Conflict over Cauvery Waters: Imperatives for Innovative Policy Options

Nilanjan Ghosh
Jayanta Bandyopadhyay
Jaya Thakur

Observer Research Foundation
20, Rouse Avenue Institutional Area,
New Delhi - 110 002, INDIA
Ph. : +91-11-35332000
Fax : +91-11-35332005
E-mail: contactus@orfonline.org

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Cover: Dry bed of the Cauvery river | Photo: François Molle — © Water Alternatives/Flickr

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Dedicated to the memory of

Dr. ST Somashekhar Reddy
(1949-2006)

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About the Authors

Nilanjan Ghosh is Senior Fellow and Head of Economics, Observer Research Foundation, Kolkata, and Chief Economic Adviser at the World Wide Fund for Nature, New Delhi. He was instrumental in setting up the Water Governance Studies division at ORF Kolkata. He holds a PhD from the Indian Institute of Management Calcutta, and works in the areas of ecological economics, developmental issues, water resources, and financial markets. His publications include seven books and over 40 peer-reviewed research papers in journals such as *Water Policy, Conservation and Society, Journal of Industrial Ecology, Journal of Index Investing*, and *EPW*, as well as book chapters. Nilanjan is also a former Vice President of the Indian Society for Ecological Economics (INSEE), and delivered the Presidential Address at the Seventh Biennial Conference of INSEE. Email: nilanjanghosh@orfonline.org.

Jayanta Bandyopadhyay is Visiting Distinguished Fellow at Observer Research Foundation, Kolkata. In 2012 he retired as Professor at Indian Institute of Management Calcutta. Following the completion of his PhD from Indian Institute of Technology, Kanpur, he shifted his research interests to the Himalayas, especially the challenges in sustaining the region's rivers. He was a CLA for the global exercise of the Millennium Ecosystem Assessment, and the Chair of the Scientific Advisory Committee of the G B Pant Institute for Himalayan Environment and Development, Almora (2007-12). He is an adviser to the Water Diplomacy Program at the Fletcher School of Diplomacy, Tufts University, USA. Author of 160 publications, his recent book by Springer (Switzerland) is *Environmental Sustainability from the Himalaya to the Oceans: Struggles and Innovations in China and India*. Email: jayantab@orfonline.org.

Jaya Thakur is a Junior Fellow with the Economy and Development Programme at ORF Kolkata. She specialises in environmental issues in geography. She previously worked with the Department of Geography, University of Burdwan as Research Fellow (first as Junior Fellow, and eventually as Senior Fellow). She obtained her PhD from The University of Burdwan in August 2018. She holds a Master's degree in Geography from the same university. Email: jaya.thakur@orfonline.org.

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Foreword

India is a land of many rivers; in the past several decades, it has become the land of many river conflicts. As the population and the economy of the country have grown, the demand for water has also increased sharply. Inter-state disputes over access to river flows are unfolding across the country. While most of the rivers are shared by more than one State, the institutions for addressing the disputes are not only limited in scope, they are in need of strengthening, given recent developments in water science and governance.

We at ORF Kolkata, realise the need for high-quality research to study and address the issue of integrated river basin management. We have published the seminal and highly acclaimed study, "IRBM for Brahmaputra Sub-basin: Water governance, Environmental Security, and Human well-being", authored by Jayanta Bandyopadhyay, Nilanjan Ghosh and Chandan Mahanta. Scholars associated with water governance studies at ORF Kolkata regularly contribute to discussions on critical issues related to water policy and governance in peer-reviewed journals and popular media—this has put ORF Kolkata in the map of India's leading think tanks in policy and governance issues related to water. Our international collaborations with the Water Diplomacy programme of MIT-Harvard-Tufts University further strengthened our endeavours and capacity in this domain. In 2017, ORF Kolkata, along with the Water Diplomacy programme, organised the "Ganga-Padma Dialogue: A Devising Seminar". ORF Kolkata also hosted the "South Asia Water Dialogue" in December 2015.

This monograph continues this stellar work. It addresses one of the most intense and oldest disputes over the waters of the river Cauvery. The conflicts over Cauvery have grown from a simple question of sharing water flows, to issues of political identity of the States of Karnataka and Tamil Nadu. Although there have been media reports and scholarly publications on the Cauvery, extant analyses have not shown a clear direction towards a resolution. In this monograph, the authors make a significant contribution by addressing the economic, institutional and ecological undercurrents behind the Cauvery conflict. They suggest measures for reducing the water demands of the stakeholder States as well as creating institutional arrangements for conflict resolution. This monograph is significant not only for the governance of the Cauvery basin, but for addressing similar cases in other river basins. This publication will be a source of useful knowledge for researchers and practitioners in the fields of economics, agriculture, water governance, law, and administration.

Ashok Dhar
Director, ORF Kolkata

01 September 2018

Preface

The February 2018 verdict of the Supreme Court of India on the issue of allocation of the waters of the river Cauvery, between the States of Karnataka and Tamil Nadu in south India, has paved the way for a sustainable resolution of the dispute through an integrated and holistic approach to river basin governance. This monograph gives an account of the Cauvery water conflict, traces the reasons for its aggravation in terms of economic rationales and existing statutes of water governance in India, and offers recommendations for possible modes of resolution.

From the economic perspective, tacit incentivisation through increased minimum support prices of water-consuming crops has led to a rise in acreage of irrigated paddy vis-à-vis the drier alternative in the form of Ragi (finger millet) and other millets in the Cauvery basin. This has led to disputes that are not clearly based on physical scarcity of water, but are a temporal coincidence of demand based on scarcity value. The existing legal and institutional frameworks are inadequate to address the critical challenge. Further, this volume argues that the final award in 2007 of the Cauvery Water Tribunal (CWT), set up under provisions of the Inter State Water Disputes Act, 1956, is embedded in the traditional engineering paradigm without any semblance of an integrated approach to river basin governance, and is prone to aggravate conflicts. The award talks of an institutional design of a Cauvery Management Board that is dominated by engineers, and hardly shows any embedment in a transdisciplinary knowledge base combining social, natural, and engineering sciences to evolve with a sustainable resolution to the complex problem of the Cauvery basin.

On the recent count, the Supreme Court's verdict in February 2018 reducing 14.75 TMC water for Tamil Nadu (from the one recommended by the CWT) and providing the same to Karnataka for its burgeoning urban-industrial water use, recognises a bigger global phenomenon of intersectoral water conflicts: agriculture versus urban-industrial water demand. The verdict has also opened up immense opportunities for setting up an appropriate river basin organisation with a holistic thinking and knowledge base for integrated governance. However, as argued in this volume, by adhering to the CWT-recommended institutional structure and disciplinary competence of the Cauvery Water Management Authority as established on 1 June 2018, the Centre might miss the opportunity to internalise the holistic and interdisciplinary paradigm of river basin governance. Given the same, “inclusivity” of stakeholders and disciplines seems a remote possibility in a governance regime dominated by reductionist engineering thinking. A critical interdisciplinary knowledge and human resource base is important with multi-disciplinary expertise.

1 Introduction

1.1. Setting the context

The ruling of the Supreme Court of India on the allocation of water of the river Cauvery, between the States of Karnataka and Tamil Nadu (Civil Appeal No: 2453 of 2007 with Civil Appeal No: 2456 of 2007), was delivered on 16 February 2018. It indicates that the apex court has been increasingly informed of the new and interdisciplinary approaches that water-management professionals at the global level have been recommending for a long time (Falkenmark 2003; Bandyopadhyay 2009; Rogers 2006). The judgment is historic on two counts: first, it marks the culmination of an old inter-state water dispute that has been an epitome of hostile hydropolitics in India; second, it sent a signal to the agricultural economy to practice demand management of water for attaining higher water-use efficiency, and crop-choice consistent with natural water endowment. The idea behind the ruling appears to be a case of "robbing Peter to pay Paul"—reducing 14.75 TMC water for Tamil Nadu and providing the same to Karnataka. Yet, it recognises a bigger global phenomenon of intersectoral water conflicts: agriculture versus urban-industrial water demand.[1] While the ruling includes prioritisation of allocation in favour of urban-industrial supplies over water for irrigation, there is a tacit push in favour of crops with lower water demand, like Ragi (Finger Millet) as opposed to paddy. The judgment opens up possibilities for looking at river basin conflicts from a more comprehensive perspective. By emphasising on the immediate setting up of the Cauvery Management Board, the Supreme Court tacitly acknowledges the criticality of River Basin Organisations (RBOs) as a crucial institution for integrated and participatory river basin governance. This has been emphasised by independent water professionals in various forums (e.g. Alagh 2016; Ghosh 2016). In short, the Supreme Court order has opened a range of possibilities not only for conflict resolution over transboundary waters, but also for better understanding of integrated approaches to their governance. This volume examines such emerging possibilities by presenting an account of the conflict, and the institutional as well as economic explanations to it. In the process, it presents possible modes of resolution.

Indeed, the Cauvery water conflict is not an exception to classic cases of upstream-downstream water conflict. Further, as will be explained later in this volume, this is a typical case of a conflict not only over water allocation between states, but also differing perceptions of property rights between those states. Similar to many other cases of water conflict, the apparent driver of the

one over Cauvery is perceived scarcity of resource, though Ghosh and Bandyopadhyay (2009) have shown that the reality is otherwise.

Extant literature on the subject explains water conflicts based largely on the neo-Malthusian creed of "scarcity induces disputes" (Westing, 1986; Homer-Dixon, 1991, 1994; Gleick, 1993; Richards & Singh, 1997; Hall & Hall, 1998). The creed was popular till the 1990s in providing explanations to most conflicts on water. Eventually, it faced challenges from critics that include Dalby (2013, 2016), as well as the extensive body of work on "securitisation" by the Copenhagen school, mainly associated with the works of Barry Buzan and Ole Waever (see for example, Buzan and Waever 2003, Booth 2007). Empirical evidence of conflicts over river basins in South Asia revealed that broader forces were at work than mere quantitative representations of scarcity (Ghosh and Bandyopadhyay 2009; Bandyopadhyay et al 2016). In understanding, for instance, the conflict over the Brahmaputra sub-basin, neo-Malthusian thinking and neo-classical economic analysis have been found ineffective (Bandyopadhyay et al. 2016, Rasul 2014; Ghosh 2015). Yet, the prominence of the reductionist thought processes can be witnessed in both the way river basins are presently managed in India and the design of the institutions of governance and conflict resolution. Thus, the main aim of governance and basis for conflict resolution has remained limited within simple measures of allocation at specific points on the course of rivers.

In the case of Cauvery—an inter-state river shared by the southern states of Karnataka, Kerala and Tamil Nadu, as well as the Union Territory of Pondicherry—the river is well-known for the intense and long-term disputes on sharing its water between Karnataka and Tamil Nadu. The importance of the flow in this river arises from its course through traditional rain-fed farming areas in the Karnataka plateau, and farming areas in the delta region with developed irrigation.

Originating from the eastern aspect of the Western Ghats mountain, the river flows south-eastward to drain into the Bay of Bengal after flowing through Tamil Nadu and Pondicherry (Fig. 1.1). The basin area is shared with the state of Kerala and the union territory of Pondicherry. With a length of 802 km, the Cauvery is one of the major rivers of Peninsular India, having its origin at Tala-Cauvery (1341 masl) in the Kodagu district of Karnataka. The area of the basin is 87,900 sq km. According to the provisions of the Indian Constitution, it is an inter-state river with Karnataka and Tamil Nadu covering most of the basin area. They are also the States staking their large claims on the Cauvery water.

The significance of the transboundary characteristic of Cauvery emerges from the conflicting demands for irrigation from the plateau region of Karnataka and the delta region in Tamil Nadu. The conflicts over the Cauvery waters have been amongst the most contentious over watercourses crossing political boundaries of States. While the Cauvery conflict, in a superficial way, might comply with the neo-Malthusian creed of "scarcity induces conflicts", the intertwined institutional issues, diverse perspectives on property rights, political drivers of the conflict and lack of holistic perspective in water governance, generate much deeper layers that need to be identified in deciphering the fundamental basis of the conflict.

1.2. The Cauvery Basin

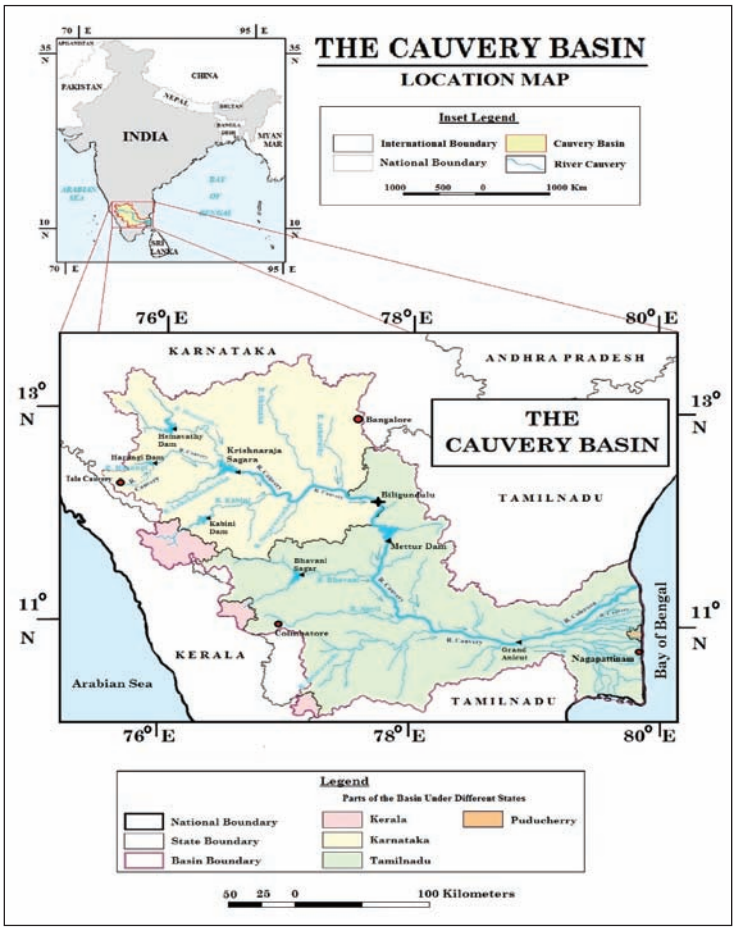
With a length of 802 km, the Cauvery is the fourth longest river in South India, after Godavari, Krishna and Mahanadi. As stated earlier, Karnataka and Tamil Nadu are the principal States in the Cauvery basin in terms of their areal extent, a small part of the State of Kerala and whole of the Union Territory of Pondicherry belong to the basin. Originating from Tala Cauvery in the Western Ghats, the east-flowing river meets the Bay of Bengal in the Karaikkal district of Pondicherry. From the origin to the confluence with the Bay of Bengal, the main river flows for 381 km in Karnataka, 357 km in Tamil Nadu, the two larger basin States. The interests of Kerala and Pondicherry in the water of the river are limited.

Table 1.1: State-wise break-up of the area of the Cauvery Basin

Name of the basin State	Catchment Area (in sq. km.)
Kerala	2,866
Karnataka	34,273
Tamil Nadu	43,868
Karaikkal region of Pondicherry	148
Total	81,155

Source: http://waterresources.kar.nic.in/river_systems.htm

Figure 1.1: Map of the Cauvery River Basin



Source: Modified by the Authors from Cauvery Basin by India WRIS, 2017

The Cauvery has several tributaries, among them, Harangi, Hemavathi, Lakshmanathirtha, Kabini, Shimsha, Arkavathi, and Suvarnavathy. In the delta area, the river branches into many distributaries and they irrigate the Karaikkal region of Pondicherry before meeting the Bay of Bengal. Cauvery is also known as the *Dakshina Ganga*[2] or "the Ganges of South India", reflecting the sacred status of the river. There is a large number of temples built along the river, signifying its religious and cultural significance. Due to great dependence on the river for drinking water and irrigation, Cauvery has been a subject of myth and legend in all parts of the basin, and finds unbridled citation in music, poetry, literature, and folklore of the region.

1.2.1. The Course of the Cauvery

The Cauvery originates from a spring at Tala Cauvery on the Brahmagiri Range in the eastern aspect of the Western Ghats, at an elevation of 1,341 m (4,400 ft) above mean sea level (Fig. 1.1). This is in the present Kodagu (Coorg) district of the State of Karnataka. Physiographically, the basin can be divided into three parts, namely, the uplands in the Western Ghats, the plateau region of Mysore, and the delta in Tamil Nadu and Pondicherry. It can be further divided into five zones depending on the relief structure (Fig. 1.2). The Mountainous Region, ii) The High Plateau Region also known as the Mysore Plateau, iii) The Transition Zone, iv) Riverine Plain, and v) the Deltaic region.

In the Western Ghats range, the river flows through forested slopes and coffee plantations till it reaches plain grounds at Bhagamandala. The uppermost course of the Cauvery flows through the rocky beds and high banks under flourishing vegetation. It passes through a narrow gorge and after plummeting 18-24 m in the rapids of Chunchankatte, the river widens to 275-365 m on the Karnataka plateau. There, its natural flow is intervened by a number of anicuts or weirs. At the expanse of the Krishnarajasagara reservoir in Mysore district of Karnataka, the Cauvery meets its two tributaries, the Hemavathi and Lakshmanathirtha (GoK 1992, Guhan 1993, http://waterresources.kar.nic.in). The dam stores water in a 31 sq km reservoir for irrigation in Karnataka. Here the river bifurcates twice, forming the sacred islands of Srirangapatnam and Sivasamudram, which are 80 km apart. Around Sivasamudram are the scenic Sivasamudram falls, comprising two series of rapids, Bhar Chukki and Gagana Chukki, plunging 98 m and reaching a width of 305 m in the rainy season. There is a hydroelectric power plant here that supplies electricity to the cities of Mysore and Bangalore, as well as the Kolar Gold Fields, more than 150 km away.

Upon entering Tamil Nadu, the Cauvery continues through a series of twisted wild gorges until it reaches Hogenakkal falls and flows through a straight, narrow gorge near Salem. There, the Mettur dam, 1.6 km long and 54 m high, impounds the Stanley reservoir of 155.4 sq km area. The Mettur project, completed in 1934, created an important agricultural and industrial area by improving irrigation and providing hydropower (Benjamin 1971).

After flowing past the historic rock of Thiruchirappally, the Cauvery breaks at Srirangam Island, an important pilgrimage centre. The Thanjavur district of Tamil Nadu marks the beginning of the braided and extensively irrigated delta region of about 10,360 sq km. The Grand Anicut was built in the 2nd century at the point where the river divides. A second anicut (1836-38) across

the Coleroon, the northern and larger channel, saved the old system from silting and extended irrigation. The open roadsteads of Nagapattinam and Karaikkal are on the seaward side of the delta. The only navigation on any part of the Cauvery course is in basketwork boats. Below the Grand Anicut, and at right angles to it, head regulators are situated for Cauvery and Vennar that branches from it. The branch that retains the name Cauvery finally enters the Bay of Bengal as a small stream (Guhan 1993, Pani 2009) near the ancient city of Puhar or Cauveri Poompattinam. A brief description of the tributaries of the Cauvery is given in Table 1.2.

Table 1.2: The tributaries of the Cauvery

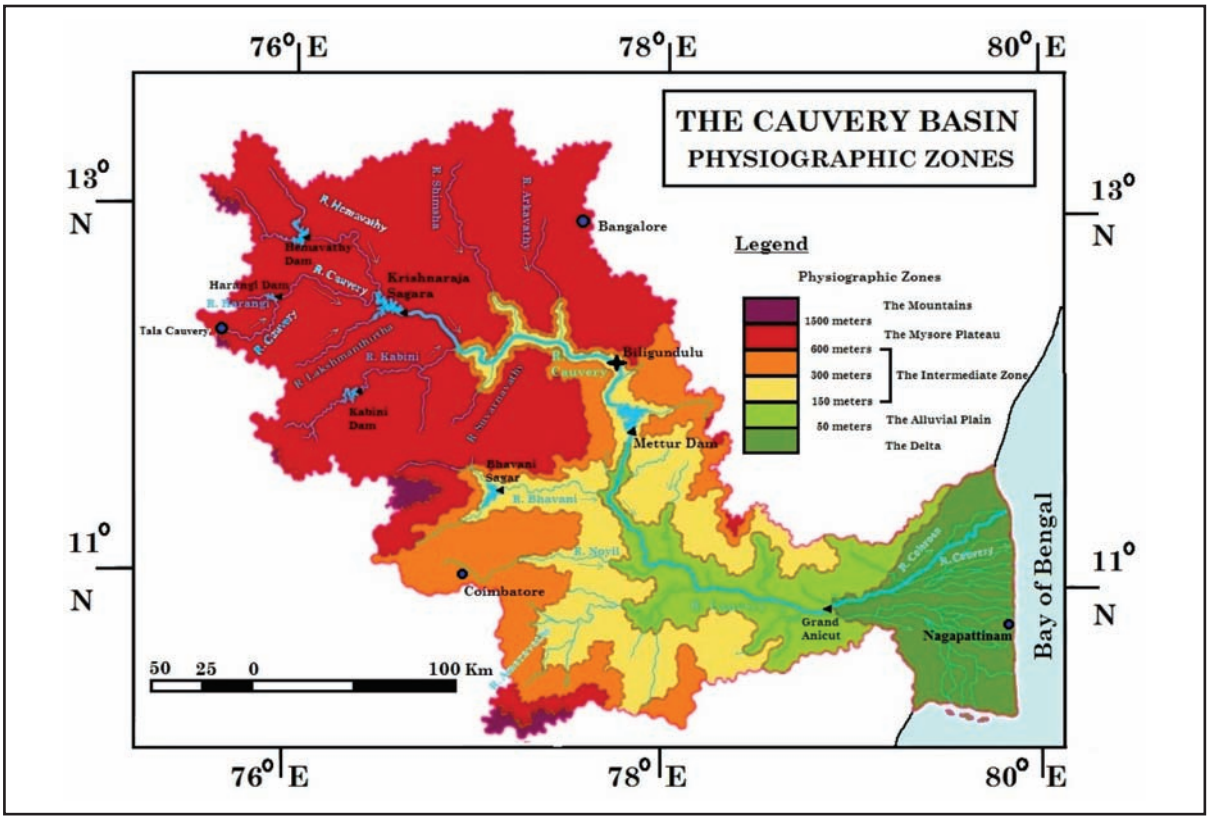
Name of tributary	Origin, Altitude & Length	Sub-tributaries	State (s)
Harangi	Pushpagiri Hills of Western Ghats 1,067 metres 50 km		Karnataka
Hemavathy	Ballarayana Durga in western Ghats, 1,219 metres, 245 km		Karnataka
Kabini	Western Ghats in Kerala, 2,140 metres, 230 km	Taraka, Hebballa, Nugu, Gundal	Karnataka, Kerala & Tamil Nadu
Suvarnavathy	Nasrur Ghat Range, 88 km.		Karnataka & Tamil Nadu
Lakshmanathirtha	Western Ghats, 1,950 metres, 131 km.	Ramathirtha	Karnataka
Shimsha	Tumkur district, 914 meters, 221 km.	Veeravaisnavi, Kanihalla, Chickkhole, Hebbahalla, Mullahalla & Kanva	Karnataka
Arkavathy	Nandidurga 1,480 meters, 161 km	Kumaudavathy, Manihalla & Kuttehole, Vrishabhavathy	Karnataka & Tamil Nadu
Bhavani			Tamil Nadu and Kerala
Amaravathy			Tamil Nadu and Kerala
Noyil			Tamil Nadu

Compiled by the authors from http://waterresources.kar.nic.in/river_systems.htm

1.2.2. Districts in the Cauvery Basin

The Cauvery basin is spread over 10 districts in Karnataka: Hassan, Tumkur, Mandya, Mysore, Chamarajanagar, Kodagu, Kolar, Bangalore (urban), Bangalore (rural), and Chikmagalur. In full or partly, 15 districts of Tamil Nadufall within the Cauvery basin: Perambalur, Thanjavur, Nagapattinam, Thiruvarur, Pudukottai, Namakkal, Thiruchirapally, Karur, Erode, Cuddalore, Salem, Dindigul, Coimbatore, Dharmapuri and Nilgiris. While upstream Karnataka and downstream Tamil Nadu are the major States staking their claim on the Cauvery water, the State of Kerala and Union Territory of Pondicherry also benefit in a minor way from the Cauvery waters.

Figure 1.2: The Cauvery River Basin: Physiographic Zones



Source: Modified by the Authors from Cauvery Basin by India WRIS and Physiographic Map of India from water-atlas.blogspot.in, 2017

1.3. Rainfall

The Cauvery basin receives rainfall from both the monsoons of South India – the south-west (SW) monsoon (June-September), and the north-east (NE) monsoon (November-January). There is no precipitation in the form of snow. The SW monsoon generates heavy precipitation in the uplands of the basin in the Western Ghats, where the main river and its tributaries in Karnataka originate. However, the rainfall rapidly declines further downstream, eastward to the plains in the rain-shadow of the Western Ghats. On the other hand, the eastern and lower parts of the basin in Tamil Nadu receive the major portion of the rains from the north-east monsoon. In other words, the contribution of the southwest monsoon declines from two-thirds in the upper reaches to almost one-third in the lower reaches (Figs 1.4 and 1.5). In total, there are 224 rain-gauge stations in the Cauvery basin, reporting to the Indian Meteorological Department. These stations are more or less uniformly distributed over the entire basin (CWDT 2007b).

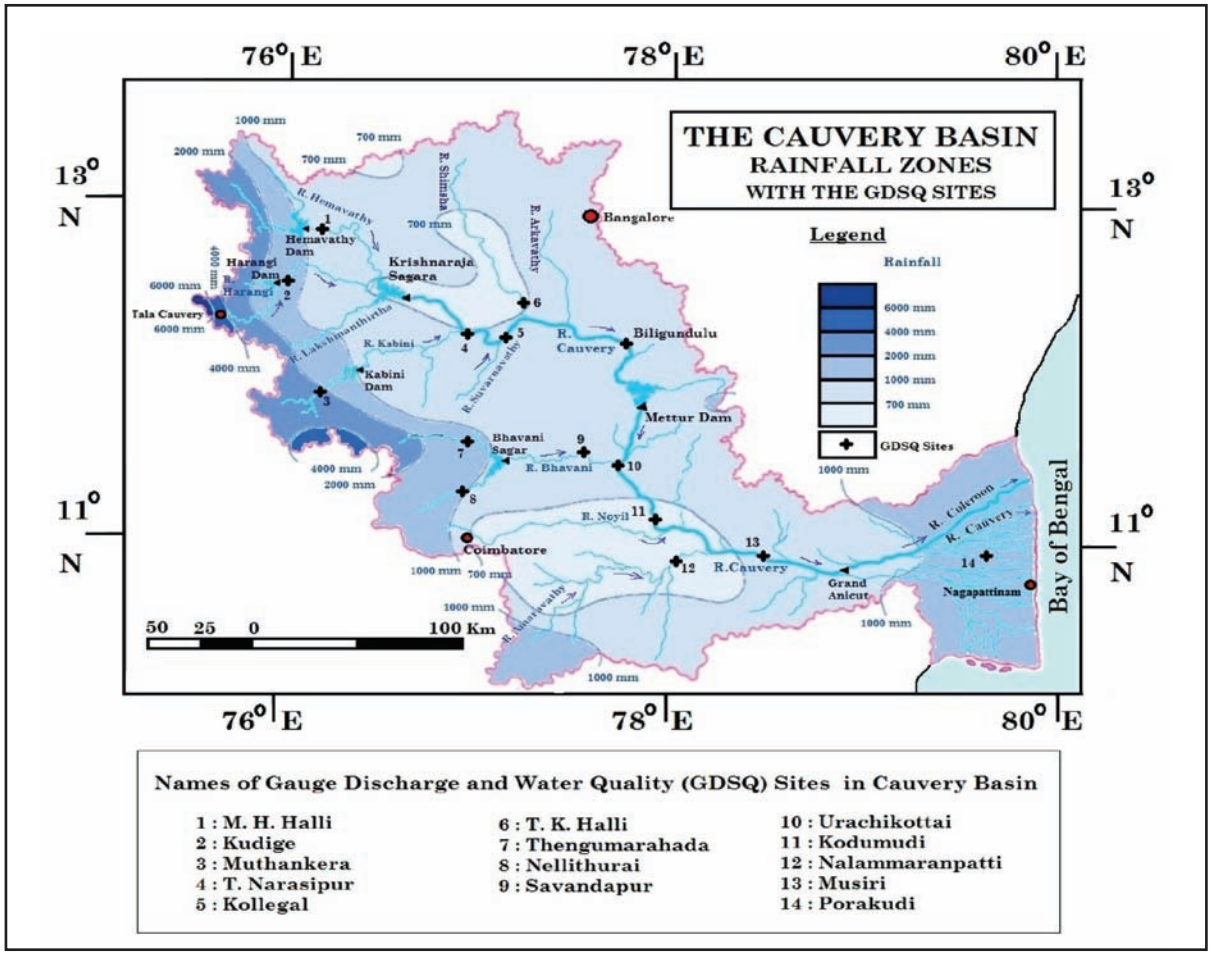
Thus, the rainfall pattern and periods vary across the basin. The eastern part of the basin, the districts under the mountainous regions of the Western Ghats and the Nilgiris receive the highest rainfall (Fig 1.5). The middle part of the basin, the plateau region and the rolling uplands downstream, receive little rainfall as this part is situated in the rain shadow region of the Western Ghats. As the river Cauvery moves towards the delta, the average annual rainfall starts to increase again, as the delta region receives rainfall from the northeast monsoon. The part of the basin in Kerala receives an annual rainfall of 2,873 mm. In the high ranges of the Western Ghats

the annual precipitation can be as high as 4,435 mm, as at Vayithri in Kozhikode district but is as low as 1,348.9 mm at Marayur in the Kottayam district (CWDT 2007 b).

Overall, the basin receives the maximum rainfall in the district of Kodagu during the southwest monsoon, due to its altitude. The highest rainfall in the Tamil Nadu part of the basin is received from the southwest monsoon by the Nilgiris, where the average annual rainfall at Devala is about 4,045.8 mm. Both the southwest and the northeast monsoons are of great importance to the basin. The north-east monsoon is the prime source of water for tanks in Tamil Nadu, where the topography and soil types favour their construction and use as storage. Apart from the two monsoon periods, some rainfall takes place in all the districts of the basin, during the hot months (March-June). In the Nilgiris, substantial rainfall takes place during that period.

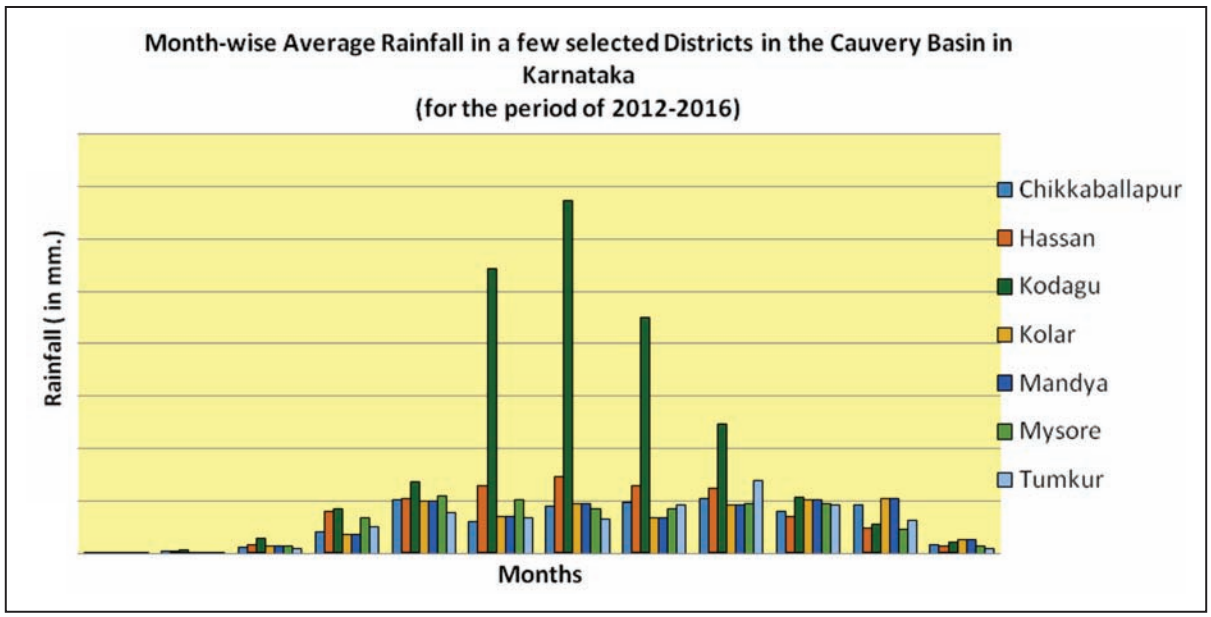
As shown in Fig 1.5, the northeast monsoon provides the major share in the annual rainfall in the Tamil Nadu part of the Cauvery basin. Figs. 1.4 and 1.5, showing the district-wise rainfall patterns have been compiled from the rainfall data obtained from the Drought Monitoring Cell, Government of Karnataka (dmc.kar.nic.in) and the various volumes of Season and Crop Report, Department of Economics and Statistics, Government of Tamil Nadu. In sum, the Cauvery basin up to the Mettur dam is almost entirely dependent on the south-west monsoon. Further downstream, the north-east monsoon plays the role of major water supplier, which sometimes also cause floods.

Figure 1.3: Precipitation zones in the Cauvery basin



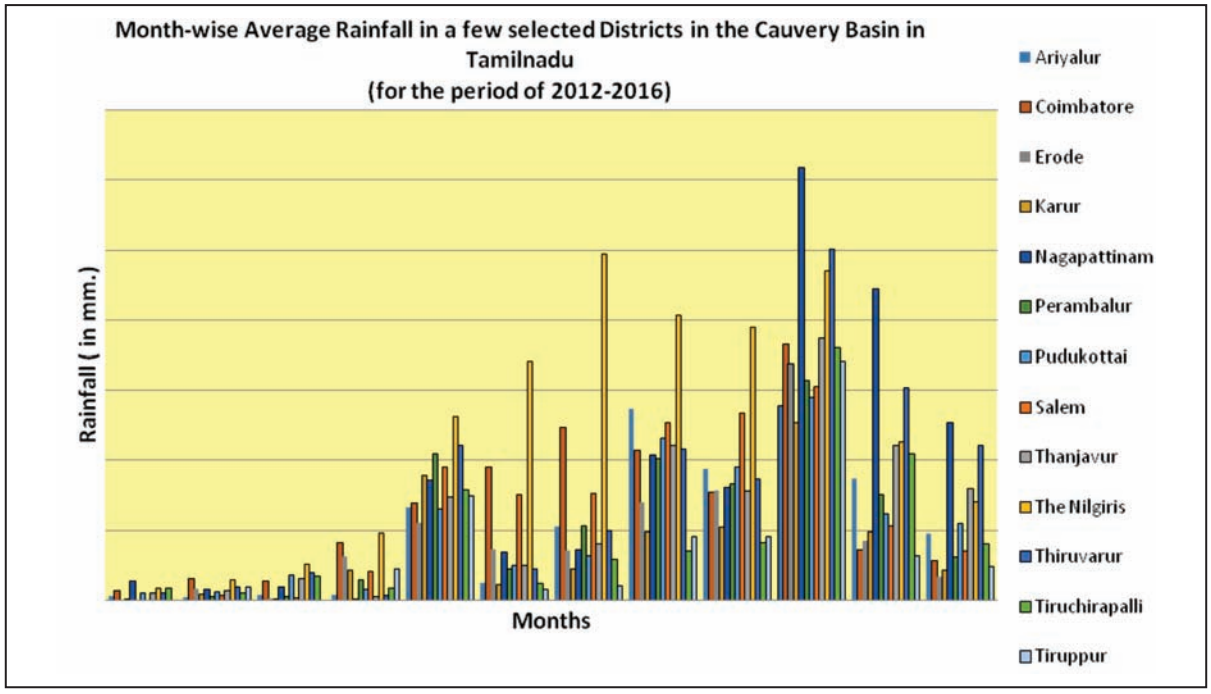
Source: Modified by the Authors from Cauvery Basin by India WRIS and Isohyet Map of India from IITM, Pune, 2002

Figure 1.4: Average Precipitation in selected districts of Karnataka under Cauvery Basin (2012-2016)



Source: Estimated by Authors from IMD data

Figure 1.5: Average Precipitation in selected districts of Tamil Nadu under Cauvery Basin (2012-2016)



Source: Estimated by the Authors from IMD data

1.4. Water availability status and Population in the Cauvery Basin

According to the Central Water Commission (2002) and International Water Management Institute (2005), the Cauvery has a total renewable surface runoff of 21.4 cu km. The potentially utilisable water in the basin (including surface and ground water), is about 27.8 cu km

(Amarasinghe, 2005). The total population in the basin in 2011 was 38.76 million, with a density of approximately 478 persons per sq km (as estimated by the Authors from Census Report, 2011) of whom about 70 percent are rural (UN, 1999). According to per capita water availability, the figure for renewable surface water resources per capita stands at 676 CuM, while that of potentially utilisable water resource per capita stands at 878 CuM. Both these figures imply that in terms of the Falkenmark indicator (Falkenmark et al., 1989), the water endowment of the basin falls under the category of chronic scarcity. However, while the public image of the conflict on water of Cauvery is of a situation of scarcity, as described in terms of arithmetical hydrology (Ghosh 2016), the underlying reality is not simple.

1.5. Soils

The soil type in the Cauvery basin has varying characteristics. The principal soil types are black soils, red soils, lateritic soils, alluvial soils, forest soils, and mixed soils. Red soils occupy a large part of the basin, beginning from southern Karnataka plateau to Coimbatore and Salem districts of Tamil Nadu.[3] The clayey red soils of Coimbatore are fertile, but the sandy red soils in Mysore are not able to retain moisture significantly and are unable to sustain a good crop after the southwest monsoon. However, the Mysore district has been endowed with loamy alluvium to a certain extent, though the same is primarily found in the delta region in Tamil Nadu, comprising Nagapattinam, Tiruvarur and Thanjavur districts. The delta soils retain moisture, which has a positive impact on the groundwater potential, while the hard soils of Karnataka allow water to run off (MoWR 2004a).

1.6. Irrigation and Cropping Pattern

The cropping pattern along the stretch of the Cauvery in Karnataka consists of paddy, sugarcane, finger millet (Ragi) and some other irrigated and dry crops. In the old delta region of Tamil Nadu, paddy cultivation has been well established for centuries. Overall, today paddy is the principal crop in the basin. In a majority of the districts in Karnataka, paddy is grown in three seasons: Kharif (growth period coinciding with the south-west monsoon), Rabi (winter crop, which coincides with north-east monsoon), and summer (growth period is April to July). Despite claims of a two-crop system of paddy cultivation at the basin level by Guhan (1993), district-level data from the Department of Economics and Statistics (DOES) reveal that three crops of paddy are being harvested over the year, with growing seasons of varying length. Therefore, paddy seasons in Tamil Nadu have often been classified by the DOES in terms of sowing seasons. These involve: Samba/ Thaladi/Pishnam (sowing season ranging from August to November), Navarai/Kodai (sowing season ranging from December to March), and Kar/ Kuruvai/ Sornavari (sowing season ranging from April to March). Kuruvai (June-September) is the first crop, and is followed by Thaladi (October-January). The Samba is a long-duration crop and is prominent in the basin. Samba/Thaladi/Pishnam has the highest acreage as it gets support from the northeast monsoon rains, which provides the highest downpour over the state (Guhan 1993).

1.7. About the volume

While this chapter intended to set the premise for an informed discourse on the Cauvery, the objective of the volume is to present the multiple facets of the conflict and the opportunities that have evolved with the Supreme Court's judgment. While the challenges are causing strain to the hydro-political relations between the states in the basin, they also pose threats to the overall environmental security. The subsequent chapters build on this premise. Chapter 2 discusses the history of the water conflict. Chapter 3 narrates the economic crux of the conflict. Chapter 4 relates the reader with the inadequacies of the existing provisions in the Indian statutes in dealing with such acute interstate conflicts like the one of Cauvery, where states have divergent definitions of property rights. Chapter 5 then analyses the Final Award of the Cauvery Water Disputes Tribunal, and criticises its embedment in the reductionist engineering paradigm. Chapter 6 is dedicated to an analysis of the Supreme Court's verdict in the context of this conflict, the opportunities that the verdict opens, and how to conceptualise the structure of the Cauvery Water Management Authority (CWMA). The volume concludes with Chapter 7, where the authors recommend some viable modes of resolving the dispute.

2 History of Irrigation and Disputes in the Cauvery Basin

2.1 Irrigation Development and Hydro-politics in the Cauvery Basin from pre-1892 to 1990

The dispute over Cauvery is based on conflicting claims by Karnataka and Tamil Nadu on irrigation waters from the river. To understand the conflict better, it is important to study the cropping schedule and history of development of irrigation in the Cauvery basin. There are four broad phases in this development:

Phase 1: Prior to the agreement of 1892 between Madras Presidency in British India (now primarily Tamil Nadu) and the then princely State of Mysore (now primarily Karnataka).

Phase 2: 1892 to 1934, when Mettur Dam was constructed in Madras Presidency. This phase also witnessed another agreement between the two concerned parties in 1924.

Phase 3: 1934 -1974, from the Mettur to the end of the agreement of 1924, in 1974.

Phase 4: 1974 – 1990 after the lapse of the 1924 Agreement.

These phases, more or less, coincide with the hydropolitical developments in the basin. Such a division has been prevalent in the literature on the history of hostile hydropolitics in the basin (e.g. Guhan 1993, Benjamin 1971, Richards and Singh 1996, Iyer 2003, CWDT 2007 b, Ghosh and Bandyopadhyay 2009, and Pani 2009).

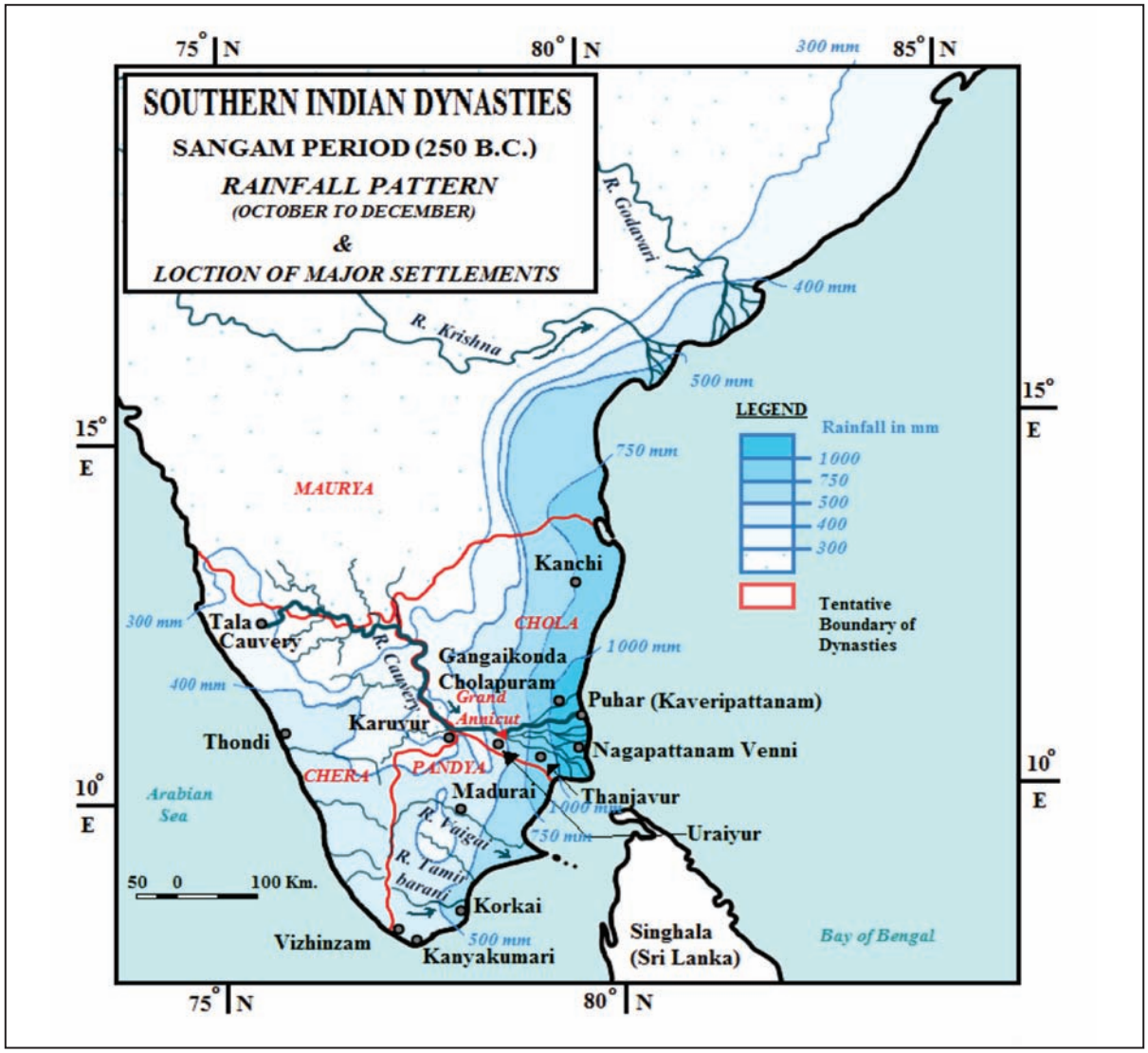
2.1.1. The phase prior to the Agreement of 1892

Records of the development of irrigation systems in Tamil Nadu exist for at least the last 1,800 years. There was massive agrarian expansion during the rule of the early and later imperial Chola dynasty (c. 0400 BC- 0200AD and 0900-1270 AD) in present-day Tamil Nadu, and particularly in the areas belonging to the Cauvery basin.[4] The Kallanai Dam or the Grand Anicut is believed to have been constructed by the early Cholas around 200 AD.[5] Most of the canals from the Cauvery river were built during the reign of the later Cholas, e.g. Uyyakondan canal, Rajendranvaykkal, and Sembian Mahadegvivaykkal (Sastri 2002).[6] The deltaic part of Cauvery basin receives rainfall of more than 1,000 mm, with most of it received during the period of October to December (Fig. 1.5) under the influence of the NE Monsoon. The NE Monsoon has had an effect on the rainfall, agricultural patterns and growth of settlements in the districts of the

Cauvery delta since ancient times. Flourishing agriculture supported by canal irrigation led to the growth of large human settlements (Fig. 2.1), which were also the seats of power for the local dynasties. Thus, the traditional irrigated agriculture of Tamil Nadu based itself mostly on the NE monsoon and local canal supplies. The situation changed with the intervention of the engineers of the Madras Presidency in this region.

This was followed by the Stage of Regulation (1850-1902) which was marked by creation of sluice gates and new canals to distribute the water of Cauvery throughout the erstwhile Tanjore district (present Thanjavur, Thiruvarur, and Nagapattinam district of Tamil Nadu) (Bohle, 1983, p.36). These developments resulted in extensive increase of acreage of crops (mainly paddy) and concomitantly in agricultural productivity, in the deltaic region of the Cauvery basin in Madras Presidency (Raju, 1941, p.130).

Figure 2.1: Precipitation from North-East Monsoon and historical settlements in Cauvery Basin



Source: Modified by the Authors from Menon (1967)[7] and PMF IAS (2018)[8]

In the process, the area under paddy cultivation increased from an average of 230,000 Ha./ year in the period of CE 1800-1850 to 315, 000 Ha./year in the period of CE 1850-1902 (Bohle, 1983,

p.41). This marked the beginning of Tamil Nadu's dependence on irrigation for securing paddy production on the perception of assured supplies from upstream. Essentially, the search for new water sources for meeting the increasing irrigation demand forms the background of negotiations between the upstream princely State of Mysore and Madras Presidency, leading to the Agreement of 1892.

The cropping pattern in Karnataka (erstwhile Princely state of Mysore) is different from that of Tamil Nadu. This is mainly due to the difference in precipitation pattern, topography, and soil. The irrigation system of Karnataka was mostly dependent on tanks that were sponsored by the local rulers and maintained by the village council and temple authorities. Small channels were dug from those tanks to irrigate the local fields. There was a difference in mode of irrigation and dependence of different types of crops and forms of agriculture in the two states. While Tamil Nadu was a rice producing region, Karnataka traditionally cultivated less water-consuming crops like diverse millets, especially Ragi. Prior to the colonial era, no serious conflict for the water of Cauvery emerged. However, the Colonial advance in the region and their economic interests changed the situation.

It was in the middle of the 19th century that Mysore also thought of developing its irrigation potential in the Cauvery basin. Mysore realised that irrigation by inundation was not possible due to the nature of the soil, undulating terrain, and the direction and the steep descent of the river. The situation was just the opposite for the lower parts of the basin, in present-day Tamil Nadu, where supply was augmented by the several tributaries, and the supplemental precipitation from the N-E monsoon. Soil conditions also proved extremely conducive for retention and re-charge of water. Soil fertility was accentuated by the rich alluvium brought down by the rivers.

By the late 1880s, the state of Mysore decided to implement major additions to their irrigation potential. This decision alarmed the engineers of Madras Presidency, who felt that increased exploitation of the Cauvery waters by Mysore would harm paddy cultivation in the Cauvery delta. Such concerns became more acute by the end of the 1890s, which led to exchanges of proposals and counter-proposals. Finally, the stalemate was broken by the signing of the 1892 agreement by the two parties (Gebert 1983, Richards and Singh 1996). The Kuruvai paddy in Tamil Nadu matures in late June or early July, and the Kharif paddy of Karnataka gets sown in around the same period. If there is any shortfall in early SW monsoon precipitation or a delayed arrival of the SW monsoon, the demands of the two states conflict with each other. This is the crux of the century-long conflict over Cauvery waters and the basis of the agreements that were to be negotiated.

2.1.2. The Agreement of 1892

The Agreement of 1892 was entitled “Rules Defining the Limits within which No New Irrigation Works are to be constructed by the Mysore State without Previous Reference to the Madras Government”. The Schedule A of the Agreement presented the list of tributaries that were under the purview of this Agreement. With a host of restrictions placed on Mysore over irrigation works, the agreement presented itself as a moral victory for the Madras Presidency,

which was the lower riparian (Gebert 1983). Mysore was prohibited from constructing any structures for irrigation development, without providing full information to, and obtaining the consent from the Madras government. For its part, Madras bound itself not to refuse consent "... except for the protection of prescriptive right already acquired and actually existing, the existence, extent and nature of such right and the mode of exercising it being in accordance with the law on the subject of prescriptive right to use of water and in accordance with what is fair and reasonable under all circumstances of each individual cases" (Guhan 1993).

The agreement of 1892 provided the first framework between two riparian States for the management of water in the basin by consultation for dispute settlement. The rules under this agreement came to be known as "Irrigation Works in Mysore State – the Madras-Mysore Agreement of 1892" (Hussain 1972, Gebert 1983, Guhan 1993).

2.1.3. Phase 2: 1892 to 1934

Over time, each state found the 1892 agreement prejudicial to their respective irrigation interests. Mysore felt that irrigation development in its territory was being throttled by the undefined prescribed right of downstream Madras. Meanwhile, Madras was of the view that it was being deprived of its share in the surplus waters by upstream Mysore. The 1892 agreement, being silent on the issue of surplus waters, left substantial scope for confusion and disputes when individual cases came up. Eventually, phase 2 was marked by negotiations and arbitrations.

Conflict arose in 1910 when Madras Presidency received plans from Mysore for the construction of the Krishnarajasagara dam. As if to repeat history, Madras reacted to prevent the construction. Being the lower riparian, it found its counterpart's attempt at irrigation development as prejudicial to its interests. At the same time, Madras also put forward its own proposal to construct the Mettur dam, but the project did not receive approval from the Government of India, pending the settlement of the disputes. An arbitrator, appointed by the Government of India in 1913, approved Mysore's project. Madras lodged a protest before the Government of India, which upheld the arbitrator's award in 1916. Madras then appealed to the Secretary of State for India. Clear conflicts of interest between the two States, and the arbitrators' failure to conciliate, could have aggravated the situation, but the agreement of 1924 saved the situation (CWDT 2007 b). The 1924 agreement was initiated at the instance of the Secretary of State, who asked for a reopening of the negotiations in November 1919 (Hussain 1972).

The agreement of 1924, entitled the Final Agreement between Mysore and the Madras Governments in regard to the construction of a dam and reservoir at Krishnarajasagara, was formally concluded by the two state governments. Under the agreement, Madras concurred with the construction of the dam and reservoir at the Krishnarajasagara (KRS)—with a height of 124 ft above the riverbed and with an effective capacity of 44.83 thousand million cubic feet (tmc). Mysore was supposed to regulate the discharge of the river through and from the KRS reservoir, strictly in accordance with the 'Rules of Regulation' annexed to the agreement (Guhan 1993, CWDT 2007b). In addition to the extent of permissible additional irrigation, both the states were supposed to limit their irrigation within a given benchmark. It is with this agreement that

the size of the Mettur reservoir was also fixed at 93.5 TMC, with which Madras was supposed to limit the new area irrigation to 121, 863 hectares.

This agreement initiated the irrigation development in the Cauvery basin. The KRS was completed in 1931, while the Mettur was completed in 1934. In the three decades before the completion of these projects, there was no remarkable development in storage and irrigation. Although, the foundation stone for KRS was laid in 1911, construction proceeded only after the Agreement of 1924. Mettur, on the other hand, was initiated in 1926.

With the initiation of the Mettur project, the irrigated area was to increase by 301,000 acres (or 121,863 hectares) in the erstwhile Thanjavur district, through the Grand Anicut canal, on which work had also started in 1926. The canal had its substantial portion thrown open in 1933 (Benjamin 1971, Guhan 1993).

2.1.4. Phase 3: 1934 - 1974

This period witnessed a rapid expansion of irrigation facility in both the States. In between this expansion, India achieved independence in 1947 and, some years later, the states were reorganised in 1956, largely on the basis of language. The former princely state of Coorg, from where the river originates, then became part of Karnataka, and some areas of Malabar in Madras State became part of the state of Kerala (MoWR 2004b). The linguistic divide added to the sensitivities around Cauvery: Kannada became the language of Karnataka and Tamil, of Tamil Nadu.

In Karnataka, irrigation from major and medium works under the Cauvery increased from 44,534 ha in 1901 to 121,457 ha in 1930, and further to 178,138 ha by 1971 (Guhan 1993, Government of Karnataka 1985, 1992). About half of this increase in 56,681 hectares is attributable to the new irrigation developments from small reservoirs, anicuts, and channels from small tributaries (Guhan 1993). In Tamil Nadu, irrigation developments were much more rapid and significant. The pre-Mettur extent of 58,996 ha of irrigation was augmented by Mettur to an extent of 129,555 ha, and to an equal extent by projects operationalised during India's First (1951-56) and Second (1956-61) Five-Year Plans. Other projects were initiated along with Mettur—namely, the Amaravathy, the New Kattalai High Level canal, and the Pullambadi canal. Altogether, between 1934 and 1972, Mettur and other projects added 259,109 ha to the pre-Mettur irrigation figures. There was a substantial increase in the area under the second crop, which increased to the extent of 182,186 ha (Government of Tamil Nadu 1971, 1987).

However, such developments in the basin did not happen smoothly. This can be taken as the starting point of almost a century-long conflict over sharing of Cauvery waters for irrigation that still continues between the States of Karnataka and Tamil Nadu. Mysore objected to the Mettur canal, the New Kattalai, and the Pullambadi projects on the grounds that they were not permissible under the 1924 agreement. After long discussions, the projects eventually came to fruition.

2.1.5. Phase 4: 1974-1990

The life of the Agreement of 1924 was 50 years, coming to an end in 1974. Perhaps because the two parties to the 1924 Agreement no longer existed, there was no serious effort to arrive at a new agreement in 1974. The problem between the two States of Karnataka (erstwhile Mysore) and Tamil Nadu, thus, worsened. At the same time, the States of Kerala and Pondicherry, which were not parties to the 1924 Agreement, also got involved in the present controversy (Iyer 2003, MoWR 2004b). Since 1974, Karnataka has formally given up any adherence to the rules for operating the KRS, specified in the Agreement of 1924. Karnataka started following a system of ad hoc releases from KRS based on seasonal conditions, their own irrigation needs, and quantum of water impounded in KRS and in the new reservoirs that came into being, including Suvarnavathy, Kabini, and Hemavathy (Guhan 1993). Such a position is close to the theory of Absolute Territorial Sovereignty (Harmon doctrine) for river basin governance.

Not being bound by any commitment after the lapse of the agreement of 1924, Karnataka was left unconstrained in expanding its irrigation potential. The process was initiated in the late 1950s, and in the subsequent years the projects that were started included those on Suvarnavathy in 1965 (came into effect in 1973), Hemavathy in 1968 (came into effect in 1978), Varuna canal (an extension of KRS) in 1979, and Yagachi in 1983 (Government of Karnataka 1985).At least four projects were completed in the 1980s, including Gundal (completed in 1980), Suvarnavathy (1984), Nallur Amanikere (1987) and Teetha (completed in 1987, and benefitting the district of Tumkur in the Cauvery Basin) (Government of Karnataka 2005).

In Tamil Nadu, the phase was marked by developments to a number of small schemes in sub-tributaries in the dry areas of Dharmapuri, Salem, Periyar, Dindigul, and Thiruchirapally districts. Thirteen such schemes have a total irrigation potential of 20,243 hectares, and a total estimated utilisation of about seven TMC. The total requirement for the existing major and medium irrigation schemes in Tamil Nadu adds up to 501.5 TMC.

Table 2.1 presents a summary of irrigation development in the two states in the Cauvery basin between 1901 and 1990, while the trends in utilisation of the Cauvery waters in the two states are shown in Table 2.2.

Table 2.1: Summary of Cauvery Irrigation Development in the two States

State	Year	Command Area (gross '000 hectares)	Estimated utilisation/ Requirement for Utilisation (TMC)
Karnataka	1901	45	27.2
	1928	45	27.2
	1971	179	110.2
	1990	866	322.8
Tamil Nadu	1901	544	366.9
	1928	585	391.2
	1971	1024	494.6
	1990	1045	501.5

Source: Computed by Authors from CWDT (2007b)

Table 2.2: Trends in utilisation of the Cauvery Waters in the two States

Utilisation	1934-70	1970-80	1980-90
Share of Karnataka in total utilisation (per cent)	22.9	27.6	42.2
Share of Tamil Nadu in total utilisation (per cent)	76.4	71.6	57.1
Share of Karnataka's utilisation in yield above Mettur (per cent)	28.7	36.8	54.7
Inflow at Mettur (TMC)	378.4	324.6	229.0
Inflow at Mettur as proportion of yield above Mettur	70.7	62.6	44.7

Source: Guhan (1993)

2.1.6. Developments in the period 1892-1990

- Mysore conceived of the KRS primarily to store the flow of Cauvery, as the area lies in the rain-shadow of the Western Ghats, and received less precipitation compared to the princely state of Coorg. The rainfall pattern shown in Fig. 2.1 clearly reveals the higher precipitation at Coorg, as compared to the other districts in the Cauvery basin.

- As shown in Table 2.1, Tamil Nadu's irrigation was well-developed in terms of gross area irrigated, and developed even further after the 1930s. With the operationalisation of the Mettur dam. Karnataka was a relatively late starter in irrigation development, and its ayacut (command area) increased only after the treaty phase of 1924 ended.

- The end of the treaty period in 1974 marked the end of the so-called British irrigation system. Karnataka, which has been arguing on the basis of absolute territorial sovereignty since the late '50s, started applying the Harmon doctrine to divert more water from the Cauvery, for its agricultural fields.

- Karnataka's increasing diversion diminished the water inflow to the Mettur both, in absolute terms and in terms of proportion of yield above Mettur, thereby directly affecting downstream Tamil Nadu's agricultural systems (see Table 2.2).

2.2. The Current Dispute

Pushed by the rapid expansion of irrigated paddy in Karnataka and the steady growth in the same in Tamil Nadu, the dispute over the sharing of Cauvery waters between the two States became acute over time, especially after the conclusion of the agreement in 1974. By that time, the States of Kerala and Pondicherry, which were not parties to the 1924 Agreement, had also got involved as minor stakeholders (Iyer 2003).

Despite decades of intermittent talks between Karnataka and Tamil Nadu, no agreement was reached. There were attempts by the Government of India to facilitate a new agreement, but they failed to achieve any concrete results. A fact-finding committee, appointed by the GoI, submitted its report in 1972. A meeting of the Chief Ministers of the three riparian states was held in October 1973. For the first time (and probably the last time) in the history of meetings related to water use in India, it was agreed by the three states, that each state should attempt to save

water by managing their demand. Eventually, the saved water was supposed to be redistributed among the states. Additional Secretary in the Ministry of Irrigation and Power was asked to carry out the detailed studies on the scope for reduction in the use of Cauvery waters (CWDT 2007d). During that time, as per the records of water use submitted by the three states to the Fact-Finding Committee and consequent revisions in the data, Tamil Nadu was using 489 TMC of water from the Cauvery, while Karnataka and Kerala were using around 177 TMC and 5 TMC, respectively. The position of Tamil Nadu is close to the theory of prior utilisation in river basin governance. It is evident that two States are following two separate perceptions of property rights in river basin governance. The resolution, therefore, awaits a more homogeneous approach.

It was proposed by the Additional Secretary that Tamil Nadu can save to the tune of 100 TMC of water by improvement and modernisation of irrigation systems (50 TMC), by providing a lined irrigation channel between Upper Anicut and Grand Anicut (20 TMC), and by more intensive use of groundwater (30 TMC). The Additional Secretary also proposed that further savings might be possible in the future through more use of groundwater potential, and storage in tributaries downstream of Mettur and improved pondage capacity upstream of the lower Coleroon /Grand Anicut/Upper Anicut, integrated operation of reservoirs. It was proposed that Karnataka can save to the tune of 25 TMC of water through modernisation of existing systems, improved agriculture and water management practices, and crop diversification (20 TMC), and integrated operation of Mettur, Krishnarajasagara, Harangi, Hemavathy and Kabini reservoirs. Eventually, it was thought that savings of 125 TMC of water can be redistributed among the states as four TMC to Tamil Nadu, 87 TMC to Karnataka, and 34 TMC to Kerala. While the savings were to be implemented over a period of 15 years, the benefits of redistribution would be available only after that (Gebert 1983). There is no such documentation on the basis of the allocation while redistributing the saved water. Apparently, equity principles might have been the consideration, but the basis of the estimates remains unknown. Based on these estimates, a draft agreement was prepared in 1976 (see Table 2.3).

Table 2.3: Water allocation as proposed in the attempted agreement of 1976

State	Water Use of the Cauvery (TMC)	Water Savings by Respective State (TMC)	Saved Water Redistribution between States(TMC*)
Tamil Nadu	489	100	4
Karnataka	177	25	87
Kerala	5	-	34
Total Use	671	125	125

*Source: Authors' own, using Iyer (2003: 40).*Thousand million cubic feet*

At the same time, the attempted agreement also proposed setting up an inter-state Authority for the Cauvery basin. The draft agreement was even announced in Parliament. However, it was a move with a flaw. Since Tamil Nadu was then under President's Rule, it was felt that there should be a popularly elected government in all the states for the draft agreement to come to force. However, the coming of the elected government did not help the cause of the treaty. The parties

rejected the formula offered in the proposed agreement, leading to a stalemate, and reducing the chances for putting an end to the controversy (CWDT 2007 b). By that time, the Cauvery issue became the concern of conflicting State identities of Karnataka and Tamil Nadu, with politicians from both sides contributing to the intensity of the public outcry.

Thereafter, despite repeated efforts by the GoI to resolve the dispute and facilitate discussions between the chief ministers of the concerned States, the dispute remained alive. In July1986, the Government of Tamil Nadu made a formal request to the GoI under the provisions of Inter-State Water Disputes Act, 1956 for the constitution of a Tribunal. The Central Government did not set up the Tribunal immediately, perhaps reckoning that adjudication is not the best means, and a better course of action would be mutual agreement through negotiations. The Tamil media expressed dissatisfaction with such approach.[9] A section of politicians found the GoI to be indifferent to the woes of the Tamil farmers in the basin.

At this juncture, a long-pending petition to the Supreme Court by Tamil Nadu farmers seeking assurance of irrigation water from Cauvery came up for hearing. The Supreme Court, taking note of both the failed negotiations and the pending request from Tamil Nadu for setting up a tribunal, ordered the Government of India to establish a tribunal within a month. The Cauvery Water Tribunal (CWT) was thus set up on 2 June 1990 in accordance with Section 4 of the Inter State Water Disputes Act, 1956. The headquarters of the Tribunal was located in New Delhi. The tribunal finally gave its award in 2007.

The intervening period, however, was not problem-free. Controversy was ignited by an Interim Order (IO) of 1991 passed by the Tribunal, for water sharing till the final award was delivered. There was a plea from Tamil Nadu that pending the adjudication process there was need for assurance of irrigation water. According to the IO passed by the Tribunal, Karnataka was supposed to release 205 TMC of Cauvery waters to Tamil Nadu annually (of which 6 TMC are to go to Pondicherry), and also laid down a detailed monthly schedule of releases. The figure of 205 TMC was arrived at by taking average of the flows of 10 years from 1980-81 onwards, by eliminating the abnormally good and the bad years (Iyer 2003).

While Tamil Nadu wanted the Government of India to immediately notify the ordinance and warrant its implementation, Karnataka was of the view that the order was unfair and cannot be implemented, as it would hurt the interests of the farmers of Karnataka. This forced the Government of India to make a reference to the Supreme Court for its opinion. The apex court gave its opinion in favour of the notification of the Internal Order (IO). Karnataka was of the view that the order was not implementable and made a reference back to the tribunal, which reaffirmed its order, observing that situations of abnormally low flows could be dealt with when they arise, and that a pro rata adjustment could be made (Iyer 2003). However, due to the fact that the Tribunal did not lay down any detailed formula for such contingencies, what were to follow in the decade were problems on various counts with the Internal Order and the flows from the Cauvery during the lean season. For the three successive years after 1990, there were good rains. Tamil Nadu was anxious that the binding nature of the IO should be recognised, till the final Award was declared. With the politics of Cauvery waters emerging as the intensified politics of identity of the states and divide between Karnataka and Tamil Nadu, violence at the

State level also emerged and heightened during the 1990s (Sebastian 1992). Thousands of Tamils and their properties were the target of attack in various parts of Karnataka in 1991 (Ghosh and Bandyopadhyay 2009).

In 1995-96, the SW monsoon rainfall was inadequate. Tamil Nadu went to the Supreme Court seeking an order for the immediate release of 30 TMC of Cauvery waters by Karnataka (calculated with reference to claimed shortfalls in releases) to save the standing crops in Thanjavur. Tamil Nadu was asked to approach the Tribunal with its request. The Tribunal listened to both parties, and ordered the release of 11 TMC to the Mettur Dam. Karnataka did not show any intention to act on the order and the case was taken back to the Supreme Court by Tamil Nadu.[10] The apex court requested the prime minister to intervene, and with the intervention of the latter, Karnataka released six TMC of water (Upadhyay 2002).

However, the apprehension with the implementation of IO of 1991 remained. The Cauvery River Authority (CRA) was set up in 1998, in pursuance of the vision to oversee the implementation of the IO. It consisted of the prime minister as the chair and the chief ministers of the basin States and Pondicherry as the members. This was conceived of essentially as the machinery, augmenting the process of dispute resolution.[11] However, the attempts taken by CRA were without any semblance of a sustainable solution; at best, they could postpone the crisis.[12] The Cauvery Monitoring Committee was set up simultaneously, consisting of the Secretary, Ministry of Water Resources as the chairperson, Chief Secretaries and Chief Engineers of the basin states, and Chairperson, Central Water Commission as Members. The CRA's role was perceived as the regulatory authority in the basin, while its primary responsibility was to oversee the implementation of the IO.

The Tamil Nadu government filed petitions to the Supreme Court in 1992, 1995, 1997 and 2001, praying for a directive to Karnataka to implement the Interim Order of the Tribunal on releasing of the water so that the standing kuruvai paddy crop in the state might be saved (Upadhyay 2002). The kuruvai crop is dependent on irrigation from the Mettur Dam, which in turn receives water from upstream reservoirs in Karnataka. Kuruvai is normally raised on around 30-40 million acres in Thanjavur, Thiruvarur, Nagapattinam and Thiruchirapally districts of Tamil Nadu (Menon and Subramanian 2002). The crop is sown during the months of April to July, and its growth period coincides with the early weeks of the S-W monsoon, i.e., from June to September. The controversy arose in 2002, when the SW monsoon not only failed to arrive in time, but was woefully inadequate. Tamil Nadu approached the Supreme Court, which on 3 September 2002 issued an order to Karnataka to release 1.25 TMC of water to Mettur during September-November (Iyer 2003). In 2004, a similar controversy recurred, but was saved by the strengthening of the monsoon in time.

On 5 February 2007, after a long wait of almost 17 years, the Cauvery Tribunal declared the Final Award. The Tribunal determined the total utilisable waters of the Cauvery for the states on the basis of 50-percent dependability to be 740 TMC (20.95 BCM). In the process, it allotted 419 tmc of Cauvery river water to Tamil Nadu(as against its demand of 562 tmc); 270 tmc to Karnataka(its demand was 465 tmc); 30 tmc to Kerala and seven tmc to Pondicherry. While allocating 726 tmc of water, the Tribunal has "reserved" 10 tmc for "environmental protection"

and four TMC for "inevitable escapages to the sea" (CWDT 2007 b). Between the two major stakeholders, Karnataka and Tamil Nadu, the allocation was far from satisfactory. Karnataka was ordered to release 192 tmc of water (which is 12 tmc more than what was specified in the Interim Order) at the inter-state contact point presently identified as Billigundulu gauge station. The basis of allocation has been rather vague from the point of recent advances in river basin management, whether in terms of the needs of the ecosystems or economic logic.

Drought prevailed yet again in 2012, with a failed monsoon. At the seventh CRA meeting (the first ever after the United Progressive Alliance came to power in 2004), then Prime Minister Manmohan Singh directed Karnataka to release 9,000 cusecs of Cauvery water to Tamil Nadu from Billigundulu. Karnataka failed to comply and was reprimanded by the Supreme Court.

Problems continued in the ensuing period with the notification of the final award of the Cauvery Water Disputes Tribunal (CWDT) in February 2013. In March 2013, Tamil Nadu moved the Supreme Court with a plea for directions to MoWR for constitution of Cauvery Management Board, within a month of the notification of the Award. In May 2013, the Supreme Court directed the Centre to set up a panel to supervise the release of Cauvery water. Almost at the same time, Tamil Nadu moved the Supreme Court, seeking INR 24.8 billion damages from Karnataka for not following orders of the Cauvery Water Disputes Tribunal.

The months of June and July of 2013 witnessed public discontent in various parts of the basin. Karnataka's inability to release 134 TMC of water in June was followed by a contempt plea against Karnataka. Further, there were problems with release of water during July: while Tamil Nadu sought 34 TMC in July and 50 TMC for August to save the Samba crop, Karnataka says that it had already released 34 TMC between June and July 13.

Further, in September 2013, Tamil Nadu Chief Minister Jayalalitha urged the Centre to instruct Karnataka not to take up any further projects on the Cauvery, including hydro-electric projects, without the prior consent of Tamil Nadu. The CM requested for the prime minister's intervention in the proposal of the neighbour State to construct a hydro-power project at Mekedatu. On 13 September 2015, Tamil Naduhad realised only 72.82 TMC of Cauvery water from Billigundulu to Mettur as against the allocated 111.33 TMC, which again created controversy. On 2 September 2016, urging Karnataka to embrace the principle of "live and let live", the Supreme Court asked them to take steps to release Cauvery water to Tamil Nadu to help the State continue to "exist as an entity". Karnataka requested for a modification in the order. On 12 September 2016, in a stern message asking people in Karnataka and Tamil Nadu "to behave", the Supreme Court denied the plea by the Karnataka government to freeze the September 5 order. The court, however, reduced the quantum of daily water release ordered earlier, from 15,000 cusecs to 12,000 cusecs.

It was during this time that the emotive issue of Cauvery waters provoked riots in Karnataka. On 19 September 2016, the Cauvery Supervisory Committee (CSC) ordered Karnataka to release 3,000 cusecs water for the rest of the month, by slashing down the figure by almost 75 percent. In April 2017, Tamil Nadu was faced with one of the worst droughts in a decade only to be aggravated by low release of Cauvery waters from Karnataka. As per the award, Karnataka

should have released 182 TMC between June and December 2016, but it let out only 67.2 TMC. The failure of the north-east monsoon during October-December 2016 has already resulted in the failure of the samba crop; there were farmers who grew despondent enough to commit suicide. Tamil Nadu recorded a 62-percent deficit, with the state receiving only 166 mm of rainfall against the seasonal average of 437 mm.[13] The situation in Karnataka was not any better. The Krishnarajasagara dam had water levels at a 15-year low. There was only seven TMC of Cauvery water left in the reservoir to meet the drinking water needs of 42 towns and cities, including Bengaluru and 625 villages. That demand comes to three TMC every month, with Bengaluru alone accounting for 1.5 TMC. With a seepage and evaporation loss of close to two TMC, the situation looked bleak for Karnataka as well.[14]

The situation started to change in July. Heavy rains in upper catchments of Cauvery led to an increase in flow. In October 2017, the inflow of water in Mettur Dam crossed 40,000 cusecs mark after four years. With a generous monsoon in 2017, the region remained fairly peaceful in the latter part of the year. Yet, the two states are far from arriving at a sustainable solution.

2.3. The Supreme Court Order of February 2018

It is in this background that the Supreme Court ruling on 16 February 2018 was announced. One needs to analyse the importance of this judgment by looking at the historical background that has already been narrated above, the economic rationales behind the conflict, and the legal-constitutional explanation of the conflict. Essentially, the solutions lie in addressing the root causes in a comprehensive manner.

3 The Economic Origins of the Conflict

3.1. The changing acreage of dry season paddy

The intensity of the conflict over the Cauvery water increased with competing demands for water for irrigated paddy during the dry season. As may be inferred from the preceding section, the intensity of the conflict increases during the summer months due to the rise in the acreage of dry season paddy. Ghosh and Bandyopadhyay (2009) have showed that it is scarcity value of water (defined as the potential net value generated when the constraint on water availability is hypothetically relaxed by a unit) that is responsible for aggravated conflict intensity of water in the basin. With more than 85 percent of the water in the 1980s and 1990s going to agriculture, they delineated scarcity value from the perspective of paddy that most dominant and the most water-consuming crop grown in the basin (Ghosh 2009).

As the data reveal, the Cauvery basin as a whole has witnessed a massive increase in agricultural area during the 1980s and the 1990s. This increase happened mostly in the part of the basin in Karnataka, while the area in Tamil Nadu basin remained more or less the same in the 1990s, as compared to the 1980s, as shown by Ghosh and Bandyopadhyay (2009). The acreage decreased in the late 1990s and in the 2000s (see Table 3.1.)

Table 3.1: Gross Sown Area (000 hectares) in the Cauvery Basin Districts

Karnataka							
Year	Dec-81	Dec-85	Dec-90	Dec-91	Dec-98	Dec-06	Dec-13
Gross Sown Area (000 hectares)	2294.14	2232.21	2562.11	2327.98	1956.398	1923.572	1841.511
Tamil Nadu							
Year	Dec-81	Dec-85	Dec-90	Dec-91	Dec-98	Dec-06	Dec-13
Gross Sown Area (000 hectares)	3463.12	3869.65	3734.6	3469.9	2785.191	2260.385	2215.73
Total							
Year	Dec-81	Dec-85	Dec-90	Dec-91	Dec-98	Dec-06	Dec-13
Gross Sown Area (000 hectares)	5757.26	6101.86	6296.71	5797.88	4741.589	4183.957	4057.241

Source: Authors' own, based on district-level agricultural data from data.gov.in , 2017

Ghosh and Bandyopadhyay (2009) conducted a statistical t-test to check on the changes in the decadal means of acreage. The t-statistic revealed that for Tamil Nadu, the mean of the gross sown area in the 1990s is not significantly different from that in the '80s, at five percent levels of significance. For Karnataka, however, the mean of the gross sown area in the '90s is significantly higher than that in the '80s, at five percent levels of significance. This result is an expected one, given the history narrated in the previous section.

In comparison to Tamil Nadu, Karnataka has been a late starter in irrigation development in the basin, and therefore, with increased infrastructure development for water supply augmentation, it brought more land under agriculture. As a comparatively late-starter, Karnataka argues that its farmers have historically been denied justice, unable to claim their rightful share in the use of the Cauvery waters; whereas Tamil Nadu had no such limitation on it in terms of expanding its irrigation facilities from 1990. The position of Tamil Nadu was that its early irrigation development was purely due to natural advantage: flat terrain leading to the natural creation of a delta. Therefore, scholars such as Guhan (1993) agree to the fact that irrigation development brought more land under agriculture.

At the same time, it has been found that in the 1990s, water availability has been a prime mover in terms of higher acreage of paddy, the most water-consuming crop grown in the region The paddy acreage has been increasing with time, with irrigation potential being developed (see Table 3.2). The figures for 1997-98 show an increase in acreage of paddy and decline in all other crops, as compared to those in 1991-92. On the other hand, as Table 3.3 shows, of all the crops grown in the region, the crop water requirement is highest for paddy. There is no doubt that the demand for water for agriculture has increased in the Cauvery basin. Table 7 reveals another interesting fact: the late decline in acreage of paddy cultivation in the Cauvery basin in the 2000s,which seems more of an organic change than anything else.

Table 3.2: Acreages of Major Crops in the Cauvery Basin (1991-92 to 2012-13)

Crop	Rice	Jowar	Bajra	Maize	Ragi	Sugarcane	Total acreage
Area (in hectares) in 1991-92	1136908	394835	77867	51510	664151	181105	2506376
Area (in hectares) in 1997-98	1254082	294698	32453	67460	624288	178073	2451054
Area (in hectares) in 2005-06	1125911	206605	11391	231098	367766	194036	2136807
Area (in hectares) in 2012-13	1000504	190171	3500	352365	435043	130490	2112073

Source: Estimated by authors from the following:

1.Indian Agricultural Statistics 1991-92, Ministry of Agriculture, Govt. of India
2.Official Website of Drought Monitoring Cell, Govt. of Karnataka
3.Season and Crop Report 1991-92, Department of Economics and Statistics, Govt. of Tamil Nadu
4.District based agricultural data from data.gov.in, 2017

Table 3.3: Water Requirements by crops

Crop	Rice	Jowar	Bajra	Maize	Ragi	Sugarcane
Water Requirements (in cms.)	150-250	25-30	30-32	50-80	25-30	60-70

Source: Estimated by authors from Lourduraj and Bayan (1999), Sandhu et al (1980), Zaman and Choudhuri (1995), Prihar and Sandhu (1987), Chattopadhyay et al (2000), and the FAO website http://www.fao.org/landandwater/aglw/cropwater/cwinform.stm (accessed between July 2010 to August 2010)

In Tables 3.1 and 3.2, it is notable that while there was an increase in acreage in paddy in the 1990s, the total acreage of major crops shows an overall downward trend during 1991 and 2012-13. The overall gross sown area has also declined in both states, with the drop being more prominent in the new millennium. This reflects two facts: the declining overall water productivity in the basin, and the demand management compelled by policy interventions as also in an organic form due to declining water productivity. In fact, it has long been argued that the Cauvery water management problem is less an issue of allocation and more of re-allocation (Guhan 1993; Ghosh and Bandyopadhyay 2009). The disputes over the Cauvery waters have erupted primarily during the month of June, when the Kuruvai paddy in Tamil Nadu needs irrigation. However, this coincides with the period of the cultivation of summer paddy in Karnataka, the cropping season of which continues till July.

There are two major sources of water for crop production in the Cauvery basin region: on-field rainfall and the irrigation water supplied from water diverted from the rivers. Incidentally, Ghosh and Bandyopadhyay (2009) find that a non-diminishing scarcity value of water, associated with a significant increase in area under the summer paddy in Karnataka, and the Kuruvai paddy in Tamil Nadu in the 1990s, as compared to the '80s, has been an important contributor to the intensification of the dispute. The late '90s witnessed a significant reduction in the rainfall in Tamil Nadu in June. According to Ghosh and Bandyopadhyay (2009), a non-diminishing scarcity value associated with an extensive increase in the area under paddy, created a situation of a high demand for irrigation water. Therefore, the pressure was on the flows in Cauvery. For a large part of the 1990s, the flow to the Mettur Dam in Tamil Nadu has been lower than that which is prescribed. This is due to the fact that while upstream Karnataka's water use has increased, there has been no significant decline in the scarcity values of water for paddy production in Karnataka.

Overall, in the context of the southwest monsoon that ranges from June to September during the 1990s, the situation can be summarised in Table 3.4.

Table 3.4: Percentage Deviations of South-West Monsoon Rainfall from its Normal in the 1990s

Year	Percentage Deviation from Normal in Karnataka*	Percentage Deviation from Normal in Tamil Nadu**	Deviation from Normal Flow to the Mettur in S-W Monsoon***
1991-92	29.39	7.23	-
1992-93	46.38	25.36	64.06
1993-94	3.23	1.61	-20.73
1994-95	28.90	2.08	65.06
1995-96	32.43	-2.57	-28.14
1996-97	54.88	41.41	-26.27
1997-98	44.43	-11.33	1.72
1998-99	45.78	2.00	-16.26
1999-00	-0.72	-44.04	-26.83
2000-01	49.97	-9.67	-
2001-02	16.41	-25.67	-

Source: Estimated by Authors from

* *dmc.kar.nic.in*

** *Season and Crop Report, Dept. of Econ. And Statistics, Govt. of Tamil Nadu, Chennai.*

*** *Menon and Subramanian (2002).*

The eruption of disputes between the two states over the Cauvery water seems to have a meteorological root—that is, the lack of adequate rainfall from the SW monsoon in the month of June. In Tamil Nadu, the kuruvai crop has a large dependence in June on irrigation from Cauvery waters. In the event of the south-west monsoon arriving late or not bringing normal rainfall in the initial weeks, the dependence on supply of water from the Cauvery becomes vital. In 1992, 1993, and 1994, the rain was adequate to meet the demand in Tamil Nadu and Karnataka. However, in 1995-96, for the first time in the decade, there was less than normal rainfall in Tamil Nadu during the south-west monsoon. In the month of June, rainfall in Karnataka was also less than normal. This resulted in lower flows to the Mettur Dam, as the upstream areas depended more on the Cauvery waters. In 1995-96 the scarcity value of water for Karnataka was the highest in the decade. On the other hand, though scarcity value of water in 1995-96 for Tamil Nadu is not significantly different from its decadal mean (leaving out the outlying rainfall years of 1991-92 and 1996-97, when water uses are the lowest), the water use in 1995-96 is significantly lower than the decadal mean (again leaving out 1991-92 and 1996-97).

In fact, interestingly, despite limitations of low rainfall and low flows to the Mettur during the late '90s, there have been substantial increases in water use for paddy, which have come at the cost of the acreage of some other crops. In Karnataka, however, it is because of the irrigation needs of the summer paddy that the water is needed, and the summer crop period continues till the end of July. It therefore needs the water during June, and whenever the rainfall is low in that month in the Karnataka parts of the basin, the demand for Cauvery waters goes higher. This is the crux of the conflict.

In the post-award period, i.e. after 2007, the situation has not changed much, as Karnataka failed to release water from Billigundulu allotted to Tamil Nadu eight out of nine times in June.

The year 2012-13 seems to be the worst year in this period, when in 10 out of 12 months Mettur had a lower flow than what was ordered by the tribunal (see Table 3.5). Of course this was a year with numerous clashes and dispute over sharing the water.

Table 3.5: Flow (in TMC) above the 2007 Award allotment received at Mettur

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
2007-08	-7.97	52.71	40.73	16.85	26.38	10.03	3.26	-1.74	-1.62	5.03	3.93	5.11
2008-09	-2.65	-29.63	14.25	0.01	16.45	4.76	9.23	-1.26	-1.22	-0.51	0.62	2.48
2009-10	-3.94	5.9	-15.2	15.35	3.27	8.93	2.94	1	-0.26	0.81	3.45	5.45
2010-11	-1.78	-27.28	-26.15	-17.49	2.94	51.27	9.05	1.25	0.42	3.14	7.04	7.78
2011-12	-3.72	-8.78	-18.13	11.22	9.24	16.2	5.2	0.3	-0.82	-0.29	0.86	3.53
2012-13	-7.67	-32.97	-42.85	-22.44	-2.75	-7.09	0.33	-0.73	0.38	-1.92	-2.25	-2.3
2013-14	-1.65	39.89	26.44	-12.67	-4.6	1.98	-3.12	-1.7	-1.63	-0.58	-0.95	2.2
2014-15	-3.22	0.67	7.68	-3.36	15.02	1.07	1.03	-1.73	-2.12	-2.03	-1.02	4.11
2015-16	1.66	-9.27	-27.29	-22.79	-5.15	15.94	1.97	-2.4	-2.23	-2.16		-2.26
Flow from Billigundulu to Mettur allotted according to 2007 Tribunal Final Award	10	34	50	40	22	15	8	7	2.5	2.5	2.5	2.5

Lowest flow in 42 years (recorded since 1975 after the 1924 agreement completed its 50 years) for that month

Highest flow in 42 years(recorded since 1975 after the 1924 agreement completed its 50 years) for that month

Flow from Billigundulu to Mettur deficit than what was allotted according to 2007 Tribunal Final Award

Source: Cauvery Technical Committee Report to SC, Volume 1, Main Report, New Delhi, October 2016.[15]

During this period, the flow from Billigundulu to Mettur was deficit in 48.15 percent of the months. June had the highest frequency of deficit flow (89.89 percent of cases) followed by February and January (77.78 percent and 66.67 percent, respectively). The first time period coincides with the kuruvai crop season of Tamil Nadu and summer crop of Karnataka, while the second time period coincides with the Samba crop season of Tamil Nadu and Rabi season of Karnataka when demand for water is high in both states. Making the situation critical is the fact that the area under Cauvery basin has been going through a period of consecutive droughts from 2012-13, the worst drought years in this period being 2012-13, 2013-14 and 2015-16., May 2013 and April 2016 saw the lowest flow of water from Billigundulu to Mettur in the period from 1975 to 2017. It is noteworthy that the legal conflict between Karnataka and Tamil Nadu also intensified in this period, with the battle focused on the denial of Karnataka to release the allotted water in a cropping season already battling with weak monsoon and scarcity of water for irrigation.

Tables 3.6 and 3.7 show he season-wise paddy acreage over the 1980s till the recent decade in the two states.

Table 3.6: Season-wise paddy acreage in Karnataka (1980-81 to 2013-14)

Year (Time Period)	Average Area Under Kharif Paddy (000 Hectare)	Average Area Under Rabi Paddy (000 Hectare)	Average Area Under Summer Paddy (000 Hectare)
1980-81 To 85-86	261.78	0.64	33.39
1986-87 To 90-91	255.03	6.14	46.22
1991-92 To 95-96	280.55	6.79	65.83
1996-97 To 98-99	287.81	6.78	68.87
1999-2000 To 2002-03	251.86	4.82	42.26
2003-04 To 2005-06	278.86	1.49	50.39
2006-07 To 2009-10	282.90	4.59	55.98
2010-11 To 2013-14	246.79	1.54	23.58

Source: Authors' own, from Drought Monitoring Cell, GoK.

Table 3.7: Season-wise paddy acreage in Karnataka (1980-81 to 2012-13)

Year (Time Period)	Average Area Under Kharif Paddy (000 Hectare)	Average Area Under Rabi Paddy (000 Hectare)	Average Area Under Summer Paddy (000 Hectare)
1980-81 To 82-83	743.04	185.58	2.04
1983-84 To 86-87	718.88	132.17	3.87
1987-88 To 89-90	657.00	32.93	37.21
1990-91 To 93-94	642.96	55.06	89.72
1994-95 To 96-97	671.87	32.63	104.09
1997-98 To 2000-01	860.56	42.92	126.28
2004-05 To 2005-06	680.70	23.02	96.86
2011-12 To 2012-13	614.78	27.53	106.01

Source: Authors' own, from various issues of Season and Crop Report, Directorate of Economics of Statistics, GoTN.

While there has been a tremendous increase in acreages of Summer paddy in Karnataka throughout the 1980s and 1990s, from 2000 onwards there is a declining trend in summer paddy acreage. This reveals that there is an attempt to manage irrigation demand in Karnataka. In fact, it seems that the acreage of irrigated summer paddy has declined in recent times to the beginning 1980 levels, thereby entailing an almost 66-percent decline from the mid-'90s levels.

However, though there is a decline in acreage of summer paddy in Karnataka, there is nominal change in the acreages of irrigated Kar/ Kuruvai/ Sornavari and they remain at mid-'90s levels.

Complicating the problem is that the rapid growth of urban demand for water especially in the city of Bangalore in Karnataka, driven by its burgeoning population, has led to serious thinking on inter-sectoral contentions over water allocation.[16] The Supreme Court order in February 2018 to allocate 14.75 TMC of water to Karnataka for use of Bangalore, is a clear recognition of the need to diversify water needs away from agriculture.

3.2. The Reasons behind movements of acreages

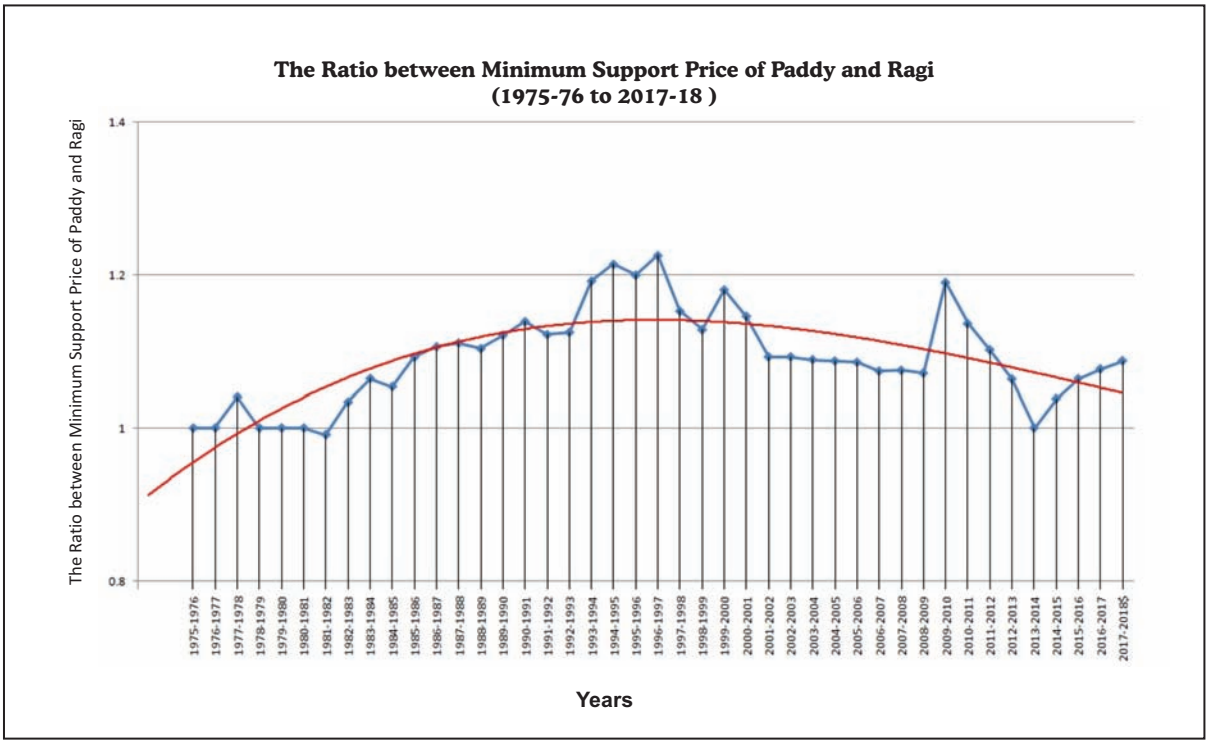
The above discussion highlights that the agricultural practices related to an important summer paddy crop in Karnataka and equally crucial Kuruvai paddy crop in Tamil Nadu are the basis for the dispute over Cauvery waters. With the increasing acreage of paddy, supply augmentation plans made independently by the states are bound to lead to serious conflicts of interest. Though initially Finger Millet (Ragi) used to be a staple crop in the region, its acreage has not increased, despite increases in irrigation potential. The benefits from enhanced supplies have primarily been directed towards paddy. The significant increase in water use for producing paddy in the three seasons is happening because of several reasons. The first involves the changes in the consumption patterns because of the government policies. The movement of production can be attributable to the movement of the prices. If Minimum Support Price is considered as one such price, its movement clearly explains this consumption shift. Ghosh and Bandyopadhyay (2009) find that the mean price ratio in the '90s has significantly increased, as compared to those of the '80s. Thus, the relative incentive for producing rice is higher on the part of the producer, as compared to Ragi. On the other hand, the demand-side situation cannot be ignored. The public distribution system has been selling rice at a much lower price than other staple crops, thereby shifting consumption towards rice through the substitution effect, as was reported in a news in Down to Earth in 2003.[17]

Before the year 1981-82, the ratio between the Minimum Support Price (MSP) for Ragi and Rice was around one, but from 1982-83 to 1996-97 the MSP for Rice started to increase heavily compared to Ragi. After 1996-97, there was another shift where the difference between MSP for Ragi and Rice started to fall. Unfortunately, the area under Paddy as of now is already more than two times that of Ragi (Table 3.2). So, the effect of the phenomenon is yet to be felt and Paddy remains the dominating crop that demands an increasing amount of water in the basin.

The other point is with the fact that the cost of irrigation waters is declining. There have been attempts in the late '80s to significantly revise the irrigation water rates, but that could not be done because of protests from farmer groups (Ghosh and Bandyopadhyay 2009). Therefore, the real cost of irrigation today, has become inconsequential to the extent of making agricultural waters almost a free resource in the basin. This, in no way, can ensure efficient demand-side management of agricultural waters.

On the other hand, that the acreage has been responding to the price ratios is noticeable from the fact that between 2005-06 and 2012-13 there is an overall decline in the acreage of paddy, and there is a gain in the acreage of Ragi (see Table 3.2).

Figure 3.1: The Ratio between Minimum Support Price of Paddy and Ragi (1975-76 to 2017-18)



Source: Authors' own, from CACP database.

4 The Cauvery impasse and legal provisions for inter-state water allocation

4.1. Water in the Indian Constitution

Water is not in the Concurrent List of the Indian Constitution but it is separately mentioned in both the Union List and the State List. In view of this, the role given to the Centre with regard to inter-state rivers and river valleys is important, as can be seen in the use of the provisions of Entry 20 in the Concurrent List. This Entry titled, "Economic and Social Planning", entails the provision by way of which major and medium irrigation, hydropower, flood control and multipurpose projects have been subjected to the requirement of obtaining a clearence from the Centre, for being included in the National Plan. These clearences are sought under the Forest Conservation Act of 1980 with its subsequent amendments (the last one being in 2004) and the Environment Protection Act of 1986. According to Iyer (2003: 23), "...It could plausibly be argued that even under the present dispensation the Centre has significant responsibilities in relation to water, and that it has not in fact discharged those responsibilities adequately".

The 73rd and the 74th amendmentts of the Indian Constitution recognised a third tier in the constitutional structure, and rendered powers to the bodies of local governance at the village and city levels: the village panchayats and the city *nagarpalikas* (municipalities). The local bodies were made responsible for drinking water, water management, watershed development, and sanitation. No doubt that the local-level institution will increasingly play an important role in local-level issues on water allocation and management.

Anand (2004) finds evidence from electoral data that hardline positions over Cauvery waters might have been crucial in determining electoral performance. In Karnataka, he found that the share of assembly members from the Cauvery district constituencies in the state ruling coalition increased significantly over time. Even in the Tamil Nadu legislative assembly, the proportion of members from Cauvery districts increased from 27 percent in 1996 to 31 percent in 2001. In both cases, these are constituencies where the claim for the Cauvery waters and call for not compromising with water from this source had been most audible, thereby resulting in indignance towards negotiated settlements. This explains the "hardline" positions. Though, there is no evidence of any direct causal relation, there are indications that over time, the scope for the present state government to pursue conciliatory measures may have narrowed down due to politicians playing to the "vote-bank" gallery. In the 2018 elections in Karnataka as well, there have been allusions to the Cauvery cause, though any hard conclusion on the basis of scientific enquiry is yet to be drawn.

4.2. Interstate Water Dispute Act 1956 and its Amendment of 2002

The Indian Constitution recognised the problems that might arise from the inter-state rivers, and through Article 262 provided for parliamentary legislation for the adjudication of inter-state water disputes. This was followed up with further vigour through the enactment of the Interstate Water Dispute (ISWD) Act in 1956. Article 262 of the Indian Constitution and the ISWD Act 1956 barred the jurisdiction of the courts (including Supreme Court) in such matters. The Act created the provision of referring any case of water dispute to a Tribunal for adjudication.

While all these provisions functioned well in the initial stages, it was eventually realised in the context of various water disputes that the tribunals had been taking a lot of time to issue their verdicts. As in the case of the Cauvery Water Disputes Tribunal (CWDT) set up in 1990, the Final Award was not declared even after a decade. This has also been the situation with many other inter-state water disputes. Considering these lapsess, amendments were put to effect in the ISWD Act in 2002, specifying the following:

a. A one-year time-limit for the establishment of a tribunal by the Central Government on a request from a State Government;
b. A three-year time-limit for the tribunal to declare its Award (extendable by a maximum of two years);
c. One year time-limit for the tribunal to give a further report if further reference is made to it as provided in the ISWD Act;
d. Moreover, the decision of the tribunal is supposed to have the same force and validity as that passed by the Supreme Court.

4.3. Institutional arrangements and definition of property rights in the Cauvery basin

4.3.1. History, Harmon and Hobbes: who interprets what?

There are two broad principles of allocation of property rights over water: the extreme principle and the moderated principle. The extreme principle of water allocation suggests the existence of three norms: Harmon, History and Hobbes. Harmon refers to the doctrine that bestows primary rights to those who own land at the source of the water (If water falls on my roof, it is mine). History confers primary rights to historical users of water irrespective of their geographical location. Hobbes identifies rights as the final result of awards obtained through negotiations. In the cases of transboundary water disputes, usually the upstream exercises Harmon to divert water for its own use, while downstream sticks to the principle of History and natural rights, in terms of its argument. Finally, the two parties indulge in negotiations.

Moderate Principles are based on the norms of the Helsinki rules, which came up as a result of negotiations among the countries sharing the Rhine basin in Europe. These include, "equitable and reasonable utilisation and participation", and "obligation not to cause significant harm". However, such moderated principles have often been questioned and criticised, as they are difficult to implement.

In the case of the Cauvery basin, Karnataka has long taken the stand that the delayed development of irrigation in that State should not entail any reduction of its rights to make the fullest potential utilisation of the Cauvery waters for agricultural and other development. Its position was based on four basic tenets (Anand 2004).

First, ever since the expiry of the agreement of 1924 in 1974, Karnataka claims that the clauses under the 1924 agreement in its entirety should be deemed to have expired. Essentially, the 1924 agreement was not between Karnataka and Tamil Nadu (from the legal perspective), but between the British-ruled Madras Presidency and the princely state of Mysore. These cannot be identified in their entirety with the present Indian states of Tamil Nadu and Karnataka. Therefore, Karnataka claims that allocations based on that agreement should not determine allocation of waters today.

Second, Karnataka declares that the farmers in the areas belonging to Karnataka in the upper areas have as much right to irrigate and grow crops as do farmers in the lower areas in Tamil Nadu. Karnataka further claims that the 1924 agreement went more in favour of the Madras Presidency because of the higher authority and bargaining powers of the British administration. The so-called prescriptive use of the downstream farmers emerged due to the financial interest of the British administration.

Third, Karnataka also took the position that while it is mainly dependent on the south-west monsoon (June-September) which contributes significantly to the flow in river Cauvery, Tamil Nadu gets two monsoons annually, the south-west (June-September) and the north-east monsoons (October-December), with the latter contributing significantly to the run-off of the Cauvery within Tamil Nadu. Karnataka thus argues that there is an inherent bias in the allocation of Cauvery water in favour of Tamil Nadu. Therefore, any claim on Cauvery waters cannot afford to ignore this unequal distribution of rainfall and the resulting runoff. In other words, Karnataka's grievance also lay with the fact that while Tamil Nadu does not have to share any water from its north-east monsoon, Karnataka is forced to share water from the south-west monsoon with Tamil Nadu – something that they perceive as inherently unfair. Karnataka further asserts that claims over Cauvery waters must be seen in the context of its contribution to Cauvery flow and also its needs in terms of drought-prone area in the basin. Karnataka claims that about 64 percent of the area of the state belonging to the Cauvery basin is drought-prone as compared to 29 percent in the case of Tamil Nadu (Anand 2004).

To summarise Karnataka's position in terms of the principles of property rights, Karnataka tends to assume a primacy of rights over Cauvery waters, and has constructed quite a few storages in the state boundary on the Cauvery basin. Their argument rests on the fact that a downstream state cannot make a claim when there is scarcity of water and inadequacy in upstream areas. Therefore, Karnataka claims to discharge waters to Tamil Nadu only if there is adequate quantity of water to meet with Karnataka's needs. This implies that the position of Karnataka is close to the Harmon doctrine, regarding its understanding of property rights over Cauvery waters.

On the other hand, the lower riparian state of Tamil Nadu feels threatened because its long-established irrigated agriculture in the delta of Cauvery remains under constant risk and

uncertainty from lack of adequate flows. Tamil Nadu feels that the foundation to development of key projects in both the states lies in the 1924 agreement, whose relevance cannot be denied even in today's context. As a result, Tamil Nadu is thoroughly reluctant in completely delinking the 1924 agreement with the present negotiations.

Taking a cue from the 1924 agreement, Tamil Nadu further feels that the long history of farmers in Cauvery delta irrigating and producing paddy should not be forgotten. These prescriptive rights recognised by the 1924 agreement need to be protected. While according to the agreement, the farmers in Karnataka can definitely use the waters, there has to be a limit on the volume of water and area to be irrigated so that upstream water use does not jeopardise the longstanding downstream irrigational uses in Tamil Nadu (Iyer, 2003).

Tamil Nadu has also put forward the argument that an inter-state river is a common property and not a private property of the upstream state. Thus, according to Tamil Nadu, Karnataka's claim that it will release only the excess waters, after meeting its own needs, is untenable (Anand, 2004). At the same time, Tamil Nadu recognises that the basin area contribution to river flow and other factors need to be given the due importance in water sharing. However, this needs to be applied to distribution of waters beyond those needed to meet the prescriptive rights of downstream farmers. Tamil Nadu refuses to consider the arguments of higher drought-prone areas in Karnataka, and the natural endowments of North-East monsoons in Tamil Nadu.

The State intends to obtain clear definition of legal right to a share of the Cauvery waters (Iyer, 2003). To do so, it takes a legalistic stance based on the principle of prescriptive rights as given in the 1924 agreement, which translates to the principle of prior appropriation or the doctrine of historical Use.

4.4. Summary

The conflict over Cauvery is rooted in the diverse perceptions of property rights of States over the river water. The upstream defines its rights in terms of Harmon doctrine, while downstream defines its rights in terms of the doctrine of Historical Use. The Hobbesian negotiation mode of resolution of the dispute has failed so far. The existing statutes of ISWD Act as well as those existing in the Indian Constitution seem inadequate to resolve this perceptional diversity. Often, states have moved to courts to voice their anguish, particularly from the '80s till the passing of the Final Award of CWDT in 2007. A unified perception is essential for any meaningful advance in negotiated settlements. According to Upadhyay (2002), frequent resort to court mediation during that phase was a reflection of the growing politicisation of the parties, relying more on the judicial process to redress grievances, rather than taking recourse to forums especially established for bilateral discussions and negotiations.

The Final Award of the CWDT does not seem to have helped the cause of allocation. The Award not only fails to resolve the conflict, but also fails on scientific criteria of ecosystem concerns, -- factors that are increasingly becoming part of the fundamental principles of integrated river basin management.

5 The Final Award of the Cauvery Water Disputes Tribunal: An analysis

5.1. The Award of the Cauvery Water Tribunal

The Cauvery Water Disputes Tribunal (CWDT) announced its Final Award on 5 February 2007. Before getting into the analysis of the scientific validity of the Award, it is pertinent to understand the basis on which the estimates of water allocation have been made. The assessors arrived at the total yield figure of the Cauvery basin areas within the States of Karnataka, Kerala, Tamil Nadu, and Union Territory of Pondicherry, at 740 TMC, with the assumption of 50 percent dependability. Each of the party State has been allocated its share of water, taking into consideration the total available yield generated in Cauvery basin.

The estimates for allocation consist of four different heads. Out of the 740 TMC, 14 TMC have been apportioned for environmental protection and inevitable flows to the sea—leaving around 726 TMC of water to be allocated among the four riparians. The remaining water was supposed to be allocated mainly for two purposes: irrigation requirement, and domestic and industrial water requirement as projected for 2011. Using crop water requirement for various crops and eventually considering the irrigated area in each of the states, the irrigation requirement was estimated by the Tribunal.

Drinking water requirements were estimated by assuming that the 25 percent of the urban population would need 135 litres per capita per day (lpcd), while 75 percent of urban population would need 100 lpcd. This was done keeping in mind the different categories of cities and towns falling in the Cauvery Basin. With respect to Bangalore city, for the area falling within the basin, 150 lpcd of water was provided. The same assumptions were followed in both the states of Tamil Nadu and Karnataka. As far as industrial water requirements are concerned, the Tribunal estimated the water requirement in 2011 by considering a 100-percent increase from the scenario existing in 1990 (CWDT 2007b).

Eventually, it was found that the total allocation for irrigation was 675.42 TMC, while those for domestic and industrial use were 5.20 TMC. This left a balance of 45.08 TMC of water, which the Tribunal distributed among the four stakeholders on the basis of population in the basin area in each state (or Union Territory) according to the census of 1991.

Table 5.1: Water Allocation from the Final Award (figures in TMC)

	States				Total
	Kerala	Karnataka	Tamil Nadu	UT of Pondicherry	
Irrigation Requirement	27.90	250.62	390.85	6.35	675.72
Domestic and Industrial Water Requirement in 2011	0.35	1.85	2.73	0.27	5.20
Water Requirement for Environmental Protection	-	-	-	-	10.00
Inevitable escapages to the sea	-	-	-	-	4.00
Share in balance water	1.15	17.64	25.71	0.22	740

Source: CWDT (2007b)

The Tribunal stated that in case the yield is less in a distress year, the allocated shares shall be proportionately reduced amongst the States of Kerala, Karnataka, Tamil Nadu and Union Territory of Pondicherry by the regulatory authority.

In terms of institutional arrangement for the implementation of the Award, the Tribunal suggests the constitution of an inter-state Cauvery Management Board (CMB) as the regulatory authority. The CMB shall also set up its machinery and devise a method to determine the quantum of unutilised water to be received from Kerala by Tamil Nadu through Kabini and its tributaries, and ensure delivery thereof in Tamil Nadu at common border (CWDT 2007b). The CMB is "further entrusted with the function of supervision of operation of reservoirs and with regulation of water releases there from with the assistance of Cauvery Water Regulation Committee (to be constituted by the Board)" (CWDT 2007b: Vol. V, 223). On the other hand, the Regulation Committee is entrusted with the responsibility of day-to-day implementation of the provisions contained in the final order of the Cauvery Water Disputes Tribunal in accordance with the directions of the Board.

5.2. Final Award: Checking for Scientific Validity

Initially, when the Interim Order of water allocation was passed by the CWDT in 1991, Karnataka was asked to release 205 TMC of Cauvery waters to Tamil Nadu, and laid down the detailed monthly schedule of releases. The figure of 205 TMC was arrived at by considering the mean of the flows of 10 years from 1980-81 onwards, by eliminating the outlier years regarding annual rainfall. From an eco-hydrological perspective, this was quite ad-hoc, and reflects a reductionist arithmetic hydrological approach. Concerns of groundwater, ecosystem, and rainfall variations year-on-year have not been taken into consideration. Continuation of such reductionist thinking in water allocation can only further aggravate the disputes and that is exactly what happened during the 1990s and in the new millennium.

It seems as if some arithmetic modifications have been done to the Interim Order to arrive at the figures of the Final Award. Clause IV of the Order states "... The Tribunal hereby determines that

the utilisable quantum of waters ofthe Cauvery at Lower Coleroon Anicut site on the basis of 50 percent dependability to be 740 thousand million cubic feet-TMC (20,954 M.cu.m.)". The arithmetic that resulted in this 50 percent dependability also relied on past precedence of estimates conducted by engineers such as K.L. Rao. Moreover, the Committee seemed oblivious to the challenges posed on the basin by global warming and climate change that might result in variability in precipitation as well as water availability. No climatic models seem to have been used to predict on the state of future dependability.

Table 5.2: Monthly Releases from Karnataka to Tamil Nadu as Allotted by The Tribunal

Monthly Releases from Karnataka to Tamil Nadu		
	Final Award (TMC ft)	**Interim Award (TMC ft)**
June	10	10.16
July	34	42.75
August	50	54.72
September	40	29.36
October	22	30.17
November	15	16.05
December	8	10.37
January	3	2.51
February	2.5	2.17
March	2.5	2.4
April	2.5	2.01
May	2.5	2.33
Total	192	205

Source: Compiled by authors from multiple sources[18]

The volume IV of the Report of the Cauvery Water Disputes Tribunal states a host of statutes emerging from the various cases of transboundary interstate water disputes internationally. Unfortunately, they have not been of significant use. The Final Order has been confined to stating a few numerical figures for water allocation, and has not really helped the process of setting up any statute or precedence of allocation that may be replicated in other disputes.

The Final Order has failed to create any mechanism to reward efficient use of water. It is well-known that the farmers in the Cauvery delta, as in other irrigation command areas in India, are habituated to utilise large amounts of water from the river for a longer time with a low end-use efficiency. The most critical reason for this inefficient use of water is also the negligible cost of water that the farmers in the basin have to pay. The extent of paddy cultivation is increasing in all parts of the basin. Given the increasing propensity of water use in the basin, one expected the Tribunal to recommend some mechanism for improving the efficiency—for instance, through

water pricing. Unfortunately, instead of promoting and rewarding more efficient use of water, the Award seems to be rewarding extravagance by providing water for such inefficient use.
More importantly, the Tribunal has made the allocation based on a so-called "normal year". The Award is absolutely vague on the pattern of allocation on an "abnormal year", when the rainfall is below average. Yet, the dispute, as has been shown, grows during years of scarce rainfall from the S-W monsoon. Given the increasing propensity of drought in the region, and the appearance of hostile hydro-politics in the basin when the rainfall is lower than average, the award may be missing the main point of dispute.

The Award has also failed to take into account the fact that the precipitation pattern has been changing in South Asia, often reinforcing the projections of the climate change phenomenon. The Cauvery basin might not be an exception (Gosain et al. 2006). As shown in Table 5.2, the schedule recommends for greater releases during the period of July-September. Over time, with the possibility of greater variability in the precipitation pattern, the sustainability of the solution may be in question.

Despite the extensive groundwater potential and its extensive use in the basin, the Tribunal does not bring groundwater within the ambit of allocation. Interestingly, Volume III of the Report of the Cauvery Water Disputes Tribunal discusses at length whether groundwater should be considered as an additional resource. Thus, Thakkar,[19] in a web article, points out that "... the Cauvery Award fails on the test of science as it does not consider groundwater availability in the Cauvery basin area while deciding the distribution of only the surface water among the claimants. Tamil Nadu, being the lower riparian, has significant availability of groundwater, while Karnataka and Kerala, being the upper riparian, have relatively little of it. … To allow unrestricted groundwater use and not to include groundwater in calculating water availability … is unscientific."

Two statements in the allocation process of the Award have been made in the "quantity reserved for environmental protection" and "quantity determined for inevitable escapages to the sea". The quantities are 10 TMC and 4 TMC, respectively. Both these statements do not seem to adhere to any scientific assessment of the ecosystem-based water uses in the basin. The Award stated that a monitoring authority is supposed to be constituted to regulate the flow of water. In terms of implementation, no such information has yet been made publicly available about the constitution of the monitoring authority.

5.3. Lessons from the Allocation

The Cauvery basin has got embroiled in a complex dispute over sharing of the river's water between the basin states of Karnataka and Tamil Nadu. The CWDT has come out with allocation figures in the final and interim awards, which do not seem to be based on updated scientific knowledge of river basin management. Rather, the award appears to be solely based on the traditional view of reductionist engineering offering only supply-side solutions. Thus, it missed the opportunity to internalise the holistic and interdisciplinary paradigm of river basin management.

One crucial lesson from this allocation is that conflicts occur also due to the failure of institutions. The institutional failure, in turn, is contingent upon the fact that laws of the land are not conducive enough to manage situations arising out of conflict over property rights. The loopholes in the ISWD Act have often been used by tribunals to delay their award. Despite placing time limits, often the ambiguity related to the deadlines has led to delay in the delivery of justice. No standardised mechanism or principle for water allocation has emerged for the Cauvery basin so far. Unlike in the US West Coast, there is no "law of the river" that has emerged as a set of compacts between riparian states.

In the US West, problems over inter-state waters are resolved through a set of agreements where there are commitments from stakeholder state/s to manage their demand. For example, the Colorado Water Delivery Agreement 2003 asks for California to manage their increasing water demand. It was signed by the Secretary of Interior, the four water agencies of California, in presence of the representatives from the seven federal riparian states of the Colorado River (namely, Colorado, New Mexico, Utah, and Wyoming, classified as Upper Basin states; and Arizona, California, and Nevada, classified as Lower Basin states). This pact mandates California to limit its use of Colorado River water to 4.4 million acre-feet (5427 million cubic metres) by adopting specific, incremental steps to gradually reduce its use over the next 14 years (USDI, 2003). The Agreement further talks of measures to provide water for San Diego and its other growing cities in the southern part of the state, which are dependent on additional water conservation within California's farming communities, as also strategies to address the environmental concerns of the Salton Sea (USDI, 2003).

The situation in India is different. In case of water scarcity due to insufficient rains, the states of Karnataka and Tamil Nadu get into conflicts with each other. Not only do such conflicts result in social tensions, they aggravate the possible solutions. Here lies the inadequacy of institution and statute.

6 The Supreme Court Award of 2018: Opportunities for Resolution

6.1. A sectoral re-allocation

On 16 February 2018, the Supreme Court reduced the allocation of the Cauvery Waters for Tamil Nadu (TN) from 192 TMC (thousand million cubic feet) annually to 177.25 TMC annually, to be released from Billigundulu to Mettur. The judgment is historic on two counts: first, it marks the culmination of the centuries-old water dispute that has been an epitome of hostile hydropolitics; second, it sent a signal to the agricultural economy to practice demand management of water through water-use-efficiency, and crop-diversification. The principle followed here, though apparently seems like "robbing Peter to pay Paul" (by reducing 14.75 TMC water for Tamil Nadu and providing the same to Karnataka for its burgeoning urban-industrial water use), recognises a bigger global phenomenon of intersectoral water conflicts: agriculture versus urban-industrial water demand.

Interestingly, departing from the existing view of water being State subject thereby leading to divergent definitions of property rights, the Supreme Court has observed that water of the Cauvery river is a "national asset and no single state could claim ownership over it." The verdict therefore presents an unprecedented benchmark in Indian water governance by seeking a departure from age-old practices. There are many solutions for managing agricultural water: crop-diversification through minimum support price regime change in favour of drier crops, promoting water-use-efficiency through technical and institutional measures, and imports of agricultural crops (or virtual water imports) from water-rich regions (Ghosh 2009). Still, the basic human needs should be met first.

One more thing that remains to be taken care of is the cause of the ecosystems. The CWT award in 2007 was thoroughly based on reductionist "arithmetic hydrology", and not on holistic eco-hydrology. The arithmetic that resulted in the 50 percent dependability of water is based on past precedence of estimates conducted by engineers such as K.L. Rao. The CWT seemed to be oblivious to the challenges posed by possible impacts of global warming and climate change that can result in variability in water availability. That award reserved the "quantity … for environmental protection" and "quantity determined for inevitable escapages to the sea" as 10 TMC and 4 TMC respectively, none of which adhere to any scientific assessment of the ecosystem-based water usages in the basin.

The present verdict does not have the cause of the ecosystem in its scope. However, ecological scientists must advocate for a more scientific approach for the cause of the ecosystems for life in the basin. The resolution mechanism worked out by the Cauvery Water Tribunal has been based on myopic number-games for sharing the waters, without much consideration about the broader institutions, economics, ecology, hydrology, and holistic understanding of the conflicts. This has to be corrected (Ghosh and Bandyopadhyay 2018).

The Supreme Court has also asked the Centre to set up the Cauvery Management Board (CMB) (as prescribed in the Final Order of the Cauvery Water Tribunal or CWT in 2007), within 40 days of passage of the order. With the lapse of the 40 days, TN wants the Centre to take immediate actions on setting up the Board. On 1 June 2018, the Centre constituted the Cauvery Water Management Authority (CWMA).

6.2. Basin-scale organisation

The need for a basin-level organisation cannot be overemphasised. A river basin organisation (RBO) to look after basin-scale water governance can be witnessed globally across many transboundary river basins. The levels of their success have varied and there is generally no unique formula for their structure and activities. Yet, there are two things that has been followed in the cases of almost all recent RBOs: a> there is an acknowledgement of multidimensionality of the basin system; b> a team with both disciplinary competence and interdisciplinary understanding of critical issues of water governance in the respective basin is constituted from the governments and the stakeholder groups, so that bottom-up governance structure and a participatory democratic approach can be followed.

6.3. Structure of the CMB as per the Tribunal Award

When one reads the recommended composition of the CMB, as stated in the CWT Award of 2007, the above two elements seem to be missing. The Award mentions a fulltime Chairman who should be an Irrigation Engineer of the rank of Chief Engineer. The choice of two members of the CMB needs to be made from the subject of Engineering and Agronomy, nominated from the respective ministries, namely, water resources, and agriculture. In the same vein, there is provision of two representatives of the Central Government who shall be of the rank "… of Chief Engineer/Commissioner to be nominated by the Ministry of Water Resources and Ministry of Agriculture respectively. They shall be part time Members of the Board". Even the state representatives from Kerala, Karnataka, Tamil Nadu and Union Territory of Pondicherry in the Board are proposed to be "… Irrigation Engineer of the rank of Chief Engineer". The Secretary of the Board needs to be "… an Irrigation Engineer not belonging to any party State, and not below the rank of a Director/Superintending Engineer". While the entire Board composition, as envisioned in the Award, has been confined to engineers and agronomists, with a small allusion of a representative of Indian Meteorological Department (IMD) in the Cauvery Water Regulation Committee (a Committee to be constituted by the Board), one gets an idea that the problem of Cauvery governance can be resolved only by traditional engineering and agricultural solutions.

This is clearly in contravention with global thinking of an integrated approach to the governance of river basins that recognises the multidimensionality of water in terms of its social, political and ecological importance. The Tribunal, even in its allocation Award, has missed out on the critical ecosystem perspective of the basin, and has somehow inflicted the Award with a narrow, reductionist engineering-driven vision that have been termed as "arithmetic hydrology" (Bandyopadhyay and Perveen 2008).

On the other hand, the entire idea of looking at the basin as a complex combination of WEBS (water, energy, biodiversity, and sediment) by acknowledging the inextricable linkages with ecosystems and livelihoods is the hallmark of the new emerging ways of water governance. The 2016 reports from the Ministry of Water Resources, Government of India, namely, Draft National Water Framework Bill 2016, and A 21st Century Institutional Architecture for India's Water Reforms, both prepared under the chairmanship of Dr. Mihir Shah, adequately acknowledge the importance of a multidisciplinary framework for water.

Therefore, substantial caution and more detailed analysis have to accompany the setting up of the CMB. There needs to be a multidisciplinary approach of the CMB with expertise from various disciplines, given the complexity that has to be dealt with and considering the myriad of stakeholders. It is imperative that a transdisciplinary knowledge base of rivers is evolved by combining various disciplines including fluvial geomorphology, engineering, hydrology, hydro-geology, ecological sciences, climate sciences, tectonic sciences, ecological economics, law, political sciences, sociology, social anthropology, humanities and culture, and institutional theory, through a multidisciplinary team. Again, the top-down approach proposed by the CWT will be exclusionary. Instead, it must include many more stakeholders at various levels including those for the ecosystems so as to follow a bottom-up approach, as in the case of the Mekong River Commission. The opportunity of creating a new RBO may be better used with a widening of the composition as argued above.

However, the Cauvery Water Management Authority (CWMA), which has been formed in place of the Board perhaps to strengthen the authority for regulation, seems to be moving along the lines of traditional engineering thinking as recommended in the Tribunal's Award.

7 The Search for Solutions

7.1. Leeway from impasse?

It is a difficult task to suggest solutions to nuanced problems such as the Cauvery conflict as they are further compounded by socio-political considerations. A scientific body ought to be created to work out a formula for water allocation across the various needs, keeping in view the integrity of the basin ecosystem.

There is an imperative for transparency in information dissemination among the various stakeholders, with data being made available to the scientific community for independent scientific assessments. Without this condition being satisfied, no framework of hydro-diplomacy can lead to a fruitful and a sustainable result. It is urgent that the effects of climate change on water availability are studied more seriously to create a holistic knowledge base for water allocation in the basin.

Economics can play an important role for institution building (creation of water markets), as well as providing an objective tool for conflict resolution (by incorporating realistic valuation). All the points raised in this monograph rest on the fundamental contention of economics providing the backbone for the analysis of hydro-diplomacy. The water laws of the land have to think in terms of such sustainable solutions. Ghosh (2010) has suggested that the development of a water futures market over time might be another mode of resolving the conflict through a market-based water allocation. This is absent in India.

For arriving at a more sustainable arrangement for allocation, more comprehensive methods for the assessment of existing projects have to emerge. There is a need to think of comprehensive evaluation through the "inclusive valuation" framework in which ecological economics has to be actively built on.

For instance, despite being a water-consuming crop, paddy has been given extensive importance in the basin, which is under "chronic water scarcity", according to the Falkenmark indicator (Falkenmark et al. 1989). A non-diminishing scarcity value for rice in such a zone, where water has been used to its full potential, is unsustainable. The first option may be a crop diversification policy on the part of the governments of the two states to shift the periods of demand and also to reduce the total demands altogether. Some apparent remedies are giving

up a portion of the production of summer and kuruvai paddy, increasing ragi production, and opting for virtual water imports for rice. Government policy, therefore, becomes extremely important in this context.

7.2. Proper Pricing of Irrigation Water

Water for irrigation in the Cauvery Basin is substantially subsidised (Ghosh 2009; Mollinga 2003). Extensive subsidisation does not even allow cost recovery. To make more efficient use of it, it needs to be priced appropriately. As a starting point, at least the operations and maintenance (O&M) costs for irrigation supplies should be recovered. The most efficient mode of pricing that the government can follow is marginal cost pricing. Crop-wise water rates need to be followed, with higher rates charged for crops consuming higher quantities of water. Unless the prices are kept at such levels, efficient demand management of water cannot take place. The pricing mechanism needs to be revised regularly, keeping in view the inflation rates and market conditions.

7.3. Virtual Water Imports

The remarkable concept that has emerged in literature to fight scarcity is the one of virtual water (Allan 1993, 1994, 1996, 1997, and 2003; Jobson 1999; Hakimian 2003; Hoekstra and Hung 2002; Wickelns 2001). The water "embedded" in the agricultural commodities is called "virtual water". It requires about 1,000 tonnes [cubic metres] of water to produce a tonne of wheat; about 16 times this volume to produce a tonne of beef. This water is sourced from freshwater or from soil water. In other words, virtual water is the volume of water needed to produce a commodity or service. Virtual water processes enable water scarce regions to meet their food needs. The concept is particularly impressive in the way it ameliorates water scarcity over vast distances. It enables non-water-sufficient economies and river basins to meet their strategic food needs. This is, thus, a classic example of Ricardo's generic concept of comparative advantage. Products with extensive consumptive use of water, if imported, entail import of virtual water. Economies like Israel have tried to balance their water budget in that manner.

Virtual water stands as one of the demand-side management options for water resources, which has often been argued as the crux of the new paradigm of water resources management. In the context of the Cauvery basin, Ghosh and Bandyopadhyay (2009) have earlier argued that around 3 billion cubic metres of water savings is possible if paddy is fully imported. However, it is clear if the acreages go for higher-value, less water-intensive crops, the farmers may be more than compensated, whereas water can be left in-stream. This will require a separate research statement.

7.4. Cropping Pattern Changes and Crop Diversification

This needs to be given serious thought in the region. In a multi-stakeholders' meeting held at the Madras Institute of Development Studies in Chennai in April 2003, with the involvement of the farmers and related stakeholders of both the states, the following was inferred: "There is a need

for a rethinking to diversify crop pattern in the Cauvery delta, in particular Tamil Nadu. The kuruvai paddy crop, which falls in summer, often gets into difficulties due to uncertainties and extreme events. The 4 lakh acres of kuruvai paddy crop could be substituted by high value dry irrigated crops such as palm (oil) seeds, turmeric, groundnut, gingili, cotton and horticultural crops. This requires thorough research in soil types and climatic conditions and their suitability for various crops. At the same time, kuruvai paddy crop could be cultivated where no other crop is possible due to particular given soil conditions" (Janakarajan, 2003). While virtual water imports through rice imports can help demand management of the existing water, the processes need to be supplemented by the promotion of crops that need less water, such as Ragi. Ragi is already a popular crop in the Karnataka part of the basin, although, not in Tamil Nadu. But, it has excellent nutrient content and high food value. This fact needs to be highlighted properly. The government's initiative is also important. From the policy perspective, it is suggested that Ragi should command a competitive price relative to rice. Relative price, in terms of the minimum support prices announced by the central government, already moved in favour of rice in the 1990s. This trend needs to be reversed for Ragi to emerge as an encouraging choice as a staple crop. As discussed earlier, there is already an indication of the reversal of this trend with terms of trade moving in favour of Ragi.

7.5. Use Of New Agricultural Technology

There have been new water management strategies to reduce water inputs for rice and these are steadily coming into the frame. There have been new ways of reducing seepage and percolation, through reduced hydrostatic pressure, by practicing either saturated soil culture (SSC), or alternate wetting and drying (AWD) (Boumann and Tuong, 2001). Suggestions about moving towards aerobic rice have also been raised, with respect to water reduction in rice production. So far, experiences of such methods have been associated with a massive decline in yield (De Datta et al., 1973; Westcott and Vines, 1986). Therefore, whether such methods should be adopted remains open to debate, considering the amounts of water saving. The system of Rice Intensification can have a promising application to reduce water use and increase productivity in the Cauvery Basin region.

7.6. Conclusion

One crucial lesson from the Cauvery dispute is that conflicts occur due to, among other reasons, a failure of institutions. This institutional failure, in turn, is contingent upon the fact that laws of the land are not conducive enough to tackle situations arising out of conflict over perceptions of property rights. The loopholes in the ISWD Act have often been used by tribunals to delay their award. Despite placing time limits, often the ambiguity related to the deadlines has led to delay in the delivery of justice. No standardised mechanism or principle for water allocation has emerged for the Cauvery basin so far. Unlike the Western United States, there is no "law of the river" that has emerged as a set of compacts between riparian states.

In the US West, problems over inter-state waters are resolved through a set of agreements where there are commitments from stakeholder state/s to manage their demand. For example, the

Colorado Water Delivery Agreement 2003 asks for California to manage their excess urban water demand. The situation in India is different, however. In case of water scarcity due to insufficient rains, the states of Karnataka and Tamil Nadu get into conflicts with each other. Not only do such conflicts result in social tensions, they even aggravate the possible solutions. Here lies the failure of institution and statute.

However, an appropriate institutional arrangement in the form of the Cauvery Management Board can have the capacity to create resolution mechanisms through best practices in governance. The CWDT, in its final Award, came out with allocation figures as also recommendations for an institutional structure, none of which seem to be based on updated concepts of river basin governance. The award appears to be solely based on the traditional view of reductionist engineering offering only supply-side solutions. This reinforces the concern that has been expressed in the introductory section of this monograph: the water governance thinking is dominated by the neo-Malthusian creed till now. There is a dominant view that the best water governance practice is to address scarcity: this hypothesis has already been refuted earlier in various contexts, as already discussed in the introductory section. Rather, by adhering to the recommended institutional structure of the CWMA as established on 1 June 2018, the Centre might miss the opportunity to internalise the holistic and interdisciplinary paradigm of river basin governance.

Various analysts have already shared sufficient cautionary words. Alagh (2018) has stressed on the need of taking time, and devising this institutional mechanism with a lot of care, after considering the global best practices. On a similar note, Ghosh and Bandyopadhyay (2018) have cautioned that a hasty decision on getting the Board in place with a narrow professional base of reductionist engineers could only aggravate the problem. The "inclusivity" cannot be an engineering solution. A critical interdisciplinary knowledge and human resource base is important with multi-disciplinary expertise. The Supreme Court order of 2018 has indeed opened up the opportunity for a more holistic thinking than what has prevailed so far. Let that opening be made bigger, capable of delivering a lasting solution by including a diversity of expertise. ORF

References

Alagh, Y.K. "A decentralised approach to water disputes", *The Hindu Business Line*, September 12, 2016.

Alagh, Y.K. "When civilizations disagree", *The Indian Express*, May 16, 2018.

Amarasinghe, U. A., B. R. Sharma, N. Aloysius, C. Scott, V. Smakhtin and C. de Fraiture "*Spatial Variation in Water Supply and Demand across the River Basins of India"*, Research Report No. 83. *mimeo*, Colombo, Sri Lanka: International Water Management Institute, 2003.

Anand, P. B. "Water and Identity - An Analysis of the Cauvery River Water Dispute", BCID Research Paper No. 3. United Kingdom: Bradford Centre for International Development, University of Bradford, UK., 2004.

Bandyopadhyay, J., N. Ghosh and C. Mahanta *IRBM for Brahmaputra Sub-basin: Water Governance, Environmental Security, and Human Well-Being*, New Delhi: Observer Research Foundation, 2016.

Bandyopadhyay, J., Water, Ecosystems and Society: A Confluence of Disciplines, New Delhi: Sage Publications, 2009.

Benjamin, N. "Cauvery waters dispute", *Economic and Political Weekly*, 6 (34), (1971): 1794- 1795.

Bohle, H. "The Cauvery Delta: An Investigation into History and Determinants of Agrarian Development and Rural Under Development", Indian Geographical Journal, 58(1), (1983): 29-46.

Booth, *K. Theory of World Security*, Cambridge: Cambridge University Press, 2007.

Boumann, B. and T. P. Tuong "Field water management to save water and increase its productivity in irrigated rice". *Agricultural Water Management*, 49(1), (2001): 11–30.

Buzan, B. and O. Wæver *Regions and Powers: The Structure of International Security*, Cambridge: Cambridge University Press, 2003.

Central Water Commission [CWC] *Water Statistics of India*, Delhi: Central Water Commission, 1998.

Chattopadhyay, P., A. Zaman and G. Dash "Effective utilisation of low land ecosystem for higher productivity under rice-fish-vegetables farming in new alluvial zone of West Bengal", *Proc. National Conference on Aquaculture: Kolkata*, Abstract no. 18,(2000): 22-23

CWDT *Final Order of the Cauvery Water Disputes Tribunal*, New Delhi: Ministry of Water Resources, 2007 a.

CWDT *The Report of The Cauvery Water Disputes Tribunal With The Decision: 5 volumes*, New Delhi: Ministry of Water Resources, 2007 b.

De Datta, S. K., H. K. Krupp, E. Alvarez and S. C. Modgal *Water Management in Flooded Rice in Water Management in Philippine irrigation systems: Research and Operations*, Los Banos: IRRI, 1973.

Deshpande, R. S. and M. Tantric. *Agriculture in Karnataka: A Historical View*. Bangalore: Institute for Social and Economic Change, 2008.

Falkenmark, M. "Water Management and Ecosystems: Living with Change", *TEC Background Paper 9*, Stockholm: Global Water Partnership, 2003.

Falkenmark, M., J. Lundqvist and C. Widstrand "Macro-scale water scarcity requires micro-scale approaches: Aspects of vulnerability in semi-arid development", *Natural Resources Forum*, 13(4), (1989): 258-67.

Gebert, R.I. *The Cauvery River Dispute: Hydrological Politics in Indian Federalism*, Vancouver: Department of Political Science of The University of British Columbia, 1983.

Ghosh, N. "Challenges to Environmental Security in the Context of India-Bangladesh Trans-boundary Water Relations", *Decision (Springer) Special Issue on Managing Critical Resources: Food, Energy and Water*, 42 (2), (2015): 211-28.

Ghosh, N. "Conceptual Framework of South Asian Water Futures Exchange", *Commodity Vision*, 4 (1), (2010): 8-19.

Ghosh, N. and J. Bandyopadhyay "A *Scarcity Value* based Explanation of Trans-boundary Water Disputes: The case of the Cauvery Basin in India", Water Policy, 11 (2), (2009): 141-67.

Ghosh, N. and J. Bandyopadhyay "Water needs a multi-disciplinary approach", *The Hindu Business Line*, May 4, 2018..

Ghosh, *N. Economics of Hostile Hydropolitics over Transboundary Waters: Scarcity Values and Interstate Water Conflicts in India and US*, Saarbrucken, Germany: VDM Verlag, 2009.

Gleick, P.H. "Water and Conflict: Fresh Water Resources and International Security", *International Security*, 18 (1), (1993): 79-112.

Gopal, L. and V. C. Srivastava *History of Agriculture in India*, Up to c. 1200 A.D., New Delhi: PHISPC, 2014

Gosain, A K, S. Rao and D. Basuray "Climate Change Impact Assessment on Hydrology of Indian River Basins", *Current Science* 90 (3), (2006): 346-53

Government of Karnataka *Cauvery Water Dispute*, Bangalore: GoK, 1992

Government of Karnataka *Irrigation Projects in Karnataka* (Major and Medium), Bangalore: GoK, 1985.

Government of Karnataka *Irrigation Projects in Karnataka*, Ministry of Water Resources retrieved from http://waterresources.kar.nic.in ,2005 (retrieved on May 7, 2018).

Government of Tamil Nadu *Brochure on the Cauvery River Waters Dispute with Mysore*, Madras: GoTN, 1971.

Government of Tamil Nadu *Irrigation Reservoirs in Tamil Nadu*, Madras: GoTN, 1987.

Guhan, S. *The Cauvery Disputes: Towards Conciliation*, Madras: Frontline, 1993.

Hall, J. V. and D. C. Hall "Environmental Resource Scarcity and Conflict" in *The Political Economy of War and Peace* edited by Murray Wolfson, Boston: Kluwer Academic Publishers, 1998.

Homer-Dixon, T. F. "Environmental Scarcities and Violent Conflict: Evidence from Cases" *International Security*, 19 (1), (1994): 5-40.

Homer-Dixon, T. F. "On the Threshold: Environmental Changes as Causes of Acute Conflict", *International Security*, 16 (2), (1991): 76-116.

Hussain, B. M. *The Cauvery River Dispute: An Analysis of Mysore's Case*, Mysore: Rao and Raghavan, 1972.

Iyer, R.R. *Water: Perspectives, Issues and Concerns*, New Delhi: Sage Publications, 2003.

Lourduraj, A.C. and H. C. Bayan "Irrigation Management in lowland Rice", *Agricultural Review*, 20 (3/4), (1999): 1885-1892.

Menon, A. S. *"A Survey of Kerala History"*, Kottayam: DC Books, 1967

Menon, P. and T.S. Subramanian "The Cauvery Tussle", *Frontline*, 19(19), (2002).

Michael, *L. Water Resources Management in South India: Irrigation and Hydro-electric Power in the Cauvery Basin (Ph.D. Dissertation)*, USA: University of Wisconsin, 1979.

Pani, N. "Institutions that Cannot Manage Change: A Gandhian Perspective on the Cauvery Dispute in South India", *Water Alternatives*, 2(3), (2009): 315- 327

Prihar, S.S. and B.S. Sandhu *Irrigation of Field Crops: Principles and Practices*, New Delhi: Indian Council of Agricultural Research,1987.

Raju, *A. S. Economic Conditions in Madras Presidency (1800-1850)*, Chennai: University of Madras,1941.

Rasul, G. "Why Eastern Himalayan countries should cooperate in transboundary water resource management", *Water Policy*, 16 (1), (2014): 19-38.

Richards, A. and N. Singh *Water and Federalism: India's Institutions Governing Inter-State River Waters*, USA: Center on Institutional Reform and the Informal Sector (IRIS) with University of Maryland and US Agency for International Development, 1996.

Rogers, P. "Water Governance, Water Security and Water Sustainability", in *Water Crisis: Myth or Reality* edited by Rogers, P., M. Ramon Llamas, and L. Martinez-Cortina, Leiden: Taylor and Francis, 2006.

Sandhu, B.S., S.S. Prihar, and K.L. Khera, "Sugarcane response to irrigation and straw mulch in subtropical region", *Agricultural Water Management*, 3, (1980): 35-44.

Sastri, S. S. *Sources of Karnataka History*, Volume I. Mysore: University of Mysore Historical Series, University of Mysore, 1940.

Sebastian, P.A. "Cauvery water dispute and state violence", *Economic and Political Weekly*, 27 (27), (1992): 1371- 1372.

Skempton, A.W. *A Biographical Dictionary of Civil Engineers in Great Britain and Ireland: 1500-1830*, London: Thomas Telford, 2002.

Upadhyay, V. "Cauvery, courts and some larger questions: Elusive search for judicial reason", *Economic and Political Weekly*, 37 (35), (2002): 3583- 3585.

USDI. *Colorado River Water Delivery Agreement 2003*. Washington: United States Department of Interior. 2003.

Westcott, M. P. and K. W. Vines "A comparison for sprinkler and flooded irrigation for rice", *Agronomy Journal*, 78(4), (1986):637–640.

Westing, A. H. (Ed.) *Global Resources and International Conflict: Environmental Factors in Strategic Policy and Action*, Oxford: Oxford University Press, 1986.

Zaman, A. and S.K. Choudhuri "Water use and yield of wheat under mulched and unmulched conditions in laterite soils of the Indian Sub-Continent", *Journal of Agronomy and Crop Science*, 175 (5), (1995): 349-53.

Endnotes

1. An evaluation of the Supreme Court order is also available in Nilanjan Ghosh's article "*Cauvery* is a national river, no state owns it", *WION*, http://www.wionews.com/india-news/opinion-cauvery-is-a-national-river-no-state-owns-it-33082, February 16, 2018.

2. *Dakshina* is a Sanskrit word meaning "South".

3. Two important data-sets were accessed from Ministry of Water Resources' previous website http://wrmin.nic.in accessed between March 2004 and June 2005. These include, "River Basin Maps of India", http://wrmin.nic.in/riverbasin/river.htm, 2004a and "Cooperation in harnessing water resources", 2004b.

4. For further information, please refer to Ruwan Rajapakse, P.E. *Concise Mahavamsa: History of Buddhism in Sri Lanka*, Maplewood, NJ : Ruwan Rajapakse, 2003.

5. For details, please see Akanksha Gupta's, "The world's oldest dams still in use", October 20, 2013 http://www.water-technology.net/features/feature-the-worlds-oldest-dams-still-in-use/.

6. One may also refer to Syed, M. S. "A rock solid dam that has survived 1800 years", *The Hindu*, https://www.thehindu.com/news/cities/Tiruchirapalli/a-rock-solid-project-that-has-survived-2000-years/article4491152.ece,*10 March* 2013. Detailed contributions of the Cholas to agrarian economy can also be found in N.K.A. Sastri's books, *A History of South India, From Prehistoric times to fall of Vijayanagar*, New Delhi : Oxford University Press, 2002, and *The Cōḷas*, Chennai: University of Madras, 1984.

7. A chart of southern Indian dynasties appeared in Menon's (1967) detailed account of the history of Kerala. See References for the full citation.

8. PMF IAS "Indian Climate: Summer & Winter Seasons", https://www.pmfias.com/ winter-season-summer-season-indian-climate-loo-andhis-norwesters/2018.

9. Please see T. Nalankilli's essays titled "Cauvery River Water Dispute and Karnataka Massacres, Part I", and "Cauvery River Water Dispute and Karnataka Massacres, Part II", in *Tamil Tribune*, http://www.tamiltribune.com/98/0201.html.

10. The detailed field account and state of water availability at Mettur can be found in Menon, P. and T.S. Subramanian "The Cauvery Tussle", *Frontline*, 19(19), (2002). https://www.frontline.in/ static/html/fl1919/19190040.htm.

11. The article by Venkatesan, V. "An Authority on Test", *Frontline*, 15(23), (1998) reports on the continuing differences between the States thereby creating a stalemate. The article can be accessed at https://www.frontline.in/static/html/fl1523/15230280.htm.

12. Ibid.

13. Please see TS Sudhir's article on "Drought in South India: As summer kicks in, TN, Karnataka and other states stare at another water crisis" *The First Post*, April 17, 2017.

14. Ibid.

15. The Hon'ble Supreme Court constituted a High Level Technical Team in its order dated 04.10.2016 to submit a report with an assessment of ground realities of the Cauvery Basin area on 17.10. 2016.

16. B.R. Gururaj, "Rapid urbanisation killing Bengaluru?", *Bangalore Mirror*, September 24, 2017, https://bangaloremirror.indiatimes.com/bangalore/ others/rapid-urbanisation-killing-bengaluru/articleshow/60810001.cms.

17. Detailed news may be found in E. Vijayalakshmi's article "*Ragi* is back – but only as an exotica", *Down to Earth*, 12 (3), https://www.downtoearth.org.in/coverage/ragi-is-back--but-only-as-exotica-130982003.

18. The data-set has been compiled by the authors from the Interim Order of 1991 and the Final Order of 2007 of the CWT.

19. H. Thakkar, "Cauvery Water Tribunal Award 2007: Why it fails the tests of science, efficiency and equity?", February 6, 2007, http://www.rediff.com/news/2007/feb/06guest.htm.

An examination of the conflict over River Cauvery between the Indian states of Karnataka and Tamil Nadu. This monograph explains the conflict's history, the stakeholders, and the drivers that have brought it to its current impasse, in the context of economic rationales and existing statutes of water governance in India. It offers recommendations for possible modes of resolution to the conflict, keeping in mind the Supreme Court's verdict of February 2018 that has opened up immense opportunities for setting up an appropriate river basin organisation. This volume aims to contribute to the formulation of a holistic paradigm for the integrated governance of river basins, not only for India, but for other riparian states as well.

Farmers from Tamil Nadu during a sit-in protest in April 2017 at Jantar Mantar in Delhi, to call attention to the severe drought ravaging their farms.
Photo by Afsar Jafri / Focus Global South (Flickr)

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20, Rouse Avenue Institutional Area, New Delhi - 110 002, INDIA
Ph. : +91-11-35332000 Fax : +91-11-35332005
E-mail: contactus@orfonline.org
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