SUSTAINABLE DELTAIC MANAGEMENT. AN ILLUSTRATIVE FIELD CASE FOR OTHER COASTAL SYSTEMS.

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ABSTRACT

Deltaic coastal systems are the result of a delicate equilibrium between marine (e.g. wave action, sea-level rise), riverine (e.g. sediment and fresh-water discharges) and atmospheric (e.g. wind, atmospheric pressure, rain) factors. These deltaic systems are, therefore, more dynamic and more sensitive to natural or human effects than other coastal systems (Ref. 4). That explains why deltas, apart from their ecological (most of the planet wetlands are in deltaic areas) and economic (a high amount of fishing activities, important water quality regulation properties, etc.) significance, can be considered as ìfield laboratoriesî for other coastal systems.

Deltas (see e.g. the Ebro delta in figure 1 for illustration) will feel earlier the impact of sea-level rise, the reduction of sedimentary supplies, the loss of habitats and bio-diversity, etc (Ref. 1). At the same time deltas constitute a "study unit" in which various driving factors co-exist and produce coastal responses of a magnitude higher than for other coastal systems, which facilitates the corresponding analyses. Because of this dynamic character (deltas are the result of pulsating events such as channel switching, river floods, marine storms, etc.) deltas are one of the best examples for the multiplicity of time/space scales present in the coastal environment (Ref. 2). For simplicity and in order to illustrate the possibility of a scientific-based deltaic management only three time-scales will be here considered (Ref. 3): i) short-time scale (from weeks to months), ii) medium-term scale (from months to years) and iii) episodic time-scale (events with return period from years to decades). The deltaic response at each of these scales will be presented and analysed, with emphasis on the natural and socio-economic dimensions, to illustrate the scientific difficulties of splitting these two aspects. The working hypothesis is that, although both natural and human dimensions converge on deltaic systems, the best scientific approach to steer the management is to incorporate the inherent deltaic dynamics into the management strategy. This allows "natural forces" (river floods, marine storms, etc.) to work within the management strategy, which greatly reduces the needs of ìexternalî supplies (monetary or otherwise quantified) to maintain the delta (Ref. 5). This, in turn, enhances the sustainability of such a coastal system.

This working hypothesis will be illustrated for a deltaic coastal fringe at the three time-scales above mentioned and showing how to quantify the physical (morphodynamic) vulnerability using three types of simulation models: i) a 3D

morphodynamic model for meter-hour scales (Ref. 6), ii) a 1-line shore evolution model for kilometre-month/year scales (Ref. 7) and iii) a 1-line nearshore evolution model for decades of kilometres-years scales (Ref. 8). The ìnatural systemî vulnerability will be quantified

In terms of indeces which will be shown to characterise the behaviour of the deltaic system. Three types of indeces will be used: change in rate of evolution, gradient change (with respect e.g. to a driving factor such as wave energy flux) and difference between source and sink environmental functions ("supply and consumption" of beach width) (Ref. 9). The potential of these indeces for impact assessment and to quantify susceptibility and resilience from a more pluridisciplinary standpoint will also be discussed.

With the obtained knowledge on the system behaviour two definitions of sustainibility (natural and socio-economic) will be presented. The natural sustainability will be quantified from a hydraulic, geomorphic and ecological perspective, showing the applicability for a more ìnaturalî deltaic management. The socio-economic sustainability and its quantifications, although briefly, will also be discussed.

The conclusion will be the need to manage deltaic systems in particular and coastal zones in general in a way which does not prevent their natural "pulses". Past management has mainly consisted in "stopping" the inherently dynamic behaviour of such systems. Sustainability therefore requires a far from trivial return to more dynamic/natural systems. The best way to put into practice these ideas for actual management is to use the available scientific knowledge/tools rather than employing the trans-disciplinary, fashionable words, which serve only to bury the real problem under words.

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