Sustainable Water Resource Management in West Bengal: A Review

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Abstract
This paper aims to identify the water related issues in West Bengal in context of sustainable development. West Bengal has already started realizing the water stress. Per capita fresh water availability continues to be declined. The state suffers from water scarcity amid plenty due to misuse and abuse of water resources. The current economic growth trends show a paradigm shift in the consumption pattern of water – more energy centric than irrigation demands. The demand supply situation also depicts a continuous deficit in future. In spite of standard rainfall during monsoon season, West Bengal depends excessively on ground water during non-monsoon season vowing a potential danger. Due to failure of tap erratic rainwater and degradation of natural drainage systems, the state faces frequent flood resulting one of the top flood prone states of India. The rivers and wetlands of Bengal are on the verge of death due to pollution, human interventions, unplanned industrial development and corruption. Pockets of ground water are contaminated by arsenic, fluoride and iron. The issues of water policies, international rivers and climate changes have been addressed in the article. A region-specific action plan has been presented for sustainable water resource management considering spatial and inter-temporal problems. Lastly, the paper concludes on inadequacy of comprehensive national water policy, approaches and importance of integrated water resource management to face the challenges of water resources likely to be confronted by our future generations.

[**Key words:** Arsenic, Climate Change, Contamination, Groundwater Flood Management, Human Interventions, Integrated Water Pollution, Participatory Irrigation Management, Resource Management, Sustainable Development, Sustainable Water Resource Management, Transboundary Rivers, Water Resources, Wetlands]

Introduction:

The state West Bengal is endowed with an excellent geophysical location - starting from the great Himalayan Range in the north to the Bay of Bengal in south. The location has a strategic significance in the eastern part of India since it places a corridor to North-East and its boundary touches three international borders, namely, Nepal, Bhutan and largely Bangladesh.

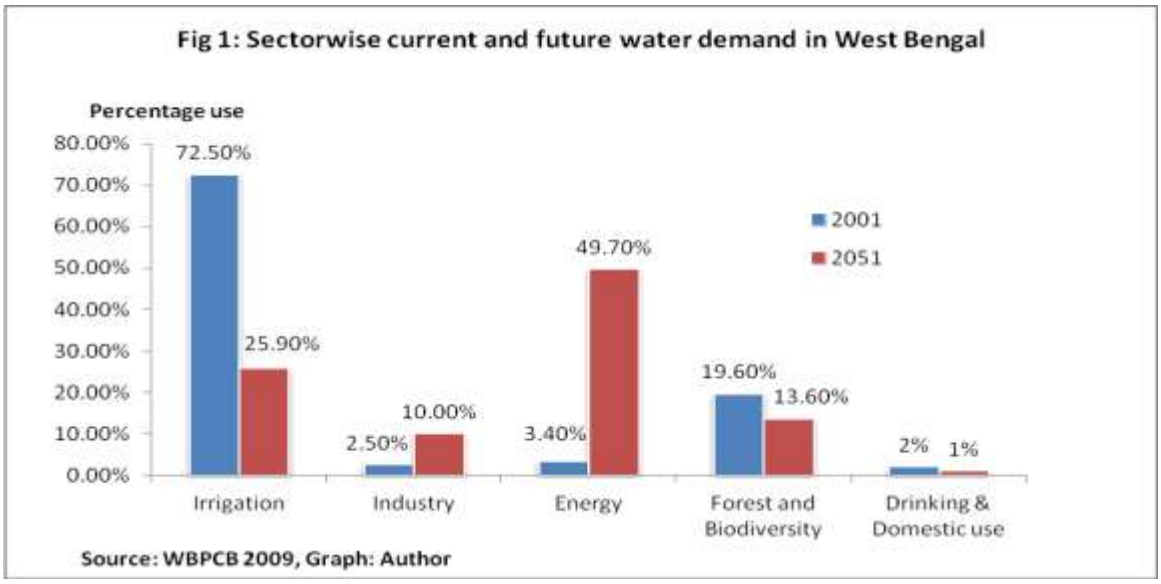
To meet the human needs, water is tapped at the point between precipitations on to land and discharge into the ocean. Only 2.5% of the water of our planet is suitable for drinking and irrigation, out of which 98.6 % water is tapped in glacier, snow, ground water and soil moisture. India gets 0.7% of world water precipitation (4000 Km^3). In India, rainfall is spatially and temporally skewed and uneven which sets serious challenges for water resource management (Rudra, 2005). West Bengal is bestowed with

7.5% of water resources of India and renders home for 8% of National Populations. Highest population density (904/Sq Km, 2011), development needs and extensive irrigation due to agriculture based economy has created water stress in west Bengal. The annual per capita availability of fresh water in 1961 was 5,177 cubic meters, which declined to 1,869 cubic meters in 2001. It is likely to fall further to 1,341 cubic meters in 2025. The present water crises in west Bengal is due to misuse and abuse of water (Rudra, 2005).

Demand - Supply Scenario:

The demand for water in West Bengal is projected to be 10.98 mhm in 2025 from 7.71 mhm in 2000 leading to a deficit of 59% from 38%. Goswami (2002) estimated 5.31 mhm of surface water and 2.38 mhm ground water are utilizable. In addition, 1.2 mhm ground water can be collected through conservation but that will also fail to meet up the total demand. Dam-Canel water network efficiency is only 30%-40% and reaches out only 3% of cultivable land water demand.

The pattern of state economic growth also depicts a paradigm shift in the use of water within the middle of the current century (Fig:1). The WBPCB projection shows that if current trend of industrial development is pursued, energy sector will consume largest share of state water resources.



Rainfall

The average annual rainfall of the State is 1750 mm, which largely runs off to the sea. State is facing an inadequate and erratic rainfall in successive years, mainly in southern part. IMD Report 2010 indicates that there is a distinctive change in the pattern of rainfall (hundred years studies: 1901- 2003). Pre- monsoon season rainfall has decreased by –14.5 mm in northern part and raises by +10.5 mm in southern resulting as a deficit of -1.7 mm.

Post monsoon season shows a reverse picture. There is an overall reduction of rainfall except hill region under study period (See Table 1).

There is tendency of shift of monsoon period-late onset coupled with late withdrawal on the India region as a whole Study during 1900 to 2008 shows that there is an increasing trend for cyclone and storms, especially in the coastal region.

Table 1: Overall Projection of Rainfall (except few)

Period	2050	2100
June - Sept	No Change	Increase
Oct – Dec	Decrease	Increase
Jan – Feb	Decrease	Decrease
March - May	Decrease	Decrease

Source: IPCC 2007

Flood Management:

Water of Bengal is characterized by scarcity amid plenty. The state being 42.3% of the geographically area flood prone, happens to be one of the prime flood prone states in the country. Brahmaputra, Ganga including Sundarbans and Subarnarekha basins are most affected by frequent floods. These rivers are the recipient of run-offs generated outside the state. Basin characteristics, inundation, ground slope, silting at river-bed and heavy downpour causes most of the floods in Bengal. Irrigation and Water Directorate in their Flood Report 2014 recommended that that embankments measuring 10000 km spread over different river systems, Dams, and control of water in the upper catchments can reduce the intensity of the flood. However, the state government expressed its inability to tackle the flood except safety measures and seeking central government interventions.

This is interesting to note that West Bengal water expert Kalyan Rudra opined that *'jacketing of the river with embankment interrupts the vital exchange of water and sediments between the channel and the floodplain, ultimately leading to the decay of drainage channel'*. Embankments were rightly judged as satanic chains. *But the State Irrigation Department chooses to remain in dark and continues to be guided by the colonial legacy of arresting the dynamic equilibrium of tropical monsoon rivers and ultimately causing degeneration of the drainage system'*.

This is a point of discourse how embankments of the river systems will be fruitful to combat floods in West Bengal.

Pollution of Rivers, Groundwater and Wetlands:

Bengal is known as motherland of rivers. There are 27 river basins across the state. Today, most of the rivers are at danger or succumb to death. River Ratnakar (Kana Nodi), Behula, Saraswati, Banka Nodi etc. are already dead. River Damodar which covers 5240 sq km of south Bengal and known as 'Sufferings of Bengal' due to his recurrent floods is also counting his death alarms. Due to intense human interventions on natural flow, rivers have lost their carrying capacity. Unplanned housing and industrial development,

siltation and sedimentation, sometimes encroachment of river beds, dumping of garbage and artificial blockage by dams has rested the rivers in ventilations.

The river Ganga is no more escape - 868 liters of waste water is poured everyday. 25% of the the effluents are contributed by municipal sewage alongside the river in Bengal. However, the pollution of Ganga is a major issue concerns and not discussed here.

The mines catchment in the basins of Damodar and Subarnarekha attracts many industrial establishments. Pollutants from mines and factory run-offs, inadequate practices of waste clean-up measures and corruptions are consistently degrading the water qualities of these rivers. The chemicals, fertilizers, pesticides and insecticides, toxic materials from industrial effluents are polluting the river water poising a serious threat to the aquifer and river biodiversity.

Table 2: Status of water-related issues in WB

Forest Cover	13.6 % of total land
Soil Erosion	15.5% of total land
Safe drinking water	82% of households
Water pollution (effluent treatment guidelines)	Rudimentary
Degradation	28.7 % (degraded land/tot non-forest land)
Improper drainage	81 % (arable land/ arable land having improper drainage facilities)

Source: Vision @2022, CII, 2009

18 % population residing at North Bengal having 60% of surface water and 28% of ground water, whereas, 82 % of south Bengal people depends on 40% of surface water and 78% of ground water. Ground water is also not free from pollution. 5 lakh people are victims of arsenic contamination in 8 districts of southern Bengal. Fluoride contamination in western part in 5 districts and Iron contamination in south Bengal including Kolkata are another two emerging problems of ground water usage.

Spread over 3.5 lakh hectors wetland including 54 natural and 9 man-made wetlands which comprise 8.5 % of national wetland. The main threats to wetland can be classified into five – infilling, excavation, change in hydrology, chemical change and biological effects. EERC studies on degradation of water bodies and wetland (Das, Moitra, Roaychoudhury, Jash, 2000) reveals that *'all the developmental activities in and around the wetlands pose serious threats to the wetland ecosystems. Deterioration of water quality and loss in bio-diversity are brought into consideration the gains are nullified to a large extent, making such conversion inappropriate*'. The research strongly discourages conversions of coastal and non-coastal wetlands for commercial aquaculture and

recommends for infrastructure development for marine fishing to reap out long term economic and environmental benefits.

A status on water-related problems in west Bengal is depicted in Table 2. We need to take up drastic steps to improve the current condition of safe drinking water, land degradation, drainage and soil erosion.

Climate Change

Indian Meteorological Department (IMD) data girded that during the last 37 years, average maximum temperature has gone down by 0.5°C but minimum temperature has boosted by 1°C as spatial resolution. Average sea level is rising 1.3 mm every year. Sea level at Diamond Harbour has gone up by 5.7 mm. The temperature will be up by 2.2°C in the year 2050 and by 3.6°C at the end of the century. During mid-century, West Bengal will be less affected by cyclones due to shift of the cyclone-centre but may go up to 25-20 cyclone per year in 2100. Though there is a fall of blue water flow in WB from 1000-1500 mm to 800-1000 mm per year in 2050 but rise of green water above 1000 mm/year both in mid-century and end-century.

International Issues:

India and Bangladesh share 54 rivers with an annual flow of 1,200 billion cubic metres of water. The Ganga Brhmaputra Meghna Basin (GBM) being a potential platform for regional development, unfortunately, thrust into most miserable economic region due to lack of trust and transparency among the stakeholders. The water agreement between India and Bhutan witnesses an example of mutual benefits to the world. Similarly, the framework for sustainable development of the GBM region can be based on a vision of poverty eradication and sustained improvement in the living conditions of the millions of its inhabitants (Biswas et al. 2004). The failure of sign on the Teesta pact is a missed opportunity for India and Bangladesh. The primary issue is the share of non-monsoon water in which Bengal is strict to the distribution of water in 70: 30 in favour of India during this period. It has been suggested that this could be 50:50 if at least 10 large reservoirs are constructed along the Teesta's banks in a mini version of the Cotton plan that K.L. Rao and M.N. Dastur expanded in detail many decades later. But negotiation failed due to the rigidity of West Bengal.

International rivers are most affected by pollution since the onus to maintain the quality of river water vested on concerned countries. To formulate a mutually agreeable international river policy is complex in nature, though, India and neighboring countries should come up with a comprehensive water policy and implement for saving the rivers and environment.

Policy Issues

National Water Policy of 1987 which may be called first step towards a national policy invites involvement of farmers in the management of the irrigation system, including water distribution and collection of water taxes. National Water Policy of 2002 re-emphasized the participatory approach for the management of irrigation water. The central government has brought out a model Bill and encouraged the states to enact new legislation to formalize the Participatory Irrigation Programme (PIM).

UNCSD (Rio+20) advocates Integrated Water Resource Management (IWRM) which is basically a holistic approach of water resource management in order to attain maximum economic and social welfare without environmental damage. IWRM is linked with the national planning programmes and tracks water related sustainable development goals set by the nations. IWRM is appreciated as best strategy to overcome the adverse impacts of climate and other changes.

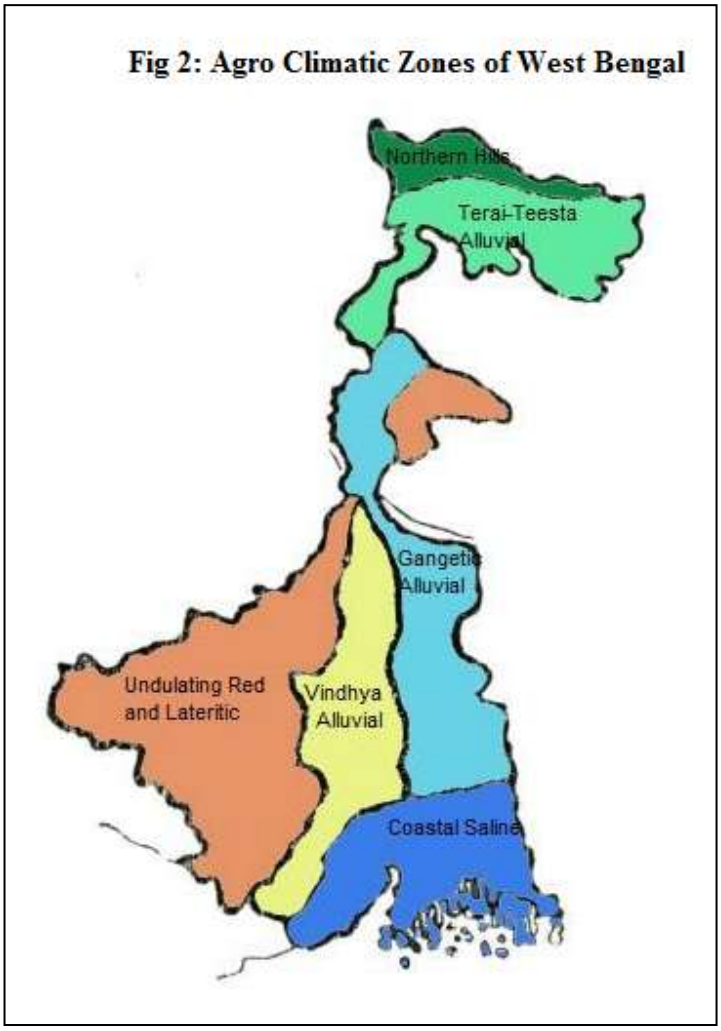
The scope for implementing IRWM in West Bengal is a complex issue. In India, 'water' itself is a state subject and role of central government is to facilitate and monitor the management programmes. The national issues on the water resource management and water governance involve regional spheres, inter-sectoral interests, sometimes transboundary concerns. Therefore, we require an integrated comprehensive national water policy involving both states and centre which clarifies their roles and responsibilities. Unnecessary blame-games which jeopardize the environmental-economic accounting of water can be avoided.

The mission of the Government relating to drinking water supply during post-independence was largely urban-centric, while the rural areas remained neglected. However, to provide safe drinking water in rural areas the scheme Swajaldhara was launched on 25 December 2002. The reforms in principles in Swajaldhara are adhered to by state governments and implementing agencies by adoption of a demand-responsive approach with community participation. Other governmental initiaves are i) National Water Mission(sets a goal of a 20% improvement in water use efficiency) ii) Integrated Watershed Management Programme (IWMP) (to prevent water loss due to transevaporation) iii) Central Water Commission (CWC) (promote integrated and sustainable management of country's water resources by using state-of-the-art technology and by coordinating with stakeholders. iv) National Rain-fed Area Authority (NRAA) (to harness the potential of rain-fed areas).

Recognizing climate change and challenges to poverty, unemployment, food and energy production the water sector must address the issues in a broader national development context, controlling the hazards, maintaining water quality of natural resources, preventing environmental degradation, and rapid socioeconomic development.

Measures for Sustainable Water Resources:

Arthur Cotton, the 19th-century irrigation engineer and army general, suggested a network of canals, reservoirs, dams and lift mechanisms linking the river system to store water during the wet months and release it when fields are parched. The problems to take up such big project is two faceted – i) require huge investment and ii) transit loss of water (around 60% of water) from reservoir to cultivable fields. The only option to achieve this target is decentralised rainwater harvesting and with the aid of low capital investment ventures. Such bottom-up options would be farmer-centered, eco-friendly and cost-effective. The major shift of paradigm should be reduction of over-dependence on ground water and that is to be utilised within the rechargeable limit (Rudra 2005). Towards sustainability, institutions like IWRD, WRIDD, SWID Panchayt Departments, Agricultural department are responsible for implementing several region-specific schemes under 12th and 13th plan for West Bengal amounting Rs 4163 Crore and Rs. 5323 Crore respectively (for details see West Bengal State Action Plan for Climate Change).



West Bengal can be divided into five agro-climatic zones, namely, Himalayan and sub-Himalayan Hill and Tarai zone, Old Alluvial zone, New Alluvial Zone, Red and Laterite Zone and saline Coastal Zone. The water related problems and sustainability issues are zone specific. To develop a strategic solutions towards sustainable water resource management a framework has been developed (Table 3). The fundamental purpose of this analysis is to address issues regarding water resources conservation (by way of recharging, replenishing, recycling or reusing), effective utilization of water and sustenance for future.

Table 3: Issues and Strategy for Sustainable Water Resource Management

Zone	Major Issue	Strategies
Hill and Tarai	Flood Control	• Reservoirs intercepting rivers Jaldhaka, Manas and Sankosh for transfer to deficit regions • Setting up Teesta barrage projects • Enhancing water-storage capacity/ check dams
New/Old Alluvial Plains	Arsenic Pollution	• raising reserve water capacity and region specific ground-water excavation systems • Emphasizing on Surface-based irrigation project • Establishing Water 'pass-through' and 'drain-out' mechanism
Red and Laterite	Draught	• Promoting nature friendly afforastation • Building up Small reservoir/surface water capacity • Measuring to mitigate fluoride contamination
Saline coastal zone	Land erosion and cyclone	• Setting up sluices to prevent saline water • Establishing marine fishing infrastructure • Taking up distinctive project
Overall	Sustainable water resources	• Regulating on compulsory rain water harvesting • Assessing water demand by sector by factoring in climate change • Establishing Pricing and regulations on water use • Taking up contamination mitigation projects • Modernize irrigation system • Periodical review
Source: Adopted from WB State Action Plan for Climate Change, 2010		

Initiatives in West Bengal:

Water Resources Investigation and Development Department, Government of West Bengal, has started the project called Accelerated Development in 2012. This is an external aided project with funding assistance from International Development Association (the World Bank). The project aims to enhance agricultural production of small and marginal

farmers in the project area. The components are strengthening community-based institutions, Irrigation System Development and Agricultural Support Services. However any study report of ADMI is yet to be published to evaluate the project implementation and impact on state sustainable development.

The state initiative of rainwater harvesting preserve to provide a replicable framework as a solution to this ecological imbalance ("Jal Dharo Jal Bharo") project was launched in 2012. In 2012, govt was able to dig 2000 ponds under the Mahatma Gandhi Rural Employment Guarantee Act. State Government aims at constructing 50,000 ponds in the next five years. Recent World Bank approval of Rs 1250 Crore for minor irrigation projects in the State will help to take up, 4,560 small irrigation projects.

Conclusion

This paper aims to identify the water related issues in West Bengal in context of sustainable development and have an analytical look regarding the policies, performance and current status. The present status of water sustainability is inadequate and fragmented. There is a need for comprehensive policy framework and dedicated institutions to work on water governance, Data observation and information dissemination and Integrated Water Resources Management (IWRM). Water is no more a state "subject" since the life of our planet is in question. A multilevel and multidimensional approach should be taken up to face the current and future water crises and related issues concerning concomitant interests of our society, economy and Environment.

The strategic approach to implement sustainable water resource management is to be transformed towards decentralization. Community involvement to address the water related issues will be drawn by both top-down and bottom up strategic tools.

Failure to negotiate on international river-water deals misses the opportunity for mutual socio-economic gains and damage bilateral relations. Both state and national government must take the responsibilities to break the ice inspite of their political compulsion.

The degree of current and potential water related problem is invisible. Our society is busy with more flashy socio-political issues than silent death of water. We need a socio-political movement towards the most precious wealth of life – Water!

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