Available online at http://www.journalijdr.com

ISSN: 2230-9926

IJDR

International Journal of DEVELOPMENT RESEARCH

International Journal of Development Research
Vol. 4, Issue, 12, pp. 2821-2827, December, 2014

Review Article

THE NATIONAL ACTION PLAN ON CLIMATE CHANGE AND SUSTAINABLE WATER RESOURCES MANAGEMENT

***Dr. Saira Gori**

Department of Law, Gujarat National Law University, Attalika Avenue, Knowledge Corridor, Koba, Gandhinagar, Gujarat-382007

ARTICLE INFO

Article History:

Received 24th September, 2014
Received in revised form
22nd October, 2014
Accepted 29th November, 2014
Published online 27th December, 2014

Key words:

Climate Change,
Sustainable water management,
Water scarcity.

ABSTRACT

With growing scarcity of water and deteriorating quality, water resources management in India is becoming more challenging with the passage of time. The imminent onset of climate change will exacerbate these impacts, placing even greater pressure on already stressed resources and regions. The National Action Plan on Climate Change of the Government of India (2008), provides useful insight on climate-change impacts on water resources. The plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures. Till date, many public debates on water have focused on the direct impacts of climate change on hydrology. However, there is growing evidence that climate change policies themselves may have substantial additional and negative impacts on freshwater resources and ecosystems and may thus result in mal-adaptation. To avoid such mal-adaptation, integrated, coordinated policy making is required. In this paper an attempt has been made to

- Analyze the agenda discussed in national climate change policy of India,
- Identify where negative trade-offs exist between climate change policies and freshwater resources,
- Analyze where institutions and structures exist to optimize integration among climate, water, and biodiversity policies, and
- Provide a much needed overview from a broad selection of countries with a view to identifying further opportunities for theoretical exploration and testing.

The synergies and conflicts among climate, energy, water, and environmental policies create additional challenges for governments to develop integrated policies to deliver multiple benefits. Synthesis include engagement of senior political leaders, cyclical policy development, multi-agency and stakeholder processes, and stronger accountability and enforcement measures and at the same time integration of climate change-related issues with other risk factors, such as climate variability and market risk, and with other policy domains, such as sustainable development.

INTRODUCTION

Water supply is not only necessary to sustain human life, but is also a key input to many industries such as manufacturing and agriculture. Therefore, the conservation and optimal utilization of this scarce resource is extremely important for economic development. While India has about 16% of the global population, it only has 4% of total water resources, and many parts of India already face water scarcity.

****Corresponding author: Dr. Saira Gori***
Department of Law, Gujarat National Law University, Attalika Avenue, Knowledge Corridor, Koba, Gandhinagar, Gujarat-382007

Water is not only greatly affected by climate change, but is also a core component of climate. The hydrological cycle includes processes such as evaporation and precipitation that are predicted to shift with climate change, and can have important implications for fresh water supply for drinking water, rain-fed agriculture, groundwater supply, forestry, biodiversity, and sea level. WATER is a finite but widely present resource. It is a good solvent, which makes it highly vulnerable to pollution. Despite its wide presence, water availability and demand at many places have high degrees of mismatch: spatial and temporal. Many a times, it is a challenge to provide water of desired quantity and quality at a desired place. This is especially true for monsoon climates where 70–90% of the annual rain falls in just 3–4 months. This leads

to too much water and often floods in the wet sea- son, and too little water and often droughts in the dry sea-son. At times, enough water may be available but the quality may be so poor that it is of no use without treatment. Sustainable water management in India poses numerous challenges:

- bridging the increasing gap between demand and supply,
- providing enough water for production of food,
- balancing the uses between competing demands,
- meeting the growing demands of big cities,
- treatment of wastewater,
- sharing of water with the neighboring countries and among the co-basin states, etc.

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, industrialization, urbanization and inefficient water use. Glacial retreat in the Himalayas, increasing variability of the Indian summer monsoon as well as sea level rises will jeopardize the water supply for millions of people, affecting not only India but the whole region. 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 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 recognize 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.

Principle Agenda of National Action Plan on Climate Change (NAPCC)

On June 30, 2008, Prime Minister Manmohan Singh released India's first National Action Plan on Climate Change (NAPCC) outlining existing and future policies and programs addressing climate mitigation and adaptation. The plan identifies eight core "national missions" running through 2017 and directs ministries to submit detailed implementation plans to the Prime Minister's Council on Climate Change by December 2008. Emphasizing the overriding priority of maintaining high economic growth rates to raise living standards, the plan "identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively." It says these national measures would be more successful with assistance from developed countries, and pledges that India's per capita greenhouse gas emissions "will at no point exceed that of developed countries even as we pursue our development objectives." The Principle Agenda of The National Action Plan for climate change focuses on

- Protecting the poor and vulnerable section of the society through an inclusive and sustainable development strategy sensitive to climate change.
- Achieving national growth change through qualitative change that enhances ecological sustainability
- Effective implementation of programmes through civil society, local government institutions and public- private partnership
- International co-operation for research development and facilitating technology transfer to developing countries under the UNFCCC

Eight National Missions

National Solar Mission: The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes:

- Specific goals for increasing use of solar thermal technologies in urban areas, industry and commercial establishments;
- A goal of increasing production of photovoltaics to 1000 MW/year; and
- A goal of deploying at least 1000 MW of solar thermal power generation.

Other objectives include the establishment of a solar research center, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012. Building on the Energy Conservation Act 2001, the plan recommends:

- Mandating specific energy consumption decreases in large energy-consuming industries, with a system for companies to trade energy-savings certificates;
- Energy incentives, including reduced taxes on energy-efficient appliances; and
- Financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.

National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning, the plan calls for:

- Extending the existing Energy Conservation Building Code;
- A greater emphasis on urban waste management and recycling, including power production from waste;
- Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles; and
- Incentives for the use of public transportation.

National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.

National Mission for a "Green India": Goals include the a forestation of 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.

National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.

National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourage private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

Climate Change Policy and Water Resources Management

In India water resources vary widely by season and region. Per capita water availability in India has fallen by almost 70% since 1950. 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 to 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 have arisen is the 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 recognized by courts, and unwritten local norms. This framework is considered as complex, overlapping and often contradictory.

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. 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. It stresses that non-conventional methods for the utilization of water, including inter basin 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, recognizing that the participation of beneficiaries would greatly help in the optimal upkeep of irrigation systems and efficient utilization of irrigation water. The participation of farmers in irrigation management is formulated through the constitution of Water Users' Associations (WUAs). In pursuance of the strategies identified in National Water Mission Document as well as deliberations in National Water Board, Ministry of Water Resources has initiated the process of review of National Water Policy, 2002. A series of consultation meetings with different stakeholders were held. Considering the recommendations and feedback received during various consultation meetings, the Drafting Committee identified basic concerns in water resources sector and adopted basic principles which should be followed to address those concerns, and accordingly, evolved draft policy recommendations. Recently a Committee was constituted for The National Water Policy, 2012 which was adopted by the National Water Resources Council (NWRC) at its Sixth meeting held on 28th December, 2012 in order to suggest a road map for implementation of NWP, 2012.

In recent years, the Government of India has initiated several steps to improve investment in and the management of the water management sector. 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. 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. The per capita availability of water in the country is 1545 cubic meters as per the 2011 census and this water availability in the country is reducing progressively due to increase in population. The average annual per capita availability of water in the country, taking into consideration the population of the country as per the 2001 census, was 1816 cubic meters which reduced to 1545 cubic meters as per the 2011 census. Due to limited availability of water, but growing demand of water due to increasing population, urbanization and industrialization India is facing water stress.

In addition due to contamination of water sources and poor water treatment facility it is often difficult to get safe drinking water. Water Quality data of various river stretches has revealed that organic pollution particularly Bio-chemical Oxygen Demand (BOD) has exceeded the desired water quality criteria in 150 river stretches covering 121 rivers. The major cause of rising organic pollution, particularly BOD in these rivers, is due to discharge of untreated and partially treated domestic effluents by various municipalities across the country. Pollution abatement in rivers is an ongoing and collective effort of the Central and State Governments. Ministry of Environment & Forests, Government of India is supplementing the efforts of the State Governments in pollution abatement in various rivers through the centrally sponsored National River Conservation Plan (NRCP), which presently covers 40 rivers in 190 towns spread over 20 States.

Pollution abatement schemes implemented under the Plan include interception, diversion and treatment of sewage; low cost sanitation works on river banks; electric/improved wood crematoria, etc. Sewage treatment capacity of 4574 million litres per day has been created so far under the Plan. The water quality, in terms of Bio-chemical Oxygen Demand (BOD) values for major rivers is reported to have improved as compared to the water quality before taking up pollution abatement works under NRCP. However, the levels of bacterial contamination in terms of fecal coli form are reported to be exceeding the maximum permissible limit at a number of locations along various rivers.

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. 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. As a result of excessive irrigation use, combined with fertilizer overuse, an estimated third of all irrigated land has been degraded through water-logging and salinisation, with 7 million hectares abandoned.

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. According to the GOI, poor policy choices are largely to blame for the overuse of water (and fertilizer). Such policies have included: highly subsidising surface water for irrigation; subsidising prices for electricity used in tube-well irrigation; directly subsidizing chemical fertilizers. 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.

Climate Change and Its Impact On Freshwater Resources

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. 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. Even relatively small climatic changes can have a huge impact on water resources, particularly in arid and semi-arid regions such as northwest India. 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).

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). 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. The observed rate of sea level rise along the Indian coast has been estimated between 1.06 and 1.75 millimeters per year. The highest recorded rise has been along the coast of West Bengal. A sea level rise of 0.4 to 2.0 millimeters has been recorded along the Gulf of Kutch. Along the Karnataka coast there has been a relative decrease

Crisis and Conflict

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. 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. 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. 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. The Bhavani river in Tamil Nadu is an example of the importance of equity, access and allocation for the overall conflict structure. 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".

Conflicts Over 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. 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.

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. The overall problem mainly arose due to insufficient rainfall. 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.

Crisis Management and Conflict 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. 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 practice 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. Following are the approaches 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.

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.

Improving Water Management Capacities

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 irrigation where poor management practices prevail. 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. 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.

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. 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. 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. 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. 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.

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. Based on these efforts, as well as analytical tools like WACCAF, climate- and conflict-sensitive sectors may be identified well in advance.

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.

Conclusion

It is pertinent to note here that even without climate change, many regions of the world are already water stressed and face challenges to ensure food production and other water-related services for a fast-growing world population. Climate change is an added driver, acting on population increase, economic growth and urbanization. The main impacts of climate change will 'hit us through water' through changes in the magnitude of water balance components, increased incidences of floods and droughts, and sea-level rise. The fragmented authority in the sector between the centre and states is a challenge. Weak institutional structures and processes and inadequate human resources and capacity are also cause for concern. Mechanisms will be needed for R&D to be shared. Public agencies in charge of water-related decisions are in disarray. Supply-side solutions will not be practical for long and water engineers need to shift their approaches towards demand-side management. The Potential Challenges to be successful are

- the mission should be led by interdisciplinary experts,
- there is need for coordination among the various institutional structures such as the Central Water Commission, Central Ground Water Board and National Rainfed Areas Authority and these should be systematically integrated with the work plan of the Ministry of Water Resources;
- Large-scale capacity building and distributed authority between the Centre and states is needed to successfully implement the mission.
- The effect of warming on different aspects of the hydrological cycle in different climate scenarios should have been a priority research objective, with special focus on water budgeting under different scenarios.

Addressing these impacts is a matter of urgency for a vulnerable country like India and all this is to be done with adequate knowledge and by employing adaptive management.

REFERENCES

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.

Cullet, P. 2007. Water law in India: overview of existing framework and proposed reform. International Environmental Law Research Centre. Geneva.

USAID, 2010. 'Country Profile: India'. Available at http:// usaidlandtenure.net/usaidltprproducts/country- profiles/ india

Food and Agricultural Organization, 2010. 'India Aquastat', Available at http://www.fao.org/nr/water/aquastat/ countries/india/index.stm http://www.fao.org/nr/water/ aquastat/flow_vis/index.stm

http://wrmin.nic.in/writereaddata/NationalWaterPolicy/Order_Committee_for_NWP20129685279133.pdf

http://pib.nic.in/newsite/erelease.aspx?relid=82676

USAID (2010). 'Country Profile: India', Available at http://usaidlandtenure.net/usaidltprproducts/country-profiles/india

Food and Agricultural Organization, 2010. 'India Aquastat', Available at http://www.fao.org/nr/water/aquastat/countries/india/index.stm And Government of India 2009. 'State of Environment Report', Available at http://moef.gov.in/soer/2009/ SoE%20Report_2009.pdf

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 Delhi: IDSA, p.167-177.

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

Institute for Defence Studies and Analyses, 2009. Security Implications of Climate Change for India. New Delhi: IDSA. Government of India, 2008. 'National Action Plan on Climate Change (NAPCC)'.

'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peace building.' http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf

'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peace building.' http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf

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

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

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 Available at http://www.american.edu/ted/ice/cauvery.htm

Renner, M. 2011. 'Water and energy dynamics in the Greater Himalayan region: opportunities for environmental peace building', http://www.peacebuilding.no/var/ezflow_site/storage/original/application/4b01f90e8a6c88cfa60c2468df82d2fe.pdf

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

Saci WATERs, 2010. 'Illustrative Cases for Teaching IWRM (Volume I). A Compendium of Ten Illustrative Cases from South Asia', http://www.saciwaters.org/pdfs/Illustrative%20Cases%20for%20Teaching%20-%20Case%20Narrations

****