

COASTAL RESILIENCE IN THE INDUS DELTA; UPSCALING NATURE-BASED SOLUTIONS

Dr Emma Rendle, Resilient Coasts Ltd, emma@resilientcoasts.com
Mr Nathan Rive, Asian Development Bank, nrive@adb.com
Mr Asad Zafar, Asian Development Bank, asadzafar@adb.org

SETTING

Sindh province in Pakistan is home to the seventh largest delta, the mouth of the River Indus is partly designated under the RAMSAR Convention on Wetlands. One of the world's largest arid mangrove forest systems once occupied the coastal belt. Systematic removal over the past 50 years has exposed the delta to energy higher during cyclones and climate related threats. Two of the 17 creeks remain active: Khobah and Khar. The others are suffering mangrove loss, destabilisation and erosion, saline intrusion, and inundation from combined flood events. Agriculture and livelihoods interrupted causing extreme poverty and migration.

THE PROBLEM

The Indus River originates in the Himalayas, a melt-cycle catchment which flows is controlled by a series of dams and barrages. The Indus Delta is controlled from Kotri Barrage, with the main flow to the sea banded for flood protection (embankments). A canal and irrigation system installed 1857-1947, poorly maintained and prone to overtopping, diverts water from the land directly to the sea during flood events. Ad hoc development of roads and other infrastructure lack drainage or culverts reducing connectivity and flood management efforts. Maps highlight 92% reduction in the Active Delta observed from 1833 to 2017; 12,900 km² to 1,070 km² (Siyal, 2018). Landsat imagery (1972 to 1917) provides quantification of temporal shoreline change in four zones (Figure 1). Coastal erosion at the exposed SE region has caused delineation, net landward recession ranges 0.5-1.2 km. Estimated river flow has decreased 80% and sediment input declined from 400m to 90m t/yr (based on barrage regulation, not observations). Present dam management practice is not following sediment passing guidelines and is likely much lower. Dams reduce sediment availability to near negligible levels, the stability afforded by mangrove forest has been lost as its systematic removal results in increasing coastal erosion, combined flooding, and saline intrusion. The salinity and agricultural practices depreciate soil quality and ability to grow crops, causing land abandonment leaving the east bank barren. The resulting human migration due to the extreme degradation of the environment, causing widespread poverty and loss of livelihoods.

BALANCING GRADIENTS

Restoring the buffer zone through reconnecting water and sediment pathways will be key to a climate resilient Indus Delta system. Releasing fresh water through the natural creek and rivers, whilst providing rainwater reservoirs for the dry season, and enabling groundwater recharge vital for sustaining life and adequately controlling soil salinity. The

waterway restoration is designed to utilise natural depressions and create hubs for town infrastructure planning; nodal points for flood and coastal risk management and engineering intervention schemes, alongside required municipal works.

STABILISING PROCESSES

National adaptation planning and policy review are central to the Sindh Coastal Resilience Project. Restoring the building blocks for environmental stability, providing a solid foundation for development. Three management zones are defined for shoreline and flood inundation under rising sea levels: (i) a coastal buffer of restored mangrove forest belt circa 30 km by 300 km; (ii) a planning zone exposed to annual storm events; (iii) a planning zone for future water levels and extreme events i.e. cyclonic activity and Tsunami. Beyond these zones will be clear differentiation for permeant infrastructure. Upscaling the successful ADB pilot study for mangrove re-forestation project using rangers and communities. The mega engineering effort to bring freshwater to the mangrove will be the unique engineering challenge.

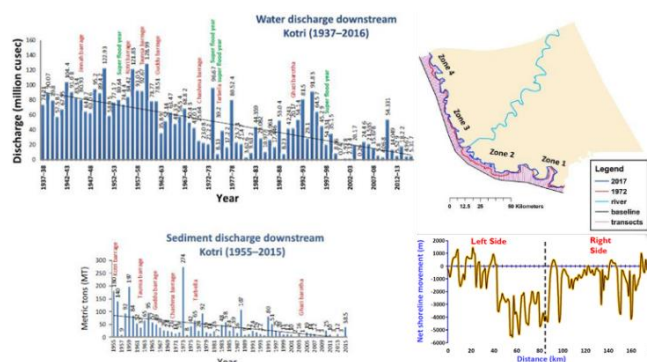


Figure 1 - Water and sediment discharged to the Indus delta from the Kotri Barage since 1937 and 1955, respectively. Source: Kidwai, 2019. Source Right: Coastal erosion pattern (1972-2017). Source: Siyal, 2018.

The willingness to work to improve the situation is not underestimated in Pakistan, an Nature-based Solution project focused on ground works is highly appropriate for maintaining the buffer. Alternative livelihood provisions land, forestry and flood management are described. Economic potential in carbon credit add benefit to re-forestation. The Indus Delta project unite Blue Economy ideals whilst providing security under climate change.

REFERENCES

Siyal (2018) Mehran University, Jamshoro, Pakistan.
Kidwai (2019) NIO, Pakistan