Tides stabilize deltas until humans interfere

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Human interference in river deltas is massive. And despite global concerns about river delta degradation, human activity in the world's largest deltas still intensifies. The extraction of natural resources, sediment retention by reservoirs and sea-level rise are all causes of degradation of deltas subject to tides. A team of researchers from Wageningen University, Deltares, University of Twente (Bart Vermeulen, Water Engineering and Management) and Delft University of Technology reveals the contrast between the roles of tides in natural and human-controlled deltas.

Under natural circumstances, tides act to stabilize river deltas. The oscillatory tidal flow counteracts the processes responsible for bank erosion, which explains why unprotected tidal channels migrate only slowly. Peak river discharges attenuate the tides, which creates storage space to accommodate the extra river discharge during extreme events and as a consequence, reduce flood risk. With stronger tides, the river discharge is being distributed more evenly over the various branches in a delta, preventing silting up of smaller channels. "But human activity in deltas intensifies," says Ton Hoitink, professor of Environmental Fluid Mechanics at Wageningen University. "Our interference in deltas is massive. Storm surge barriers are constructed, new land is being reclaimed and large-scale sand excavation takes place to collect building material. Evidence from deltas around the globe shows that in human-controlled deltas the tidal motion often plays a destabilizing role."

Some 100 scour holes in channels of the Rhine-Meuse Delta were recently identified, which relate to the altered tidal motion after

completion of a storm surge barrier. Sand mining in the tidally-influenced Mekong Delta has led to widespread river bank failures. The catastrophic flood event in the Ganges-Brahmaputra Delta by Cyclone Aila, which caused the inundation of an embanked polder area for over two years, was preceded by river bank erosion at the mouths of former tidal channels that were blocked by the embankment.

Efforts to predict the developments of degrading deltas are few. Existing delta models are capable of reproducing expanding deltas, which is essentially a matter of simulating the transport of sediment from source in a catchment to the sink in a delta. Processes of soil compaction, mixing of sands and clay, and the influence of peat layers complicate the prediction of delta erosion. Hoitink: "Considering sea-level rise, sediment depletion and all the direct human modifications in deltas, there really is a need for a new generation delta models using quantified erosion resistance from geological records."

More information: A. J. F. Hoitink et al. Tidal controls on river delta morphology, *Nature Geoscience* (2017). DOI: 10.1038/ngeo3000

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