum yield in the definition above.

28.1 Village Details

There are a total of 228 villages in the catchment area with 65 villages in the Malwa agro-ecological zone and 163 in the Vindhya agro-ecological zone. The difference is due to the fact that the former is of lesser area and has individual villages with larger area. The cropping calender is given in Table 16 below. The Kharif season presently starts from May itself as the cotton crop is sown in the summer before the onset of the monsoons with borewell irrigation.

Table 16: Cropping Calender for the Study Area

Crop	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April
Paddy		√	√	√	√	√	√					
Wheat							√	√	√	√	√	√
Sorghum		√	√	√	√	√						
Maize		√	√	√	√	√						
Gram						√	√	√	√	√	√	
Red Gram		√	√	√	√	√	√	√	√	√		
Black Gram		√	√	√	√	√						
Groundnut		√	√	√	√	√						
Soyabean		√	√	√	√	√						
Cotton	√	√	√	√	√	√	√	√	√	√	√	
Vegetables	√	√	√	√	√	√	√	√	√	√	√	√

The Village level cropping area data have been taken for the years 1989 which is the oldest still available and 2011. These have been summed up over the whole agro-ecological zone to arrive at the cumulative areas for each crop used in the water use computation below.

28.2 Annual Rainfall in Study Area

The annual rainfall in the study area is given in Table 17 below from 1989 to 2011.

Table 17: Comparative Annual Rainfall in the Man Basin in mm.

Year	Avg	89	90	91	92	93	94	95	96	97	98	99	2000	01	02	03	04	05	06	07	08	09	10	11
Malwa	913	783	1246	596	540	969	1416	822	1123	1104	916	781	524	694	725	1091	874	743	1103	845	943	963	892	981
Vindhya	738	801	1017	574	413	665	1056	532	954	861	742	584	328	603	868	1017	590	543	1171	731	813	751	746	701

Source: Department of Land Records, Dhar, 2011

As is evident in more than half the total number of years the rainfall during the period under review is below the average values. So, the area has been water stressed quite frequently. The years of low rainfall are also the years when the kharif crop is under water stress leading to lower than average yields. The Malwa region typically gets more rainfall as compared to the Vindhya region.

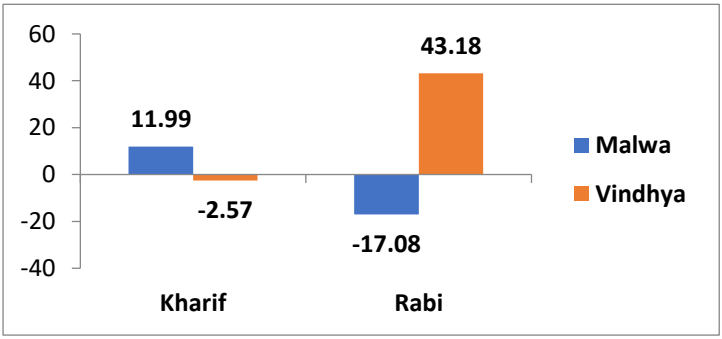
28.3 Crop Water Demand

The crop water demand in the Kharif and Rabi seasons for the Malwa and Vindhya regions have been calculated using the empirical formula with the appropriate adjustments discussed above. This water demand has been compared with the total annual precipitation in these regions. The total annual precipitation is the product of the average annual precipitation over the period under review from 1989-2011 and the total geographical area of each agro-ecological region. The total annual precipitation is **233.73 million cubic meters (mcum)** for the Malwa region of the Man dam catchment area whereas it is **320.29 mcum** for the Vindhya segment. Thus, for the purposes of the present estimation a constant total annual precipitation value has been taken for both the years in each basin.

The water demand in the Malwa region has gone up in the Kharif season slightly mainly due to an increase in the acreage under agriculture resulting from the conversion of fallows and cultivable wastes into cultivated land. This increase in overall area has cancelled out the decrease due to the replacement of coarse cereals and pulses which have higher water demand by soyabean which has a lower water demand. The water demand in the Rabi season has gone down slightly because of a reduction in the acreage of gram which earlier used to be grown only with crop moisture. The reduction in soil moisture due to

deforestation and erosion of top soil has led to the decrease in dry land gram cultivation in the rabi season. The limits to irrigation increase have also been reached in the region and many tubewells which are the main source of irrigation have gone dry or are yielding less water so there has not been much increase in the area under irrigated wheat. There has been a reduction in the Kharif season water demand in the Vindhya region. This is due to a decrease in overall acreage because of submergence of part of the area in the Man dam reservoir. The substantial increase in acreage of soyabean replacing pulses and cereals which have a higher water demand than the former has also contributed to this. A significant increase in the area under irrigated wheat and cotton have led to a considerable increase in the water demand in the Rabi season over the period under review. The comparative change in water demand across seasons has been estimated and compared in Fig 3 below.

Fig. 3: Comparative Change in Water Demand (%)*



Thus, overall, there has been an increase in the water demand for agriculture in the catchment area. 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 in the study area is sustainable or not. As we have seen earlier 90% of the rabi demand in the study area is being met from groundwater either in the return flow in the streams or in the confined and unconfined aquifers. Thus, if the groundwater demand is more than the groundwater recharge then the water use in the study area is unsustainable. Consequently it has to be assessed whether the ground water demand in the Rabi season is less than the ground water recharge in the study area or not.

28.4 Groundwater Recharge

Quantification of ground water recharge as a proportion of the precipitation is a problematic exercise. It is a complex function of meteorological conditions, soil, vegetation, physiographic characteristics and properties of the geologic material within the paths of underground flow. Soil layering in the unsaturated zone just under the surface plays an important role in facilitating or restricting downward water movement to the water table. Also, the depth to the water table is important in ground water recharge estimations. 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% 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 as mentioned earlier. Consequently, the total groundwater recharge in the basin is in all probability less than 10% of the total annual precipitation. Thus, the current levels of rabi season water demand as a proportion of total precipitation of 29.87 per cent in the Malwa and 14.33 per cent in the Vindhya regions of the study area are unsustainable, especially so in the former. Moreover, of the water that seeps through into the upper unconfined aquifer a much lesser amount infiltrates the lower confined aquifer because the porosity of the hard rock layer is very low. Consequently, the recharge of the unconfined aquifer is much less.

The level of water demand was even higher in the Malwa region in 1989 and so over a considerable period of more than two decades there has been extensive over drawal of water from the confined aquifers without corresponding recharge. This has resulted in the groundwater aquifers in the basin having become over exploited as noted earlier. 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 ground water primarily because in most farms soil depth is low leading to high evapotranspiration losses resulting in insufficient soil moisture being available for optimum crop growth.

28.5 Deteriorating Water Quality

Finally a word about the deterioration of the quality of groundwater in the basin due to policy failure with respect to provision of fertiliser subsidy. A tricky aspect of agriculture is the optimisation of ratios in which the different nutrients have to be supplied in mixed fertiliser application (Trionfo, 2000). Depending on the soil characteristics there is an optimum ratio at which the Nitrogen, Phosphorus, Potash and micro-nutrient fertilisers must be applied. If one of these fertiliers 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 fertilisers. Over the past decade or so faced with a resource crunch the government has been reducing the subsidy given to fertilisers in a lopsided manner (Chand and Pandey 2008). The withdrawal of subsidy from Potassium and

Phosphorus fertilisers has been much more than for Nitrogen. This has made the farmers apply much more of 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 per litre in the Malwa region of the basin (CGWB, 2005).

28.6 Water and Energy Use in the Man 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 subsidised rate for the operation of pumps and subsidised 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 5 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 characterised 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 optimise production in the long run because more the resource is used the more 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 goes down and in the next year the extraction cost will be greater and this will go on 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.

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 failed by adopting the opposite stance of subsidising the greater use of water which also effectively scuttled any possibility of communities coming together to use water resources sustainably.

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 additon 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 ground water 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 fertilisers. These too had become scarce and more expensive due to a combination of supply not keeping pace with demand and declining subsidies for their manufacture (Chand and Pande op cit).

28.7 Traditional Adivasi Agricultural Practices

A hybrid irrigated cum dryland agricultural system will be a welcome synthesis between modern agriculture and the traditional sustainable agriculture of the Bhil Adivasis for a more sustainable regime. Traditionally, the Bhil Adivasis of Western Madhya Pradesh have practised a bio-diverse system of agriculture (Shah et al op cit.). This system consisted of the sowing of a wide variety of indigenous cereals, pulses and oilseeds like sorghum, maize, millets, black gram, red gram, green gram, groundnut and linseed and also jute and vegetables during the Kharif season through intercropping in the same plot. Each of these crops had varying capacities for withstanding water stress or excess rainfall the two threatening situations that normally befall a rain dependent agriculture. Thus, even in years of drought or excess rainfall some part of the crop would always survive and some of the agricultural production would be harvested. There was also a practice of rotating the crops across the farm plots from one season to the next so that the leguminous crops would by turns fertilise all the plots.

The Kharif crop being a dryland wheat or gram variety would be sown after harvesting the maize and pearl millets which have short growing periods, taking advantage of the soil moisture in the farm plots still extant in the month of October from the monsoon rains. All this changed with the introduction of hybrid external input agriculture with heavy subsidies for the inputs. But now that these inputs have become expensive due to withdrawal of subsidies there is a possibility of synthesising a more sustainable agricultural system with water use sustainability at its core. Such systems 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 systems. 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 and this hasn't happened.

28.8 Agriculture Using Less Virtual Water Crops

The concept of "virtual water" embedded in a particular crop being produced in an area has now gained in currency (Hoekstra & Chapagain, 2007). This involves the estimation of the total water that goes into the production of a particular crop and then calculating the amount of water that is required for a unit weight of that crop. This varies with the species of the crop and also the way in which it is produced. For example, dryland wheat

will have less water embedded in it than irrigated wheat and even in the latter some varieties like Lok1 can have less water depending on the amount of watering used during production. 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 and this can be used as an advocacy tool to convince people to change consumption patterns towards lesser virtual water crops. Thus, the consumer demand pattern for crops will also change and it will become easier to ensure more sustainable water use in agriculture.

29. Conclusions and Recommendations

The serious and growing threat to sustainable development arising from misuse of fresh water leading to its pollution and scarcity was comprehensively discussed for the first time at the International Conference on Water and Environment organized by the World Meteorological Organization in Dublin, Ireland in January 1992 (GDRC, 2009). The conference, attended by water resource experts from over a hundred countries, put forward four guiding principles for concerted action to ensure sustainable use of water resources known as the Dublin Principles that have since come to be universally accepted as the basis for all future governance in the water sector and so they are being quoted here in full -

Principle No. 1 - Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

Principle No. 2 - Water development and management should be based on a participatory approach,

involving users, planners and policy-makers at all levels

The participatory approach involves raising awareness of the importance of water among policy makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

Principle No. 3 - Women play a central part in the provision, management and safeguarding of water

This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

Principle No. 4 - Water has an economic value in all its competing uses and should be recognized as an economic good

Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful

and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources. Thus, combined with the concept of IWRM these principles provide a comprehensive framework within which to address the problem of unsustainability of water use.

29.1 Lack of a Vision of Water Sustainability

Clearly these principles have been wantonly violated by the Government of Madhya Pradesh in water governance in the Man basin over the last two decades in a manner that seems to indicate that the government agencies are not aware of them at all. The major consequence of this has been that traditional communitarian practices with regard to soil and water conservation, especially among the Bhil Adivasis, have decayed and a culture of unsustainable water consumerism has set in. Panchayati Raj has been in operation here for a long time now pre-dating the 73rd Constitutional Amendment. Consequently people in the basin are well aware of their political rights and are mostly affiliated to either the Congress or the Bharatiya Janata Party which have both been promoting an unsustainable water use paradigm. But the dominance of these political parties and their reluctance to promote people's participation in development has led to the

distortion of Panchayati Raj and its degeneration into being an appendage of the centralised governance system.

Consequently with regard to water use and governance people are mostly of the opinion that water should be made available in some way or other for farming and other use and are not overly concerned about the sustainability of water use. An attempt was made during the research to spread the message that it is necessary to harvest rain water and conserve soil as much as is possible in situ and use the increased topsoil depth and moisture to grow the less water demanding traditional crops over a larger area rather than extract excessive water either from the deep confined aquifers or by building expensive and harmful large dams to grow high yielding varieties of wheat. This did not arouse much enthusiasm apart from nods of the head. The people in one village who had lost most of their lands in the reservoir of the Man dam listened patiently to this and then said that there was one large stream, Donglia, a tributary of the Man river, that did not have any dam on it. If one big dam was built on it then all the lands below it including those in their village that were not yet submerged could be irrigated. When they were asked whether those upstream of the dam were prepared to give up their lands for this they remained silent.

Two public meetings were organised to discuss the results of the research, one in the Malwa region and one in the Vindhya region. Two whole weeks were spent in going

from village to village and talking to people and they all nodded their heads and said that in situ soil and water conservation combined with a switch to dry land cropping was the way to go. However, in the public meetings, the people said that they should be given either drip or sprinkler irrigation systems which were more efficient in the use of water than traditional flood irrigation. Once again the penchant was for energy guzzling and capital intensive modern technological solutions that could be implemented at best in a very small area.

There was no enthusiasm at all for the traditional communitarian labour intensive and resource conservative agriculture even if it was to be supported by Government subsidies. Such is the hegemony of the idea of modern development that even when one version of it fails people still feel that a newer version based on newer, more energy intensive technology supported by higher government subsidies will succeed. Only a few farmers in the Man basin agreed to undertake the dry land wheat cultivation experiment described earlier which has been adopted by a number of farmers elsewhere in the western Madhya Pradesh region where NGOs have been active for over two decades and so have greater credibility to be able to counter the dominant and unsustainable development paradigm.

29.2 Lack of People's Participation

There has been considerable work done under various schemes like the Rajiv Gandhi Watershed Development Mission (RGWM) and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in the sphere of watershed development. But this has remained restricted to the physical works without much involvement of the people in communitarian practices that can improve the water availability and use in the basin on a sustained long term basis. Moreover, a serious problem in both the RGWM and the MGNREGS is the tremendous delay in the payment of wages which puts people off from participating in these schemes as has been confirmed in the household survey.

In Madhya Pradesh the MGNREGS has been coupled with the State Government's own Kapil Dhara scheme for digging of dug wells. This has led to the indiscriminate digging of dug wells with little regard to water availability and many of these wells go dry in winter or are unable to provide enough water for irrigation.

An analysis of the MGNREGS and Panchayati Raj as they have evolved in the area reveals the difficulty of people's mobilisation for water governance. The entire basin is a Fifth Schedule Area and so under the provisions of the Panchayat Extension to Scheduled Areas Act (PESA) 1996, the Gram Sabha should be the most powerful body. However, the reality is quite different. The elections to the

Panchayat Executive constituted by the directly elected Sarpanch and the Panches or ward members ensure that it is this body that holds the powers and in most cases Gram Sabhas are not held at all. Development works are carried out arbitrarily by the Sarpanch under the directions of the Panchayat bureaucracy and in many cases the accounts are maintained without transparency.

Into this the MGNREGS has now been dovetailed. In all the works that were going on under the MGNREGS that were surveyed during this research, there were no muster rolls being maintained at the site and only the names of the workers were being noted in a register. Neither were the job cards being filled daily. It appears that the job cards and the muster rolls are filled in later and the former are mostly kept with the Sarpanch or the Panchayat Secretary. Thus the same corrupt nexus of elected representatives and government staff that bedevils the functioning of public services at the central, state and district levels has now manifested itself at the panchayat level. Ingenious methods have been found to circumvent the latest provision of making payments of wages directly into the bank accounts of the workers by roping in the bank staff also into the system of graft. The Sarpanches and Panches along with the Panchayat Secretaries have become considerably more powerful by feeding on the MGNREGS funds and are bent against the holding of Gram Sabha meetings. A review of the MGNREGS implementation commissioned by the Ministry of Rural

Development has revealed that these problems are there in greater or lesser measure across the country and have prevented the programme from realising its potential (Shah, 2012). Not surprisingly the attempt during the present research to involve people in studying the problems of water governance and seek communitarian solutions to them did not get a favourable response.

29.3 Improper Interpretation and Implementation of IWRM

The World Bank is a major inspiration for water resource development and governance in this country and has provided considerable technical and financial support to the kind of unsustainable water resource development that we have witnessed in the Man basin in violation of the principles set forth in IWRM. Once the Dublin Principles became widely accepted, the World Bank, perforce, had to subscribe to them and so it came up with a new water resources management policy (World Bank, 1993). While continuing with its thrust on large projects there was now a greater stress than before on recovery of capital investment and Operation and Maintenance expenses of these projects through greater involvement of the beneficiaries in the management of the distribution system. So all lending was made conditional to the charging of irrigation cesses and the implementation of participatory irrigation management for ensuring their collection. Simultaneously there was a push for IWRM

ostensibly for ecological sustainability through rationalisation of surface and groundwater usage in a holistic basin wide approach but more importantly, to try and ensure that electricity supplied for groundwater irrigation was also charged at rates that were economically sustainable for the power generation and distribution companies (Malik 2007). There was little appreciation of the fact that over four decades of unsustainable agriculture and water use had made it impossible for the farmers both rich and poor to bear the present full economic costs of water.

The Ministry of Water Resources followed suit and constituted a National Commission for Integrated Water Resources Development in 1996 which submitted its report in 1999 which too recommended that ongoing projects should be expeditiously completed and water charges should be raised and their collection facilitated through implementation of Participatory Irrigation Management (PIM). Consequently the focus was directed on more efficient delivery of water and an Accelerated Irrigation Benefits Programme was initiated in 1996 and PIM took off in a big way from 1997 onwards. The crisis of groundwater too received attention and as a corollary the sore point of non-recovery of electricity charges from farmers. The National Water Policy of 2002 (GOI, 2002) and the Madhya Pradesh Water Policy of 2003 (GOMP, 2003) are comparatively good documents that incorporate the Dublin Principles and try to strike a balance between

the need for greater public investments in the water sector and cost recovery, between the need for adequate supply of water for various uses and the requirement of environmental sustainability, the need for greater involvement of people in water resource management, the need for complementarity between land and water use especially with regard to augmentation and use of groundwater. Both stress the importance of good data collection and analysis for consistent planning and management of water resources.

However, in practice there is hardly any awareness or implementation of these policies at the ground level among the water resource department staff in the Man basin. The concern is only for creating more structures big and small. None of the engineers interviewed had heard of the "Master Plan for Artificial Recharge of Groundwater in India" prepared by the Central Groundwater Board (CGWB, 2008) which gives detailed state wise plans for surveying and using underground aquifers for storage of monsoon rainfall through appropriate artificial recharging techniques involving the direction of surface water to fractures in the hard rock. Instead their view was that river interlinking should be adopted to bring water to the region.

29.4 Feasibility of a Water Rights Framework

Finally a word about the possibility of introduction of water rights and recovery of costs through appropriate

pricing and creation of water markets in the basin on the lines suggested by some proponents for India as a whole (Saleth, 1996). The creation of water rights is based on the principle that it is possible for the Government to create individual rights over a public good through legislation and then apportion these rights to a set of people (Coase, 1960). Thereafter trading in the market place, it is argued, will ensure an equitable and efficient use of the public good. This is the principle for the apportioning and trading of pollution permits in the United States of America under the Clean Air Act of 1990 and the carbon credit trading system set up under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC, 2009).

However, even theoretically there are several problems in this because this holds only in a perfect equilibrium market situation where there are only two bargainers. When there are many bargainers and they have different endowment levels with regard to other resources, then this system does not work as the apportionment of rights suffers and the markets also tend to malfunction. Moreover, in the case of water, for apportioning of rights to be possible first there must be an accurate estimation of the amount of water available for apportioning. As we have seen this is a highly problematic area in India and especially so in the Man basin. The ownership of land is highly skewed and tends to distort the economic and

political power structure in the basin and this too will affect the apportionment of water rights and trading.

Also given the long history of free or subsidised supply of water, electricity and other inputs and the overwhelming dominance of external input agriculture, it is very difficult for any Government in a democratic set up to impose an actual cost based trading system for these inputs. Thus, in reality this system of creating institutions for apportioning rights in public goods and creating markets for trading in them has not worked very well anywhere. In the water sector in India, where there is practically no effective regulation and most people source their water directly from nature in an informal water economy, despite over a decade of implementation of IWRM, the results are not very encouraging (Shah, 2007).

29.5 Introduction of Direct Cash Transfers

There have been suggestions, on the basis of the fact that the actual loss to the economy is much greater than the actual amount of the subsidies due to inefficient use, leakages and theft that these subsidies encourage, that the subsidy amounts should be directly transferred to the beneficiaries while letting the prices of water, diesel and electricity be fixed at levels that cover the actual cost (Morris ed, 2004). This is similar to the direct cash transfer approach being advocated as being a more efficient method of subsidising the poor than the MGNREGS (Kapur et al. 2008) and which is now being

tried out in bits and pieces across the country. The Planning Commission has been implementing some pilot schemes of direct cash transfers. Even though this is quite appealing at an academic level, there are many problems with its implementation, not the least being the ingenuity of politicians and bureaucrats in subverting any scheme (Nayar & Pillai, 2009). How far they will be successful with agricultural inputs such as fertilisers, water and electricity is a matter to be seen.

29.6 Fostering Communitarian Natural Resource Management

The foregoing discussion makes it abundantly clear that ultimately competent natural resource management can take place only if there is conscious community mobilization at the grassroots level in support of this. Even markets by themselves cannot function equitably and efficiently without proper regulation. As we have seen, macro-level policies that have fostered bad governance and market failure have also led to the decay of communitarian management of resources and especially those of land, water and forests. Given the lack of vision and commitment in the government and the bureaucracy, good water management will have to be attempted at a decentralised level by communities themselves. Especially as such communitarian water management will also have a mitigating effect on climate

change (Cruz, 2009) and make the communities eligible for carbon credits.

One of the foremost votaries of such communitarian approaches to the management of common pool natural resources, Elinor Ostrom, has been awarded the Nobel Memorial Prize for the Economic Sciences in 2009 thus putting the imprimatur on the validity of this approach (Ostrom, 2001). However, as has been amply demonstrated by the failure of attempts to get people organized in the Man basin, people's mobilisation for alternatives in the face of Government and bureaucratic apathy and opposition is a difficult task. Thus, alternative water governance experiments should first be taken up in places where there is already people's mobilisation of a high order so as to demonstrate the feasibility of this approach while simultaneously advocating and campaigning for a drastic change in macro level policies. Some of these experiments like those of Tarun Bharat Sangh in Alwar district of Rajasthan and the Hiwre Bazaar Panchayat in Maharashtra have already been discussed.

One such area in the western Madhya Pradesh region is Alirajpur district where the Khedut Mazdoor Chetna Sangath (KMCS) has mobilized the local Bhil Adivasi population on rights issues for close to three decades (Banerjee, 2008a). Apart from rights-based mobilisation the KMCS has taken up soil, forest and water conservation work on a large scale through voluntary

participation in defiance of the negative attitude of the government and the bureaucracy and the results are evident. The stream running through village Attha, has water flowing perennially even though there are as many as seventy motor pumps on the stream drawing water from it for irrigation. In the light of the insights gained from the present research, detailed geo-hydrological investigations should be carried out in such a sub-basin and alternative water utilisation plans for agriculture and bio-mass development should be drawn up and implemented as a pilot which can then be projected as a replicable prototype for adoption by others.

29.7 Recommendations

The exploratory investigations carried out under this research and detailed above, unequivocally indicate that the water use in the Man River basin is unsustainable. The primary factor responsible for this is a misconceived agricultural policy. Even now the Madhya Pradesh Government is forced to provide an annual subsidy of about Rs 1500 crores for the supply of cheap electricity to farmers. However, since this culture of subsidies for over consumption of water has decimated the state's coffers it does not have enough resources to build new power stations.Thus, there is a tremendous shortage of power and the deficit peaks on an average to 2000 MW in the Rabi season. Consequently, there is insufficient supply of electricity forcing farmers to use more expensive diesel to

meet the gap or be satisfied with lower yields due to lesser availability of water.

This means that an unsustainable agricultural regime is being sustained through subsidies and grants inefficiently. On the whole it is turning out to be costlier both economically and environmentally. The net result of all this is that farmers continue to labour on in an unsustainable regime and are not inclined towards trying out more sustainable agricultural options. The situation has been compounded by a decay of traditional communitarian natural resource management practices due once again to government support for an unsustainable system. The provisions of the Fifth Schedule of the Constitution, PESA, MGNREGA and the Scheduled Tribes and other Forest Dwellers (Recognition of Rights) Act 2006 and various other enabling provisions that favour the Adivasis can together ensure a revival of communitarian and sustainable natural resource management in the basin which is predominantly an Adivasi area but there is minimal initiative on the part of the Government to make this possible. All efforts made to wean farmers away from this unsustainable system as a part of this research came a cropper in this basin primarily because of the Government's support for the system. Summarising the insights gained from this study the following recommendations can be made for improving the prevailing sorry state of affairs -

1. 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.

2. There is need for calculating the "virtual water" embedded in a particular crop being produced in an area. 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 and 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.

3. Measures have to be taken to increase the sustainable water availability through soil and water conservation and afforestation and reduce water consumption through greater reliance on the use of in situ soil moisture. The MGNREGS is the best option for ensuring this. So steps have to be taken to improve its functioning and make it realise its goal of conserving and enhancing the natural resource base of the basin. Specifically the Gram Sabhas

have to be empowered both financially and technically to plan and implement these natural resource conservation and management projects and also take part in data collection and impact assessment. The help of knowledgeable NGOs with experience in water resource management can be taken to operationalise such a people oriented water management exercise to ensure its success.

4. Panchayati Raj, MGNREGS, PESA and the Scheduled Tribes and Other Forest Dwellers (Recognition of Rights) Act 2006 along with various other enabling provisions for Adivasis must be properly synergised to revitalise communitarian natural resource management as the major thrust for solving the problem of unsustainability of water use in the basin given that the numerically dominant population is one of Adivasis. Care should be taken to see that women participate equally in these efforts.

5. Biomass-based local farm manuring and energy production has to be encouraged to reduce fertiliser application, enhance soil quality and soil depth and water retention and reduce use of fossil fuel based energy. In the initial stages this also 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 MGNREGS.

6. All of the above have to be combined in an integrated plan at the sub basin level so as to optimise sustainable resource use while at the same time ensuring a decent

livelihood for the people. Thus, there is a need for the design and implementation of such plans on a pilot basis with grant support involving the Panchayat Raj Institutions, Government Departments and NGOs, and this should be followed up with wider policy level changes once these plans have been locally validated.

7. Serious thought has to be given to the methods in which grant and subsidy support are to be given to farmers and the poor, including those involving direct cash transfers so as to ensure that leakages do not take place and the market can function in an efficient manner to allocate scarce resources while at the same time promoting communitarian natural resource management and sustainable agriculture.

8. There is considerable scepticism regarding the equity and feasibility of the cap and trade mechanism for combating climate change (Hovi & Holtsmark, 2006) but nevertheless in the near future this is going to be the way forward. The United Nations has initiated a programme for transfer of funds for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries and associated efforts to conserve, sustainably manage, and enhance forest carbon stocks (UN-REDD, 2009). Measures should be adopted for registering the programmes above under this scheme for providing direct support to resource conserving Adivasi communities.

To conclude, water, in the short term, is a public good in the sense that it is 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 and 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 jeopardised the long term environmental and economic sustainability of agriculture, natural resources and energy production. There is thus a need for sustainable water management to ensure through a judicious mixture of regulation, assigning of property rights, imposition of taxes and communitarian sharing that this vital resource is properly utilised. Both macro and micro level changes of a drastic nature outlined above are necessary to bring about a more equitable and sustainable water management regime in the Man basin and the country as a whole.

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