Mahanadi Basin: An Alternative Approach to Inter-state Water Sharing and Management

An Approach Paper

K.J. Joy | Neha Bhadbhade | Sarita Bhagat | Abraham Samuel

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Supported by: Global Greengrants Fund

Cover and Layout Design: Rohinee Chakral

Published by: Forum for Policy Dialogue on Water Conflicts in India, Pune
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First published in January 2021

Citation: Joy, K. J., Neha Bhadbhade, Sarita Bhagat and Abraham Samuel (2021) Mahanadi Basin: An Alternative Approach to Inter-state Water Sharing and Management – An Approach Paper. Forum for Policy Dialogue on Water Conflicts in India, Pune.

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Acronyms

BAU	–	Business As Usual
BCM	–	Billion Cubic Meters
CGWB	–	Central Ground Water Board
CWC	–	Central Water Commission
ET	–	Evapotranspiration
FGD	–	Focused Group Discussion
IWRM	–	Integrated Water Resources Management
LPCD	–	Liters Per Capita Per Day
MCM	–	Million Cubic Meters
MoWR	–	Ministry of Water Resources
NRSC	–	National Remote Sensing Centre
RBO	–	River Basin Organization
SOPPECOM	–	Society for Promoting Participative Ecosystem Management
SRI	–	System of Rice Intensification

Foreword and Acknowledgment

Forum for Policy Dialogue on Water Conflicts in India (Water Conflicts Forum in brief) has been working extensively in the Mahanadi basin for more than ten years which has spanned across three phases. In the initial phase, the Water Conflicts Forum established the Odisha State Resource Centre where efforts were made to document 19 water conflict case studies related to dams and displacement, river diversions, pollution and water sharing.[1] Later the Water Conflicts Forum along with the Odisha State Resource Centre undertook an action research on the conflict around Hirakud water allocation.[2] The Water Conflicts Forum then expanded its scope of work to the entire basin looking at inter-sectoral water allocations and use, environmental flows, and competition and conflicts around groundwater.[3] Arghyam Trust, Bengaluru, provided financial support to the Water Conflicts Forum for this work in the Mahanadi basin. Later, Global Greengrants Fund provided certain limited resources to continue the engagement of the Water Conflicts Forum in the Mahanadi basin and with this resource we could conduct one stakeholder meeting and also undertake a short field visit.

During this third phase of work, the inter-state water conflict emerged among the states of Chhattisgarh and Odisha where claims were made by the Odisha Government that the Chhattisgarh Government has not informed them about the new barrages being built in the Mahanadi basin, reducing the inflows into the Hirkaud dam. Odisha Government demanded for a Tribunal to resolve the inter-state conflict. Over the last few years, the Water Conflicts Forum initiated a series of knowledge based dialogues amongst various stakeholders, especially the civil society organizations (CSOs), in the basin. In a joint stakeholder meeting held on 10-11th August 2016 in Raipur, Chhattisgarh, the inter-state water conflict issue was deliberated. A common statement was issued by the people's organisations from both the

1. Choudhury Pranab R., Bhupesh C. Shahoo, JindaSandbhor, Suhas Paranjape, K.J. Joy, Shruti Vispute (Ed.), 2012, "Water Conflicts in Odisha: A Compendium of Case Studies", available at: https://waterconflictforum.org/lib_docs/OdishaCompendium-complete-final.pdf (accessed on 10 January 2021).
2. Choudhury Pranab, JindaSandbhor, PriyabrataSatapathy, 2012, "Floods, Fields and Factories: Towards Resolving the Conflicts around the Hirakud Dam", available at: https://waterconflictforum.org/lib_docs/OdishaActionresearchreport-complete-final.pdf(accessed on 10 January 2021).
3. Based on this work, the Water Conflicts Forum published the following reports: 1) Mahanadi River Basin: A Situation Analysis, 2) Hasdeo Basin Report: A Situation Analysis, 3) E-flows in Indian Rivers – Methodologies, Issues, Indicators and Conditions – Learnings from Hasdeo Basin, 4) Water Allocations and Use in the Mahanadi River Basin: A Study of the Agricultural and Industrial Sectors, 5) Integrated Water Management of the Mahanadi Basin: Water Resources, Water Allocation and Inter-Sectoral Use, and 6) Groundwater in the Mahanadi River Basin. All these reports are available at: https://waterconflictforum.org/books-reports (accessed on 10 January 2021).

states taking a common stand to oppose the rising trend in using the sharing of Mahanadi River waters for partisan politics and that the issue of the inter-state water sharing should be resolved amicably in a socially and ecologically just manner.

Since the issue water sharing between Chhattisgarh and Odisha could not be resolved amicably, the Government of India constituted a tribunal in 2018 under the Inter-state Water Tribunal Disputes Act. The tribunal has not moved forward much and is still in the initial stages of dialogue and arbitration to find amicable solutions to the dispute. Unlike the Cauvery basin, the waters of the Mahanadi basin are not yet allocated completely and therefore there is ample opportunity to evolve an approach for managing the water resources in an integrated, equitable, democratic and sustainable manner. In this approach paper, based on the research and dialogues conducted in the Mahanadi basin in the last two phases of the Water Conflicts Forum, we discuss an alternative approach to inter-state water allocation and management of Mahanadi basin waters. Thus, in this paper we try to detail out the issues around the Mahanadi water dispute and propose an alternative approach to resolve the conflict, moving away from the conventional approaches to inter-state water disputes. It is based on a hierarchy of principles, taking into consideration water needs for life and livelihoods and other requirements including that for the environment. This approach is embedded in the principles of equity and environmental sustainability ensuring institutionalized stakeholder participation and water use efficiency to bring down the overall water footprint.

We would like to thank all those who have been part of the Water Conflicts Forums engagement in Mahanadi basin spanning a period of more than 10 years. Our special thanks to all the three thematic groups that worked on inter-sectoral water allocations and use, environmental flows, and competition and conflicts around groundwater especially Craig Dsouza, late A. Latha, Shripad Dharmadhikary, Jinda Sandbhor, Himanshu Kulkarni and Siddharth Patil.

We would like to thank all the stakeholders for participating in the research as well in the dialogues. We very warmly acknowledge the inputs, guidance and support provided by Lingaraj, Ashok Pradhan, Achyut Das, Saroj Mohanty, Bimal Pandia, Prafulla Samantara, Pranab Choudhury, Sudarsan Das, Shishir Behera, Arttabandhu Mishra, Alok Shukla, Anand Mishra, Nandkumar Kashyap, Parivesh Mishra, Sulakshana Nandi, Makarand Purohit and many others from the basin.

We would like to thank both Arghyam Trust and Global Greengrants Fund for providing the financial support for the Water Conflicts Forum's engagement in the Mahanadi basin. We thank our administrative staff Pratima Medhekar and Tanaji Nikam for assisting us especially in organizing various stakeholder meetings in the basin. We thank Sugeeta Roy Choudhary for the copyediting of the paper and Rohinee for layout and Yogesh Dabhade for printing.

K. J. Joy, Neha Bhadbhade, Sarita Bhagat and Abraham Samuel

January 2021

Abstract

As in the case of many inter-state river basins in India, the Mahanadi, which has its basin areas in Chhattisgarh, Odisha, Maharashtra and Jharkhand, has recently been experiencing a conflict between the two major riparian states of Odisha and Chhattisgarh. Since the issues of contention could not be settled amicably by the two states, it has been referred to an Inter-state Water Dispute Tribunal in March 2018. The Tribunal is in the initial stages of dialogue and arbitration to find amicable solutions to the dispute. Through this paper, we try to understand the issues around the Mahanadi water dispute and propose an alternative approach to resolve the conflict, moving away from the conventional approaches to inter-state water disputes. It is based on a hierarchy of principles, taking into consideration water needs for life and livelihoods and other requirements including that for the environment. It also draws on the learning from various international conventions on managing inter-state waters, sound policies and principles around river basin management and conflict resolution. The paper also highlights the need for nested institutions for water governance and management. It provides an approach and strategy for the Tribunal to make allocations based on the principles of equity and sustainability without compromising on the health of the riverine ecosystem.

1 Background

The Mahanadi is an inter-state river which primarily benefits the riparian states of Chhattisgarh and Odisha. Since 2016, tensions over water sharing have been rising between the two states. In 2016, the Odisha government filed a case against the Chhattisgarh government for constructing a series of barrages in the upstream, which shall, according to the Odisha government, reduce the inflows into the Hirakud reservoir and have implications on the water share/use in Odisha. The Chhattisgarh government responded that all these barrages, except the Kelo, were minor projects and they would not affect the downstream flows. They also claimed that the information about these projects had been shared with the Centre as well as the Odisha government.

In order to resolve the issue, the Supreme Court ordered the setting up of a Joint Control Board, as per the provisions in the 1983 agreement between the two states, and accordingly, an 11-member committee was formed. However, this arrangement between the two states did not work. The Government of Odisha sought to refer the dispute around sharing the waters of the Mahanadi basin to a tribunal for adjudication under the Inter-State River Water Disputes Act, 1956. Eventually, a tribunal was set up on 12 March 2018 to resolve the dispute. The Tribunal has been constituted following the orders of the Supreme Court dated 23rd January 2018, in a suit filed by the Government of Odisha. The Tribunal has three members—Justice A.M. Khanwilkar (Judge, Supreme Court of India as Chairman), Justice Ravi Ranjan (Judge, Patna High Court as Member) and Justice Indermeet Kaur Kochhar (Judge, Delhi High Court as Member). Two assessors were also appointed to help the States and the Tribunal. It is interesting to note that the setting up of the Mahanadi Tribunal has been rather fast, given the fact that this inter-state dispute has become a serious issue only recently.

1.1 Water Conflicts Forum's Engagement in the Basin

The Forum for Policy Dialogue on Water Conflicts in India (Water Conflicts Forum) has been working intensively in the Mahanadi basin for the last 10 years or so. Initially, the focus was on the Hirakud dam and its influence areas, understanding the farmers' movement against increased allocation to industries at the cost of irrigation, which was a major issue of the farmers' movement.[4] While the initial phase was more concentrated on

4. The research in this area was conducted for almost four years which resulted in the study report, *Floods, Fields and Factories: Towards Resolving Conflicts around Hirakud Dam* (Choudhury, Sandbhor and Satapathy, 2012).

the Odisha part of the river and specific problems raised by the movement, the subsequent phase of Water Conflicts Forum's work spread to the entire basin, looking at inter-sectoral water allocations and use, environmental flows, and competition and conflicts around groundwater. As the Water Conflicts Forum engaged with these areas of interests, the inter-state dispute emerged between the two major riparian states, Odisha and Chhattisgarh, mainly as a result of each state's political compulsions before the assembly elections, besides intra-state issues of water allocation between agriculture and industry. Thus, inter-state conflict became an area of Water Conflicts Forum's engagement in the basin, which opened up the scope of trying to work with a live dispute and search ways and means to resolve the issue through sound research, reliable data and information on the river and its resources, and more importantly, through stakeholder consultation and participation.

1.2 Dispute Resolution Mechanisms for Inter-state Rivers

While the current mechanism for resolving inter-state water disputes is through the tribunals constituted under the Inter-State River Water Disputes Act, 1956, experience shows that there are many limitations of the tribunal process and there is a need to restructure and strengthen the functioning of the tribunals. One of the major problems is the inordinate delay in reaching a consensual solution and institutional mechanisms to enforce the decisions. As Chokkakula (2018) states, 'it is equally important for the states to facilitate mechanisms for processing and implementing the awards in mutually agreeable terms. Very often, the non-state actors, including basin communities, have no role in the working or decisions of the tribunal'. There is also the viewpoint that since the tribunals apportion water taking the state as the unit of allocation, it strengthens the state (sub-national) and linguistic identities, thus rendering inter-state conflicts intractable. This gives rise to a demand for making districts within the basin as the units of allocation (Pani, 2018).

The Inter-State River Water Dispute Act has undergone several amendments since its enactment, the last one being introduced in Parliament in 2017 and getting Cabinet approval in 2019. This Amendment introduced a mechanism to resolve water disputes amicably by negotiations through a Disputes Resolution Committee, to be established by the Central Government, and consisting of experts from relevant fields, before such disputes are referred to a tribunal, besides introducing a single Standing Tribunal with multiple benches for different disputes.

1.3 Water Conflicts Forum's Engagement with the Dispute

Over the last few years, the Water Conflicts Forum initiated a process of knowledge-based dialogue amongst various stakeholders, especially the civil society organisations (CSOs) in the basin. Most of the CSOs from both Chhattisgarh and Odisha have come

on a common platform with a common stand on various issues pertaining to the basin and its management, including the issue of sharing of the Mahanadi waters between the two major states. This is reflected in the joint statement issued at the end of a dialogue meeting held on 11 August 2016 at Raipur. The Water Conflicts Forum believes that the ongoing conflict between Chhattisgarh and Odisha can be resolved amicably within the spirit of mutual understanding, dialogue and negotiation, benefiting the people of both the states as well as the river. Towards this end, we proposed an alternative approach to dispute resolution and river basin management and water sharing. This approach is based on the principles of equity, environmental sustainability, restructuring institutional mechanisms and facilitating stakeholder participation through a democratic process and by improving the water use efficiency to bring down the overall water footprint.

2 Mahanadi Basin: Water Availability and Use

The Mahanadi originates at 442 meters above mean sea level near Pharisya village, in the Dhamtari district of Chhattisgarh. The main Mahanadi river has a total length of 851 km, of which, 357 km falls in Chhattisgarh and 494 km in Odisha. The major tributaries are the Seonath, the Hasdeo, the Mand, the Ib and the Jonk connecting to the Mahanadi above the Hirakud dam, and the Ong and the Tel joining below the dam. The total area of the Mahanadi basin is 141,589 km^2, of which 73,214 km^2 or 51.71% of the area is in Chhattisgarh, while 65,847 km^2 or 46.51% is in Odisha (CWC and NRSC, 2014). The Mahanadi basin can be broadly classified into three reaches: the Upper Mahanadi and the Middle Mahanadi lying mainly in Chhattisgarh, and the Lower Mahanadi spread across Odisha (CWC and NRSC, 2014).

The average annual rainfall in the basin is 1291 mm, with regional, spatial and temporal variation, and the precipitation amounts to 182 BCM (Billion Cubic Meters) of water resources.[5] There are varying estimates for the water resources of the basin but the often-used estimate is the following one by the MoWR. The average annual surface water availability is 66.8 BCM; of this, Chhattisgarh and Odisha contribute 36.9 BCM (~55%) and 29.9 BCM (~45%), respectively (CWC and NRSC, 2014).

The total utilisable average surface water in the basin is estimated to be about 50 BCM and using the same proportion of 55% and 45% of contribution from Chhattisgarh and Odisha, the relative shares of utilisable surface water of the two states are 27.5 BCM and 22.5 BCM, respectively (CWC and NRSC, 2014). The total replenishable groundwater in the basin is about 13.6 BCM. Since no separate figures of replenishable groundwater for Chhattisgarh and Odisha are available, we apportion this on a 50:50 basis to the two states (6.8 BCM each). Thus, the total utilisable water in the basin is about 63.6 BCM. Of this, the contribution of Chhattisgarh is 34.3 BCM and that of Odisha is 29.3 BCM. The current per capita availability of water in the basin is 1432 m^3/person, which is far better than the national average of 900 m^3/person.

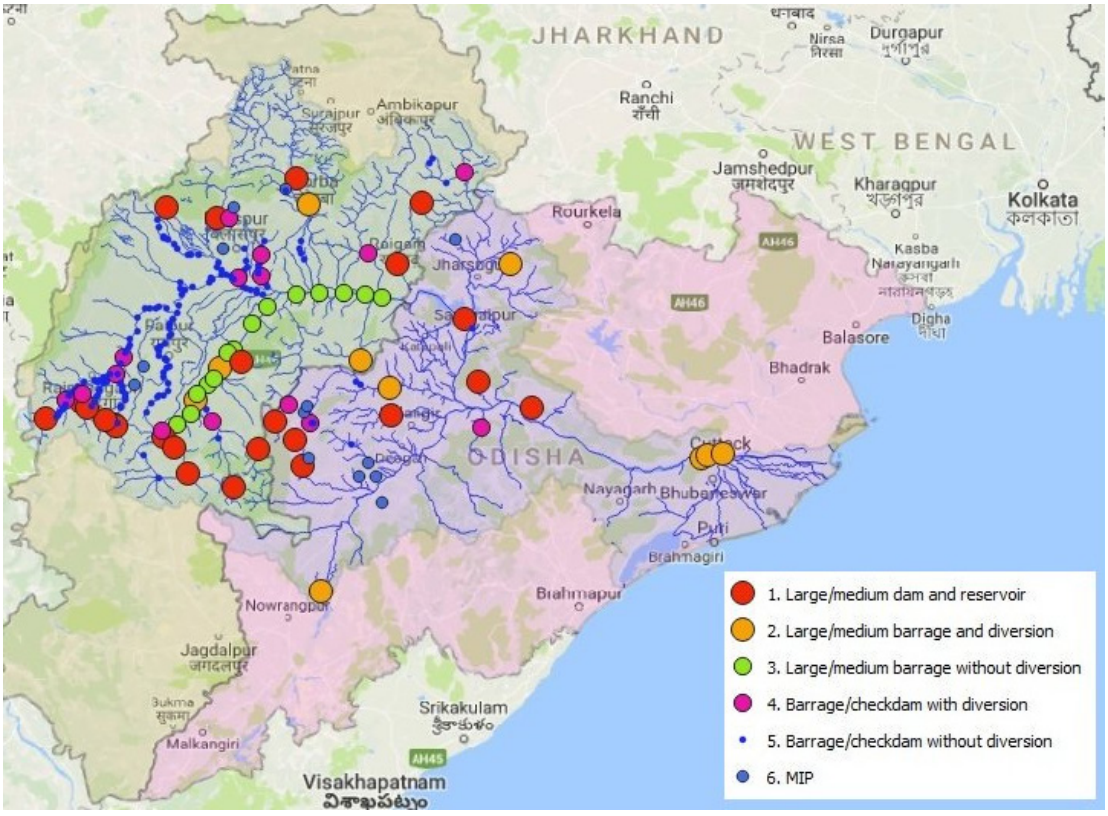
5. Many studies and Water Conflicts Forum's own analysis of 112-year rainfall data shows a decreasing trend in the rainfall over the Basin. The Jeyaseelan Committee, the High-Level Technical Committee to Study Various Aspects of Water Usage for the Hirakud Reservoir, notes a decreasing trend in the rainfall, especially in the post-Hirakud project phase and its potential impact on inflow to the Hirakud. The spatial variation in rainfall is also found to be significant in the pre- and post-project period, with decreasing trend of rainfall in the post-project phase.

However, while discussing the water resources of the basin, two issues are very important and have significant implications for inter-state allocation issues. One is the reducing trend of average annual flow of the river and the other is the high inter-annual variations in the runoff. This would mean that there would be less water available in the long run and it calls for the need to adopt a dynamic water allocation mechanism rather than a static one, which is the existing principle of allocation.

3 Water Resources Development in the Basin

3.1 Surface Water

Figure 1: Map of the Mahanadi Basin with all Major, Medium and Large Structures



Source: Created by Bimal Prasad Pandia

There are 22 major irrigation projects, 54 medium irrigation projects and five hydroelectric projects in the basin. The total live storage capacity in the basin is estimated at 14.244 BCM, of which 12.799 BCM has been completed and 1.465 BCM is under construction (Central Water Commission, 2016). This works out to 28.50% of the 50 BCM of utilisable surface water. There is another 10.094 BCM under consideration that together makes 48.68% of the utilisable surface water resources. Of the completed storage, 52% is in Odisha while the rest is in Chhattisgarh. Altogether, the Central

Water Commission (CWC) lists 253 dams of varying capacities and 24 barrages/ weirs/ anicuts in the Mahanadi river basin. Of these structures, 74 are either major or medium irrigation projects, covering a potentially gross irrigable area of 32.8 lakh ha (15.4 lakh ha in Odisha and 17.4 lakh ha in Chhattisgarh). This is 40% of the 82.3 lakh ha Gross Cropped Area in the river basin. Apart from reservoirs, about 3839 tanks, which help to store surface water, are identified in the river basin. Tanks are an integral part of the system in both Chhattisgarh and Odisha; they help in meeting not only irrigation needs but also other non-drinking domestic needs.

3.2 Conflict around New Water Resource Development

The major contention between the states is a series of new projects in the upper part of the Mahanadi in Chhattisgarh. The controversy pertains to around 13 barrages and diversion weirs across the Mahanadi which includes the Arpa-Bhaisajhar Barrage project and seven pick-up weirs under construction in Chhattisgarh. Besides these, two new under construction projects—the Pairy-Mahanadi Intra State Link Project and the Tandula Reservoir Augmentation Scheme of the Mahanadi River Project—are also a point of contention between the states. Odisha feels that these developments would reduce the inflow to Odisha, mainly impacting the Hirakud non-monsoon storage, which is already being felt. These new projects are being built to provide water for industries. An assessment by Water Conflicts Forum on eight new barrages and one anicut shows that the proposed annual allocation for industries is around 1258.16 MCM. These barrages will supply water to more than 45 power plants in three districts of Chhattisgarh. In the post liberalisation era, we do not witness development of large dams but a large number of small dams, weirs, anicuts and barrages. During our field visits, interviews and stakeholder consultations, it was also observed that irrigation water is increasingly being diverted for industrial use in recent times in both the states. The sectoral conflicts around water in both the states are being strategically hidden and the conflict is being posited as a conflict of inter-state sharing, as observed by us. In the Hirakud influence areas, for a long time, the farmers' movement has been raising the issue of water diversion to industries and also the issue of water shortage in the Hirakud reservoir, but, as stated by the activists, the Odisha government has kept denying it, and instead argued that there has been increasing inflow in non-monsoon months to the reservoir, as stated in the 2007 report of the Jeyaseelan Committee.

3.3 Groundwater

The replenishable groundwater resource of the basin is 21.29 BCM, of which the utilisable groundwater resource is about 13.6 BCM. Groundwater is mainly used in the basin for drinking and domestic water needs and most of the basin area is in the 'safe' category with reference to groundwater development/extraction. The 2011 census shows that the rural groundwater dependency for drinking and domestic needs ranges between 77–97%

(Census, 2011). The use of groundwater for irrigation is not very high, nor widespread, in the Mahanadi basin. However, secondary data shows increase in groundwater use in certain pockets, especially in the Chhattisgarh part of the basin in comparison to Odisha. This development is further backed by various government schemes that provide subsidies for borewells and tubewells in both the states.

The Mahanadi basin is already vulnerable to decreasing groundwater quality, not mainly as a result of over-extraction but due to other anthropogenic, mining and industrial activities rampant in the catchment. Two major contributors to pollution are thermal power projects which dump fly ash, and coal mining activities which result in pollution of both surface water and groundwater. Salinity and fluoride are the major identified concerns. Iron in the delta region and arsenic in the coal and gold mining belts and around ash dumps are emerging issues that need attention from the perspective of the safety of drinking water.

4 Irrigation and Industrial Water Use in the Basin

One of the major reasons for the present inter-state conflict is the increasing demand for water from industries and agriculture in both the states. Chhattisgarh, a newly formed state, feels that traditionally it has used very little water of the Mahanadi and that its increasing use is very crucial for its industrialisation and agricultural development. Odisha, also a backward state, feels the same as far as industrial development is concerned. The liberalisation agenda of both the states encourages the industries to harvest more and more natural resources, whether it is water, minerals, forests, etc.

In order to understand the inter-sectoral allocation to industries and agriculture, the Water Conflicts Forum undertook a thematic exploration of the water use in the basin.[6] Irrigation is the largest water user in the basin. As per the study of the Water Conflicts Forum, the gross irrigated area in the basin is estimated at around 3.32 million hectares. Of this, approximately 2.134 million ha (64%) is irrigated by surface water and the remaining by groundwater sources.

Chhattisgarh irrigates about 1.596 million ha annually. About 0.983 million ha (61%) is irrigated by surface water sources. Odisha, on the other hand, irrigates about 1.724 million ha annually; of this, 1.151 million ha, or 66% of its gross irrigated area, is irrigated by surface water sources (Dsouza et al., 2017).

The estimated surface water use for irrigation in the basin is 13.72 BCM (5.481 BCM in Chhattisgarh, 8.234 BCM in Odisha), which is about 27.4% of the utilisable surface water of 50 BCM. The irrigation use of surface water component increased from 11.057 BCM to 13.72 BCM between 2001-02 and 2014-15, reporting a 24% increase in 13 years. The estimated groundwater use is around 5.10 BCM, which is 37% of the 13.6 BCM of utilisable groundwater as estimated by the CWC (Samuel, Joy and Bhagat, 2017).

Thus, the total irrigation water use is approximately 18.82 BCM, which is 30% of the total utilisable water resource, pegged at 63.6 BCM. At present, 3.32 million ha (39.4% of the gross cultivated area) is irrigated using 18.82 BCM of water, which is approximately an average of 5665 m^3/ha of irrigation.

6. The base data and analysis for the inter-sectoral water use pertains to base year 2014-15. The analysis also made a comparison of water use over the past 15 years (2001-02 to 2014-15) after the formation of the state of Chhattisgarh.

Data on industrial water use or allocation at the basin scale does not exist. The Water Conflicts Forum tried to overcome this by analysing the water allocation to industries through the database on industries that have been given environmental clearance in the basin and by validating this estimation with secondary data and field verification. Based on these estimates, the total amount of water in the Mahanadi basin allocated to large industries is about 1.130 BCM in Chhattisgarh and 0.944 BCM in Odisha. This amounts to 2.074 BCM of water for industrial use.

In volumetric terms, even though the industrial water consumption in the basin is less, the increasing thrust on industrialisation, especially the growth of water-consuming industries such as thermal power plants, iron and steel plants, mining, cement, etc., would mean increasing demand for water.[7] The detailed study at two sites (Hasdeo Bango and Hirakud projects) shows that the allocation from these two projects to industries is 13.6% and 6.7%, respectively, and that there has been an increase in allocation to industries over the years. It is also noticed that most of the new barrages and pickup weirs, that are already developed or under construction in Chhattisgarh, are exclusively for industries, having a combined capacity of above 1 BCM.

7. In the peer group review on Agriculture-Industry Report, one participant (name withheld) who works closely with Chhattisgarh WRD on the Mahanadi basin mentioned that the use in Chhattisgarh alone would have reached 2 BCM in the near future.

5 Water Allocation and Use in the Basin

The Mahanadi, unlike many other peninsular basins in India, is not a closed basin yet, and all the utilisable water resources have not been fully allocated. There is still a lot of potential that could be developed and managed in an integrated manner. The message is that the Mahanadi need not go the Cauvery way, provided all the concerned stakeholders in both the states come together in a spirit of understanding each other's needs as well as that of the river and share and manage water sustainably. However, we should keep in mind that some of the major tributaries are facing significant water shortage as evident in the field and also as reported by the stakeholders. This is as a result of excessive mining, deforestation and also increasing damming of these rivers. Thus, a comprehensive and sustainable development of the basin needs to take into consideration its watersheds and sub-basins as a unit of planning, while not losing sight of the basin.

In this paper, we have tried to work out two scenarios of possible water sharing between the two states with projected estimations of water use in the basin for 2030 and 2050. The two scenarios are: 1) Business As Usual (BAU) scenario, and 2) Alternative Approach-Based scenario. These scenarios have implications for water allocation in general and the allocation mechanisms of the Tribunal in particular. Most often, tribunals allocate water between states based on a conventional understanding of water resources and its perceived use. It is also interesting to note that the existing legal provisions for water allocation of inter-state rivers do not include a clearly defined framework or principles while making allocation decisions. It also fails to capture the dynamic nature of the resource as well as changing needs and aspirations, such as the need for keeping minimum environmental requirements, or the changes induced as part of climate change scenarios, or the new emerging needs. Most often, allocations are based on the principle of 'business as usual' approach and hence we propose an alternative scenario that takes into consideration the need for a framework based on a hierarchy of principles and uses, need for dynamic understanding of the resources, factoring non-anthropocentric water uses and also building the changing patterns of water use and availability.

5.1 Business As Usual Scenario

The BAU scenario assumes that the current trend in water use would continue into the future in terms of different sectoral uses. Accordingly, water use/demand for different sectors is estimated for 2030 and 2050. The estimated water use/demand at present and

projections for all sectors for 2030 and 2050 as per the BAU scenario is based on the following assessments and assumptions.

Drinking water and domestic needs

The population of the Mahanadi basin, based on the 2011 census, is 38.66 million. The current population (2018) of the basin is about 44.42 million. At present, the rural and urban per capita water requirement is pegged at 55 lpcd (litres per capita per day) and 70 lpcd, respectively. Using these values, the current domestic needs of the Mahanadi are 0.95 BCM, of which 0.5 BCM is for Chhattisgarh and 0.45 BCM for Odisha. If the population continues to grow at the current rate, the domestic water demand for 2030 and 2050 is projected at 1.23 BCM and 1.9 BCM respectively, which is 1.9% and 3% respectively, of the potentially utilisable water of 63.6 BCM in the basin.

Livestock

According to the livestock census (2012), the livestock population in the basin is about 17.7 million and the trends show that there is no large change in the number and we can observe only fluctuations over the years. The livestock water requirement is factored as an average of 30 litres per day per unit. Thus, the current livestock water requirement is about 0.54 BCM (Samuel, Joy and Bhagat, 2017). The projected figure for livestock remains the same, as one does not see much change in the overall livestock population. Thus, the demand for livestock has been estimated to remain more or less constant till 2050.

Agriculture

The agriculture sector remains the largest consumer of water. As per our estimate, about 40% of the total gross cropped area in the basin is irrigated, using surface and groundwater. The total estimated surface water use for irrigation in the basin is 13.715 BCM and groundwater use for irrigation is pegged at 5.10 BCM (CGWB, 2011). Thus, the total water use for irrigation is about 18.815 BCM, which is approximately 30% of the total utilisable water by 2018. This works out to a water use (known as irrigation duty) of 5665 m^3 per ha. At the current estimation of 1.9% of annual increase in the irrigated area, the water demand in 2030 and 2050 will increase to 24.18 BCM and 31.33 BCM, which is 38.28% and 49.6% of the total utilisable water in the basin, respectively.

The irrigation use in Chhattisgarh is around 8.031 BCM as of now. The average annual growth in irrigated area in the basin is pegged at 1.9%, based on our analysis of the trend. Thus, for 2030 and 2050, for Chhattisgarh, the increase in water demand is projected at 10.31 BCM and 13.37 BCM, respectively. Similarly, in Odisha, 10.784 BCM water is used for agriculture. The water demand for irrigation for 2030 and 2050 is projected at 13.86 BCM and 17.96 BCM, respectively. However, we need to keep in mind that agriculture water demand may not follow the current linear trend as many other

factors including policies for accelerating irrigated agriculture through various subsidies could change the picture. Another major issue is that, at present, in canal irrigated areas, tail enders are denied water whether it is in Chhattisgarh or in Odisha, and this would push them more towards groundwater use and thus cause increase in overall water use by farmers.

Industry

The current industrial water demand is about 2.07 BCM (1.13 BCM in Chhattisgarh and 0.94 BCM in Odisha). In volumetric terms, even though the industrial water consumption in the basin is less than 3.3% of the utilisable water, with the increasing thrust on industrialisation, especially thermal power plants and mining, the total water demand in the basin for industrial use is expected to increase. According to the Report of the Working Group on Water Resources for the XI Five Year Plan (CWC, 2006), the industrial water demand in the country is expected to increase by 81% by the year 2025 and then by 20% by 2050 (baseline year is 2010). Assuming a similar trend of industrial water demand in the Mahanadi basin, the industrial water demand by 2030 would be about 4.08 BCM. Similarly, the industrial water demand would be 4.5 BCM by 2050.

Table 1: Estimated Water Use/Demand for Different Sectors As Per BAU Scenario

	Current (2018) water use (BCM)			Projected water use in 2030 (BCM)			Projected water use in 2050 (BCM)		
Sector	**Chhattisgarh**	**Odisha**	**Total**	**Chhattisgarh**	**Odisha**	**Total**	**Chhattisgarh**	**Odisha**	**Total**
Domestic	0.50	0.45	0.95	0.68	0.55	1.23	1.17	0.72	1.89
Livestock	0.27	0.27	0.54	0.27	0.27	0.54	0.27	0.27	0.54
Agriculture	8.03	10.78	18.81	10.31	13.85	24.18	13.37	17.96	31.33
Industries	1.13	0.94	2.07	2.50	1.58	4.08	2.80	1.81	4.61
Total	9.93	12.44	22.37	13.76	16.25	30.01	17.61	20.76	38.37
Utilisable water	34.30	29.30	63.60	34.30	29.30	63.60	34.30	29.30	63.60
Overall water balance	24.37	16.86	41.23	20.54	13.05	33.59	16.69	8.54	25.23

From the BAU scenario, it is clear that, for 2030, about 47.1% of the total utilisable water (30.01 BCM) will be required for various sectoral uses and for 2050, the water required will be 60.3% (38.37 BCM). Thus, the projected water use is very much within the utilisable water in the basin when we employ conventional methods to estimate the water use and demand.

In terms of inter-state water requirement under BAU scenario, Chhattisgarh could be allocated 17.61 BCM while Odisha could be allocated 20.76 BCM by 2050. This would mean that nearly 40% of the utilisable water resource of 63.6 BCM, which includes replenishable groundwater, would remain unbound in the river (as environmental flow) and in the aquifers. Of course, one also needs to factor in year to year fluctuations and seasonality of the flow.

The BAU scenario shows that there is no shortage of water in the basin and both the states could take a realistic view about water resources and reach a consensus on water sharing and mutually agreed upon arrangements. The quantum of utilisable water can also increase because of return flows which have not been factored in here. There is also ample scope to reduce water use by bringing in water efficient technologies, demand side management and so on, which would pave newer ways of sustainably managing the resources by both the states.

There are certain limits to the BAU approach and estimating allocations based on these principles. It does not factor in the impact of climate change on flows or availability of utilisable water even though there are conflicting views on the impact of climate change on eastern India and its basins. A study to estimate the flows in the Mahanadi for forty years (1981–2000 and 2041–60) by Gosain and Rao (2003, as cited in Asokan and Dutta, 2008) shows that climate change would lead to a 28% increase in the flow. Though another study by Asokan and Dutta (2008) broadly agrees with this trend (they say the increase would be 26.8%), it shows an escalation in river runoff in the month of September for the future years, while the results for the month of April show the reverse, pointing to the likelihood of increasing floods and droughts in the future (Asokan and Dutta, 2008). However, a recent study by Ghosh et al. (2016) presents a contradictory view, stating that climate change could lead to a reduction in the annual water flows by at least 10%. Another issue, mentioned earlier, is the decreasing trend of rainfall in the catchment, as shown in the Water Conflicts Forum's own estimate as well as that of the Jeyaseelan Committee and also a study by Patil, Kulkarni and Bhave (2017). Another crucial issue is that the BAU scenario does not consider environmental flow as an element of water use planning and allocation and instead treats it more as a residual. It also fails to ensure water use priority or ensure equitable access to meet the livelihood needs of the people in the basin.

5.2 Scenario for Allocation Based on an Alternative Vision

The techno-anthropocentric approach to rivers and waters, especially in terms of water use and allocation, has resulted in many river ecosystems reaching a point of no return and many basins getting depleted and closed. We have innumerable examples from the country with respect to inter-state rivers where all the utilisable water is allocated for the states as part of the tribunals, resulting in over exploitation and damming of the rivers by

the respective states. While such allocations focus mainly on conventional uses of water, they fail to take into consideration a set of guiding principles for allocation or water use including the rivers' own need to flow. Thus, in this alternative approach, we propose a set of guiding principles along certain normative concerns as well as criteria for allocations based on these principles which would result in sustainable water use, equitable allocation as well as help in managing the health of the river ecosystems. These are drawn from the learnings of managing waters as propounded by international conventions, national policies as well as Water Conflicts Forum's own engagement with water disputes and various stakeholders trying to address these issues.

Absence of agreed upon norms and principles for water sharing

One of the important issues that has plagued inter-state water allocation in India is that there is no agreed upon framework or norms/principles for allocation across the riparian states. Different tribunals have used different norms, principles and assumptions. Similarly, different contending states also advocate different principles to be used as per their relative advantage. For example, in the case of the Cauvery conflict, the lower riparian state of Tamil Nadu invoked the principle of prior appropriation right to protect the water it has been historically using. Karnataka invoked the Harmon doctrine or what is known as 'upholding absolute territorial integrity'. According to this principle, a riparian state is the sole authority and can do what it pleases with its waters. Both these can be termed extreme positions as far as the management of an inter-state river is concerned (Janakarajan and Joy, 2011).

Norms and principles embedded in international declarations and doctrines[8]

The inter-state water sharing could learn from some of the international treaties and declarations for managing international waters. Though international declarations/ treaties around transboundary rivers acknowledge the right of the riparian nations to use the waters that they are entitled to as per the prior appropriation principle, it can be operationalised under two conditions: one, it should not be at the expense of the legitimate rights of others; and two, it should not cause any 'significant harm' to the other.

The Helsinki Rules on the Uses of the Waters of International Rivers, 1966, considered to be the most comprehensive of all international doctrines, says, 'Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin'. What is a 'reasonable and equitable share', is to be determined in the light of all the relevant factors in each particular case. The relevant factors include: geography and drainage area in each basin state/nation, hydrology of the basin, climate affecting the basin, prior use, economic and social needs

8. This sub-section is adapted from Samuel and Joy (2017).

of each basin state, population dependent on this water, comparative costs of alternative means of satisfying the economic and social needs of each basin state, availability of other resources, avoidance of unnecessary waste in the utilisation of water, practicability of compensation to one or more of the co-basin states as a means of adjusting conflicts among uses, the degree to which the needs of a basin state may be satisfied without causing substantial injury to a co-basin state.

The Stockholm Declaration of 1972 acknowledges that states have the sovereign right to exploit their own resources pursuant to their own environmental policies, but with the responsibility to ensure that activities within their jurisdiction do not cause damage to the environment of other states. Agenda 21 of Rio conference 1992 (especially clauses 18.4 and 18.5) highlights the need for cooperation among riparian nations and also the need to formulate water resources strategies and harmonisation of these while dealing with shared waters. It also gives special importance to the integrated water resources management (IWRM) framework.

The United Nations Convention on the Law of the Non-Navigational Uses of International Water Courses (1997) brings out the following rights and obligations: equitable and reasonable utilisation and participation by basin states, prevention of significant harm to other basin states, regular exchange of data and information, no inherent priority of any one kind of use over other kinds of uses, notification of planned measures with possible adverse effects on other riparian states, protection and preservation of ecosystems, prevention, reduction and control of pollution, notification of and cooperation with respect to emergency situations.

All these international conventions and proclamations have many elements that promote equitable sharing and sustainable and participatory management of shared river basins. The alternative approach presented here is informed by these conventions, proclamations and doctrines.

Draft national policy guidelines for water sharing/distribution amongst states

In 2013, the Ministry of Water Resources, Government of India, came out with a 'Draft National Policy Guidelines for Water Sharing/Distribution Amongst States'.[9] According to this document, the broad objective that governs inter-state water sharing is: 'Developing the waters of inter-State rivers for the betterment of the population of the co-basin States/ Union Territories such that developments are not detrimental to the interests of one another and are guided by national perspective'. It advocates 'equitable apportionment' of available water, and the factors to be considered include: a) contribution of each of the co-basin states to the waters of the basin, b) requirement of water in each of the co-basin

9. Available at: https://cdn.downtoearth.org.in/dte/userfiles/images/cwc.pdf (accessed on 19 December 2020).

states, c) practicability of utilisation of water demanded, and d) availability of alternate or supplementary sources for meeting the water demand. However, it clearly states that setting priorities for the allocated water among co-basin states is not part of inter-state water sharing, though these priority uses and needs may be considered while deciding on the shares of the co-basin states. This is highly problematic because it can go against the grain of a socially and ecologically just sharing arrangement. Also, it can give rise to intra-state water conflicts. Also, its stipulation, by and large, to protect existing uses could be highly problematic, as, very often, development of water resources among the co-basin states is not uniform. It can privilege those states which are historically advanced in terms of water resource development and forecloses future options for more sustainable and equitable sharing and use. It is also silent on ecological or environmental needs of the riverine system.

New issues to be addressed as part of inter-state water sharing[10]

Inter-state water sharing is a very complex issue. It needs reliable, robust and scientific data on various factors of the river hydrology, ecology and socio-economic-cultural context of the basin. First, it needs dynamic understanding of precipitation/rainfall pattern, partitioning of the precipitation into different components (such as in situ soil moisture, evapotranspiration, percolation and recharge, groundwater pumping, run offs, and so on), water availability at a certain dependability such as 50% or 75%, land use and cropping pattern, different types of water uses and requirements, and changing socio-economic contexts.

Second, the issue of increasing uncertainty needs to be taken seriously. Changing rainfall, land use and cropping pattern, flows, and groundwater abstractions are all contributing to increasing uncertainty. The scenario gets further complicated because of knowledge gaps or the inability to understand and/or predict how all these would change in the future. Climate change would exacerbate them. As mentioned earlier, in the context of the Mahanadi, there does not seem to be an agreement among the knowledge community on the impact of climate change on flows.

Third, the concept of 'stationarity' often assumed by the tribunals to estimate the water yield of the basin needs a re-look. If we say that the 50% dependable yield of the Mahanadi basin is 66.88 BCM (this figure is taken just as an example and may not be exact), it assumes that this amount of flow would be available in the river for 50% of the years. To be able to make such a claim, we need to know that 'on an average' inflows are technically the same or more, the statistical properties of inflows are not changing over time. This assumption is called 'stationarity'. In other words, if the tribunal uses the data

10. This sub-section draws on two articles by K.J. Joy on the Cauvery Tribunal award in the wake of the 2016 violence around the Cauvery water sharing between Karnataka and Tamil Nadu (Joy 2016a; 2016b).

for the period say 1950 to 2000, to arrive at 66.88 BCM as the 50% dependable yield, then the same must hold true for the current period and for all times to come! Now, for the flows in the stream to be 'on an average' the same, two factors need to stay constant: one, the rainfall must be 'on an average' the same, and two, the relationship between rainfall and inflows (run off) must be stable, meaning both rainfall and the relationship between rainfall and run off must be stationary. Only if these are true, will the stream flow remain the same 'on an average', that is, the stream flow will remain stationary. Available data on the basin and sub-basins have shown that this is no more the case (i.e. stream flow is not stationary) because of both non-anthropogenic and anthropogenic causes (such as declining trend in the rainfall, increased groundwater pumping and/or increased evapotranspiration, etc.).

Fourth, very often, the Tribunal Awards restrict themselves to sharing only surface water flows or stream flows. According to geo-hydrologist Sekhar Muddu from the Indian Institute of Science, Bengaluru, this is highly problematic as stream flow cannot be the correct indicator of total available water. Only a small fraction of rainfall, say around 10 to 20%, ends up as surface water. A major portion of the rainfall, to the extent of 60 to 70%, is directly taken up by vegetation, including crops, from the soil and evapotranspired to the atmosphere.[11]

There are many factors such as land use, groundwater pumping, evapotranspiration (ET) that affect flows. For example, if any of the riparian states takes up extensive watershed development and stores water in small and decentralised check dams and/or recharges it into groundwater and then abstracts it out, then the estimated flow available for allocation can go completely off the mark. The ET-precipitation relationship also could be different in different parts of the basin. Thus, it is important to go beyond stream flows as the basis of inter-state water allocation; instead, all available water—in situ water, groundwater, stream flows—needs to be taken into account. The starting point could be rainfall as that is more reliable, followed by a bottom-up approach in working out water balances, say starting from micro watersheds to sub-basins and basins.

Fifth is the issue of using 50% dependability to estimate the water available for sharing. Earlier, most of the tribunals used 75% dependability as the basis. However, in the recent past, there seems to be a trend to go for 50% to 65% dependability. The second Krishna Water Disputes Tribunal also brought down dependability to 65% though the first one had used 75%. Similar is the case with the Cauvery Water Disputes Tribunal Award. At 50% dependability, though the quantum of water available would be at more than 75% dependability, it would be available for only 50% of the years. Whereas, in the case of 75% dependability, though the quantum would be less than 50% dependability, there is more assuredness as to the availability of water, as the estimated water would be available

11. As quoted in Joy (2016a).

for 75% of the years. The reason for this shift seems to be a populist way of dealing with the issue as it creates an illusion among the contending states that they are getting more water and everybody is apparently happy. In the overall context of uncertainty and climate change, it would be better to work with higher levels of dependability, say 75%. This would bring down the number of years of uncertainty in terms of water availability, allow more water to flow and give more flexibility to deal with unforeseen and emergency situations.

Sixth is the issue of water quality and sediment transfer. These have not been dealt with at all by the tribunals. With increasing urbanisation and industrialisation, the pollution load has increased tremendously. With various structures—small and large—on the tributaries and the main stem of the river trapping the sediment, the sediment regime would be completely restructured. There are studies that show that the deltas are sinking as they are not receiving adequate sediment from upstream. The Cauvery delta is often cited as a case.

Seventh, environmental flow (e-flow) and water quality are often not considered. The issue of keeping certain amount/proportion of flows unbound in the rivers has received some attention only recently in India. Very often, e-flow is considered as a residual after meeting all other uses. In the case of the Cauvery Tribunal Award, the e-flow allocation is ridiculously low. Similar is the case with water quality—something that is completely off the radar of the Tribunal. In the case of the Mahanadi, the overall flows may not be a serious problem yet (seasonality and inter annual variations of the flow could be), but pollution load is a problem as per Water Conflicts Forum's assessment and many other studies and stakeholder observations. However, since the abstraction is going to increase over time to meet various needs, we propose that water for ecological needs should be secured before allocations are made for other uses.

Amarasinghe, Shah and Anand (2007) provide insights into the environmental flow requirement of the various basins in India. For the Mahanadi basin, it ranges from 20 to 27% of the renewable water resources (depending upon the environmental management class, or EMC, which ranges from critically modified basin to moderately modified basin). The total volume of water that needs to be allocated as e-flows in the basin (including tributaries) to maintain it in fair condition is estimated as 24% of the total renewable water resource of 66.88 BCM, i.e. about 16 BCM. In the alternate scenario, given below, we have made a provision of 16 BCM as e-flows as a high order priority allocation.

Inter-state allocations cannot ignore the problems of the basin. Water pollution has been a very serious issue in the Mahanadi basin. Many water quality assessment studies show that many pockets of the basin and its tributaries are becoming extremely polluted, especially where there is a large concentration of mines, thermal power plants and human habitation. Heavy metal pollution from the mining areas and thermal power plants is of particular concern in this region. This has adversely affected the livelihoods of those directly dependent on the river, such as the fishing communities and the riverbed farmers.

Though Inter-state Water Dispute Tribunals very often do not engage with these sets of issues discussed above, we sincerely hope that the newly constituted Tribunal to resolve the Mahanadi water sharing dispute would engage with them. This can truly open up a new approach to the functioning of inter-state water dispute tribunals and inter-state water sharing in the country. So, it is a great opportunity that we should not miss.

Alternative principles for water sharing[12]

The most important area of consensus building is regarding the norms and principles to be used in deciding the water allocation across the two states. An alternative vision and approach are needed for managing the waters of the entire river basin including, but not confined to, the visible flows in the river or allocations between the states. Such a vision for integrated water management in the river basin would be imbued with the universal goal of equitable and sustainable resource use and democratic governance, grounded in a hierarchy of principles, and draw upon a rigorous and nuanced understanding of the prevailing ecological and socio-economic situation in the basin.

The hierarchy of principles in the sharing of the Mahanadi waters could be:

- First, water for life: providing adequate water of acceptable quality for meeting the drinking, cooking and sanitation needs of all the people and animals in the basin; for working out water allocations, we have shown livestock requirement as a separate category.
- Second, water for the ecosystem: ensuring adequate water flows and water in the river system for aquatic life and other ecological functions.
- Third, water for sustaining livelihoods: enabling productive activities while ensuring equitable use and protecting public health.
- Fourth, water for adaptation to change: keeping reserves and margins for ongoing and future demographic, economic and land use changes and climate change.
- To the above priority uses, we have also added the water needed for industrial and other related uses.

Working out the alternative water allocations for the Mahanadi basin

Based on the above hierarchy of principles, we have tried to work out the water allocations for both the states. Please do note that the numbers are not absolute and could change

12. This sub-section is taken from the joint statement on the Cauvery dispute: 'Sharing the Waters of the Cauvery: An Alternative Vision and Approach'. Available at:https://waterconflictforum.org/lib_docs/Cauvery%20joint%20statement_final%20with%20signatories_26%20Oct%202016.pdf (accessed on 19 December 2020).

as we get more firm data. The main purpose is to illustrate a methodology for working out the water shares of both the states based on the alternative principles discussed above.

Underlying assumptions:

- Water for life (domestic water): 100 lpcd (litres per capita per day) for all households in the basin without making any distinction between urban and rural people
- Water for livestock: 30 litres per animal unit (same as the BAU scenario)
- Water for the ecosystem (environment flows): 24% of the total renewable water resource of 66.9 BCM, i.e. about 16 BCM (as suggested by Amarasinghe, Shah and Anand, 2007). However, for our calculations, we have used 24% of the utilisable water (which is 63.6 BCM) which amounts to 15.26 BCM. Though in terms of actual basin planning, this water needs to be kept in the river as a whole, for allocational purposes between the two states, we have apportioned the environmental flow requirement of 15.26 BCM on a 55:45 proportion between Chhattisgarh and Odisha (the relative contribution of the two states to the utilisable water).
- Water for sustaining livelihoods: Every rural household (an average of five members) gets 4000 m^3 of applied water (at source) for their livelihood needs including agriculture. Broadly, this is in line with the present per ha irrigation water use in the basin. Globally, it is said that if the per capita water availability goes down below 1000 m^3 per person, then that region is seen as a water scarce region, and the livelihood needs cannot be fulfilled. SOPPECOM's biomass based approach shows that a family of five would require a water use of about 6000 m^3 to produce enough biomass (including crops) to meet all its needs. Of the 6000 m^3, 50% (3000 m^3) is assumed to be available in situ and 50% (3000 m^3) is to be provided as applied water. We think that the provision of 4000 m^3 is very liberal as this will mean a total water use of about 8,000 m^3 if we take into account the in situ use also. For the 2030 scenario, we have assumed that every family will be provided 4000 m^3 of water. However, for the 2050 scenario, we have brought down the applied water component to 3000 m^3 (taking in situ water use, the total water use would come to 6000 m^3) assuming that with the increasing adoption of water saving agronomical practices such as the System of Rice Intensification (SRI), technologies, demand side management and so on, the applied water requirement would come down.
- Water for adaptation to change: This is taken as 10% of the utilisable water.
- Water for industrial/commercial water use: The same as in BAU scenario.

Table 2: Water Use Projection under Alternative Approach-Based Scenario (in BCM)

Uses	2030			2050		
	Chhattisgarh	Odisha	Total	Chhattisgarh	Odisha	Total
Water for life	1.13	0.94	2.07	1.92	1.28	3.02
Water for livestock	0.28	0.28	0.56	0.28	0.28	0.56
Water for the ecosystem	8.39	6.97	15.36	8.39	6.97	15.36
Water for agriculture livelihoods	16.50	15.60	32.10	18.30	14.70	33.00
Water for adaptation to change	3.50	2.86	6.36	3.50	2.86	6.36
Water for industrial water use	2.50	1.58	4.08	2.80	1.81	4.61
Total use/allocation	32.30	28.23	60.53	35.19	27.90	63.09
Utilisable water	34.30	29.30	63.60	34.30	29.30	63.60
Overall water balance	2.00	1.07	3.07	-0.89	1.40	0.41

The above proposed alternative approach-based water allocation scenario shows that overall, we are operating within the available water except in the case of the 2050 scenario for Chhattisgarh where there is a very small gap between availability and requirement. This gap can be more than made up by improving water use efficiency in both agriculture and industrial sectors, reuse and recycling of wastewater and effluents, and also using water saving techniques especially in thermal power plants (for example, using air cooling instead of water cooling). Domestic water use, especially in urban areas, can be brought down by reuse of treated sewage for luxury uses such as gardening, washing vehicles, swimming pools, etc., which presently get clubbed with domestic water.

We would like to emphasize once again that the numbers given here are not absolute; they would change if we get more reliable data, and there are changes in the assumptions as well as the principles and norms. The alternative approach was widely discussed in the last consultative meeting of stakeholders held in Raipur in 2019. While there was consensus on the approach and methodology and figures, stakeholders felt that even though it may appear that the basin as a whole may not be facing any water shortage in the near future, there are specific pockets and sub-basins having seasonal scarcity. They also felt that in the irrigated belts of both the states, the water allocation is very limited and most of the tail ends are deprived of irrigation water. Another issue that emerged in the consultation is that of increasing water diversion to industries (as already highlighted) and

not allocating water for rabi crops in Chhattisgarh even when there is sufficient water in the reservoirs. People were of the view that inter-state conflict is a strategy to camouflage increasing inter-sectoral conflicts within the states and diversion of more water to industries by the respective states.

Sharing of shortages

One of the important gaps in the various tribunal awards has been the lack of clarity with regard to sharing of shortages. With climate change and other uncertainties, this issue is going to become all the more serious. The Cauvery Tribunal has said that the shortages need to be shared on a pro-rata basis, which means that if there is a 10% deficit in rainfall in the basin, then a 10% reduction in the water shares of the basin states would be enforced. Arguably, this is not the best way to go about it mainly because the rainfall deficit may not be evenly spread out in the basin. Here, one probably needs to take a sub-basin approach and identify the deficit sub-basins where there are shortages and then take corrective measures. Also, there needs to be a clear understanding as to where to apply the 'cut' (in terms of different water uses). The alternative approach and the hierarchy of different water uses discussed here can give a methodological handle on how to go about the task of sharing the shortages. Needless to say, the process of deciding how to share the shortages needs to be transparent.

Hotspots of scarcity and water pollution

Though, at the basin scale, there is enough water to meet everybody's needs and also that of the river, the civil society activists from both the states pointed out in the stakeholder consultation held in February 2019, that there are a number of hotspots within the basin where there are issues of water availability and also water quality.[13] Both these issues need to be addressed.

The villages located in the tail-end of the Hirakud command are not receiving their quota of committed water. In a Focus Group Discussion (FGD) conducted in Bajbalpur village on the right bank canal of the Hirakud system, it was seen that the village was mostly irrigated through lift irrigation scheme. However, according to the farmers, these lifts are not working as non-monsoon flows in the river have reduced. The farmers complained that they were not getting their share of water in spite of paying taxes (water charges). In another FGD conducted in the tail-end village of Ghodadhar, the farmers said that they have not been receiving water for the last 15 years. Till 1984, this region was getting water for two crops. This was slowly decreased to a single season. The land under the command was also increased, resulting in certain areas not getting adequate water. The canals have also been poorly maintained. The farmers said that there are about 30–40

13. These issues are also discussed in detail in the following: Choudhury et al., 2012; Panda, 2010.

villages that are not getting water in their region. The farmers were also of the opinion that there is a lot of mismanagement of the water of the Hirakud and there is a lot of wastage at the head of the command area. There is more water flowing back into the river at the head of the command area, which is reducing the water in the canals. The farmers have also complained to the irrigation department that the canals need repairs as they have narrowed down and do not carry water as per the designed capacity. However, there is not much concern shown by the irrigation department to solve these issues.

Water quality is a very serious concern in the Mahanadi basin due to rapid industrial development and mining. Chemicalised agriculture also contributes to it. The pollution will be a very critical issue and will affect the availability of the water for use. Almost all the tributaries of the Mahanadi are facing critical problems of pollution. The three tributaries of the Mahanadi —the Kelo, the Ib and the Bheden—are all badly affected. Another tributary of the Ib called the Lilari in Jharsaguda district has become practically a dead river due to the pollution load from iron and steel plants. The groundwater in the Jharsaguda district has also declined due to mining. The Ib and the Kelo are also polluted to a point that their water is not only unfit for direct human consumption but is also unfit for irrigation. Fishing in these rivers has been almost finished because of pollution. The fate of the Hasdeo river in Chattisgarh is almost similar. These issues related to water quality and localised water scarcity also need to be addressed by the Tribunal.

6 Institutional Arrangements and Processes for Basin Management

The present process for settling inter-state disputes over sharing of water is a top-down one, limited to only state actors. Non-state actors (such as civil society organisations, academic institutions and also communities) have no role. Against this, we suggest a participatory and transparent process for deciding on water sharing. For this, the following must hold:

- Sharing the Mahanadi waters cannot be left to a centralised political or bureaucratic process alone; water governance must be democratic, decentralised and participatory.
- All information and data pertaining to water at all scales and locations—rainfall, runoff, evaporation, surface and groundwater stocks and withdrawals, land use and cropping—that is gathered by any agency using public funds must be made publicly available.
- Collaborative networks of citizens, civil society organisations, academics and state agencies dedicated to analysing and communicating this information for use by decision-makers at all levels—village, town, taluka, district, state and basin—should be enabled.

6.1 Bureaucratic River Basin Organisations Would Not Work

The current institutional structures fail to enable integrated and participatory governance of water resources. The alternative scenario that we have proposed, based on integrated management of water resources, would require an inclusive and democratic/participatory institutional mechanism where all stakeholders (officials as well as various water users and interest groups) are involved in the river basin planning, management, governance including conflict resolution. In recent times, there is an emphasis on the formation of River Basin Organisations (RBOs) as part of the Integrated Water Resource Management (IWRM) strategy. Various water related policy documents, including the National Water Policy 2012, also talk about the need to create RBOs. As part of such developments, Odisha has undertaken experiments in forming RBOs. But so far, the experience shows that such initiatives have been highly top-down, centralised and bureaucratic. The current practice of tribunals is to suggest one joint management board. For example, the Cauvery Tribunal suggested setting up of the Cauvery Management Board (CMB).

6.2 Nested Institutions at Different Scales

Under the present conditions, it may be rather ambitious and difficult to form a single RBO for the Mahanadi, cutting across the two state boundaries. However, effective institutions from the bottom, say starting from the micro-watershed and then moving to a milli-watershed and sub-basin scales in the respective states, within a nested and delegated democratic framework, could be possible. These institutions should have representation of various stakeholders and should be a platform for democratic decision making. To start with, the state-level basin institutions of both the states can coordinate and collaborate with each other and then eventually, once there is enough trust in each other, form an apex RBO for the entire basin. The institutions at various hydrological scales need to function within the principle of subsidiarity which would mean that the decisions that can be taken by a lower-scale institution need to be left to that institution, and a higher-level institution should not interfere. Also, these institutions need to be legally mandated in the sense that the decisions taken by these institutions need to be legally enforceable.

6.3 Separate Institutions for Governance and Management

Institutions play two types of roles, namely, governance which is political in nature and management. Governance functions would involve deciding on the norms and principles of resource allocation, water rights and entitlements, pricing policy, operation and maintenance (O&M), conflict resolution and so on. Management functions would involve activities such as the day-to-day functioning, execution of the governance decision, operation and maintenance, data collection and so on. We suggest that separate institutions would be required to carry out these different functions. The decentralised RBOs (or multi-stakeholder platforms) could be the governance institutions at different scales and these institutions can set up smaller teams for the management functions. The management teams need to function under the guidance and supervision of the governance institutions.

Since there is asymmetry in terms of power, access to data, etc., among various stakeholders, creating a level playing field through capacity building, access to data and so on is a pre-requisite for proper functioning of these institutions.

7 Periodic Review

The Tribunal Award should not be seen as a one-time effort or event. It is true that all the tribunal awards do have a provision for a review and possible reallocation of unutilised water. This leads to very desperate and often socially and ecologically unsustainable measures to utilise each state's share of water. For example, the first Krishna Water Dispute Tribunal Award (also known as the Bachawat Award) had said that the award would be reviewed in 2002 with a proviso to re-allocate the unutilised water. This led to a rat race among the three riparian states to show that they had utilised their share of water mainly through large dams and huge lift irrigation schemes. They also built in extra capacity in reservoirs to bargain for more water during the review. This type of a situation needs to be avoided by adopting a transparent process as well as doing it within the alternative framework presented here. The second issue is related to the time span or frequency of the review. We would strongly recommend a shorter time span and more frequent reviews, say once in five years ideally or at the most, once in 10 years. This is important because of the rapid changes taking place (and the resultant uncertainties) in people's livelihood patterns and aspirations, land use, climate and so on.

8 Adaptive Management

An important lesson from different types of water related conflicts is that one-time, prescriptive, top-down solutions—either by a tribunal or by the Supreme Court—may not resolve these conflicts—whether they are inter-state, intra-state, inter-sectoral, or upstream-downstream conflicts—in a meaningful way. For a socially and environmentally just solution to the Mahanadi conflict, we need to move to an adaptive management approach. In the light of various lacunae in the functioning of tribunals (as discussed earlier), the increasing uncertainties and knowledge gaps, what we need is an adaptive management approach. Adaptive management allows us to make changes in the water sharing plan in the light of improved understanding of the bio-physical and social systems, new information resulting from changed or unforeseen circumstances, and new or updated models. It provides space to review and make changes in the principles that embed the water sharing plan as per the changing context and stakeholder preferences. It encourages stakeholders to discuss disputes in an orderly fashion while environmental uncertainties are being investigated and better understood. It uses uncertainty as an important factor in decision making. The approach also needs to be embedded in an alternative set of principles of sharing, sound science and participatory processes with active participation from non-state actors.

9 In Conclusion

In conclusion, we would like to reiterate that the Mahanadi is not yet a closed basin and would not face water stress in the very near future. It need not go the Cauvery way in the long run if we can all get our act together and see that the Tribunal functions in a way that moves away from the conventional approach towards water resource planning and allocation. The alternative approach proposed here opens a way for sustainably managing the water resources and the health of the river while not compromising on the human requirement of water for life and livelihoods. This could help in arriving at a socially and environmentally just water sharing arrangement.

It is high time all of us went beyond our own narrow, fragmented viewpoints and positions on the Mahanadi and saw it as an integrated whole, because a healthy Mahanadi is important for the well-being of all the people (as well as non-human life forms) in both Chhattisgarh and Odisha and beyond. Since the river basin is an integrated and inter-connected one, any action anywhere in the basin can impact all in the basin, especially those that are downstream. It is also important to take an integrated basin approach going beyond the fragmented, political and administrative boundaries because of the various 'disasters' that are now getting magnified or exacerbated by climate change. These disasters include catchment area destruction, pollution of various types, floods and droughts and basin closure.

As the Tribunal is formed and there are discussions on reaching a mutually agreeable resolution to the conflict in the basin between Odisha and Chhattisgarh, the civil society organisations from both the states need to engage with the Tribunal for working out a sustainable approach to dispute resolution. It is also reported that after its formation, the many proposed meetings of the Tribunal were deferred citing various reasons, and as in the case of many tribunals prior to this one, it is also going to be a long-drawn affair. As per the directives of the Tribunal, the technical teams of the respective states have conducted field visits a couple of times to each other's states. However, even this has not resulted in breaking the ice even as Joint Reports are being submitted to the Tribunal. Odisha, through an interim application to the Tribunal, is demanding the release of 1.74 million acre-feet of water by Chhattisgarh during the non-monsoon season, and this is fast becoming a point of contention.

We would certainly like to say that what is needed is the creation of an atmosphere conducive to dialogue, based on facts and mutual trust. In fact, this should precede

any effort towards a political settlement. The first step in creating such a dialogue would be mutual accommodation. The Chhattisgarh and Odisha governments should assure transparency, in the form of providing data especially on all the barrages and dams in both the states and also setting up a joint process of monitoring of actual inflows, water utilisation and outflows from these structures. Without this, no dialogue or trust building can take place.

In the long run, the people of Chhattisgarh and Odisha have to live side by side (or upstream-downstream of the same river) and share the Mahanadi. Whatever else we might do, we cannot change that. Geographic advantages and disadvantages can only be resolved by negotiation. That is what history tells us and that is what common sense advocates. It is not the Mahanadi, but the politics of water as an instrument of power that divides us.[14] We need to see the Mahanadi herself uniting us, nurturing us, through good and bad years. And, for that, it is important to rise above partisan politics. But the question is, will that be possible?[15]

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14. This is not to say that we need to wish away the politics in the context of inter-state conflict. In the context of the Cauvery Tribunal verdict, Chokkakula says, 'Thus, politicisation is an inevitable and ineradicable feature of inter-state water disputes in India. While the adverse impact of politicising inter-state water disputes cannot be discounted, I pursued an alternative perspective on these politics. With the support of recent literature on international water conflicts and Mouffe's model of the agonistic model of democracy, I argued that politics might be helping in accentuating inter-state interdependencies and deepening democracy in India. But to augment this, there is a need for creating institutional spaces to ensure the transparent exchange of information between states, defuse tensions, and facilitate negotiations and collaborations. The inter-state council is a potential institutional space for channelising the politics of inter-state water disputes towards stronger inter-state relations. This, however, does not mean that such institutional solutions will in any way serve as a substitute for legal adjudication by the SC and/or tribunals. These institutions will supplement and support the judicial institutions in evolving the right kind of practices and discourses for improved coordination of inter-state agreements and arrangements' (Chokkakula, 2014).

15. This last paragraph is an adapted version from an article on the Babhli conflict on the Godavari river (Gujja, Joy and Paranjape, 2010).

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The Water Conflicts Forum and Its Work

The Water Conflicts Forum (Forum for Policy Dialogue on Water Conflicts in India) is a dynamic initiative of individuals and institutions that has been in existence since 2004. Initiated by a handful of organisations that had come together to document conflicts and supported by World Wide Fund for Nature (WWF), it has now more than 250 individuals and organisations attached to it. The Water Conflicts Forum has completed three phases of its work, the first centring on documentation, which also saw the publication of 'Water Conflicts in India: A Million Revolts in the Making', and a second phase where conflict documentation, conflict resolution and prevention were the core activities. In the third phase, Water Conflicts Forum's emphasis was on backstopping conflict resolution. Apart from the core activities like documentation, capacity building, dissemination and outreach, advocacy and policy dialogue, the Water Conflicts Forum worked on themes like agriculture and industrial water allocation and use, environmental flows in the context of river basin management and competition and conflicts around groundwater in the Mahanadi basin. It also worked on right to water and sanitation, which was funded by WaterAid India. Arghyam Trust, Bangalore, funded the second and third phase. In continuation of Water Conflicts Forum's work in the Mahanadi basin, the present publication talks about an alternative approach for resolving the inter-state water dispute.

The Forum's Vision

The Forum believes that it is important to safeguard ecology and environment in general and water resources in particular while ensuring that the poor and the disadvantaged population in our country is assured of the water it needs for its basic living and livelihood needs. The Forum is committed to the core values of equity, environmental sustainability, efficiency, livelihood assurance for the poor and democratisation.

The Forum's Mission

The Forum's mission is to influence policies and actions at all levels and work towards resolving, and preventing water conflicts in an environmentally and socially just manner, and creating awareness for achieving participatory, equitable, and sustainable water use. The Forum aims to carry out these through stakeholder interactions, knowledge creation, policy advocacy, training, networking and outreach.

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