

# RIVER ASSESSMENT AND WATER MANAGEMENT STRATEGY FOR SOUTH-WESTCOASTAL REGION OF BANGLADESH

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**Abstract** - The upstream-downstream water sharing between transboundary rivers is challenging and growing conflicts among neighboring countries. The Ganges, one of the largest river systems in the world, rises south of the main Himalayan and divides near Gangotri (elevation 4500 m) in Uttar Pradesh, India. The river divides into two channels below Farakka. The left main river enters Bangladesh and joins the Brahmaputra River at Goalundo. Shyamnagar, Satkhira is located at the south-western coastal region of Bangladesh and most of the rivers in this region receive flow mainly from the Ganges river system. After the construction of Farakka Dam, distributary rivers of the Ganges inside Bangladesh are slowly facing death for not receiving their winter flow. As a result freshwater source is decreasing and the salinity situation has been aggravated in the south-western coastal region of Bangladesh. The major portion of the floodplain is low-lying, barely one meter above mean sea level and below high tide level. Moreover, people's interest in shrimp culture has aggravated salinity in the region along with the climate change impacts. So, it is necessary to prepare a distinct and realistic water management plan for the south-western coastal region of Bangladesh. To understand the changes in the region, major rivers are assessed by trend analysis and Satellite map overlays. In co-operation with the local community and based on the river assessment findings, major five problems have been ranked and a 5-year phase water management strategy has been proposed for the south-western coastal region of Bangladesh.

**Keywords** - Transboundary, Water Management Strategy, South-West, Shyamnagar, Salinity, River Assessment

## I. INTRODUCTION

Being the lowest riparian of the Major Himalayan Rivers, Bangladesh has no control over the huge cross boundary flow. Having a flat topography, it also cannot store the huge monsoon water.

As a result, Bangladesh faces floods, prolonged waterlogging during the wet season and droughts, a significant reduction in water availability, salinity intrusion, over-extraction of water, contamination of water during dry season. Coastal areas are more vulnerable to climate change and natural disasters.

Due to increased weather extremes, caused by climate change, the coastal communities fall at high risk of casualties and damages. Shyamnagar Upazila at Satkhira district has been selected as a study area.

Being very close to the sea these areas face natural disasters more frequently. Cyclone, flood, salinity intrusion, sedimentation, water logging are common problems in this region. As most of the people are poor and living below the poverty line, the situation becomes worse during and after any climatic hazards (Bhuiyan, et al., 2015).

The major rivers of the study area are either trans-boundary or they receive water from trans-boundary rivers. Some of the main rivers of this region are Kholpetua, Kalindi, Madar and Kopotakkho.



Figure 1 Shyamnagar Upazila

Due to increasing withdrawal of the Ganga River in its upstream inside India, its distributaries inside Bangladesh are slowly facing death for not receiving their winter flow. This decreases groundwater recharge and lowers groundwater level. As a result salinity intrusion and scarcity of freshwater becomes a major problem. This causes lack of freshwater for drinking, agriculture, aquaculture etc. For scarcity of fresh water, people adapted alternate livelihood options like shrimp culture which causes salinity in the soil. Increasing salinity is causing skin diseases, impairment of women health, loss in agriculture,

ecological damage and thus affecting health, biodiversity and economy.

Natural causes have a significant influence on the inter-annual variations of salinity, but fluctuations of the Ganges water flow, as controlled by the Farakka Barrage, may be the most important factor (Mirza & Sarker, 2004). As a part of this broader and holistic objective, the technical analysis on rivers is carried out to fulfill the following sub-objectives:

- ✓ Assess the present condition of the rivers in south-west coastal region
- ✓ Propose a future water management strategy based on community engagement and research findings

## II. CONCEPTUALIZING THE CONTEXT

Bangladesh is located in the Ganges-Brahmaputra-Meghna catchment, one of the largest basins in the world. Around 405 rivers crossed by the country in which 57 rivers are shared with other riparian countries and known as trans-boundary rivers (JRC, 2013). The country is densely populated and Population is expected to rise to 179 million by the year 2025 and to 202 million by the year 2050 (World Bank, 2017). Thus the competition for water for the water supply and sanitation, agriculture, industry, fisheries and wildlife, navigation, hydropower and recreation is accelerating day by day. Climate change issues will further result in more challenges on overall development of Bangladesh (BDP, 2015).

The Ganges, Brahmaputra and Meghna (GBM) basins, shared between Bangladesh and India, as a whole, receive more water than necessary over the year, but the spatial and temporal distribution of water availability are very uneven. Both countries have built dams and barrages on these rivers to satisfy their water needs without considering the ecological settings. Consequently, the dwindling supply of water in dry season has become one of the key contested issues between the two countries.

Negotiations, however, for water sharing in this region are mostly based on anecdotal rather than scientific evidence. Both Bangladesh and India classify river flow data as secret and use the lack of mutually acceptable data as a tactic to promote their own national interests

Bangladesh and India are close neighbors, who share geography and politics. But water sharing between these countries is characterized by discontent, disbelief and mistrust (Nishat & Faisal, 2000). Hence, political concept of environmental security and trans-boundary resource management receive more attention than ecological dynamics in this context. Bangladesh is a downstream country that receives many of these common rivers at a mature state. When

the velocity drops, sedimentation rates increase and the river changes its course, braiding into multiple channels.

Trans-boundary fresh water resources management has become complex because of water scarcity due to increased water demand and climate change associated precipitation variability (Biswas, et al., 2004). Despite Bangladesh's overwhelming dependency on the GBM Rivers for livelihood and agriculture, the country is unable to manage water resources of these rivers on its own as 92 percent of the GBM basins are situated outside the country (Faisal, 2002). Thus dwindling supply of water in the dry season has become one of the key contested issues between Bangladesh and India (Nishat & Faisal, 2000). Analyzing pre-Farakka (1949–1970) and post-Farakka (1975–1995) data of inflow of water at the Hardinge point (Bangladesh part), it has been found that the average inflow during the dry season of the Ganges reduced to 51 % during the period. Such a drastic drop in the flow of the Ganges water during the dry season resulted in significant ecological and economic damages for Bangladesh (Bharati & Jayakody, 2011; Faisal, 2002).

However, increased adaptive capacity to cope with climatic hazard can minimize the impacts. If the identified potential impacts and vulnerable areas get special priorities with enhancing the awareness of local communities about their vulnerability (social, economic, environmental and physical) to climate change, it can strengthen their resilience in the long term and will help to cope with the challenges posed by climate change (Bhuiyan, et al., 2015).

## III. DETAILS EXPERIMENTAL

A number of steps will be followed to assess the rivers and to prepare a water management strategy.

### A. River Overview

General overview on the rivers will be discussed in this section. Moreover, transboundary connection of the rivers will also be discussed here.

### B. River Assessment

Major rivers will be assessed based on trend analysis, planform analysis and present scenario analysis. These analyses will show the changes in river flow over the years due to transboundary impacts and climate changes.

### C. Future Water Management Strategy

A water management study will be prepared based on the cooperation with local community and river assessment. Based on the inventory of available structures and water demand, a list of management strategies will be prepared and proposed for a 5 year phase in the south-western coastal region of Bangladesh.

**D. Conclusions**

Summary of the river assessment and the water management strategy on the south-western coastal region will be addressed in this section.

**IV. RIVER OVERVIEW**

Rivers play direct role in Water supply, Transportation, Irrigation for agriculture, Fisheries, Employment, Biodiversity, Carrying Sediments and minerals.

**4.1. Kholpetua River (SW – 23)**

Kholpetua is a major river in South-western coastal region. The River has three distinct physical setting – Fresh water, brackish and saline zone. It receives fresh water flow from Betna in the upstream and tidal flow in the middle from Morichapa and finally drains into the Bay of Bengal through Kapotakkho River.

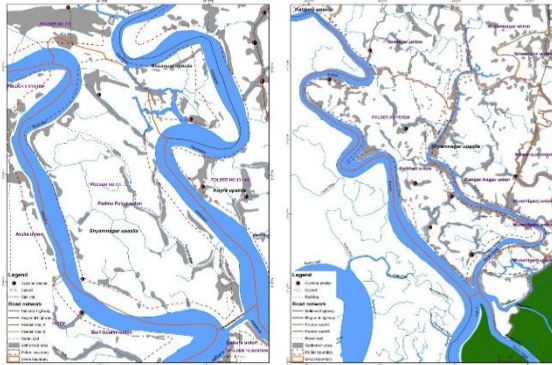


Figure 2 Kholpetua and Kalindi River

**4.2. Kalindi River (SW – 7)**

Kalindi River is a tidal estuarine river around the Sundarbans of Bangladesh. It originates from Bhairab-Kapotakkho River and ends at the Raimangal River. Kakshiyali is the only tributary whereas Bhairab, Saphamara-Habra, Murichap-Lobongaboti, Chitra are the distributaries.

**4.3. Madar Gang River (SW – 77)**

Madar Gang originated from Kakshiyali River of Satkhira District. The river flows through Satkhira District and finally falls into Kalindi River.

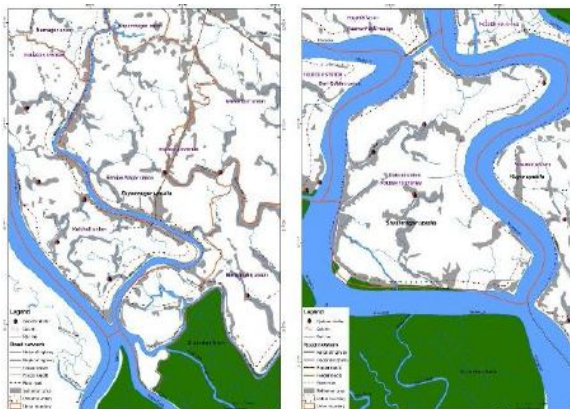


Figure 3 MadarandKapotakkho River

**4.4. Kapotakkho River (SW – 9)**

The origin of Kapotakkho River is from Jessore district’s Bhairab River. River Kapotakkho is one of the main water resources system located in the south western region. During the last few decades, the flow of the Kapotakkho River had been declining very rapidly. Tide generated from the bay brings huge sediment towards the inland through the tidal pumping process.

**V. RIVER ASSESSMENT**

An overview of these rivers, including determination of their trend will clarify many aspects like, excess and low flow period in a year, the rate of flow, reasons behind decreased flow, way to mitigate identified problems etc.

**5.1. River Trend Analysis**

Trend analysis of each of the four rivers helps to assess platform change, widening or narrowing of banks, determination of left or right bank erosion of each river, identification of dried or filled up portions of each river etc.

**5.2. Kalindi River- 1985 to 2014**

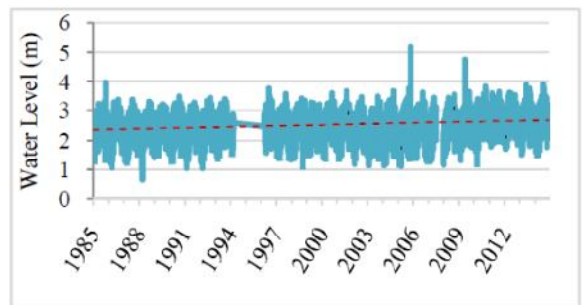


Figure 4WL-Time Series, Kalindi River(1985-2014)

Observations from the trend analysis:

- ✓ Water Level trend has almost been similar for the last 30 years
- ✓ Average water level is 2.46m PWD.
- ✓ Max WL is 5.20m PWD and Min WL is 0.65m PWD.
- ✓ Average tidal range is 1.68m.

**5.3. Kholpetua River- 1985 to 2014**

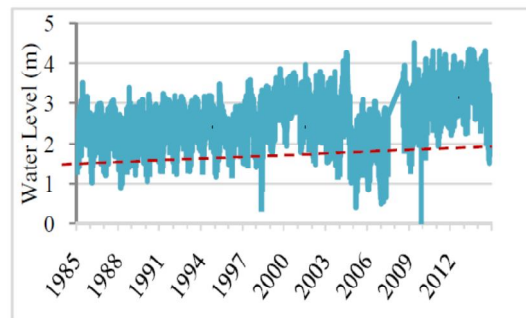


Figure 5WL-Time Series, Kholpetua River (1985- 2014)

Observation from the trend analysis:

- Water Level is in increasing trend for the last 30 years and almost 0.75m WL has risen.
- Max WL is 4.49 m PWD and Min WL is 0.00 m PWD.
- Average tidal range is 1.87 m.

#### 5.4. Kapotakkho River- 1985 to 2014

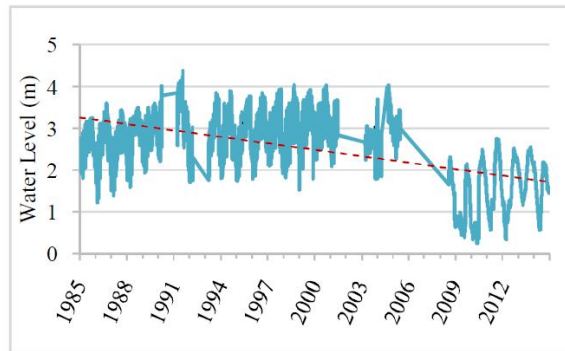


Figure 6 WL-Time Series Kapotakkho River (1985-2014)

Observations from the trend analysis:

- Water Level is in decreasing trend for the last 30 years and almost 2.18 m WL has been reduced.
- Max WL is 4.38 m PWD and Min WL is 0.3 m PWD.
- Average tidal range is 1.72 m.

#### 5.5. River Planform Analysis

Over the last few decades, the local rivers Kalindi, Kholpetua, Kapatakko and Madar of Shyamnagar Upazila, all has become narrower with time and dried up a bit in places.

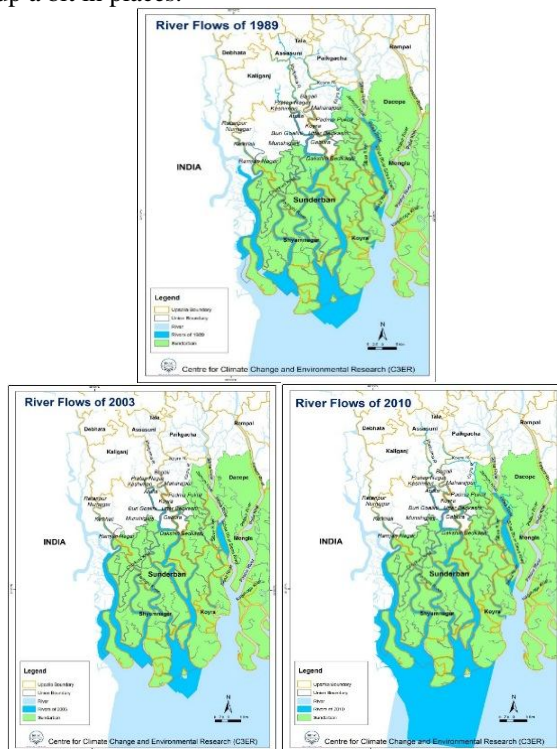


Figure 7 River Flows of 1989, 2003, 2010

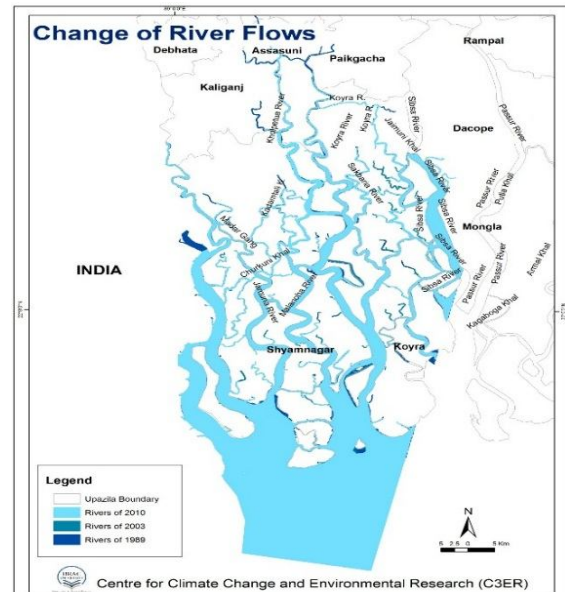


Figure 8 Satellite Image overlay of River Flow Changes over the years (1989-2010)

Observation from the Planform analysis:

- From the overlapping of the images of three different years, it can be seen that in the recent image some small branch rivers are missing
- In 1989, local rivers had better flows and were wider (marked with darker shades of blue).
- In 2003, some rivers become narrower with time.
- In 2010, many branches of rivers have dried up and also the river has become narrower than ever.
- All of the rivers are distributaries of Ganges River and decreased their flow over time.

#### 5.6. Scenarios of Local Rivers (Year 2014)

The report will also provide a short overview on the present condition of the river based on the climate change and transboundary impacts.

##### 5.6.1 Kalindi River

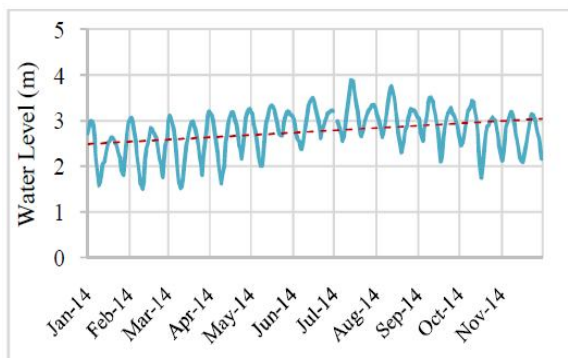


Figure 9 Water Level Time Series (Kalindi River 2014)

Observation from Kalindi River-

- Water Level increases during Jan to July and is as high as 3.89 m PWD.
- Water Level decreases during August to December and is as low as 1.50 m PWD.

- WL is high during Monsoon (June-October) and low during Winter (November to April)
- Average water level is 2.76 m PWD.
- Average tidal range 1.77 m.

### 5.6.2 Kholpetua River

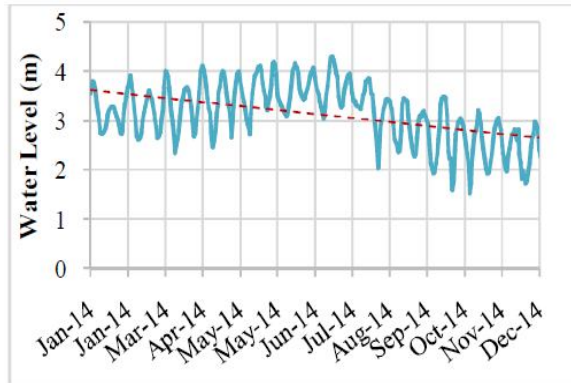


Figure 10 Water Level Time Series (Kholpetua River-2014)

Observation from the graph of Kholpetua River-

- ✓ Water Level increases during Jan to July and is as high as 4.3 m PWD.
- ✓ Water Level decreases during August to December and is as low as 1.52 m PWD.
- ✓ WL is high during Monsoon (June-October) and low during Winter (November to April)
- ✓ Average water level is 3.13 m PWD.
- ✓ Average tidal range 2.18 m.

### 5.6.3 Kapotakkho River

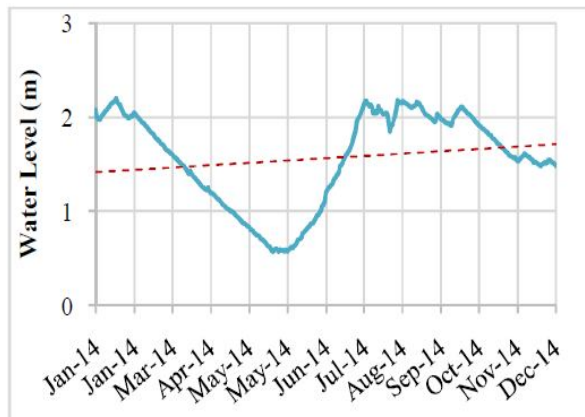


Figure 11 WL-Time Series, Kapotakkho River (2014)

Observation from the graph of Kapotakkho River-

- ✓ Water Level increases during May to July and is as high as 2.2 m PWD.
- ✓ Water Level decreases during Nov to March and is as low as 0.57 m PWD.
- ✓ WL is high during Monsoon (June-October) and low during Winter (November to April)
- ✓ Average water level is 1.56 m PWD.
- ✓ Average tidal range 0.10 m.

## VI. FUTURE WATER MANAGEMENT STRATEGY

### 6.1 Problem Ranking

Sessions held at Union Parishad offices in Shyamnagar involved the members to rank and prioritize their problems related to water. The major problems in the region have been ranked according to the community perception, represented in the graph below:

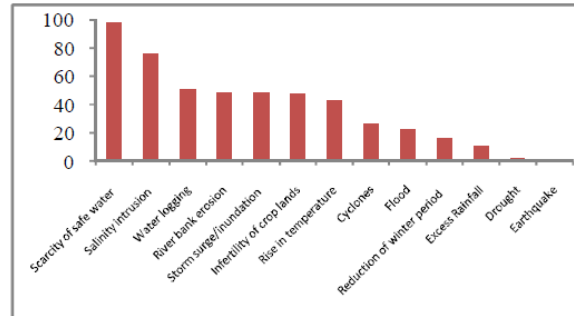


Figure 12 Problems identified and ranked by local authorities

### 6.2 Alternative livelihoods

When the people spoke about livelihood practices it was clear that there are two major livelihood options in the region: agriculture and aquaculture. Agricultural practices have remained almost the same but after Aila struck the region, they were unable to harvest any crops for 6-7 years. They stop agricultural work in the winter when water scarcity is at its worst and they migrate to other cities in search of work. They tend to engage in various alternative income generating activities such as construction, poultry rearing, tailoring, volunteering for NGO, etc. The people are more concentrated on shrimp and crab culture as these are more profitable. Among the people who own Ghers to harvest shrimps and crabs, many also collect larvae from rivers.

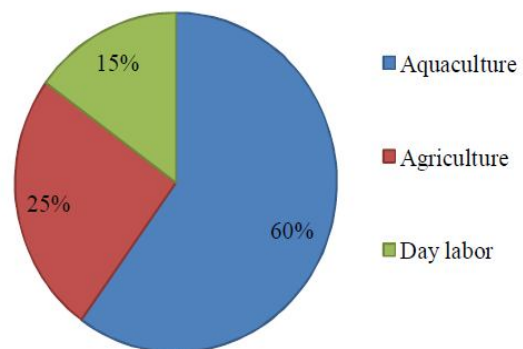


Figure 13 Livelihood in Shyamnagar (Local authorities)

### 6.3 Water Management Strategy

A master water management plan is a necessity to ensure the water security for the marginalized communities of the Shyamnagar Upazila.

Table 1 A Master plan with problems &amp; measures

Problems	Implementing Organizations	Measures	Est. Work	Est. Cost (Mil)
PHASE-1: Scarcity of Safe Water (June, 2018)	BWDB, Upazila Council, NGO, DPHE, World Vision	Water Supply thorough Pipe	36.8 Km.	63.6
		RWHS in Schools	277 nos.	35.9
		RWHS in Households	3191 nos.	95.4
		Deep and Shallow Tubewell Setup	1199 nos.	59.0
		Maintenance of fresh water ponds	103 nos.	15.9
		PSF Setup	107 nos.	25.9
		Repairing of PSF	80 nos.	5.3
PHASE-2: Unavailability of Irrigation Water due to Salinity Intrusion (June, 2019)	CPP, Upazila Council, NGO, Union Parishad	Excavation of Ponds	75 nos.	10.9
		Raising of Embankments and Excavation of Canals	56.5 km.	49.1
		Shallow Pump Setup	80 nos.	4.0
PHASE-3: Waterlogging (June, 2020)	Union Parishad, BWDB, Upazila Council, LGED	Construction of Sluice Gates	14 nos.	38.2
		Construction of new Culverts for Water Drainage and transports	100 nos.	43.4
		Drainage management and Excavation of Canals	32 Km.	17.1
PHASE-4: Endangered Polders (June, 2021)	BWDB, Upazila Council, NGO	Repairing, block dumping and Raising of Polders	69 km.	375.2
PHASE-5: Vulnerable to Cyclone and Storm Surge (June, 2022)	Union Council, LGED, DMB	Construction of new Cyclone Shelters	54 nos.	820.0

## CONCLUSIONS

From our study, it is observed that the main rivers of Shyamnagar Upazila are facing problems due to transboundary issues. The maps reflect changing pattern of river flow during a period of 1989 to 2010. These rivers depend on the flow from the Ganges which originates from Nepal and through India it reaches this region in Bangladesh. The overlapped map is showing that all the river flow has been decreased over this period of time. Even, the distributaries have dried up. Rivers are getting narrower day by day. Because of a decrease in upstream flow, ultimately the river flow in this lower riparian area is decreasing also which is affecting the livelihood of people in this area. Rivers are the main source of fresh water here and availability of water is crucial in this region for maintaining ecological, environmental as well as social sustainability. Due to

decreasing flow in these rivers South-western region is facing problems like salinity intrusion, siltation, scarcity of water for drinking, agriculture and fisheries and athreat to ecology. To solve these problems emphasis should be given on internal river management and proposed water management strategies for a 5year phase so that the rivers receive their natural flow and maintain ecological balance.

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