

# The Living Lab for Mud: integrated sediment management based on Building with Nature concepts

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**Introduction:** Increasing human development in low lying delta areas is causing important shifts in sediment regimes world-wide as well as abundance or lack of sediments challenges: the turbidity of many rivers, estuaries and shallow seas is increasing, leading to degradation of water quality and enhanced siltation near or within hydraulic structures; large volumes of sediments are disposed and often lost offshore; reservoirs behind dams are full. Coastal regions and river banks are eroding exposing towns to more recurrent flooding. Coastal development activities demand for large quantities of sediment as building material. These challenges indicate that smart, integrated and across uses and boundaries sediment management is critically necessary.

Human development activities are shifting toward mud-dominated systems and with focus on building with low-cost or non-conventional material (e.g. mud). Mud dominated systems are ecologically valuable, hosting a wide range of ecosystem, and physically peculiar, experiencing complex processes, such as flocculation, transition between fluid and solid states, large settlements etc.

Integrated sediments management approaches leveraging on Building with Nature (BwN) concepts represents a potentially powerful solution to these enormous world-wide challenges.

**Methods:** With this in mind, EcoShape initiates the Living Lab for Mud (LLM). The LLM is designed to develop integrated knowledge and technologies to improve understanding and implementation of management, use and reuse of (fine and soft) sediments, often coupled to the application and restoration of muddy coastal ecosystems (e.g. salt marshes and mangroves).

The LLM consists of a series of pilot projects in The Netherlands and abroad which integrate the various aspects and processes of sediment management: from sedimentation and resuspension, to fate and transport, to consolidation and strength development. LLM integrates these physical processes with biota and socio-economic aspects, in order to derive BwN concepts that can drive site-specific sustainable

solutions. Pilots include: optimization of sediment disposal to naturally nourish coastal mudflats (i.e. mud motor, The Netherlands)), enhancing sediment trapping to encourage mangroves restoration and coastal aggradation (i.e. Demak, Indonesia), utilization of fine dredge material for island construction (i.e. MarkerWadden, The Netherlands).



**Fig. 1:** Permeable dams at the Demak site, Indonesia .

**Results:** This presentation will introduce the LLM initiative and give an overview of these pilot projects. We will show how permeable wood-based dams (Figure 1) enhanced sediment deposition and favored mangroves recovery and coastal aggradation in Demak, North Java, Indonesia where intense fish farming caused kilometers of shoreline erosion.. Two years ago, a series of permeable dams were installed to enhance sediment trapping. Two monsoon seasons later, sediment is depositing behind the dam and mangroves are returning.

We will also illustrate how dredge sediments from the Delfzijl Haven in The Netherlands is utilized as nourishment for coastal mudflat enhancement. Dredge sediment is deposited offshore the mudflat at precise tidal windows, when currents are expected to naturally transport this sediments in the mudflat areas. A combination of numerical models and field observations are performed to design and prove this solution.