WATER, CRISIS AND CLIMATE CHANGE IN INDIA: A POLICY BRIEF

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KEY MESSAGES:

CHALLENGES:

- Changes in temperature, precipitation, and humidity due to climate change may have significant long-term implications for the quality and quantity of water in India.
- India's water resources are under increasing pressure from population growth, economic development, industrialisation, urbanisation and inefficient water use.
- Glacial retreat in the Himalayas, increasing variability of the Indian summer monsoon as well as sea level rises will jeopardise the water supply for millions of people, affecting not only India but the whole region.

WATER CRISIS AND CONFLICT POTENTIAL:

- Several internal water disputes already existing in India between states, communities and/or water user groups in the domestic and the industrial sectors may be aggravated.
- River systems of the Brahmaputra, the Ganga, and the Indus have a history of regional conflicts and cooperation with neighbouring countries and therefore are subjects for major concern.
- These challenges may not only increase the pressure on already existing tensions within water management structures, but also cause new crises and conflicts among water user groups.

CONFLICT PREVENTION AND MANAGEMENT:

- Approaches need to be promoted aimed at reducing the overall amount of future water stress and at improving water management capacities.
- Joint monitoring and planning of water user groups as well as initiatives for education and training on water, climate change and crisis can enable water user groups to recognise crisis potential at an early stage.
- The improvement of water management capacities as well as the strengthening and adapting of water management institutions are needed to build confidence as well a climate of cooperation in India and South Asia.

ACRONYMS

GOI	Government of India
IfP-EW	Initiative for Peacebuilding – Early Warning
MDG	Millennium Development Goals
MoEF	Ministry of Environment and Forests
NAPCC	National Action Plan on Climate Change
NATCOM	India's Initial National Communication to the United Nations Framework Convention on Climate Change
NGO	Non-Governmental Organisation
NWP	National Water Policy
UNFCCC	United Nations Framework Convention on Climate Change
WACCAF	Water, Crisis and Climate Change Assessment Framework
WUAs	Water Users' Associations

INTRODUCTION

Although India has sizeable water resources, the country faces huge challenges in the water sector as the distribution of water varies widely by season and region. Pressure on and competition around water resources are increasing not least due to climate change. Such increasing competition can lead to crisis and conflict potential, especially if it leads to unequal water access and availability and combines with other conflict factors, such as marginalisation or past conflicts. Water can also be a simultaneous source of peace and cooperation if it is managed in an equitable and sustainable way.

This policy brief gives an overview of the challenges India is facing in the water sector and their potential to transform into local conflicts by outlining some of the common and possible worsening conflict dynamics around water in India. In order to identify ways forward and actions to prevent these challenges from turning into conflict, a number of innovative approaches and initiatives to solve and prevent water conflicts are illustrated.

The policy brief is based on and follows the structure of the Water, Crisis and Climate Change Assessment Framework (WACCAF) which was developed as part of the European Commission's Initiative for Peacebuilding – Early Warning (IfP-EW) Network.[1] It is targeted at practitioners from the public sector as well as NGOs and donor communities working on conflict and/or water.

1 L. Ruettinger, A. Morin, A. Houdret, D. Taenzler and C. Burnley (2011). *Water, Crisis and Climate Change Assessment Framework (WACCAF)*. Initiative for Peacebuilding - Early Warning (IfP-EW). Brussels.

WATER AVAILABILITY AND ACCESS

This section outlines the major challenges in India's water sector by focusing on the main factors impacting water availability and access: water management and infrastructure, the environment and human impact, and climate change.

1. THE ROLE OF WATER MANAGEMENT AND INFRASTRUCTURE

In India water resources vary widely by season and region. Per capita water availability in India has fallen by almost 70% since 1950.[2] This is due to increased water use by all categories of water users and to increased demand due to economic and population growth. The water supply is put under further stress by the increased pollution of existing finite water resources, which not only restricts potential uses of available water but also threatens future use. One of the specific problems that has arisen is the dramatic increase in groundwater overuse, which has led to depletion in many areas.

These trends have been exacerbated by inadequate institutional reforms and ineffective implementation. The legal framework for water rights in India includes the Constitution, national and state laws, common law, human rights principles as recognised by courts, and unwritten local norms. This framework is considered as complex, overlapping and often contradictory.[3] The Government of India (GOI) controls the development and regulation of interstate rivers, and state governments control all other water supplies, including irrigation and canals, drainage and embankments, water storage and water power. However, rights to use surface and groundwater are unclear, and vary by state.[4]

At the central level, the most comprehensive water management document is the National Water Policy (NWP), adopted in 1987 and revised in 2002. The NWP requires all Indian states to develop a state water policy within the framework of the national water policy. The NWP prioritises drinking water, followed by irrigation, hydropower, navigation, and industrial or other uses.[5] It stresses that non-conventional methods for the utilisation of water, including interbasin transfers, artificial recharge of groundwater and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, should be practiced to augment usable water resources. Many states now have mandatory water harvesting programmes in several cities. It furthermore emphasises a participatory approach in water resource management, recognising that the participation of beneficiaries would greatly help in the optimal upkeep of irrigation systems and efficient utilisation of irrigation water. The participation of farmers in irrigation management is formulated through the constitution of Water Users' Associations (WUAs).[6]

State legislation sometimes conflicts with customary laws and local norms, which often give ownership rights over water resources to individuals who own the land on which the resource is located. At the local level, groups

2 A. Jaitly (2009). 'South Asian perspectives on climate change and water policy', D. Michel and A. Pandya, (Eds.) (2009). *Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources*, Washington, DC, Stimson Center, p.17-31.
3 P. Cullet (2007). *Water law in India: overview of existing framework and proposed reform.* International Environmental Law Research Centre. Geneva.
4 USAID (2010). 'Country Profile: India', accessed 24th October 2011. Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india
5 Food and Agricultural Organization (2010). 'India Aquastat', accessed 24th October 2011. Available at http://www.fao.org/nr/water/aquastat/countries/india/index.stm
6 Ibid and Government of India (2008). 'National Action Plan on Climate Change (NAPCC)', accessed 24th October 2011. Available at http://pmindia.nic.in/Pg01-52.pdf

have developed their own rules to regulate access to water (for irrigation and domestic use) from human-built water sources, such as tanks. These norms are usually unwritten and are often based upon caste divisions. They run parallel to formal laws, and are often not acknowledged or taken into account in the formation of new legislation.[7]

In recent years, the Government of India has initiated several steps to improve investment in and the management of the water management sector.[8] Despite considerable investment in water sector infrastructure, India continues to struggle against growing fiscal austerity to complete water sector reforms and finance operational and maintenance costs.[9] Severe water shortages have already led to a growing number of intra- and interstate conflicts between users (for example agricultural, industrial or domestic use). Emerging challenges include the management of existing infrastructure and of the water resource itself:

- Water accessibility differs between different user groups. Although it is stated in the Constitution that no person should be restricted from using wells, tanks and bathing ***ghats***, access to water is often related to caste and social status. 16 percent of the rural population and 4 percent of the urban population still lack access to sources of drinking water. Numbers are even higher with regards to sanitation facility access: 46 percent of the urban population and 79 percent of the rural population have no direct access to sanitation facilities.
- Water supply per capita in 2001 was 1,902 cubic metres but is expected to decline to 1,401 cubic metres by 2025.[10] The average per capita availability of water, estimated at 1,600 cubic metres per year, is expected to fall to around 1,000 cubic metres per year by 2050 based on current population projections.[11]
- India is stricken by low water use efficiency. India gets on average 1,197 millimetres of rainfall every year. This amounts to a total precipitation figure of 4,000 billion cubic metres. However, 3,000 billion cubic metres are lost due to runoff, and only the remaining 1,000 billion cubic metres are available as surface and ground water sources, amounting to circa 1,000 cubic metres annually for per capita water availability. Moreover, India has only 200 cubic metres' storage capacity per person.[12] The National Water Mission, which was established under the NAPCC, aims to tackle this problem and to generate 20 percent improvement in water use efficiency.
- Extraction of groundwater exceeds natural recharge in many areas of the country. Unregulated groundwater pumping drains utility resources and depletes water tables across the subcontinent. Groundwater levels in some areas are far below levels recorded in the 1970s. Per capita water availability in India is expected to decline to as little as 1/30th of per capita availability in the United States.[13]
- India's irrigation infrastructure is the largest in the world. The total area equipped for irrigation is estimated at 61.9 million hectares. However, irrigation and water supply methods in India are generally inefficient. India has made substantial efforts to improve its irrigation infrastructure through large public operations such as the rehabilitation of the irrigation system.[14] As a result of excessive irrigation use, combined with fertiliser overuse, an estimated third of all irrigated land has been degraded through water-logging and salinisation, with 7 million hectares abandoned.[15]

7 P. Cullet (2007). *Water law in India: overview of existing framework and proposed reform*. International Environmental Law Research Centre. Geneva.
8 USAID (2010). 'Country Profile: India', accessed 24th October 2011. Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india
9 Asian Development Bank (2007). 'Water Resources Development in India: Critical Issues and Strategic Options', accessed 24th October 2011. Available at http://www.adb.org/Documents/Assessments/Water/IND/Water-Assessment.pdf
10 Food and Agricultural Organization (2010). 'India Aquastat', accessed 24th October 2011. Available at http://www.fao.org/nr/water/aquastat/countries/india/index.stm; USAID (2010). 'Country Profile: India', accessed 24th October 2011. Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india
11 Ibid.
12 Leadership Group on Water Security in Asia (2009). 'Asia's Next Challenge: Securing the Region's Water Future', accessed 24th October 2011. Available at http://asiasociety.org/files/pdf/WaterSecurityReport.pdf
13 USAID (2010). 'Country Profile: India', accessed 24th October 2011. Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india
14 Food and Agricultural Organization (2010). 'India Aquastat', accessed 24th October 2011. Available at http://www.fao.org/nr/water/aquastat/countries/india/index.stm
15 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf

- Water quality is negatively affected by industrialisation, agrochemicals, erosion, soil degradation, domestic pollution and wetland degradation. By the time surface water reaches the user, its quality has often been severely degraded. The combination of the intensive use of irrigation and fertilisers has also contributed to groundwater contamination in many parts of the country.[16] According to the GOI, poor policy choices are largely to blame for the overuse of water (and fertiliser). Such policies have included: highly subsidising surface water for irrigation; subsidising prices for electricity used in tube-well irrigation; directly subsidising chemical fertilisers.[17]
- India is a riparian state of the river systems of the Brahmaputra, the Ganga, the Indus and other smaller rivers together with Pakistan, Nepal, Bangladesh and China. Water management and distribution have been sources of tension several times in recent decades.

2. THE ENVIRONMENT AND HUMAN IMPACT

With 1.18 billion people (July 2011 estimate), India already has the second largest population in the world. Facing a population growth rate of 1.344 percent (2011 estimate) India's population continues to grow.[18] Although India encompasses about 16 percent of the global population, it has only 4 percent of total global water resources.[19] This large population combines with further environmental and human factors:

- The agricultural sector continues to dominate water use owing to its continued importance to the Indian economy, while industrial demands are increasing as the sector continues to grow. The irrigation sector is the main consumer of water, consuming 80-85 percent of available freshwater. Demand for water for industrial, hydroelectric generation and other uses will rise from 67 billion cubic metres to 228 billion cubic metres by 2025.[20]
- Changing consumption patterns due to rising average income alongside economic growth pose serious challenges such as increasing waste generation and an increasing need for water-intensive products. Although the number of people living below a dollar a day (according to 2005 prices) has come down from 42 to 24 percent over the last 25 years and the poverty rate has declined at little under one percentage point per annum, there is still a huge number of people living just above this line of deprivation. The number of poor living on less than $1.25 a day has increased from 421 million in 1981 to 456 million in 2005. Poverty poses a distinct threat to water quality and sustainable groundwater usage, as high poverty rates go hand in hand with a lack of financial and technological capacity for sustainable resource use and overuse in order to sustain basic needs.[21]
- Indian cities are growing rapidly with an urbanisation rate of 2.4 percent (2010-15 estimate). 30 percent of India's population is already living in urban areas and is being confronted with increasing water stress.[22] No major Indian city currently has a continuous water supply. As most households receive water only twice a day, middle-class families rely on water storage tanks. Water supply cuts are common in the hot summer months and reports of protests and violence over water scarcity are on the rise. Especially difficult is the situation for the urban poor - almost 40 million slum dwellers do not have sufficient access to fresh water and even resort to begging for water in more affluent neighbourhoods.[23]
- Precipitation decline and droughts in delta regions of India have resulted in the dessication of wetlands and the severe degradation of ecosystems.[24] Wetlands provide a range of ecological services, including water

16 Food and Agricultural Organization (2010). 'India Aquastat', accessed 24th October 2011. Available at http://www.fao.org/nr/water/aquastat/countries/india/index.stm
17 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf
18 CIA World Fact Book (2011). 'India', accessed 24th October 2011. Available at https://www.cia.gov/library/publications/the-world-factbook/geos/in.html
19 Government of India (2010). 'Climate Change in India: A 4x4 Assessment', accessed 24th October 2011. Available at http://moef.nic.in/downloads/public-information/fin-rpt-incca.pdf
20 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf
21 World Bank (2011). 'Revised Poverty Estimates: What does this mean for India?' accessed 24th October 2011. Available at http://go.worldbank.org/CG39MFTA90
22 CIA World Fact Book (2011). 'India', accessed 24th October 2011. Available at https://www.cia.gov/library/publications/the-world-factbook/geos/in.html
23 USAID (2010). 'Country Profile: India', accessed 24th October 2011. Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india
24 Intergovernmental Panel on Climate Change (2008). *Climate Change and Water*. Geneva.

conservation, recharge of groundwater and preservation of flora and fauna, including species and varieties which are at risk and a source of livelihood to many. However, wetlands face the threat of conversion for other uses, which would cause damage to their ecological systems, making those who depend on them vulnerable.[25]

- Water pollution is a serious problem in India as almost 70 percent of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic and inorganic pollutants. In many cases, these sources have been rendered unsafe for human consumption as well as for other activities such as irrigation and industrial needs, illustrating that degraded water quality can contribute to water scarcity as it limits its availability for both human use and the ecosystem.[26]

3. THE ROLE OF CLIMATE CHANGE

According to the assessment of the Intergovernmental Panel on Climate Change (IPCC) on the vulnerability of India to climate change, key challenges are most likely to be surface warming, a rise in sea level, decreasing water availability due to glacial retreat, significant reduction in crop production and a loss of flora and fauna.[27] Among the key forecasts are:

- Climate projections indicate increases in both maximum and minimum temperatures over the region south of 25°N. The maximum temperature is projected to increase by 2-4°C during the 2050s. In the northern region the increase in maximum temperature may even exceed 4°C. Model projections also indicate an increase in minimum temperature by 4°C.[28] Even relatively small climatic changes can have a huge impact on water resources, particularly in arid and semi-arid regions such as northwest India.[29]
- Despite the fact that, at an all-Indian level, observed monsoon rainfall has not shown any significant trend during the 20th century, a trend of increasing monsoon seasonal rainfall has been observed along the west coast, northern Andhra Pradesh and northwest India (+10-12 percent over the last 100 years), while decreasing monsoon seasonal rainfall has been observed over east Madhya Pradesh, northeast India and some parts of Gujarat and Kerala (-6-8 percent over the last 100 years).[30]
- Glaciers form the main source of water for key perennial rivers such as the Indus, Ganga and Brahmaputra. Almost 67 percent of the glaciers in the Himalayan mountain ranges have retreated in the past decade and will continue to retreat, diminishing flows of the aforementioned rivers and leading to severe water shortages as well as potential food insecurity and energy security (hydropower generation).[31]
- The frequency and intensity of extreme weather events, such as heat waves, droughts and floods, has increased over the past two decades and will increase further due to climate change. With a rising sea surface temperature of 2-4°C there is the possibility of a 10-20 percent increase in cyclone intensity. Extreme weather events do not only create health problems by seriously contaminating freshwater supplies with human waste and bacteria, they also increase the lack of reliability of water availability.[32]The observed rate of sea level rise along the Indian coast has been estimated between 1.06 and 1.75 millimetres per year. The highest recorded rise has been along the coast of West Bengal. A sea level rise of 0.4 to 2.0 millimetres has been recorded along the Gulf of Kutch. Along the Karnataka coast there has been a relative decrease

25 Government of India (2008). 'National Action Plan on Climate Change (NAPCC)', accessed 24th October 2011. Available at http://pmindia.nic.in/Pg01-52.pdf

26 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf

27 Intergovernmental Panel on *Climate Change (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate.* Geneva; see also A. Gupta, S. Chauhan and P. K. Gautam (2009). *Security Implications of Climate Change for India.* Institute for Defence Studies and Analyses. New Dehli: IDSA, p.167-177.

28 Government of India (2004). 'Initial National Communication to the UNFCCC (NATCOM)', accessed 24th October 2011. Available at http://unfccc.int/resource/docs/natc/indnc1.pdf

29 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf

30 Government of India (2008). 'National Action Plan on Climate Change (NAPCC)', accessed 24th October 2011. Available at http://pmindia.nic.in/Pg01-52.pdf; Government of India (2004). 'Initial National Communication to the UNFCCC (NATCOM)', accessed 24th October 2011. Available at http://unfccc.int/resource/docs/natc/indnc1.pdf

31 Institute for Defence Studies and Analyses (2009). *Security Implications of Climate Change for India.* New Dehli: IDSA; Government of India (2008). 'National Action Plan on Climate Change (NAPCC)', accessed 24th October 2011. Available at http://pmindia.nic.in/Pg01-52.pdf

32 Ibid.

in sea level.[33] Rising sea levels will lead to salt intrusion into coastal fresh water sources and thus threaten water availability.[34]

- Along a 10,000 kilometre stretch of the Sundarbans, the world's largest mangrove wetland in the Ganges-Brahamputra delta, the first signs of sea level rise, the subsequent submersion of coastland, and the destruction of ecosystems and biodiversity are visible.[35] Low-lying areas and coastal megacities, such as Mumbai, Kolkata and Chennai, are suffering from increased erosion and the loss of coastal protection from ecosystems such as coral reefs and wetlands. Rising sea water temperatures have led to large scale coral bleaching along the Indian coast line.[36]
- There is a projected decline in total runoff for all river basins, except those of Narmada and Tapti. For the Sabarmati and Luni basins, a decline of more than two thirds is anticipated. This will put additional stress on intrastate water management and relations between lower and upper riparian states.[37] Overuse of groundwater forces the water table lower and increases the arsenic content of groundwater. Future climate change will ostensibly exacerbate this problem.[38]

Glacial retreat, decreased rainfall and increased flooding in certain areas will threaten water availability, access and quality. The per capita availability of freshwater in India is expected to drop from around 1,820 cubic metres currently to below 1,000 cubic metres by 2025 as a result of the combined effects of population growth and climate change.[39]

33 Institute for Defence Studies and Analyses (2009). *Security Implications of Climate Change for India*. New Dehli: IDSA.
34 Government of India (2004). 'Initial National Communication to the UNFCCC (NATCOM)', accessed 24th October 2011. Available at http://unfccc.int/resource/docs/natc/indnc1.pdf
35 Institute for Defence Studies and Analyses (2009). *Security Implications of Climate Change for India*. New Dehli: IDSA.
36 Ibid.
37 Government of India (2009). 'State of Environment Report', accessed 24th October 2011. Available at http://moef.gov.in/soer/2009/SoE%20Report_2009.pdf
38 Leadership Group on Water Security in Asia (2009). 'Asia's Next Challenge: Securing the Region's Water Future', accessed 24th October 2011. Available at http://asiasociety.org/files/pdf/WaterSecurityReport.pdf
39 Intergovernmental Panel on Climate Change (2008). *Climate Change and Water*. Geneva.

CRISIS AND CONFLICT POTENTIAL

Water stress on an unprecedented scale will be the most serious consequence of climate change in India. India is highly vulnerable to the threats outlined in the previous sections, as its large population has a high dependence on climate- and water-sensitive sectors, such as agriculture and forestry, for livelihoods. Any adverse impact on water availability would threaten food security, cause the destruction of natural ecosystems, including species which sustain the livelihoods of rural households, and adversely impact economic growth and energy security. In the past, India has already faced a number of conflicts linked to water allocation.[40] Tensions have occurred as a result of regional and transboundary water disputes: water disputes are a persistent occurrence in India, as well as between India and its neighbouring countries of Pakistan and Bangladesh. To a certain degree, these tensions are attributed to the lack of a clear legal framework for water permits and provisions for water sharing which are effectively binding.[41]

In addition to international riparian concerns, there are several internal water disputes in India on a local or intrastate level as laws and regulations to manage intrastate water usage are insufficient. More and more conflicts are likely to emerge around water issues at the grassroots level.[42] As a result, there are numerous conflict groupings. We will not provide an analysis of the transboundary conflict settings which have been subject to numerous reports and studies.[43] Rather, we sum up examples of different water user disputes identified using the WACCAF framework.[44] We then discuss in more detail the case of the Cauvery River as a domestic conflict.

In different parts of India, diverse disputes on water and water-related issues can be identified against the backdrop of conflict typology suggested within the WACCAF framework:

- Conflicts between pastoralists, different agricultural as well as domestic users: traditional farmers have to compete with domestic users and investors; for example, tourist resorts or factories. There are examples of villages competing with each other for the same water resources, such as conflict between villages over water use of the Shapin River in Jharkhand. Conflicts are also occurring over the quality of water, the Kolleru lake in Andhra Pradesh being a prime example.[45] The Bhavani river in Tamil Nadu is an example of the importance of equity, access and allocation for the overall conflict structure.[46] In addition, Indian pastoralists are facing numerous challenges. They are located in the western districts of Rajasthan and Saurashtra, and on the Deccan plateau, regions which already experience uncertain rainfall patterns today. They also need to deal with critical issues regarding rights and relevant legal frameworks since they often have only "customary rights".[47]

40 D. Taenzler, B. Schinke and C. Bals (2006).,*Is there „Climate Security" for India? „Tipping Points" as Drivers of Future Environmental Conflicts*. Bonn, Berlin: adelphi and Germanwatch; Institute for Defence Studies and Analyses (2009). *Security Implications of Climate Change for India*. New Dehli: IDSA; M. Renner (2011). 'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peacebuilding.' accessed 24th October 2011. Available at http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf

41 R. M. Saleth (2004). 'Strategic Analysis of Water Institutions in India: Application of a New Research Paradigm', *IWMI Research Report No: 79*, International Water Management Institute.

42 Leadership Group on Water Security in Asia (2009). 'Asia's Next Challenge: Securing the Region's Water Future', accessed 24th October 2011. Available at http://asiasociety.org/files/pdf/WaterSecurityReport.pdf

43 Ibid.

44 L. Ruettinger, A. Morin, A. Houdret, D. Taenzler and C. Burnley (2011). *Water, Crisis and Climate Change Assessment Framework (WACCAF)*. Initiative for Peacebuilding - Early Warning (IfP-EW). Brussels.

45 Rama Rao, Jairath and Umesh (2006). 'Pollution through Aqua Culture: Kolleru Wildlife Sanctuary', *Economic and Political Weekly, 41(7),* 585-587.

46 A. Rajagopal and N. Jayakumar (2007). 'Equity, Access and Allocation. Conflict in the Bhavani', *Economic and Political Weekly February 18, 2006*, accessed 24th October 2011. Available at http://www.conflicts.indiawaterportal.org/sites/conflicts.indiawaterportal.org/files/conflicts_bhavani.pdf

47 M. Dhas, K. Vivek and S. Phansalkar (2006). 'Water for migrant livestock: issues, concerns and policy', *Livestock Research for Rural Development 18 (9).*

- Conflicts between public or private water managers and domestic water users: bad water management, a lack of investment in infrastructure or maintenance and/or changes in water management organisation can cause disruptions in water availability or access which, in turn, can lead to conflicts, especially if inadequate service is combined with rising water prices. In 2000, water riots were held in some areas of Gujarat to protest against the government's failure to arrange adequate tanker water supplies. A police intervention in the village of Falla near Jamnagar killed three and injured 20 following protests against the diversion of water from the Kankavati dam to the town of Jamnagar.[48] Another example is the conflict between domestic water users and the private sector, illustrated by the privatisation of the Sheonath river in Chhattisgarh.[49]
- Conflicts between different user groups on large infrastructure projects: there are numerous reports and analyses on case studies in this regard in India. Such disputes are related to infrastructure projects that are likely to negatively affect the livelihoods of other user groups. One example is the Haribad minor irrigation project and its impact on the villages of Haribad and Sakad in the Badwani district, western Madhya Pradesh. The project is said to cause unequal benefits for the user groups: while the village of Haribad will benefit, the tribal people of Sakad will lose their land.[50] The construction of dams is a particular source of ongoing tension, as the conflict between Maharashtra and Karnataka on the Krishna River indicates. In March 2004 the Rajapur dam, located in Maharashtra, was the target of attacks by farmers from Karnataka. The farmers were suffering from a severe ongoing drought as well as general water scarcity and considered the dam in the neighbouring state as the central cause of the increased water stress. As a result, political instability increased and security measures to protect the dam were tightened.

The case of conflicts between regions in India deserves special attention as a number of conflict components become clear when the contexts are examined. Most of the agriculture in the three Indian states of Andhra Pradesh, Karnataka and Tamil Nadu depends on the southwest monsoon, which accounts for nearly 75 percent of all rainfall in this geographical area. Here a close relationship between the monsoon and increasing tensions may be observed.[51] As a significant portion of the population depends on farming activities and the rainfall distribution in India is very uneven, the consequences of changing rainfall patterns would be tremendous. Adverse impacts on water availability due to a decrease in rainfall but also increased flooding in certain areas endangers central parts of the economy and food security, as well as the livelihoods of rural communities. Negotiations on water sharing agreements for the rivers of Krishna (Andhra Pradesh/Karnataka) and Cauvery (Karnataka/Tamil Nadu) have already taken place among the states. However, as the history of several agreements clearly indicates, political approaches are not sufficient to ensure a peaceful solution to water crises in cases where the monsoon fails to provide the water needed to raise food crops. A draft agreement on the Cauvery River in 1974 was not adopted because both Tamil Nadu and Karnataka backed out. The preceding agreement, dating back to 1924, had been dominated by the Madras Presidency under the British rule and was perceived as unjust by Karnataka. Thus Tamil Nadu, as a lower riparian state, felt threatened by the diminishing inflow into the state, which was harmful towards its irrigated agriculture. As a result of this political impasse, violent protests occurred *inter alia* in Tamil Nadu in 1995 after the monsoon had failed to fill the tributaries of the Cauvery.

In 1991 the Supreme Court of India tried to solve the dispute by deciding to set up a tribunal as a mediating institution. However, the tribunal's decision that Karnataka was to release 205 billion cubic metres from the Cauvery reservoirs every month was in no way a solution to the dispute. The decision to allocate additional waters to Tamil Nadu actually triggered violent conflict, demonstrating that court decisions are not always successful in solving disputes. Riots by Karnataka citizens ended in violence against Tamils, which resulted in deaths. Officials from Karnataka threatened to block any release of water to Tamil Nadu and farmers from Mandya besieged the banks of the Cauvery River to ensure that no water was released.[52]

48 Down To Earth (2000). 'Mismanaging water can create a crisis and lead to panic. This is exactly what led to a water riot near Jamnagar in Gujarat', accessed 24th October 2011. Available at http://www.rainwaterharvesting.org/conflicts/Jamnagar.htm

49 D. Das and G. Pangaree (2006). 'Privatisation. In Chhattisgarh, a River Becomes Private Property', *Economic and Political Weekly February 18.*

50 S. S. Rehmat and S. Dharmadhikary (2006). 'Dams and Displacement. When Multiple Conflicts Overlap Haribad Project in Madhya Pradesh', *Economic and Political Weekly February 18.*

51 K. Krishna Moorthy, K., S. Suresh Babu and S.K. Satheesh (2005). 'Aerosol characteristics and radiative impacts over the Arabian Sea during inter-monsoon season: Results from ARMEX field campaign', *J.Atmos. Sci., 62 (1), 192-206.*

52 Gleick, P. (1993). 'Water and conflict: Fresh water resources and international security', *International Security 18, Vol. 1, 79-112* ; A. Pereria (1998). 'Cauvery Water Dispute'. *Inventory of Conflict and Environment No. 53*, accessed 24th October 2011. Available at http://www.american.edu/ted/ice/cauvery.htm

The overall problem mainly arose due to insufficient rainfall. From 1992-1994 rainfall was sufficient and no violence between Tamil Nadu and Karnataka was reported. However, it is important to note that this conflict was also triggered by unfavourable economic, social and political conditions. A further reason for the emergence of a conflict situation was that neither early warning mechanisms nor appropriate emergency capacities were in place to prepare both states and their farmers for cases of insufficient rainfall. The dispute over the Cauvery River indicates future potential for violent conflicts in India as a result of decreasing water availability.

COOPERATION, CONFLICT PREVENTION AND RESOLUTION

In order to prevent future climate change-induced conflicts over scarce water resources, different options already exist today for peaceful crisis management and conflict resolution. First of all, however, India needs to address interdependencies between climate change and water. The National Water Mission component of the NAPCC proposes to enact a new national water policy to combat, mitigate, and adapt to water scarcity scenarios which may arise out of climate change. If climate change uncertainties are to be integrated into water management planning, there is an urgent need to augment water storage capacity, to consider reducing subsidies that encourage overconsumption, and to practise more judicious use of ground and surface water. The successful implementation of a national water policy responsive to climate challenges will require both a dependable knowledge base and appropriate institutional support at the national, regional, and local levels, as well as financial resources.

Moreover, the Indian Constitution reserves the power of the central government to establish legislation on the use of interstate rivers and on the adjudication of interstate disputes over water. The Interstate Water Disputes Act (1956), for example, establishes special tribunals for this purpose. What can be learned from transboundary water management is the general notion to go beyond the notion of water sharing to reach a level of shared benefits.[53] We list approaches below which are aimed at reducing the overall amount of future water stress, at improving water management capacities and at building confidence as well as cooperative arrangements among water user groups.

1. JOINT MONITORING AND PLANNING ON CLIMATE CHANGE IMPACTS AND WATER DATA

An initiative for joint monitoring and planning can help to build confidence and inform decision makers not only between neighbouring countries but also within countries themselves. Hydrological as well as meteorological data need to be collected and combined with socio-economic data to inform water governance initiatives as well as adaptation processes. The most challenging efforts will be to translate information on global climate change into regionally appropriate forecasts due to the complex modelling requirements needed to capture climate variability. Improved capacities at the community level will also be needed to improve measures for disaster readiness and management, especially in coastal areas.[54]

2. IMPROVING WATER MANAGEMENT CAPACITIES

In principle, there are a number of approaches to improve water management and hence decrease tensions among user groups.[55] Through the establishment of updated and more efficient water equipment, waste of water resources can be reduced. The use of water saving techniques is especially needed with respect to

53 Institute for Defence Studies and Analyses (2009). *Security Implications of Climate Change for India*. New Dehli: IDSA.

54 M. Renner (2011). 'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peacebuilding', accessed 24th October 2011. Available at http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf; A. Houdret, A. Kramer, and A. Carius (2010). The *Water Security Nexus. Challenges and Opportunities for Development Cooperation*. Eschborn: GTZ.

55 Ibid.

irrigation where poor management practices prevail. Most recent examples from Andhra Pradesh illustrate that interventions need not only to be reactive, but substantially proactive from the outset, to address future water challenges.[56] The introduction of drip irrigation approaches and the establishment of rainwater harvesting methods can also build further capacities. For the latter, there are already successful examples in urban areas such as in Chennai and Bangalore.[57] With a view to adapting to climate change it may also be necessary to discuss the replacement of water-intensive crops with alternatives which are more drought resistant.

3. STRENGTHENING AND ADAPTING WATER MANAGEMENT INSTITUTIONS

Water management institutions can serve as powerful platforms for cooperation and dialogue, which has been shown various times in international contexts.[58] Therefore, they need to represent all water user groups and ensure that they have equal rights during decision-making processes. For example, women are usually not represented in many of the traditional irrigation communities.[59] Such potential conflict drivers can be avoided if institutional arrangements are designed according to the principles of good governance such as participation, the rule of law, transparency, responsiveness, consensus orientation, equity and inclusiveness, effectiveness, and efficiency and accountability.[60] For Andhra Pradesh, it has been shown that water arrangements need to coordinate state, regional and user levels with strong functional linkages, both vertically and horizontally. Guiding principles should help to provide for participatory processes, expert advice and review mechanisms to inform decision-making processes.[61] Such approaches can be a starting point to form capable institutions for adaptive water governance which also need to consider conflict-sensitive practices such as the involvement of marginalised groups into decision-making processes.

4. PROMOTING EDUCATION AND TRAINING

The promotion of technical approaches needs to be accompanied by water management education schemes. Linking different water user groups and representatives through research and education can help to establish a new vision of water use throughout Indian society which will also be helpful in overcoming the challenges of climate change. By offering training courses the identification and tackling of adaptation in water-dependent sectors can be further facilitated. There are already teaching approaches available in India.[62] Based on these efforts, as well as analytical tools like WACCAF, climate- and conflict-sensitive sectors may be identified well in advance.

5. FOSTERING DIALOGUE AND CONFIDENCE BUILDING

To address the numerous micro-level conflicts already existing in India, competing water user groups should be supported by public authorities and donors to work together on the construction and management of water supply systems, thereby building trust and opening communication channels among the groups in the process. Using a conflict-sensitive approach, water infrastructure projects have the potential to foster cooperation in the design and construction phases of a project and also during the operation and maintenance of the water supply system. Based on a process considered as legitimate, inclusive and transparent, the long term sustainability of water supply systems can be significantly improved.

56 S. Gupta (2010). 'Irrigation Governance Challenges: Perspectives and Initiatives in Andhra Pradesh', *South Asian Water Studies Journal, Vol. 2, No.1*, p.17-36.

57 M. Renner (2011). 'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peacebuilding', accessed 24th October 2011. Available at http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf

58 A. Wolf, A.Kramer, A. Carius and G. Dabelko (2006). 'Water can be a pathway to peace, not war', *Navigating Peace Policy Brief No.1.* Woodrow Wilson International Center for Scholars.

59 International Fund for Agricultural Development (2007). *Gender and water. Securing water for improved rural livelihoods: The multiple-uses system approach.* Rome: IFAD.

60 GTZ (2010). 'Good Governance', accessed 6th October 2011. Available at http://www.gtz.de/en/themen/882.htm

61 S. Gupta (2010). 'Irrigation Governance Challenges: Perspectives and Initiatives in Andhra Pradesh', *South Asian Water Studies Journal, Vol. 2, No.1*, p.17-36.

62 SaciWATERs (2010). 'Illustrative Cases for Teaching IWRM (Volume I). A Compendium of Ten Illustrative Cases from South Asia', accessed 22nd April 2011. Available at http://www.saciwaters.org/pdfs/Illustrative%20Cases%20for%20Teaching%20-%20Case%20Narrations.pdf

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