Wetland
ecosystem services

Factsheet 4
in a series of 10

Sediment & nutrient retention and export

The nutrient-rich waters of the Nile River have nourished Egypt for centuries. Photo © David Rogers

Wetlands play a crucial role in the natural cycling of sediments and nutrients in the environment – an attribute that is hugely beneficial to human livelihoods and well-being but which can easily be damaged by unsustainable development.

The plants that grow in wetlands take up and store nutrients from soil and water. These nutrients are either released back into the environment when plants die, or are removed when plants are harvested – perhaps for food or building materials. Productivity varies widely according to wetland type, nutrient availability and climate. Some of the highest yields are found in fast-growing grasses and sedges – plants such as *Arundo donax* (giant reed), *Cyperus papyrus* (papyrus), *Phragmites* (reed) and *Typha* (cattail, bulrush). In tropical Africa, papyrus production may reach over 140 tonnes per hectare per year.

In addition to 'locking up' nutrients in vegetation, wetlands also act as sediment 'traps'. When rainwater runs off across the ground, it carries with it particles of sediment (e.g. sand, silt or clay), the size and quantity varying with rock and soil type, steepness of slope, intensity of rainfall and degree of vegetation cover. Small streams join to form rivers, together transporting vast amounts of sediment through the landscape. When rivers reach other wetlands, such as floodplain lakes and marshes, the speed of water flow suddenly slows. A narrow, fast-flowing river channel may spread out gently over a wide valley floor, where dense stands of wetland vegetation, such as reedbeds or floodplain forests, also act as physical barriers to slow flows and trap sediment.

The natural fertility and productivity of floodplains means that they have been used for thousands of years for growing crops. Increasingly, however, the natural cycle of seasonal flooding and replenishment of nutrients through the deposit of water-borne sediments has been replaced by a largely artificial system. Floodplains have been cut off from rivers by embankments (e.g. almost 90% of the River Rhine's original floodplain had been lost by the late 20th >>>

In brief...

- Wetlands act as 'storehouses' for sediments and nutrients carried in rainwater runoff, streams and rivers.
- Dissolved nutrients, such as nitrates and phosphates from fertilizers and sewage effluent are taken up by wetland plants and stored in leaves, stems and roots, so helping to improve water quality.
- The astonishing productivity of some wetland plants makes them particularly good for removing excess nutrients from water – e.g. papyrus production can be over 140 tonnes per year in tropical climates.
- Many nutrients are 'attached' to particles of sediment which are deposited on floodplains or physically trapped by plant stems and roots.
- The continual supply of nutrients make floodplains and deltas naturally fertile.

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Sediment & nutrient retention and export...

century) and crops are increasingly grown with the aid of irrigation and chemical fertilizers to replace the previous natural fertility. Upstream dams have also reduced sediment flow and prevented seasonal flooding. While these engineered solutions mean that floodplains can be cultivated year round in many countries, it is at the expense of ecosystem services that nature used to provide for free – not to mention the loss of much wetland biodiversity.

Some of the most productive habitats on Earth – among them the mudflats, saltmarshes, creeks and mangroves of river estuaries and deltas – support vital fisheries and provide food for millions of migratory waterbirds. However, they depend for their very existence on a regular supply of sediment. The Ebro Delta in north-east Spain, for instance, needs up to 2 million cubic metres of sediment every year just to maintain its current condition.

>>> *In brief...*

- Floodplains and deltas depend on seasonal flooding to keep them 'topped up' with sediment; Spain's Ebro Delta needs 2 million cubic metres of sediment per year.
- Dams have cut the sediment supply to Pakistan's Indus Delta by 75% resulting in erosion of the delta and progressive loss of its ecosystem services.
- Nearly 90% of the River Rhine's floodplain had been drained, developed or artificially cut off from the river by the late 20th century.

Yet more and more deltas around the world are in crisis because the continuous inflow of sediment – effectively their lifeblood – is being cut off and trapped behind barriers, especially dams. For example, construction of upstream dams and water abstraction for irrigation reduced the flow of water in Pakistan's Indus River to such an extent that the volume of sediment reaching the Indus Delta shrank by 75%, from an estimated 400 million tonnes before river engineering to just 100 million tonnes currently. As a consequence, the delta is gradually eroding, resulting in the degradation and loss of mangroves and other wetland ecosystems that support human livelihoods and biodiversity.

The natural ability of wetlands to trap nutrients and sediments means that artificial or 'constructed' wetlands are being used more and more as 'living water treatment plants'. The applications of constructed wetlands are varied, ranging from treatment of highly acidic wastewater from mining, to cleansing of sewage effluent in rural areas where conventional water treatment is not possible. In the United Kingdom alone there are now more than 1,200 constructed wetlands in use.

Nevertheless, the capacity of wetlands to handle sediments and nutrients is limited. When water-bodies are artificially enriched, a process called eutrophication occurs, typically through sewage or fertilizer runoff. This causes 'algal blooms' (massive growth of algae) that starve other aquatic plants and animals of oxygen and light, eventually killing the original wetland ecosystem. While wetlands, both natural and constructed, can contribute to reducing the effects of eutrophication, more attention must be given to controlling pollution at source.

Downstream wetlands can be 'smothered' when upstream erosion, perhaps due to deforestation, is excessively high. China's Yangtze River Basin shows the dual effects of upstream deforestation and erosion and reclamation of floodplain wetlands. One of the most important remaining wetlands, Dongting Lake (now a Ramsar Site) shrank from its original size of 6,300 km^2 to its present size of 2,700 km^2 due to increasing sedimentation over the last century. The lake's biodiversity decreased dramatically, frequent flooding has driven people from their homes, and clean water has become a luxury – but efforts to restore the lake's natural ecosystem services are now underway.

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