UNESCO-IHE
Institute for Water Education

ADB

Delft3D model based alongshore sediment transport rates at Pesalai, Gurunagar, Point Pedro and Mullaitivu, Sri Lanka (Phase 2 Final Report)

Project :
COMPREHENSIVE MODELING OF LONGSHORE SEDIMENT TRANSPORT AT PESALAI, GURUNAGAR, POINT PEDRO AND MULLAITIVU, SRI LANKA

October 2016

Executive Summary

In Nov. 2015 , under the Asian Development Bank (ADB) – UNESCO-IHE partnership, UNESCO-IHE was invited to to perform a detailed, state-of-the-art numerical modelling study to comprehensively assess the present-day longshore sediment transport regime along the North coast of Sri Lanka to inform the planned construction of four fishery harbours along the North coast of Sri Lanka.

The overall study consists of two Phases. Phase 1 will develop a coarse hydrodynamic model to simulate the dominant large scale wave, wind and tide driven circulation patterns and use those results to design and implement a bathymetric survey of the 4 study areas (Pesalai, Gurunagar, Point Pedro and Mullaitivu) which will feed into Phase 2. Phase 2 will perform detailed coastal sediment transport modelling for the 4 sites, and assess the prevailing alongshore sediment transport regime in the 4 study areas.

This report constitutes the deliverable of the 2nd phase of this project and documents the details pertaining to the application of the Delft3D/SWAN model suite to the 4 study areas, and provides estimates of net and gross longshore sediment transport rates and recommendations for the 3 sites. Note that the construction of the harbour at Mullaitivu was abandoned during the course of this study, and hence only a sediment budget is provided for this site.

Detailed Delft3D/SWAN models, based on the bathymetric surveys undertaken in Phase 1 of this study, were setup for each of the study sites. Wave input data for the detailed (i.e. local) models were derived from large scale wave and tide models forced with global and regional hindcast models. The longshore sediment transport rates predicted by the detailed Delft3D/SWAN models were verified with the one-line model UNIBEST-LT, and a combination of field observations and Google Earth imagery. The longshore sediment transport (LST) rates thus estimated for the 4 sites are shown below in Table E1.

Table E1 Annual longshore sediment transport rates at proposed Pesalai, Gurunagar and Point Pedro harbour locations

Location	Net annual alongshore sediment transport rate (m^3/year)	Gross annual alongshore sediment transport rate (m^3/year)
Pesalai	**10,000 from east to west**	**1,000 from west to east** **11,000 from east to west**
Gurunagar	**5,000 from west to east**	**5,000 from west to east**
Point Pedro	**30,000-150,000 from east to west**	**30,000-150,000 from east to west**
Mullaitivu	**North of inlet 10,000-65,000 to north** **South of inlet 30,000(to south)-20,000 (to north)**	**North of inlet 10,000-65,000 to north** **South of inlet 30,000 to north-35,000 to south**

The spatially dstributed annual sediment budgets for the 3 sites are shown below in Figures E1-E4.

Figure E1. Annual Sediment budget at Pesalai – white arrows, unit – 1000m^3/year. White dashed lines represent the proposed harbour breakwaters (not included in the model).

Figure E2. Annual Sediment budget at Gurunagar - white arrows, unit 1000 m3/year. White dashed lines represent the proposed harbour breakwaters (not included in model).

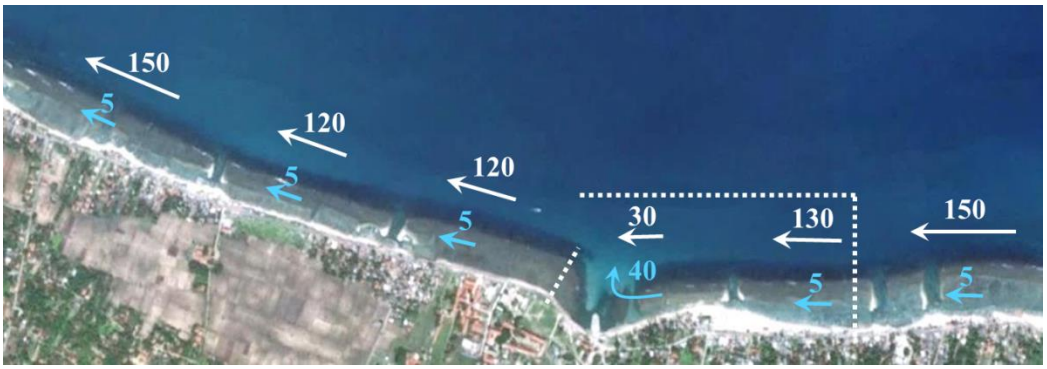

Figure E3. Annual Sediment budget at Point Pedro: unit – 1000m^3/year, white arrows – sediment transport seaward of the reef, blue arrows – sediment transport between reef and the beach, white dashed lines represent the proposed harbour breakwaters (not included in model).

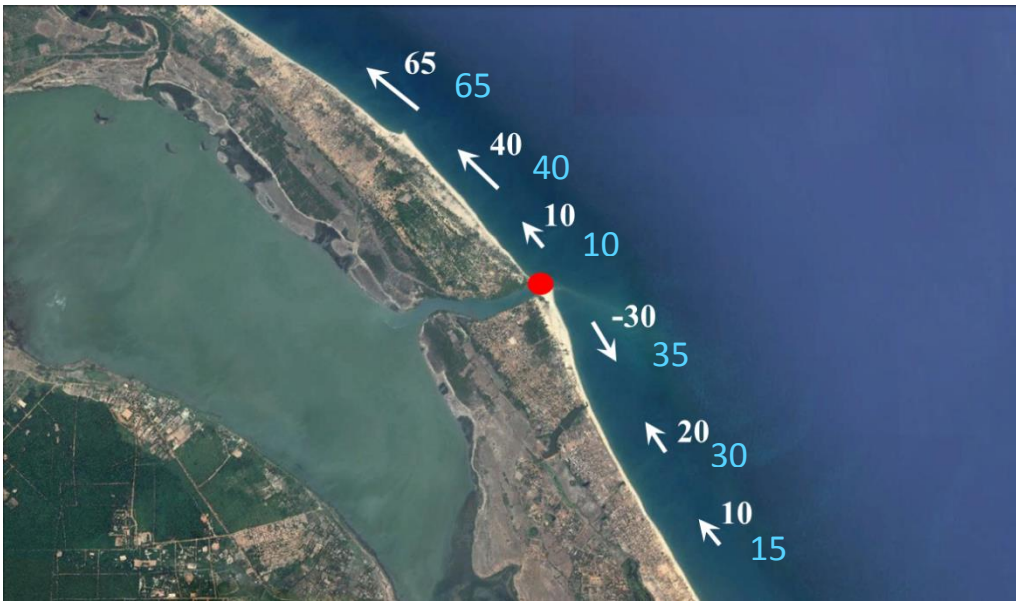

Figure E4. Sediment budget at Mullaitivu – white arrows and numbers show net longshore transport. Gross sediment transport rates are shown in blue numbers, unit – 1000m^3/year. The red circle shows the earlier proposed harbour location.

Based on the above results, prevailing field conditions and careful consideration of the conceptual designs for the proposed harbours, the below follow-on actions are recommended:

- **Morphodynamic modeling**: it is strongly recommended to extend the modelling undertaken within this study to incorporate morphodynamic modeling (in which bed level changes resulting from LST gradients are fed back into wave/flow models and vice versa within a continuous feedback loop) for the proposed harbours at Pesalai and Point Pedro to determine their potential effects on the adjacent coasts, sand bypassing, harbour sedimentation, and especially at Pesalai, possible negative impacts due to the harbour induced perturbation of prevailing sand bar dynamics. Given, the LST estimates predicted for these two sites (and prevailing morphodynamic conditions) it would not be prudent to construct the harbours at Pesalai and Point Pedro as they are presently designed without having a clear knowledge of the medium-term (1-3 yrs) morphodynamic response to the proposed harbours.

- **Wave measurements**: it is strongly recommended to measure nearshore wave data for at least one year using wave buoys at the locations of the proposed fishery harbours (just outside the breaker zone) to obtain improved model verification.

- **Sediment data:** it is strongly recommended to measure the sediment size distribution at the beach and in the breaker zone (especially at Point Pedro) near the locations of the proposed fishery harbours using sediment grabs and sieving analysis