The Indus Delta: Impact of Seawater Intrusion under Changing Climate Scenario

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The Problem

The Indus Delta is one of the most vulnerable of the world's large deltas. Many factors—decrease in the river flow with the resulting reduction in sediment deposits, surface and subsurface seawater intrusion, coastal erosion, sea level rise, climate change, and human activities—have all contributed to the shrinkage and degradation of one of the largest ecosystems of the world.

The study

Using remote sensing and geospatial tools this study sought to assess the impact of climate change in the region with the aim of providing policymakers with definitive data to help develop a strategic action plan to mitigate the adverse impact of seawater intrusion under current climate change scenario on the environment and to adopt measures for protecting the biodiversity of the Delta.

Findings

The study revealed some alarming facts with regards to temperature, rainfall, vegetation, soil salinity, surface and groundwater quality, shifting shoreline, and seawater intrusion which need to be addressed urgently if the worst effects of seawater intrusion are to be managed effectively.

The active Delta which in 1833 occupied an area of about 1.3 million hectares (Mha) has now shrunk to only 0.1 Mha—an approximate 92% reduction in area. Where there were once 17 river mouths, there are now only two active creeks–Khobar and Khar. An analysis of the data of the annual flow below the Kotri Barrage in billion cubic meters (BCM) from 1937 to 2017 reveals an 80% decrease in water flow, with a resulting reduction in sediment deposition to the extent of about 90 million to 400 million tons per year.

Poverty is widespread in the Delta. Diseases prevail, and health services are scarce. A socio-economic survey of the area revealed that some 39.3% of the people are engaged in agriculture, followed by fishing (16.6%), government/private jobs (15.0%) and daily wage earners (12.7%). About 88.4% of the population lives below the poverty line. This depressing picture is made even grimmer by the fact that decrease in water availability combined with rising sea water levels and the degradation of the mangroves has left the Delta susceptible to tsunamis and cyclones, further endangering the lives and livelihoods of the coastal communities.

It appears that summers in the Delta are getting warmer while the winters are turning colder. There has been a significant decrease in mean monthly rainfall (of up to 23%) for the period June-August 1991-2016compared to June-August 1960-1990, while an increase in mean monthly rainfall (100%) was observed for September and October for 1991-2016as compared to 1960-1990.

Vegetation in the Delta has been declining at a disquieting rate. While there was a slight increase in the area covered by mangrove forests in 2017, the overall picture remains unsatisfactory. Mangrove forests now occupy only 12.6% of the total tidal flood plains or about 6.2% of the entire Delta.

Mangrove coverage as a percentage of delta and floodplains

Year	% of Delta	% of Floodplains
1990	7.91%	16.03%
1995	6.28%	12.72%
2000	6.14%	12.44%
2005	4.84%	9.81%
2010	4.98%	10.08%
2017	6.22%	12.6%

Mangrove coverage as a percentage of Delta and Floodplains has declined by 1.69 and 3.43 percentage points (ppt), respectively, between 1990 and 2017.

A graph may be added…

About 42,607 hectares (ha) land of the Delta has degraded due to surface seawater intrusion whereas subsurface seawater intrusion has affected an estimated 88.3% of the Delta.

There has been an increase of about 7.1% in the tidal floodplains of the Delta over the last 45 years. Out of the total degraded land about 31,656 ha is now under seawater while about 10,951 ha of new land has been converted into the tidal floodplain area. It was further found that low mangrove coverage, oil extraction, and flat land slope make the coastal area on left bank of the river more susceptible to coastal erosion as compared to the right bank.

Satellite imagery reveals that water bodies in the entire Delta have doubled in the last 27 years. However, analysis of water samples collected from these water bodies show that about 78% of this water is saline and hence unfit for drinking. Furthermore, the sampled water bodies were unsuitable even for irrigation purposes.

Recommendations

This study leaves little doubt that climate change represents a direct and immediate threat to the Delta, and quick intervention is needed if the worst effects of climate change are to be managed.

Strengthen bulwarks against surface seawater intrusion

- Expand the already constructed 38 km long coastal highway up to 200 km on the left bank of the Indus by putting a bridge across the river at Kharo Chhan. This will function as a defense-line against surface seawater intrusion impeding further erosion of the Delta by the sea.
- Ensure an escapage of 5,000 cusecs of water throughout the year below the Kotri Barrage to check seawater intrusion and maintain the river channel as recommended by the International Panel of Experts (IPOE). Also, ensure the total volume of 25 Million Acre Feet (MAF) in a five-year period be released below Kotri as flood flows.
- Plantation of mangroves on the tidal floodplains, especially on the left bank of the Indus should be initiated on an emergency basis. This will provide a credible defense-line against natural calamities such as extreme tides, cyclones, and tsunamis. Moreover, the river silt trapped by the mangroves will help with the accretion process along the coast.
- Ensuring adequate water flow in the Indus and in the canals originating from the Kotri Barrage will help minimize surface and subsurface seawater intrusion in the entire Delta.

Revitalizing the Delta

- Ensuring adequate water flow in the Indus and the canals originating from the Kotri Barrage will provide drinking water to coastal communities and will fulfil the freshwater needs of the flora and fauna.
- Efforts should be made to restore relic river channels, such as Ochito and Old Pinyari. These channels will carry extra flood water to the sea during peak flood times; plus, the channels will carry silt-laden water during floods and discharge it into the sea away from the main river estuary. This will be supportive in silt deposition in areas where river water and silt usually do not reach.
- Most of the natural lakes in the Delta are saline. These should be revived by adding fresh water during the monsoon period. Freshwater lakes can play a vital role in providing drinking water to the communities and work as groundwater recharge hotspots.

The economic development of coastal communities

- The extended coastal highway will provide coastal communities quick and easy access to the markets of Karachi.

- Restoring derelict river channels will help supply fresh water to the coastal communities living far away from the main river course.
- Plantation of mangroves on the tidal floodplains will provide a natural breeding ground for fish, shrimps and other marine life which in turn will provide wood, fodder, and livelihood to the coastal communities.
- Biosaline agriculture should be encouraged, especially in tidal floodplains and over the vast barren salt-affected soils lying between tidal floodplains and the canal irrigated areas of the Delta to provide food and fodder for the coastal communities and their livestock.
- Cutting of mangroves for wood, and the use of fine mesh nets for catching small size fish and shrimps should be discouraged to allow time for regeneration.
- Tourism, especially boat cruising, in the mangrove-lined creeks of the Delta could provide an alternate source of livelihood to local communities.
- Quantifying the alteration in climatic factors such as temperature and rainfall and creating awareness about the impacts among the local communities will help the people in combating climate change and its adverse effects.

For more information, see the full report at...