Effectiveness of grey and green engineered solutions for protecting the low-lying muddy coast of the Chao Phraya Delta, Thailand

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Supplemental Information

- Fig. S1: Shoreline change rates after construction of each structure versus distance from the initial shoreline and the differences in shoreline change rates before and after construction of each structure.
- Fig. S2: Sediment trapped sediment behind coastal protection structures.
- Fig. S3: Mangroves recolonized seaward across the deteriorated bamboo fence.
- Fig. S4. Shoreline change, land subsidence rates, and groundwater extraction in the eastern Chao Phraya Delta since 1954.
- Fig. S5. (a) Bamboo debris at Ban Si Long after three years from construction.
- Fig. S6. Bamboo fence east of Ban Si Long between Sta.28+540 and Sta.29+500. after 2–3 years from construction.
- Fig. S7. Trapped sediment and recolonizing mangrove behind nearshore breakwaters constructed in 2015.

Supplemental materials

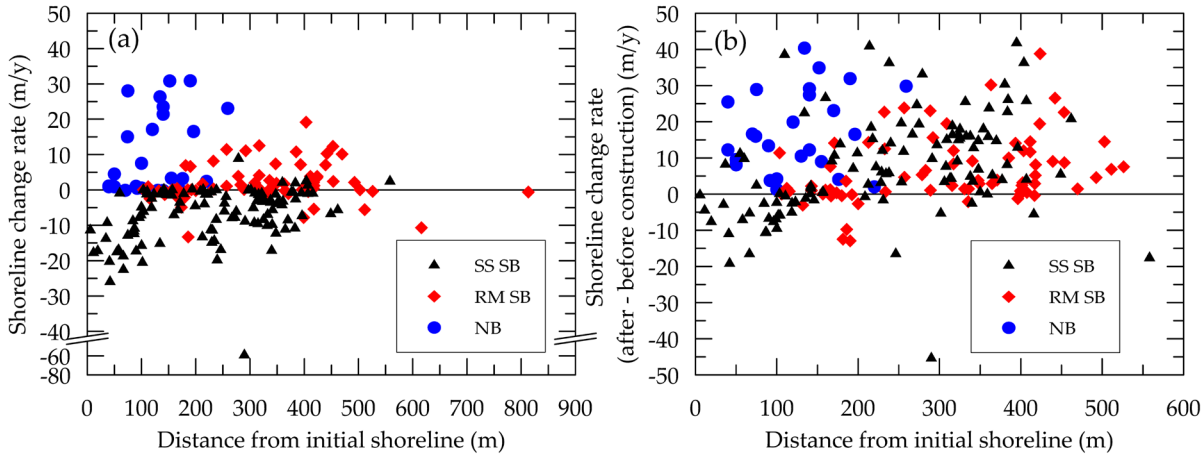

Figure S1. (**a**) Shoreline change rates after construction of each structure versus distance from the initial shoreline. (**b**) Differences in shoreline change rates before and after construction of each structure. NB is a nearshore breakwater and SS-SB and RM-SB are sand-sausage-submerged breakwater and rubble-mound rubmerged breakwater, respectively.

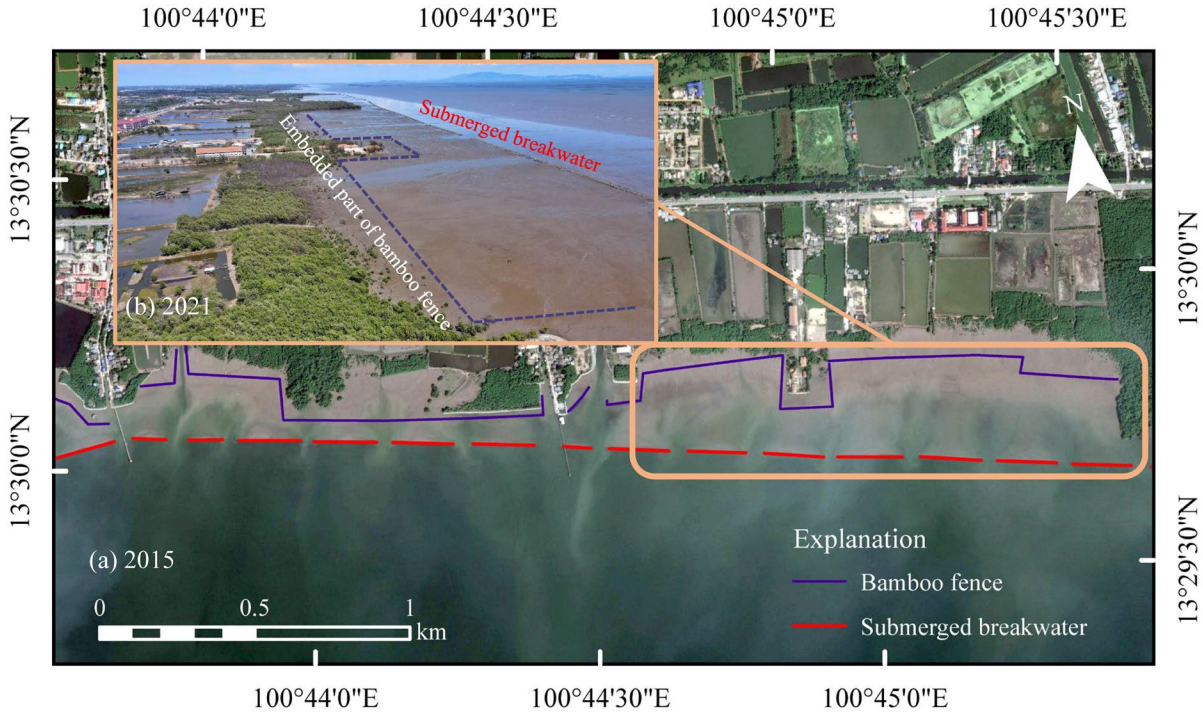

Figure S2. (**a**) Submerged breakwaters between Sta.15+000 to Sta.18+400 effectively traps sediment behind the structure. (**b**) Sediment trapped by submerged breakwaters. The purple dashed line shows the embedded part of bamboo fence, which completely deteriorated since 2015.

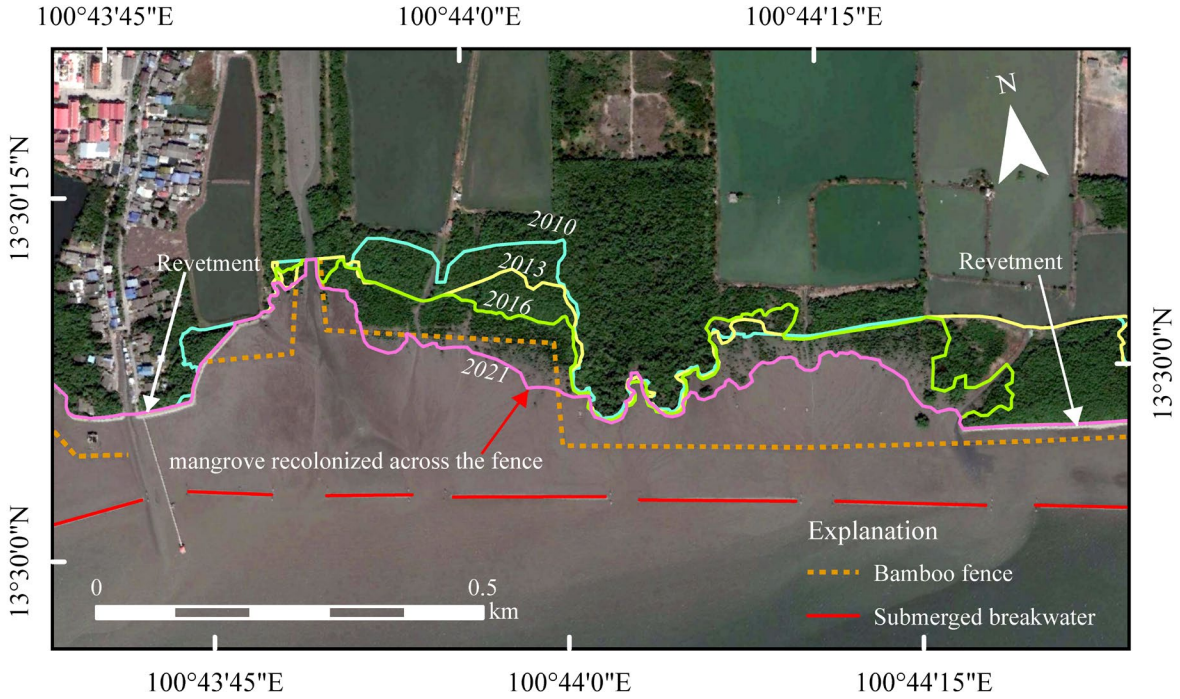

Figure S3. Mangroves recolonized seaward across the deteriorated bamboo fence between Sta.15+040–Sta.16+500.

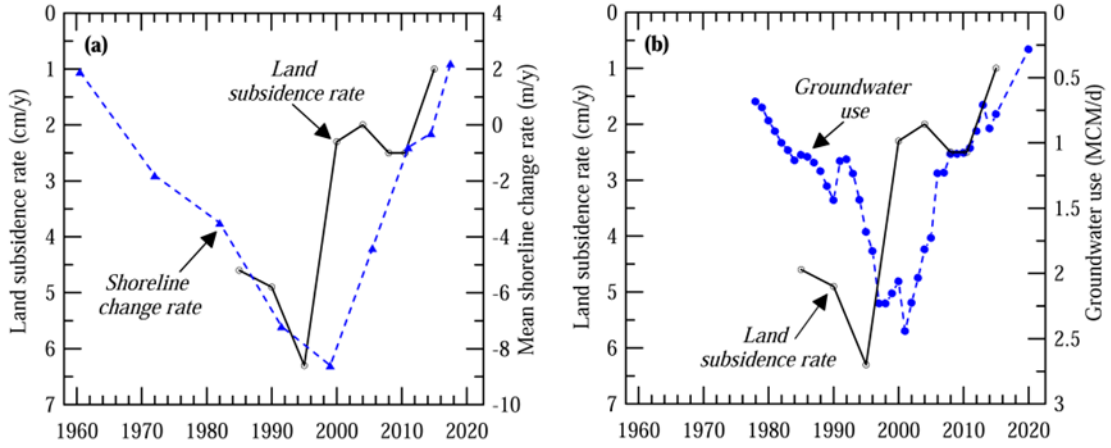

Figure S4. (a) Shoreline change and land subsidence rates in the eastern Chao Phraya Delta since 1954. **(b)** Plot of groundwater extraction in the lower Chao Phraya plain during 1962–1992 together with rates of subsidence in the same area studied by Sok et al.[14]

Figure S5. (**a**) Debris bamboo east of Ban Si Long after three years from construction. (**b**) Bamboo debris west of Ban Si Long three years after construction.

Figure S6. (**a**) Bamboo fence east of Ban Si Long between Sta.28+540 and Sta.29+500. As the bamboo normally breaks into two parts after 2–3 years from construction, the red ellipse shows the embedded part of the bamboo fence. (**b**) The embedded part of the

fence seems too short to dissipate the wave energy during high tide and obstructs coastal access.

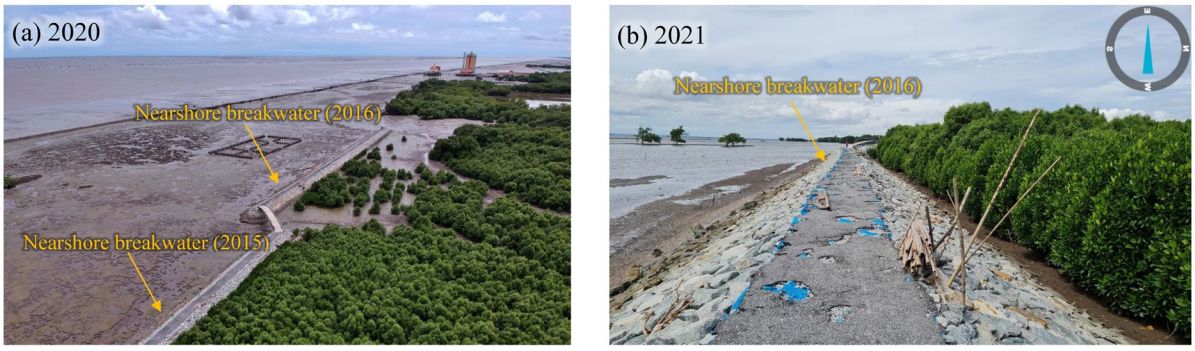

Figure S7. (**a**) Nearshore breakwaters constructed in 2015 and 2016 at Ban Khlong Hong Thong coastline (Sta.31+860–Sta.32+220) effectively trapped sediment behind the structures resulting in mangrove rehabilitation. On the other hand, these structures obstructed mangroves from colonizing further seaward. (**b**) Mangroves fully occupied the lee side of the nearshore breakwater constructed in 2016 within one year (2020–2021). The structure trapped approximately 1-m high sediment after five years from construction.