

## **Environmental and socio-economic issues associated with the impact of climate change on the rivers of India**

Les questions environnementales et socio-économiques liées à l'impact du changement climatique sur les fleuves de l'Inde

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### **RÉSUMÉ**

Les changements environnementaux mondiaux et les demandes qu'exige une consommation multiple d'une population croissante font de la gestion des rivières en Inde une tâche complexe, qui s'accompagne de diverses conséquences socio-économiques associées au changement climatique et à une accessibilité à l'eau en baisse. La mousson subit de profondes variations géographiques et interannuelles liées aux anomalies climatiques mondiales. Toute extrême supplémentaire dans les précipitations et dans les modifications de la fréquence et de l'intensité des rudes conditions météorologiques dues à un changement climatique, aura de sérieux impacts sur les ressources en eau et sur l'agriculture, et se répercutera sur tous les aspects de la vie. Il y a de nombreux facteurs qui affectent la quantité et la qualité de l'eau en Inde, notamment l'industrialisation, l'urbanisation, le développement de l'agriculture, les changements des modèles d'exploitation de la terre, l'usage excessif des eaux souterraines et de surface, à quoi s'ajoutent une consommation irréfléchie et un mécanisme institutionnel inefficace dans la gestion et la conservation. Une estimation détaillée de l'impact du changement climatique sur les ressources en eau des bassins des rivières majeures et un examen critique des politiques actuelles et des stratégies de gestions, tel est l'objet de cet article.

### **ABSTRACT**

Global environmental changes and demands for multiple use of increasing population make river management a difficult task in India with several socio-economic issues associated with climate change and decreasing water availability. Monsoon undergoes wide spatial and interannual variations associated with global climate anomalies. Any further extremes in rainfall and changes in the frequency and intensity of severe weather systems due to a changing climate will have serious impact on water resources and agriculture, and it will be reflected in all facets of life. There are number of factors that affect the water quantity and quality in India including industrialisation, urbanization, agricultural development, changing land use patterns, overuse of surface and groundwater, and after all the careless use and inefficient institutional mechanism for the management and conservation. A comprehensive assessment of the impact of climate change on the water resources in the major river basins and a critical review of current policies and management strategies is attempted in this paper.

### **KEYWORDS**

Climate change, India, management, policy, river

## 1. WATER RESOURCES OF INDIA

Annual precipitation in India is estimated to be 4000Bm<sup>3</sup>, the southwest monsoon being the major contributor (3000Bm<sup>3</sup>). This precipitation contributes to the formation of twelve major river basins and eight other basins formed by the combinations of medium and minor basins. The major and medium river basins contribute over 90% of the total runoff in the country. Of the total water potential of 1869Bm<sup>3</sup>, only 1122Bm<sup>3</sup> can be put to beneficial use. Out of this, 690Bm<sup>3</sup> is surface water and 432Bm<sup>3</sup> is replenishable groundwater. There will be a considerable gap between the water need and availability in various basins in two or three decades from now.

Water balances in the major river basins have been computed, based on the methods developed by Thornthwaite & Mather (1955). The per capita availability of the surplus water from precipitation has been computed. Considering the rate of growth of population and the rate of increase in temperature and changes in precipitation pattern, the per capita availability have again been computed for the entire river basins by the year 2025 (Table 1). The availability ranges from 13404m<sup>3</sup> in the Brahmaputra to 122m<sup>3</sup> in Brahmani-Baitarni. The average value is nearly 1700m<sup>3</sup>. But, excluding Brahmaputra it is only 550m<sup>3</sup>. Even today, availability on annual basis is less than requirement in many of the basins, especially in the interior peninsular region. The study reveals that by the year 2025, at the current rate of growth of population and with the predicted increase in global temperature, the availability will be drastically reduced to 650 m<sup>3</sup> for the regions as a whole and to 250 m<sup>3</sup> in the basins excluding Brahmaputra. In almost all parts of India, seasonal water deficiencies show an increasing trend and the surpluses show a decreasing trend. Northeast India has high values of per capita availability. But, the very high growth rate of population in these regions will reduce the availability up to one-fifth of the present level by 2025. Change in rainfall seasonality may lead to more seasonal water crisis.

Table 1. Water availability in the major river basins

River	Per capita availability, year 2005	Per capita availability, year 2025
Indus	1313	694
Ganaga	1216	513
Brahmaputra	13404	4652
Narmada	1348	534
Tapi	281	114
Brahmani-Baitarni	122	51
Godavari	208	77
Krishna	224	113
Pennar	224	113
Cauvery	275	130
Sabarmati	285	127

## 2. ISSUES ASSOCIATED WITH RIVER MANAGEMENT

The study points out that there will be a considerable shortage of water in all river basins by the year 2025. Government is planning to meet the estimated freshwater requirements from exploitable surface and ground water resources. Increased urbanization has stressed water use and water supply infrastructure beyond capacity. Growth of mega cities highly pollute rivers and add more stress on water. Mega-cities have to cope with intense competition from agriculture and industry to provide their expanding populations, especially the urban poor, with adequate water supply. Mega-cities also have to address the increasing pollution of their freshwater sources from growing volumes of urban waste and the increasing environmental risks from over-abstraction of groundwater resources, inadequate drainage and floods. Urban migration makes water allocation a complicated issue. Only a portion of the water surplus will be reliably available for human use due to deterioration of water resources, especially during dry months when the demand is more. Increased demands in agricultural, industrial and domestic sectors lead to considerable imbalances in the quantity and quality of river water. Climate change and variability are likely to worsen the existing situation by further limiting the water availability. Potential changes in temperature and precipitation pattern may adversely affect soil moisture condition, erosion, sediment transport annual runoff and ground water recharge.

Extreme water conditions and quality issues add to major problems in water resources management. The magnitude and severity of these problems vary from one basin to another. The social,

environmental and political issues related to the rivers are worsening. More water withdrawal for agriculture may lead to increased desertification, land degradation and loss of soil fertility. Overextraction of groundwater in some basins has resulted in reduction of summer runoff in rivers. Sand quarrying in river basins in the State of Kerala has resulted in the depletion of groundwater level by more than one metre in ten years. In this State, deforestation lead to large scale soil erosion and sedimentation, making seven once perennial rivers seasonal in few decades.

Increased population and increasing demand in the agricultural, industrial, and hydropower sectors will put additional stress on water resources. In addition to these, limited water management capacity, fragmented organizational structures, and inadequate water planning, management, and conservation are among the contributing factors to water crisis. Situation seriously underlines the need for taking up integrated plans for water conservation & utilization at basin level to meet the increasing demands of irrigation, water harvesting, human & livestock consumption, expanding industry, hydro-electric power generation, recreation, navigation & other uses. Changing government policies create new water issues. With globalisation, there has been a significant migration of manufacturing industries from developed countries to India and this trend is likely to continue. Degradation of water resources has made reliable water a scarce resource. Almost all rivers in India are polluted far above limits, industries being the major polluter. Another major environmental and social issue is gradually spreading with the starting of implementation of is 560 billion project to interlink rivers. Corruption, misappropriation money, non-cooperation among different government departments, slow government machinery, and vested regional and political interests always retard major projects for river basin development, water conservation, irrigation and even public water supply. For the efficient utilisation of the water resources, though late, India developed a national water policy in 1987, which was updated in 2002 and 2012. The policy doesn't provide guidelines for effective implemtnation.

### 3. SUGESTIONS FOR EFFICIENT WATER RESOURCES MANAGEMENT

Though water is becoming a serious and most challenging issue in the country, measures adopted to face it are inadequate and slow. India needs an appropriate and frequently updated water policy and a strong political will to implement it. Policy development should involve climate change impact on socio-economic conditions in different zones. Water management should be brought under a central control instead of the various departments making delays in decisions. Legal and institutional mechanisms are to be improved. Disputes over transboundary rivers continue to be a major hazard in water related development activities. There should be a consensus among major political parties. Autonomous River Basin Organizations generally better coordinate basin welfare programmes. But, in the typical socio-political set up in India, impartiality should be ensured in its formation.

An option to overcome financial crisis is private sector participation. But, private sector financing should be seen to be complementary and in no way a substitute for the state's responsibility in providing basic necessities for all. Water should continue to be provided free to the extreme poor and to the marginal farmers. Awareness in conservation and management is more important. The fundamental right of access to safe water and sanitation with environmental protection is to be ensured. But, strict control is to be made to avoid overuse and wasteful use. Satisfactory water allocation with consensus among different users is a key factor in the development of society and in maintaining harmony. Involvement of non-governmental organizations and charitable organizations are better performed in India than the Government in providing basic necessities like water. People's participation should be an integral part of all aspects of water resources management. Rivers are to be used in an environmentally sustainable manner in order to maximize its economic and social benefits. It should not be overused or polluted. Addressing water problems requires an inter-sectoral approach that recognizes their links with land use, agriculture, technology and health. Reformation in agricultural sector is urgently needed in maximum and efficient use of water and in minimising input of pollutants. Policy packages using a mutually reinforcing mix of institutional and policy reform, and legal, economic and management instruments will be needed. Strong political decision by the state to implement the rules and regulations is most important.

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