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Impacts of poldering: elevation change, sediment dynamics, and subsidence in the natural and human-altered Ganges Brahmaputra tidal deltaplain

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In the Ganges-Brahmaputra Delta (GBD) and other tide-dominated low-lying regions, periodic tidal and cyclonic storm surge flooding of the land surface promotes sediment accretion and surface elevation gain which offsets elevation losses from eustatic sea level rise and subsidence. However, over the past several decades, anthropogenic modification of the GBD tidal deltaplain through embankment construction has precluded sediment delivery to densely populated embanked islands, locally-termed polders, resulting in landscapes 1-1.5 m lower than adjacent natural mangrove platforms. Recent discussion on GBD sustainability includes whether land surfaces (natural or anthropogenic) are keeping pace with local sea-level rise rates, and the quantification of continued elevation change, vertical accretion, and land subsidence. To provide local-scale, longitudinal trends of landscape dynamics, an array of Rod Surface Elevation Tables (RSETs) and sediment marker horizons was deployed in natural and embanked settings near Polder #32 and monitored seasonally over the past 6 years (expanded throughout the SW delta in 2019). These data are compared to existing and new co-located continuous GPS measurements (also expanded 2019). Near Polder #32, elevation gain is taking place in both natural and embanked regions (1-3 cm/yr), though it appears to be slightly greater (30%) within the poldered areas. This may be due to increased accommodation space and/or embankment sloughing. There also is a distinct seasonal pattern in both regions, with greater elevation change documented after the wet monsoon season (May-Sept), and either less elevation gain, or even elevation loss after the winter dry season (Jan-May). Elevation gain is a direct result of exceptionally large sediment vertical accretion (2-3 cm/yr), as measured from marker horizons and sediment tiles, and rates appear to be keeping pace with local effective sea-level rise documented by Pethick and Orford (2013). Seasonal shallow subsidence (0.8-1.1 cm/yr) is also observed, exacerbated in poldered regions during the dry season. These measurements of shallow subsidence are 30-50% greater than deeper subsidence measured with GPS (0.3-0.7 cm/yr) but consistent with resurveys of geodetic monuments (see Steckler et al. abstract). Preliminary results delta-wide show shallow subsidence can be as much as 3 cm over the course of one year. These data provide critical information to local stakeholders about the natural versus human-altered delta dynamics, and have cross-disciplinary implications for ecological productivity, social well-being, and flood risk mitigation.