European Sediments [1]

SEDNET Network
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1. Introduction: Scope

Sediment is an essential, integral and dynamic part of our river basins. In natural and agricultural basins, sediment is derived from the weathering and erosion of minerals, organic material and soils in upstream areas and from the erosion of river banks and other in-stream sources. As surface-water flow rates decline in lowland areas, transported sediment settles along the river bed and banks by sedimentation. This also occurs on floodplains during flooding, and in reservoirs and lakes. At the end of most rivers, the majority of the remaining sediment is deposited within the estuary, delta and in the coastal zone and constitute major important wetland areas.
It is not only the quantity of sediment which affects downstream areas but even more so the quality of the sediments. In particular, the presence of contaminants like heavy metals, nutrients pesticides and other organic micro-pollutants has biological impacts on waterways, wetlands and estuarine systems.
Negative impacts of changes in the sediment regime in Europe are manifold and range from increased erosion of fertile soils, trapping of sediments behind dams, decrease in wetland and delta areas as well as the quality of the sediments (contaminants) affecting aquatic ecosystems. It is expected that global change and in particular climate change will require an extensive pan-European research effort by both the natural and social sciences to improve management and anticipate global change.
Current policy and regulations as well as research efforts try to take sediment issues into account, however these regulations and efforts lack coherence and do not contribute to efficient management.

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2. European policies related to sediment

2.1. European Union specific standards, policies and regulations

The Water Framework Directive

Land-water interactions such as land-use, land erosion and related sediment fluxes are subject to several environment and sector policies. The inheritance of too many sector orientated policies obstructs sustainable land-water interactions at catchment level. In Europe, agricultural land-use is for instance strongly influenced by the Common Agricultural Policy (CAP). The recently adopted Water Framework Directive (WFD) (2000/60/EC) is an attempt to provide a more integrated approach to water management at river basin level. However, the way how for instance the European Habitat Directive or Natura 2000 will be linked to this new Directive is still unclear. How the WFD will deal with land-water transition zones, like wetlands, is also not clear yet.

First indications of the designation of water bodies in European river basins, as required by the WFD, suggest that their inclusion and classification differs widely across Europe. Hence, there is a clear need for a more coordinated and integrated approach to manage land-water interactions through specific, tailor-made policy at catchment-level, including river basin-coastal zone interactions. The European WFD may play an important coordinating role in this, as it seems to have a legitimate, legal basis to facilitate this process, but much will depend on the actual implementation process in the near future in individual Member States.

The WFD does not specifically address "sediment" nor "dredged material". Although the WFD provides a list with priority hazardous substances, of which many have the preference to adhere to sediment, sediment fluxes are not explicitly included. It is clear that sediment and water quality are closely linked. Thus contaminated sediment fluxes significantly impact water quality. Article 16(1) of the WFD requires the adoption of specific measures to progressively reduce discharges, emissions and losses of priority substances, and to cease or phase out discharges, emissions and losses of priority hazardous substances. This provision not only can be of help to tackle existing pollution sources in European River Basins, thus reducing ongoing sediment contamination, but even more, it can provide an efficient instrument to deal with historical contamination of sediments and soils on a river-basin scale.

There are a number of other international and national conventions and regulations which deal with sediments. In most cases they deal with quality of sediments (e.g. dredged material). They are listed below.

International conventions

The following conventions are of relevance for sediment management in Europe. Their purpose and primary aim is the environmentally sound disposal (relocation) of dredged material within the sea.

- The London Convention - LC on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Dredged Material Assessment Framework - DMAF (2000)
- The OSPAR - Convention on the Protection of the Marine Environment of the North - East Atlantic: Revised Guidelines for the Management of Dredged Material (2004)
- The Helsinki (HELCOM) Convention on the Protection of the Marine Environment of the Baltic Sea Area: HELCOM RECOMMENDATION Disposal of dredged spoils (1992)

Special national guidelines provide assessment criteria for the aquatic disposal (relocation or confined) for inland and coastal waters. Whereas the coastal guidelines are in line with the guidelines of the international conventions national guidelines and criteria may differ for the inland part of the rivers. Due to national implementation of international conventions and EU Directives the European member countries have developed special dredged material guidelines with different (limited) competences in practices.

European soil legislation

A European regulation for the protection of soils is under discussion. Some European countries have set Soil Protection Acts into force already. For example in The Netherlands sediments (subhydric soils) are part of the Dutch Soil Protection Act, in Germany they are excluded.

The soils in the flood plains which often show the same characteristic of contamination as the sediments in a river basin (due to flood events) is also under the scope of soil protection legislation. Furthermore a goal of soil protection is the avoidance of soil erosion which means prevention of increased introduction of suspended matter into the river.

European Waste legislation

The European Waste Directive (75/442/EEC, Article 1a) defines:

> "Waste" means any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force.

The European Waste Catalogue (2001) contains two waste codes for dredged sediment:

- 170505 "Dredging spoil containing dangerous substances"
- 170506 "Dredging spoil other than those mentioned in 17 05 05"

This definition is independent from the contamination of sediments. The waste legislation follows the principle: 1. Avoidance of waste – 2. beneficial use (incl. treatment) – 3. safe disposal. All three options have to be part of an integrated sediment management. Several technical guidelines in waste legislation apply for sediments and differ to some extent on national level.

The European Landfill Directive (1999) has to be applied if dredged material has to be disposed on land.

2.2. The Millennium Development goals (MDG)

The Millennium Development Goals – the commonly accepted framework for measuring development progress - commit the international community to an expanded vision of development, one that vigorously promotes human development as the key to sustaining social and economic progress in all countries, and recognizes the importance of creating a global partnership for development. The goals were adopted by the UN Member States in September 2000 as part of the Millennium Declaration based on a long-term iterative process including multiple agencies.

The first seven goals are mutually reinforcing and are directed at reducing poverty in all its forms. The last goal - global partnership for development - is about the means to achieve the first seven. In this context there is a fundamental need for cross-cutting and underpinning science to inform the decision-making and development for sustainability. Horizontal exchange of experiences and the comparison of approaches against the goals and reviewed under the perspective of strong and weak sustainability options and including the application of new technologies that may derive from this interdisciplinary and integrative research and which has been manifested for instance in the 2004 Environmental Technologies Action Plan of the European Union (COM 2004 38 final), the countries need to set their own strategies and work, together with the global partners, to ensure that poor people are included in the benefits of development. Obviously, and following explicitly from Goal 7, research has a leading-role to play and so have horizontal exchange and joint investigations.

The **"Water Continuum"** through which downstream areas (including the coastal areas) are linked with the whole drainage basin is a major trajectory of social and economic development where the temporal and spatial scales of issues and political/institutional response show a high variability depending on the issue of concern. This refers in particular to the sediment issue, which ranges from the erosion of fertile soils in the catchment, to the need for sediment supply for "healthy" delta and wetlands areas. They are the receiving areas reflecting the multiple pressures and state changes and where human and global forcing are most evident. However, the downstream zone is also the domain expecting the highest demographic change in the future (Millennium Assessment 2004/2005 Synthesis Chapter 24) and from where the highest proportion of environmental goods and services derives. Wilson et al. (2004) estimate the value of service provision (marketed and non marketed) summing up to a total of ~ US $ 17.5 trillion as compared to the total of ~US $ 33.3 trillion for all ecosystem-services globally.

In recognition of this high relevance of the water-continuum for human security and sustainable development, at the Johannesburg World Summit on Sustainable Development (WSSD) in 2002 the need was underlined to build on the impetus and achievements made since the Rio Conference in 1992

and many internationally agreed actions concerning the water sector were involved in the plan of implementation of this WSSD.

The European Water Initiative (EUWI) was set up as a reaction in order to develop a strategic partnership aimed at contributing to the plan of implementation of the WSSD. This will include to report on progress and ensure that all activities are complementary to the WSSD. The link between the implementation of the plan and the EUWI will primarily be in terms of making sure that all EU and Member State actions in water contribute to and follow the lines of the WSSD plan of implementation.

3. European Research Potential and European added value

Compared to water, **sediment** has received much less attention worldwide. Methodological and conceptual frameworks to assess the influence of changes of sediment quantity on fluvial and coastal ecosystem dynamics are almost inexistent. Sediment is, however, an essential component of the fluvial-to-coast catchment dynamics and has strong influence on the health and durability of natural systems (rivers, floodplains, wetlands, deltas, beaches), on the stability and expected life of transportation and hydraulic infrastructures, on the availability of aggregate for construction, and drives sanitation, navigation, and ecosystem restoration efforts in many countries. The failure to appreciate the integral connection of sediment and water, from the catchment headwaters to the deposition zones, underlies many environmental problems in river management today. The multidisciplinary nature of the information needed, necessitates the application of an integrating framework such as that of D-P-S-I-R which allows scoping, scaling and flexibility in scenario and policy alternatives evaluation.

Thus it is essential to look at the river – coast continuum as the trajectory of economic and social development and focus on sediment fluxes, their change in quality and quantity and what the ramifications are for human society and coastal goods and services.

Many projects have been carried out with in the framework programs of the EU which deal with isolated aspects of sediments in the water continuum. Notable are many research projects dealing with wetlands, coastal erosion, toxicity of sediments and soils, erosion of soils, flooding etc. Hence there is a research potential which, however, has to be brought together in a holistic manner in order to advance research for management at large spatial scales. Furthermore in most of these studies the temporal aspects are missing or insufficiently covered. Advances have been made in incorporating socio-economic studies in the various projects, however this has been marginal and focused on issues in the Western and Northern countries of the European Union. However, sediment issues are not restricted to these regions but are also evident in Southern and Eastern Europe.
In view of global change and long term management needs this should be remedied in the 7th framework.

The four challenges for research in the 7th framework are:

- integrate the natural and social sciences in research for management dealing with sediments in the water continuum
- incorporate the appropriate temporal and spatial scales
- anticipate and predict impacts due to global and climate change: scenario development
- link quantity and quality of sediments in the water continuum

More specific detailed research requirements needed to face these challenges are:

- Especially in the context of perturbations due to climate change, improve our understanding, and thus also our capability, to predict or model, the fate of contaminants: from emission (upstream) to adherence to soil and/or suspended particles to sedimentation (also upland) and re-suspension (downstream).
- Improve our understanding of sediment transport processes (including erosion and sedimentation) at the river-basin scale as a function of land and water use and hydrological (climate) change in Europe.
- Investigate new architectures for policy processes with respect to sediment and soil issues that enable the interaction of several involved policy domains, interaction with stakeholders, new joint knowledge-production processes and joint actions.
- Investigate how the connection between the different involved policy levels and between strategy and implementation can best be established.
- Evaluate (social/economic/technical/environmental) source-control programmes, and perform a cost-benefit analysis of risk reduction through source control, including the management of historic contamination.
- Downscale global, European and country scale socio-economic scenarios to the river-basin scale and their effects on sediment quantity and quality and soil quality, and to stimulate research into the development of best management plans to comply with current and future EU regulations.