IWMI- TATA
Water Policy Program

19
2005

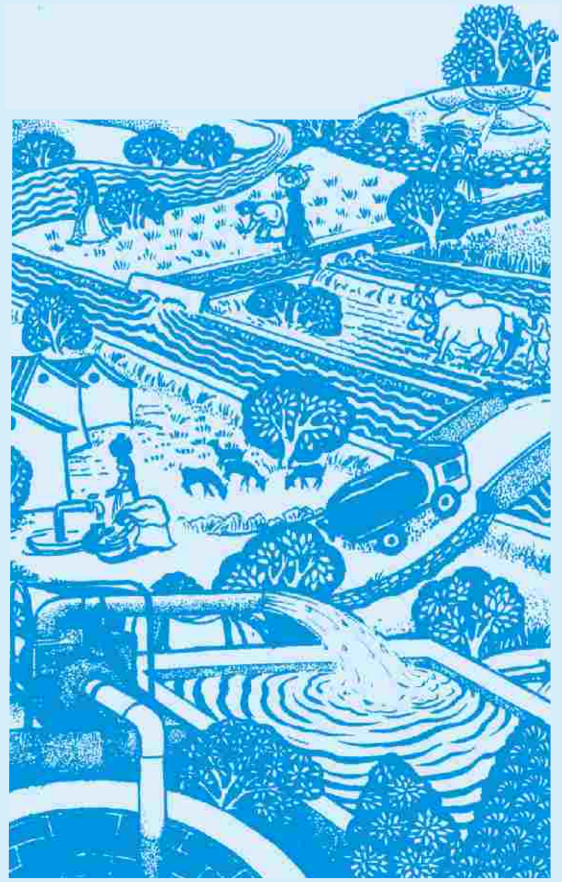
Water Policy Research

Highlight

Changing Water Use Hydrology of Narmada River Basin:

Implications for Basin Water Allocation

O. P. Singh,
M. Dinesh Kumar
and
Santanu Ghosh



During the past two and a half decades, several changes have taken place on the socio-economic front in the Narmada river basin, with impact on water use patterns and the hydrological system. Changing water use hydrology can have serious implications for the sanctity of the allocation norms that form the basis for sharing of flows from the basin, enforced by Narmada Control Authority (NCA) for the party states. This is serious, and a potential source of conflict, particularly when recent records have shown flows lower than the estimates.

Private lifting of water from surface sources in the basin is heavily underestimated. Increased diversion of water through gravity systems means increased recharge and increased availability of water for agricultural wells in the region. Increased green water use would have significant implications for surface flows, as the basin hydrology gets altered because of this.

Changing Water Use Hydrology of Narmada River Basin: Implications for Basin Water Allocation[1]

Research Highlight Based on a Paper with the Same Title

The Narmada Water Disputes Tribunal (NWDT) allocated all the estimated dependable yield of 28 million acre feet (MAF) of the entire basin among the four party states, viz. Madhya Pradesh (MP), Gujarat, Maharashtra, and Rajasthan. Recent stream-flow records in the Narmada basin show a decline in annual flows at the location of the terminal dam, posing threat to realization of planned benefits of irrigation, power generation, drinking and industrial water use in the Gujarat part of the basin.

Changing water use hydrology in the Narmada river basin can become a source of future conflicts

During the past two and a half decades, several changes have taken place in the basin. The cropped area has increased and groundwater abstraction structures have also increased manifold. This means increase in the use of green water and blue water, which can reduce runoff. Lowering of water levels could induce additional recharge. Illegal diversions of river water seriously affect the downstream flows, thus affecting the planned utilization of water in the designated command areas, especially during lean seasons. All these change the water use patterns, and as a consequence the hydrological system.

The changing water use hydrology can become a source of future conflicts. The Tribunal award is not comprehensive enough to account for the indirect uses of basin's water and unaccounted diversions, and their implications for sharing of water among contesting parties. The Narmada Control Authority (NCA), which is mandated to do the basin water accounts, monitors only surface water diversions. However, alterations in surface flows, evapo-transpiration due to *in situ* use of precipitation for crop production, groundwater recharge, non-beneficial evaporation and beneficial transpiration from the water diverted or other consumptive uses could alter the hydrological system.

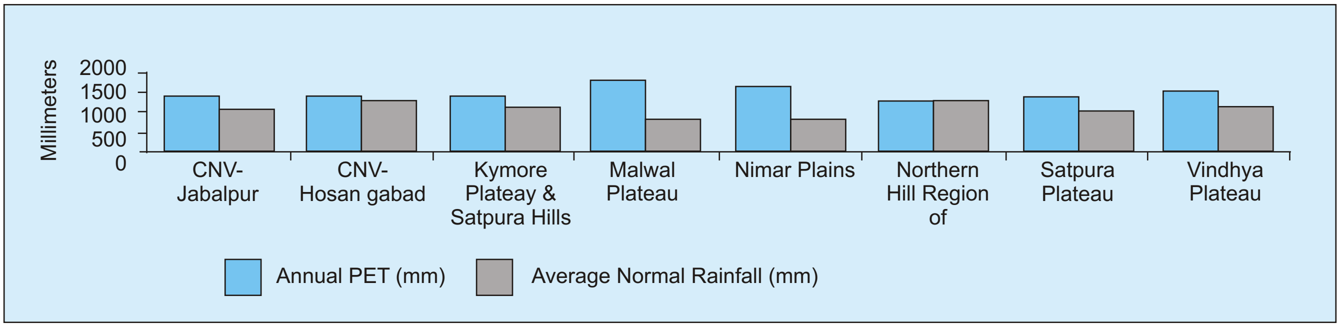
The purpose of the study is to analyze the water use hydrology of the Narmada river basin and the challenges in meeting the planned utilization of surface water from the basin. The study has four objectives: [1] to quantify the amount of blue water use in various competitive sectors such as agriculture, domestic use, and industrial uses in typical rainfall years; [2] to get a quantitative assessment of green water use for agricultural production in typical rainfall years; [3] to get a qualitative assessment of in-stream uses of water from the basin; and [4] to have a break-up of blue water use by source, viz. canal water, groundwater, and river lifting and to find out how that varies between a wet year and a dry year.

Agro-climatic Regions and Evapo-transpiration Demands

Nine agro-climatic zones fall in the Narmada river basin, fully or partially (Figure 1). The northern hills of Chhattisgarh have moist sub-humid to dry-sub-humid climate. The four regions — Kymore plateau and Satpura hills, Vindhya plateau, Satpura plateau, and the central Narmada Valley have dry sub-humid climate. The Malwa plateau and the Nimar plain have semi arid climate. The district of Jhabua, which falls in the region, named "Jhabua hills", is semi arid.

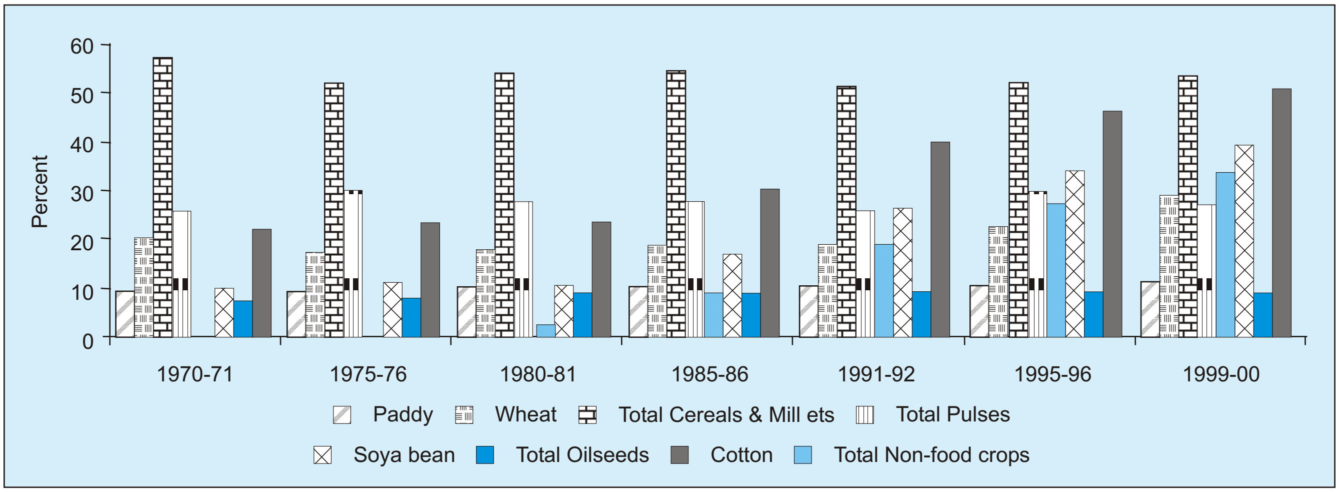
[1]The research covered by this IWMI-Tata Research Highlight was carried out with generous support from Sir Ratan Tata Trust, Mumbai under IWMI-Tata Water Policy Program. The research paper can be downloaded from the IWMI-Tata Website http://www.iwmi.org/iwmi-tata.

Figure 1: Region-wise Annual PET and Mean Annual Rainfall in Narmada Basin, MP



Source: Authors' estimates based on data from Government of Madhya Pradesh

Figure 2: Historical Growth in Net Sown Area under Different Crops in Narmada River Basin, M.P.



Source: Authors' estimates based on data from Government of Madhya Pradesh

Drivers of Change in Water Use

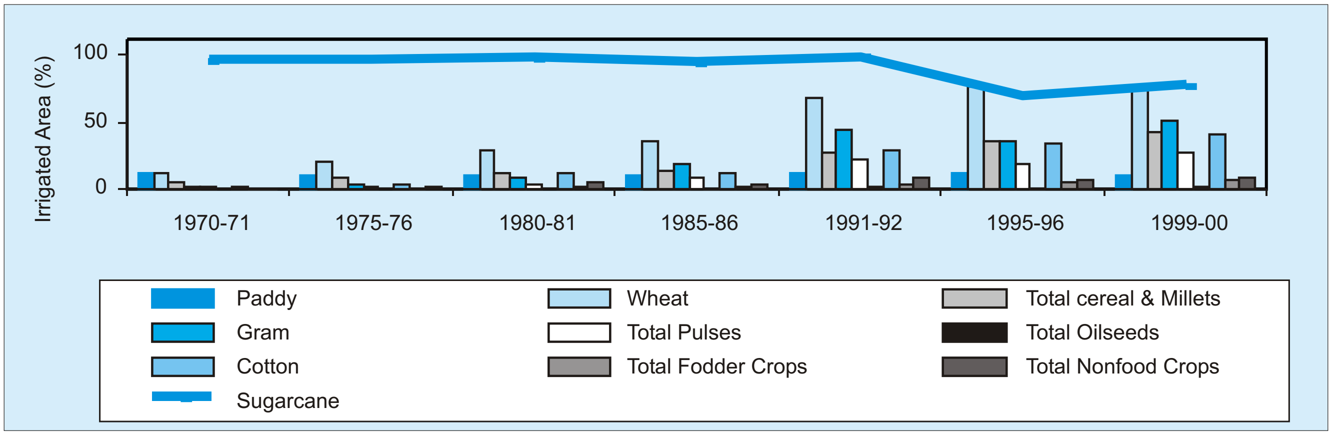
Cropping Pattern in the Basin

In 1970-71, cropping intensity in the basin was 104 percent. It increased to 136.7 percent in 1999-2000[2]. Till 1995-96, farmers in the MP part of the basin had allocated more than 50 percent of the net cropped area to cereals and millets crops. During the period 1995-96 to 1999-2000, area under this category of crops went down slightly. It stood at 52 percent in 1999-2000 (Figure 2). More significantly, area under pulses marked a major drop during the two decades; from 27.3 percent of the net cropped area in 1975-76 to 15.5 percent in 1995-96, though area under common pulses such as gram, pigeon-pea, and masoor has not changed significantly. During the three decades, area under non-food crops increased more than two fold, from 22 percent to 55.77 percent. Soyabean, an oilseed crop, which was introduced in the basin nearly 3 decades ago in 1975-76, from an area of 10,772 ha coverage has increased to 1,328,361 ha by 1999-2000. Area under cotton has remained more or less same during last 30 years, though there has been a slow

The cropping intensity in the basin grew from 104 percent in 1970-71 to 136.7 percent in 1999-2000. A significant contribution came from increase in area under non-food crops.

[2]1999-2000 was used as the reference year for estimation of percentage area under different crops as there has not been much change in net sown area over the time period under consideration.

Figure 3: Historical Growth in Percentage Irrigated Area to Cropped Area in the Basin



Source: Authors' estimates based on data from Government of Madhya Pradesh

and steady rise in area under this crop during 1970-90. Thus a lion's share of the increase in cropping intensity has come from increase in area under non-food crops, especially oilseeds like soyabean, with a small but significant contribution coming from pulses such as green-gram, black-gram, gram, and masoor.

Historical Growth in Irrigated Area

In 1970-71, gross cropped area in the basin was 4.12 million hectare (mha). Out of this, about 5.6 percent was irrigated. At that time, the net cropped area was 3.82 mha and nearly 4.8 percent of this was under irrigation. In a time span of 30 years (1999-2000), gross cropped area rose to 5.39 mha of which gross irrigated area was 28.94 percent. By 1999-2000, the net sown area in the basin became 3.95 mha, of which 39 percent was under irrigation (Figure 3). These data clearly shows that the increase in cropping intensity essentially came from expansion in area under irrigation crops, with an aggregate increase of 1.37 mha in irrigated area against an increase in cropped area of 1.27 mha.

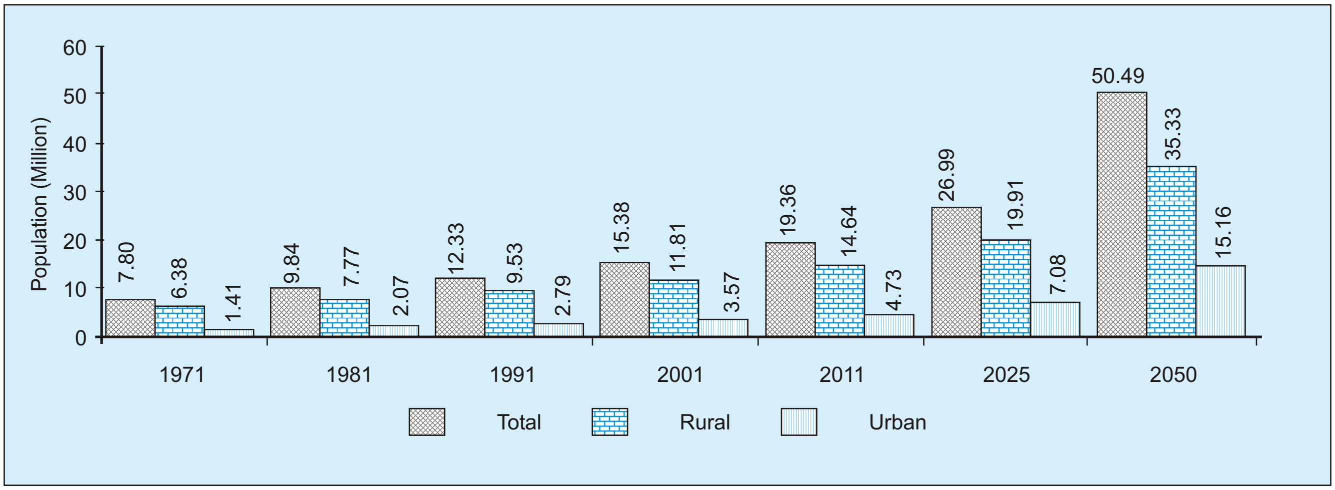
This is worth noting as the growth in gross cropped area is not commensurate with the growth in gross irrigated area. This means that a part of the growth in irrigated area has come from introduction of irrigation water to some portion of the existing crops, which were previously grown under unirrigated conditions, and not by simple addition of new crops that are irrigated. Now, our earlier analysis has shown that the area under some totally rainfed crops like soyabean had increased remarkably during the reporting period—from zero to 33 percent of the net cropped area. This means that the growth in irrigated area should have resulted from the introduction of irrigation to crops which were previously rainfed.

Of the total area under kharif paddy, only 11 percent is irrigated, and has remained more or less constant during 1970-71 to 1999-2000. During 1970-71, only 12.4 percent of the area under wheat was irrigated, but it increased to 75.19 percent by 1999-2000. In the case of gram, only 2.7 percent area was under irrigation during 1970-71, but it increased to 51.3 percent by 1999-2000. If we take all the pulses together, total irrigated area increased from 1.04 percent to about 28 percent by 1999-2000. On the other hand, irrigated sugarcane area, shows a declining trend. In the case of cotton, the share of irrigated area went up from 2 percent to 41 percent during the reporting period.

Blue and Green Water Use in Different Regions

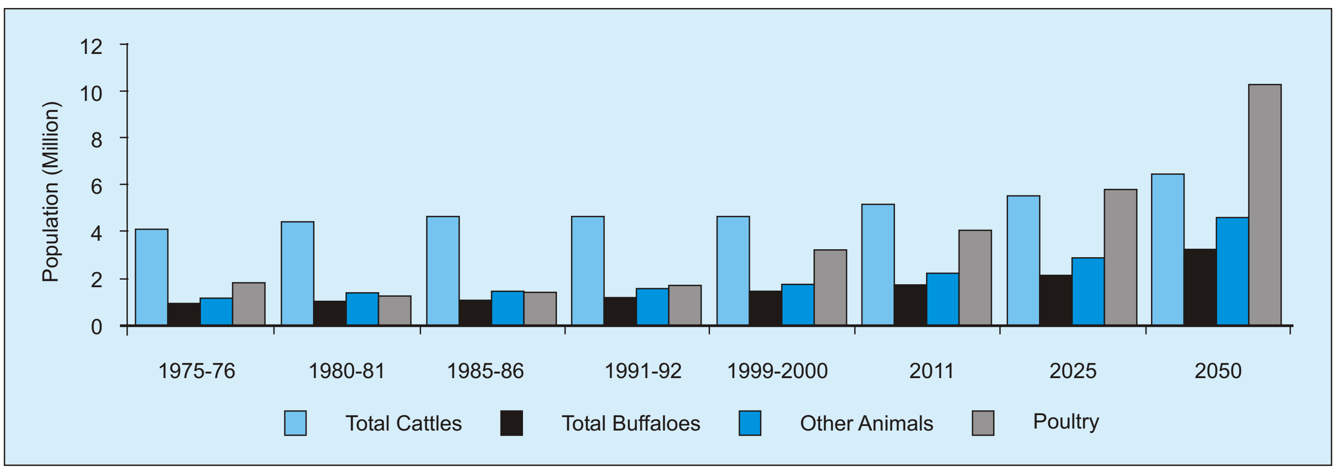
Green water use is assumed to be same for all the sample farmers for a given crop during a given season. Almost all the crops grown during the winter season are assumed to be dependent on blue water. Whereas, in the case of kharif crops, all the crops use only green water, except for paddy and cotton. Paddy and cotton crops use both green and blue water. Sugarcane, which is a year-long crop uses both blue and green water.

Figure 4: Historical Population Growth in Narmada River Basin, M.P.



Source: Authors' estimates based on data from Government of Madhya Pradesh

Figure 5: Historical Growth in Livestock Population in Narmada River Basin, M.P.



Source: Authors' estimates based on data from Government of Madhya Pradesh

Human Population Growth in the Basin

Total human population in the MP part of Narmada basin was 9.84 million in 1981. Out of this, about 79 percent is in rural areas and 21 percent in urban areas (Figure 4). In two decades, the basin population increased to 15.38 million. Rural population in the basin has grown at a compound growth rate of 2.03 percent per annum during 1981-2001, whereas urban population grew at an annual growth rate of 3.23 percent. Based on the short-term (1981-2001) growth trend of rural and urban population of the basin, population projections for 2011, 2025 and 2050 were made. As per our projections, total population of the basin would be 19.36, 26.99, and 50.49 million during 2011, 2025 and 2050 respectively. In 2050, the share of rural and urban population would be 70 percent and 30 percent. This implies that even in 2050, the Narmada basin would be dominated by rural population.

Growth in Livestock Population

In 1975-76, total population of cattle, buffalo, poultry, and other animals in basin was 4.11, 0.94, 1.83, and 1.10 million, respectively increasing to 4.75, 1.40, 3.20, and 1.75 million in 1999-2000 (Figure 5). We calculated the annual compound growth rate of all the livestock during 1975-76 to 1999-2000 and made projections for 2011, 2025 and 2050 assuming that the same growth rate would continue. As per our estimates, in 2050, cattle population would increase to 6.39 million, buffaloes to 3.25 million, poultry to 10.27 million and other animals to 4.58 million.

WATER USE IN DIFFERENT SECTORS

Agricultural Water Use

Substantial differences exist between crop consumptive use and the volume of water diverted, particularly in surface systems.

In 1970-71, about 95 percent of the net sown area was rainfed and the remaining was dependent on either blue water or both blue and green water. In 1999-2000, the contribution of net rainfed area to net sown area was 61 percent and crop production was solely dependent on green water. The remaining area used either blue water or both blue and green water. Total water (blue and green) used in the basin was 17.20 BCM in 1970-71, which increased to 22.05 BCM in 1999-2000 (figure 6). In 1970-71, total blue water used for crop production in the basin was 0.62 BCM, and it increased to 4.53 BCM in 1999-2000. Significant amount of green water is being used for the crop production even today. Green water use in the basin was 96.39 percent (16.58 BCM) in 1970-71 and its share declined to 79.44 percent (17.52 BCM) in 1999-2000.

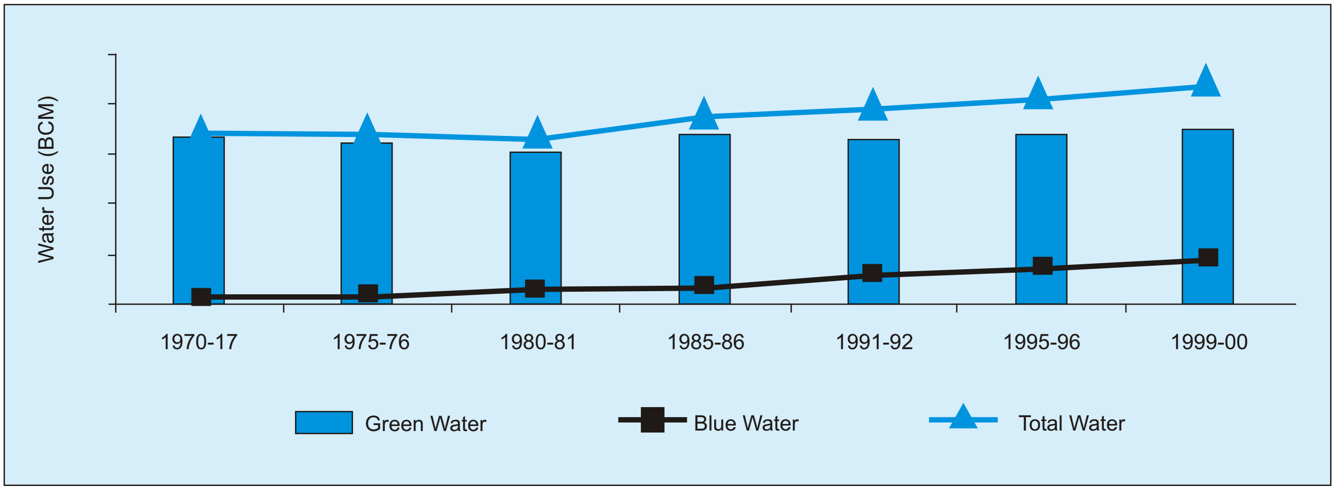
It can be seen that the growth trend in green water use is not uniform. Green water use declined to 15.32 BCM in 1980-81, then increased drastically to 17.05 BCM; 1991-92 showed a decline by 0.14 BCM compared to 1970-71; since then it has increased slightly. The declining trend during 1975-80 can be attributed to the occurrence of drought and wet years. On the other hand, no declining trend is found in the case of blue water use.

Water Diversion for Irrigation and Consumptive Use

Substantial differences exist between crop consumptive use and the volume of water diverted, particularly in surface systems. A significant portion of the diverted water gets lost in seepage and percolation; another significant chunk is lost in field application as deep percolation. This happens because control over water delivery and reliability of water supply are poor in the case of surface irrigation. These factors lead to excessive application of water during each watering. In the case of groundwater irrigation, some water would be available for reuse in the case of paddy as the fields remain inundated after irrigation. But these components would be available for reuse if the groundwater in the region is of good quality.

As Table 1 shows, in the case of paddy, crop consumptive use and irrigation water applied are

Figure 6: Historical Growth in Agricultural Water Use in Narmada River Basin, M.P.



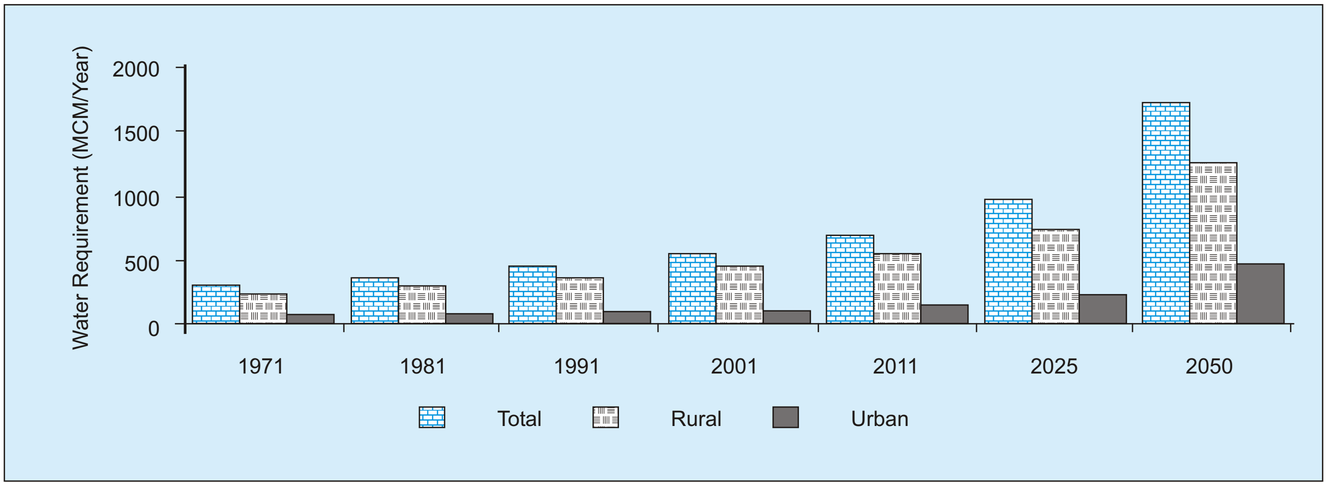
Source: Authors' estimates based on data from Government of Madhya Pradesh

Table 1: Total Irrigation Water Use and Effective Water Diversion from Narmada River and its Tributaries and Groundwater in M. P. (1999-2000)

	Canal and tanks (MCM)	Tubewell and wells (MCM)	Other sources (MCM)	Total (MCM)
Total irrigation consumptive use	1560.88	2161.74	806.08	4528.70
Total irrigation water applied in field	1561.02	2174.79	806.80	4541.88
Effective water diversion from Narmada river system for irrigation	2767.93		824.61	3592.54
Losses (conveyance + percolation)	1207.05	Not considered	18.53	1225.58
Percent losses (conveyance + percolation)	43.61		2.25	

Source: Authors' estimates based on data provided by NCA

Figure 7: Historical Growth in Domestic Water Requirements in Narmada River Basin, M.P.



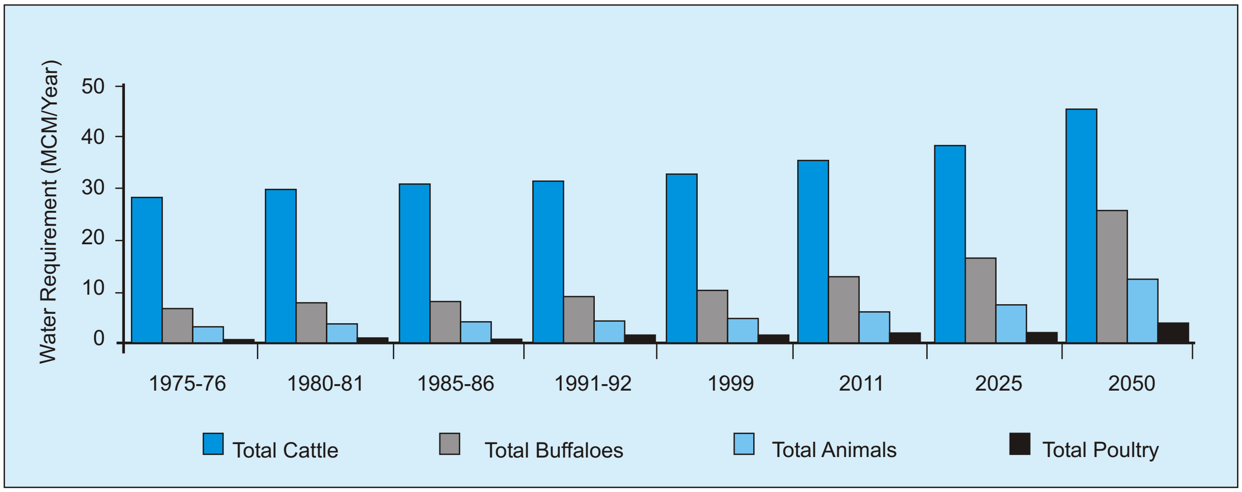
Source: Authors' estimates based on data provided by GoI and Government of Madhya Pradesh

different due to the return flow. This would be reflected in the case of water use figures provided for groundwater irrigation. Again, in the case of canal irrigation, irrigation water diverted, irrigation water applied, and crop consumptive use are different.

Domestic Water Requirement

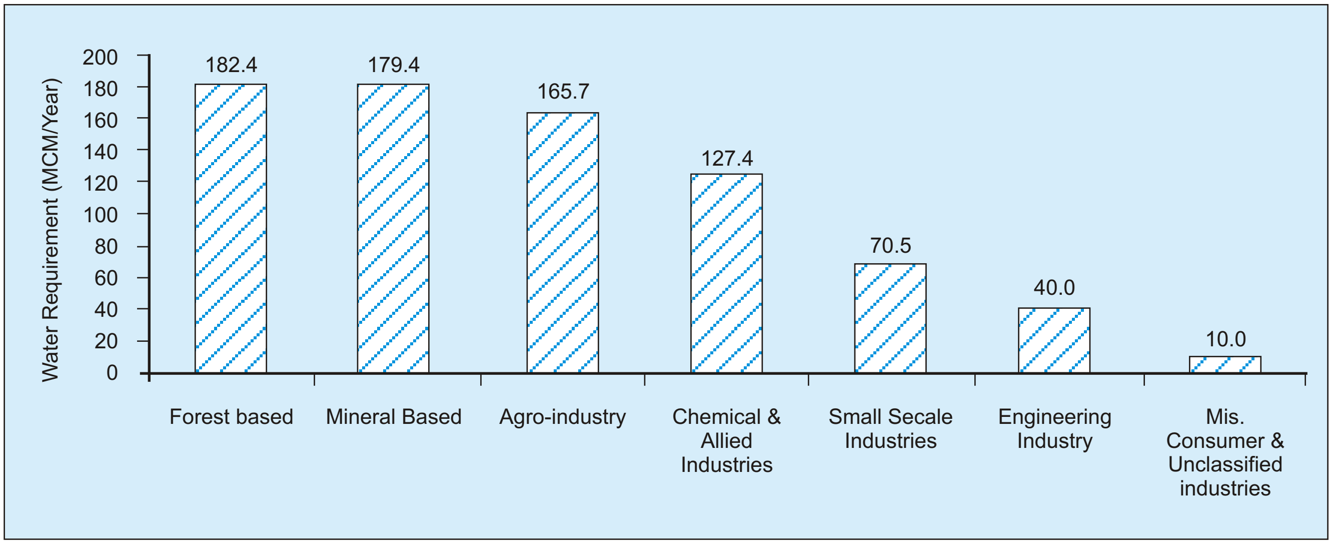
In 1970-71, total water requirement for domestic uses in the basin was 282.51 MCM (Figure 7). Out of this, share of rural and urban domestic water was about 84.4 percent and 15.6 percent respectively. As per our estimate, total domestic water requirement in the basin for the year 2001 was 548.6 MCM. Out of this, the shares of domestic water use by the rural and urban population were about 79.9 percent and 20.06 percent respectively. In 2050, the total domestic water required would be 1729.90 MCM. Out of total domestic water requirement in the basin, the share of rural and urban domestic water use would be 73.6 percent and 26.4 percent, respectively.

Figure 8: Historical Growth in Livestock Drinking Water in Narmada Basin, M.P.



Source: Authors' estimates based on data from Government of Madhya Pradesh

Figure 9: Water Requirement for Industrial Use in Narmada Basin



Source: Authors' estimates based on data from Narmada Control Authority (NCA)

Livestock Drinking Water Requirements

On the basis of primary survey we estimated the total livestock drinking water requirement in the basin. On an average drinking water used by bullock, cow, calf, she buffalo, buffalo calf, small ruminant (sheep, goat, pig) and poultry is 26.48, 21.74, 6.15, 30.67, 7.52 and 1 litre per day per animal respectively. In 1975-76, total livestock drinking water requirement was 38.82 MCM per year (Figure 8). In 1999-2000, the total drinking water used by livestock in the basin was 49.36 MCM. According to our projections, total livestock drinking water requirement in the basin would be 87.03 MCM in 2050.

Industrial Water Requirement

Estimation of water requirement for industrial production is based on unit water requirement for the type of industry and total production volume. For the estimation of industrial water requirement, the expected production figures which are provided in the master plan for development of water resources of the Narmada in MP were used since district wise actual production volume for industries are not available. The total water requirement for industrial use in the basin is 775.4 MCM per year (Figure 9).

Water Supply for Various Purposes from Different Sources

In 1984-85, total water supplied for various uses such as irrigation, domestic use, and industry was 2418.08 MCM from Narmada River (Figure 10). Out of this, the share of irrigation water was 96.95 percent. Share of domestic and industrial water use were 2.89 percent and 0.17 percent respectively. During last 16 years (from 1984-85 to 2001-02), quantum of water supplied for domestic, industrial and agricultural uses has doubled from 2,418.08 MCM to 4,787.57 MCM.

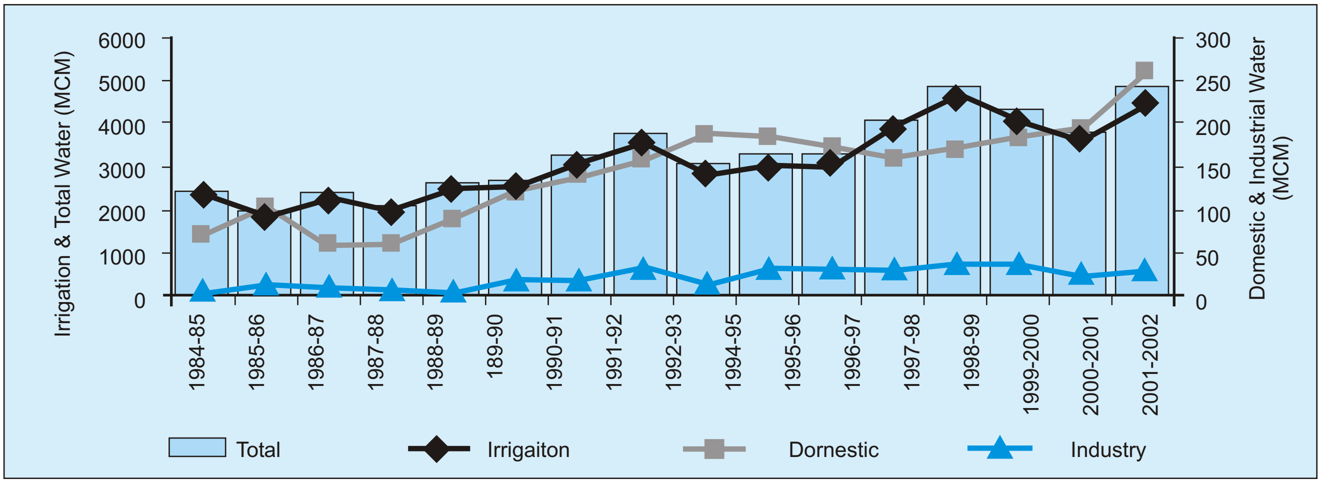
The share of water supplied for irrigation purpose from surface sources has come down from 96.95 percent to 93.96 percent. But in aggregate terms, volumetric diversion for irrigation has steadily gone up from 2340 MCM in 1984-85 to 4498 MCM in 2001-02. But against the total volumetric diversion of 3,598 MCM (in 1999-2000), the actual water used for irrigation is only 2,366 MCM. According to our estimates based on the irrigation water use rates and irrigated cropping pattern. If the official figures of water diversion by public schemes are to be believed, then the amount of return flows are very significant (1,207 MCM) available for reuse from the groundwater system of the region. This is quite substantial when one considers the total agricultural water use of 4,530 MCM for the entire basin.

A major chunk of blue water use in agriculture (in 1999-2000) is still groundwater, which is estimated to be 2,161 MCM against 2,366 MCM of surface water.

What is more striking is that, as per official estimates, the water diverted through river lifting by minor irrigation schemes and individual farmers is only 824.61 MCM. But as per our estimate, consumptive use itself comes out to be 806.08 MCM. If we consider a 25 percent loss in conveyance and application of water from the rivers and canals to the field, then the effective water diversion from other sources should be much higher (1,074 MCM) than what is reported to the NCA (824.6 MCM). Another important feature is that a major chunk of the blue water use in agriculture (in 1999-2000) is still groundwater which is estimated to be 2,161 MCM against 2366 MCM of surface water.

On the other hand, a positive growth is observed in the share of diversion of water for domestic and industrial uses to total surface water diverted.

Figure 10: Historical Growth in Water Supply for Domestic, Industry and Irrigation Purpose in Narmada Basin



Source: Authors' estimates based on data from Narmada Control Authority (NCA)

As per the master plan, total water to be allocated from the Narmada basin for domestic and industrial uses in MP is 1.5 MAF, a small percentage of which (11.4 percent) is currently diverted from the Narmada river and its tributaries directly or from the reservoirs built on them.

The total domestic water demand for Narmada basin for the year 2001 is estimated to be around 548 MCM. The remaining amount will have to come from groundwater sources such as wells, hand pumps, and tube wells. Similarly in the case of livestock drinking, a total of 38 MCM of water is required in the basin. But water diversion from the river system is only 165.8 MCM for both the uses as per the data available from NCA. The remaining 420 MCM has to come from groundwater draft, if we assume that all the human and cattle needs are fully met.

Major Findings

The agricultural component of blue water use is likely to go up steadily, following the past trends with increased impoundment of surface water in the basin and increased groundwater draft.

As Table 2 indicates, agriculture uses lion's share (76.7 percent) of the total water diverted from aquifers and surface water sources in the basin. The agricultural component of blue water use is likely to go up steadily, following the past trends with increased impoundment of surface water in the basin and increased groundwater draft. This is because only 39 percent of the net sown area is currently irrigated. The increase in use of effective rainfall is small (0.94 BCM). The projection made on human and livestock population in the basin support our arguments as they had implications for water demand for domestic consumption, agriculture and industry.

The green water use went up from 16.58 BCM to 17.52 BCM. The change in use of blue water for agriculture production is rather dramatic. This is facilitated by increased access to well irrigation and large scale investment in surface water development. As per our estimates, the total groundwater draft for irrigation alone (2161 MCM) exceeds the total groundwater draft figures provided by the Central Ground Water Board. Based on our conservative estimates, the net increase in groundwater draft is a phenomenal 1541 MCM.

Effective surface water diversion from the Narmada river and its tributaries till Garudeshwar for agriculture is 3.59 BCM in 1999-2000. Of this, the share of water consumed by agriculture is nearly 57 percent. The remaining amount is lost in percolation, but is largely available for reuse. The same is not true for surface lift irrigation schemes (including private lifting) where water available for reuse is quite low. One reason for the low figures could be under-reporting.

During drought years, well irrigators reduce the area under winter (irrigated) crops as a coping strategy to deal with groundwater scarcity. The same trend can perhaps be found in the case of

Table 2: Water Use Hydrology of Narmada Basin in Madhya Pradesh

Year	Total water use in MCM in					Total water use (MCM)
	Irrigation		Industry	Domestic	Livestock drinking	
	Blue water	Green water				
1970-1971	620.00	16,580.00		282.520	38.820$	
1999-2000	4,530.00	17,520.00	775.400*	548.610	49.360	23,423.00

* Estimates are made on the basis of the projected outputs from various industrial sub-sectors in the basin as provided in the Narmada basin master plan.
**1975-76

canal irrigation. But it is found that irrigation water dosage is higher during drought years compared to that in normal rainfall years. This is quite understandable as the amount of residual soil moisture available for winter crops could be lower during drought years. The implication is that the amount of diverted water use for irrigation during drought years would be more or less same compared to normal years.

Inability to secure reliable information on river lifting could pose serious challenges to meeting planned water utilization.

CONCLUSIONS

Water use hydrology of the Narmada basin is fast evolving. The major changes are gradual and steady rise in green water use for crop production and rapid rise in the diversion of water from surface and underground sources for crop production, domestic and industrial uses. The total diversion of water for various uses is still far below the allocation made by the Narmada Water Disputes Tribunal (NWDT) for MP. Apart from the numerous publicly-owned minor irrigation schemes, there are hundreds of thousands of individual farmers lifting water directly from either the river or the canals of gravity irrigation schemes.

Our analysis suggests that private lifting of water from surface sources in the basin is heavily underestimated. This could be due to heavy underreporting of area irrigated through canal lifting and river lifting. Increased diversion of water from the river through surface schemes would reduce the flows in the downstream parts of the basin. Inability to secure reliable information on river lifting can pose serious challenges to meeting planned water utilization. The challenge is bigger when one considers the fact that hardly 20 percent of the allocated surface flows are currently diverted from the basin in the MP part. Further, the amount of water consumptively used by gravity irrigators is only 60 percent of the total water diverted for the purpose. Increased recharge of groundwater from surface schemes can increase the availability of water in agricultural wells in the regions which are endowed with surface irrigation schemes.

Another challenge posed by changing water use hydrology is green water use in the basin. This would have significant implications for surface flows. While it directly reduces the surface flows by increasing the *in situ* use of rainfall; and it further reduces the prospects for runoff generation potential by increasing the infiltration rates. This can lead to MP taking more than its due share of water from the basin without being properly accounted for. On the other hand, increased kharif cropping would result in increased infiltration of rainwater. At the same time, increased groundwater draft could lead to increased surface water inflow into the groundwater system. This could benefit the upper basin areas while jeopardizing basin water allocation and use planning. In years of drought, the threat could be severe as the total surface flows and groundwater could reduce significantly, while the net consumptive use may not proportionally reduce as the study has brought out.

HEADQUARTERS
127, Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka
Mailing Address : P. O. Box 2075, Colombo, Sri Lanka
Telephone : +94 11 2787404, 2784080
Fax : +94 11 2786854; E mail : iwmi@cgiar.org

REGIONAL OFFICE FOR SOUTH ASIA
C/o ICRISAT, Patancheru 502324
Andhra Pradesh, India
Telephone : +91 40 30713071
Fax : +91 40 30713074; E mail : iwmi-southasia@cgiar.org

NEW DELHI
South Asia Liaison Office
2nd Floor, NASC Complex, DPS Marg
PUSA Campus, New Delhi 110012, India
Telephone : +91 11 25840811-2
Fax : +91 11 25841294; E mail : b.sharma@cgiar.org

NEPAL
Department of Irrigation, Room # 412 and 413
Jawalkhel, Lalitpur
GPO 8975 EPC 416, Kathmandu, Nepal
Telephone : +977 1 5542306
Fax : +977 1 5536219; E mail : d.pant@cgiar.org

CHINA
Center for Chinese Agricultural Policy
Chinese Academy of Sciences
Building 917, Datun Road, Anwai
Beijing 100101, China
Telephone : +86 10 64889440
Fax : +86 10 64856533; E mail : i.makin@cgiar.org

REGIONAL OFFICE FOR CENTRAL ASIA (Pakistan)
12KM, Multan Road, Chowk Thokar Niaz Baig,
Lahore 53700, Pakistan
Telephone : +92 42 5410050-53
Fax : +92 42 5410054; E mail : iwmi-pak@cgiar.org

REGIONAL OFFICE FOR CENTRAL ASIA (Uzbekistan)
Apartment No. 123
Home No. 6, Murtazaeva Street,
Tashkent 700000, Uzbekistan
Telephone : +998 71 1370445
Fax : +998 71 1370317; E mail : m.hassan@cgiar.org

REGIONAL OFFICE FOR SOUTHEAST ASIA
P. O. Box 1025, Kasetsart University,
Bangkok 10903,Thailand
Telephone : +66 2561 4433
Fax : +66 2561 1230; E mail : iwmi-sea@cgiar.org

REGIONAL OFFICE FOR AFRICA
Private Bag X813, Silverton 0127, Pretoria, South Africa
Telephone : +27 12 845 9100
Fax : +27 12 845 9110; E mail : iwmi-africa@cgiar.org

SUB REGIONAL OFFICE FOR WEST AFRICA
IWMI Ghana, PMB CT 112, Cantonments, Accra, Ghana
Telephone : +233 21 784752-4
Fax : + 233 21 784752; E mail : iwmi-ghana@cgiar.org

IWMI-Tata Water Policy Program

The IWMI-Tata Water Policy Program was launched in 2000 with the support of Sir Ratan Tata Trust, Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations.

Through this program, IWMI collaborates with a range of partners across India to identify, analyse and document relevant water-management approaches and current practices. These practices are assessed and synthesised for maximum policy impact in the series on Water Policy Research Highlights and IWMI-Tata Comments.

The policy program's website promotes the exchange of knowledge on water-resources management, within the research community and between researchers and policy makers in India.

IWMI-Tata Water Policy Program
Elecon, Anand-Sojitra Road
Vallabh Vidyanagar 388120, Gujarat, India
Telephone: +91 2692 229311-13
Fax : +91 2692 229310
E-mail: iwmi-tata@cgiar.org
Website: http://www.iwmi.org/iwmi-tata

International Water Management Institute

FUTURE HARVEST
IWMI is a Futures Harvest Center Supported by the CGIAR