Shifting system boundaries in vision-building for river basin management

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Abstract The European Water Framework Directive poses new challenges to sovereign nations that share river basins. Upstream and downstream countries now must cooperate in developing long-term plans that address policy issues related to water management in the entire river basin. Vision building and strategic planning in (transboundary) river basins are presented as a means to overcome lack of common goals and fragmentation in planning and implementation. Systems analysis is a first step in planning. The definition of system boundaries cannot be limited to the watershed of the river: system boundaries must shift according to the policy issue concerned. These shifting boundaries, and their consequences for the selection and implementation of measures to improve water management, are presented in a student vision for the Scheldt river basin.

Key words vision building; stakeholders; river basin management; River Scheldt; shifting system boundaries; European Water Framework Directive

INTRODUCTION

In past decades, members of the European Union have made plans for water management on a regular basis. These plans address national problems related to water management and are carried out by the appropriate regional authorities. The European Water Framework Directive now poses new challenges to sovereign nations that share a river basin with upstream or downstream countries (European Union, 2000; Verhallen *et al.*, 2001). Plans must be developed in cooperation and address policy issues related to the integrated management of the entire river and its tributaries, the groundwater resources, and the relationship between aquatic and terrestrial ecosystems in the river basin. Furthermore, the Directive aims at participation of stakeholders in the development of the plans.

Mitchell (1990) describes these and other challenges as "Fragmentation and shared responsibilities are realities [in water management] which are likely to always exist". He explains that "fragmentation leads to management problems at the boundaries-or those points situated between states, between levels of government, or among agencies". Boundary issues may occur in the physical system of a river basin (boundaries set by aquifers, watersheds or ecotopes may not overlap), but also in the human system: social, economic and administrative aspects of society are the cause of boundaries between people, organizations and government institutions.

Comprehensive plans for long time periods must find solutions for these boundary problems or cope with them in a systematic manner. Systems analysis offers methods and procedures to deal with the differences in objectives and problem-solving capacity among stakeholders (Thissen, 2000).

In March 2000, an international workshop on vision building for water management of transboundary river basins was organized. Participants were students and staff from French, Flemish and Dutch universities. The purpose of the two-week workshop was to introduce a framework for vision building and to apply this to the Scheldt River basin, shared by France, Belgium and The Netherlands. The workshop produced a problem-analysis and a long-term vision for the Scheldt basin. The purpose of this paper is to present the vision-building framework and some results of the workshop:

(1) the shifting system boundaries, which are appropriate for strategic planning in the Scheldt River basin as a whole, and
(2) a summary of the vision the students created.

STRATEGIC PLANNING AND VISION-BUILDING EXERCISES

Society depends on the functioning of the river basin to support important social and economic activities (e.g. safe housing, water supply, removal of erosion materials and waste, industry, agriculture, shipping, transportation, tourism). The demands that society places on the river basin often conflict with each other and impair the quality and acreage of natural areas. Sustainable development demands that these conflicts are solved or mitigated. Therefore, we propose issue formulation in a multi-actor context (Thissen, 2000) to identify conflicts and constraints as the first step in strategic planning, and in vision building also (Fig. 1). Systems analysis is used to improve the initial problem formulation as perceived by stakeholders. A system analysis may give new insights in cause and effects of a problem situation and lead to reframing of the problem, which can be a reason to redefine system boundaries. Selection of objectives for planning and management is one result of the problem specification step. The formulation of possible futures (scenarios) is the next step, exploring the uncertainties of a problem situation over time.

Strategic planning in river basins requires that multiple objectives for river basin management are either shared or accepted within the stakeholder network to enable

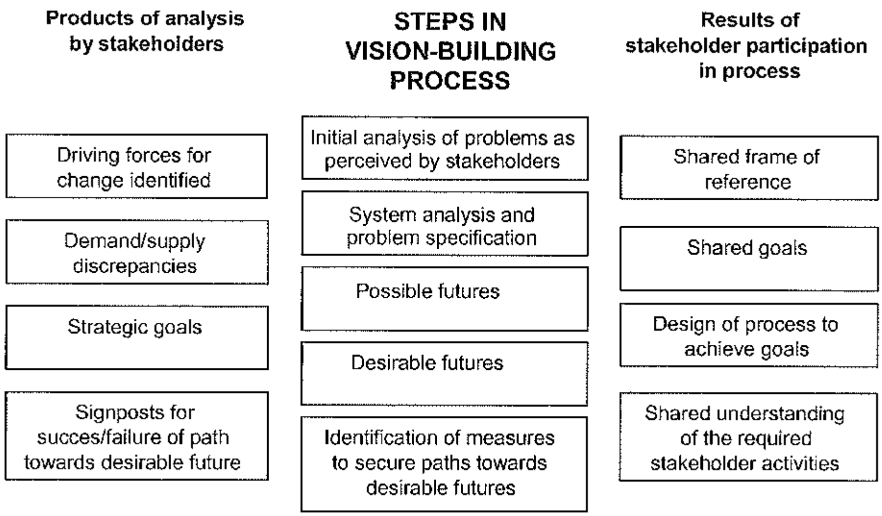

Fig. 1 Overview of steps and products in a multi-stakeholder vision-building process.

selection of potential successful strategies and implementation in spite of fragmentation of authority. This need for shared objectives in river basin planning has given cause to the development of visions for water management (Cosgrove & Rijsberman, 1998).

Bertrand *et al.* (1999) have described an extensive method for scenario building, used in the design of five scenarios for Europe in 2010. We use a rapid method for the formulation of possible scenarios, focusing on the main forces driving changes in the structure of the river basin system (Enserink, 2000). In addition, we have asked the participating students to describe the characteristics of desirable and non-desirable futures by formulating goals for the future and the constraints on reaching these goals. In this manner, desirable futures can be selected from the pool of possible futures. Finally, students identify measures needed to be able to secure the path towards the shared vision (Fig. 1).

DESCRIPTION OF THE SCHELDT RIVER BASIN

The River Scheldt starts in the northern part of France (Fig. 2). Its length from source to mouth is 355 km; the river basin covers about 21 000 km^2 in three countries (France, Belgium, The Netherlands). The rainfed lowland river and its tributaries are mainly characterized by low velocities and discharges. The maximum discharge near Gent is 200 m^3 s^{-1}, much lower than the maximum discharge of 3500 m^3 s^{-1} for the River Meuse near Rotterdam. The important tidal dynamics bring sea water into the upstream inland waterways for about 160 km, creating a quite unique river reach with, unfortunately, a high potential for flooding during storm tides. The ecological value of this part of the river is very high as a result of the saltwater–freshwater gradient. The downstream reach called "Westerscheldt" is a typical estuary downstream of the harbour in Antwerp. The economic pressure to further deepen the access waterways in

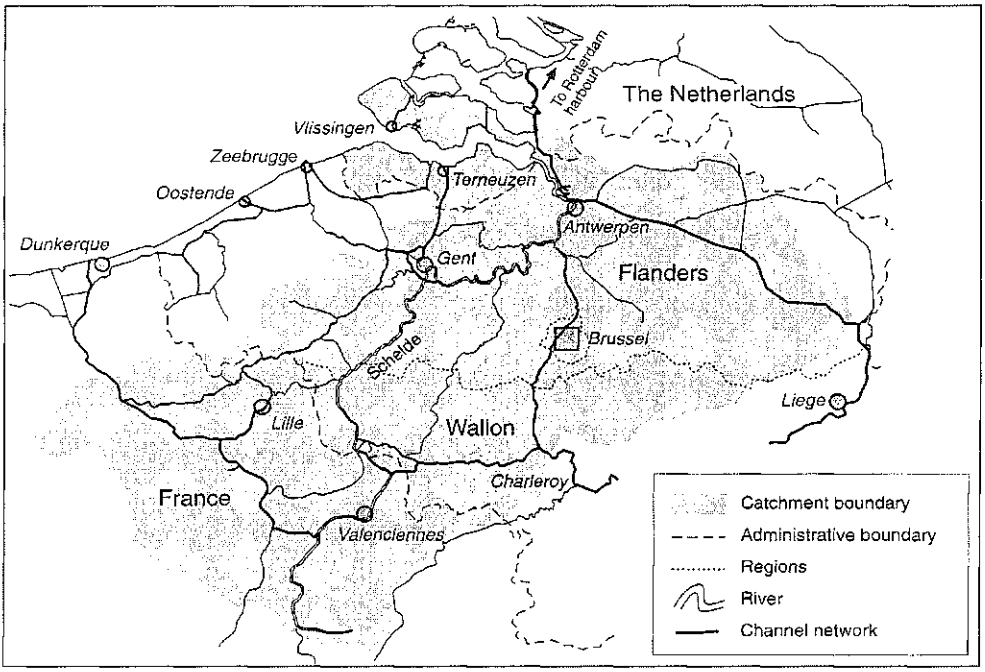

Fig. 2 The Scheldt River basin.

the estuary is very high and conflicts with the desire to protect and restore its ecological value.

The basin is used mainly for intensive agriculture and there are large urban conglomerations associated with industry. The Scheldt River, its tributaries and canals, are important shipping routes connected with different industrialized areas, the ports of Le Havre and Terneuzen, and the very influential port of Antwerp. More than 10 million people live in the river basin; the average population density is 477 inhabitants km^{-2}. This high population density results in a high groundwater abstraction rate. The river system is used as an additional source for drinking water supply, but also receives untreated wastes from households and industry (ICBS/CIPE, 1997).

SHIFTING SYSTEM BOUNDARIES WITHIN THE SCHELDT BASIN

Water system boundaries

A water balance for the Scheldt River basin indicates that about 20% of the total volume originates from the basins of the Rhine and the Meuse. Also, 65% of the Scheldt water is laterally discharged to the North Sea, short-circuiting the natural downstream flow towards the western Scheldt estuary. Obviously, the boundaries of the water system of the Scheldt River basin have been extended beyond the watershed. Strategic plans will have to take into account the demand for inter-basin water transfers. Of course, strategic and operational decisions about water transfers not only have serious implications for society but also for the potential of nature development or nature preservation.

The principal groundwater reserve in the Scheldt River basin is formed by two main groundwater aquifers on the northern French–Wallon area. These aquifers can also be accessed in regions in the Meuse River basin and in the Artois region. The groundwater reserves are especially important for drinking water preparation but they are being depleted at a fast rate. Purification of surface water, as is done for the Flanders region near the canal of Kortrijk–Bossuyt, is a good alternative for drinking water preparation if the quality and availability of river water can be secured. Plans for the Scheldt basin are thus tied to the plans for the neighbouring basins with respect to groundwater abstraction.

Ecosystem boundaries

The predominant hydrological characteristics of the Scheldt River, the freshwater flow and the tidal influence, delineate the boundaries of four ecotopes (Baeyens *et al.*, 1998). The potential for development of these ecotopes is severely hampered by the other uses of the river and the tributaries, which alter the dynamics within the subdivisions of the river. Also, human activity prevents the formation of connected habitats, like an ecological network or corridor. Aside from the large area of the Westerscheldt, the aquatic and terrestrial ecosystems, which are characteristic of these subdivisions, have disappeared or the biodiversity has declined. The natural boundaries of the ecosystems have faded and environmental rehabilitation should restore these boundaries by re-establishing ecological corridors, freshwater–saltwater gradients, and tidal dynamics.

Boundaries related to socio-economic development

Different centres of economic activity have developed in the basin. Potential for trade plays an important role in economical development efforts, as they do in the industrial areas around Lille, Antwerp and Terneuzen. Waterways and roads for transportation of goods link these three centres of economic activity. The canal system ties the river basin to harbours along the axis of Le Havre–Hamburg. Therefore, the boundaries of the economic system do not coincide with the water system boundaries but extend into international systems for industrial production and trade. As a consequence, the capacity to solve problems related to economic development and shipping is not limited to stakeholders active within the river basin.

The Scheldt River basin contains many cultural regions that can be characterized by the influence of history, as far back as the sixteenth century and the Spanish occupation, language, religion and ties to or independence of social, economical and cultural policies from the three seats of national governments. The political points of view in river basin planning are determined by these cultural differences and by the different economic interests (Ovaa, 1991). The capacity to solve problems related to historical and cultural differences (e.g. cooperation among water management institutions) is to be found within the river basin system but can be influenced by forces outside the basin, such as the implementation of laws within the European Union.

Boundaries related to administration

The three countries share the basin, but the federal system in Belgium actually divides the basin in five parts with different administrative mandates, characteristics and problem solving capacity. In France there is a strong national governing system, which since 1964 has adopted the river basin as a policy unit. Recently in France we can see more decentralized power and the growing influence of the six l'Agences de l'Eau in water management related policy arenas. In Belgium, Wallon, Flanders and Brussels are still in the process of implementation of the new mandates. In The Netherlands the Scheldt estuary is governed directly by the Ministry of Transport and Waterways because of its (international) importance. The governments of the five territorial states have signed and ratified a treaty establishing the International Commission for the protection of the Scheldt in 1994/1998 (ICBS/CIPE, 1997). These governments are all subject to European Environmental Law but till now they set different priorities and use different normative systems for water quality. This fragmentation of administration can be an important barrier to cooperation, unless the five administrative units agree to participate fully in the strategic planning process and share the framework of reference, goals, and understanding of required stakeholder activities (Fig. 1). Therefore, administrative boundaries do not need to be part of the problem analysis but must be dealt with in the strategic planning process.

SHIFTING BOUNDARIES: IMPORTANT ELEMENTS OF A STUDENT VISION FOR THE SCHELDT RIVER BASIN

The challenge in building a vision for the Scheldt River basin is to find long-term solutions for transportation problems, economical development and social demands without disabling the functioning of the ecosystem. The vision that was built in March 2000 contained the following elements:

- The different harbours within and outside of the river basin specialize their shipping activities to keep maritime navigation in the Scheldt area within acceptable ecological and safety boundaries. Rotterdam continues to handle the large oil tankers while the infrastructure at Antwerp is directed towards handling smaller ships. To prevent high risks of calamities inside the estuary, dangerous loads are sent to Zeebrugge. This specialization is agreed upon through communication and negotiations between the harbours on the Le Havre–Hamburg axis.
- For accessibility of the hinterland by inland shipping and also to foresee in a dynamic ecological structure, a functional differentiation between rivers is established. Rivers along the main transport axes have a transport function, while other sub-basins are returned to a more natural structure (e.g. meandering, flood plains, tidal flats) and facilitate proper functioning of the ecosystem. The surroundings of waterways are nevertheless restored to promote leisure activities (jogging, cycling) in order to satisfy the urban demands for green areas. The preservation of the water quality of smaller, more natural tributaries allows this surface water to be used for drinking water supplies and prevents overexploitation of groundwater resources.

- Water supply and water uses are balanced in the river basin between socio-economic activities and nature by both lowering water consumption and enhancing infiltration. Water consumption is managed through pricing policy, which fosters domestic water reuse and promotes total industrial recycling. Industrial and urbanized zones have improved and expanded their wastewater treatment. Effluent and water quality standards are based on a common, standard monitoring system of biodiversity (through biotic index), water quality and quantity for the whole river basin. Infiltration is enhanced by a new agricultural policy, which reduces subsidies to intensive production and prevents pollution at the source. Subsidies are given to help prevent erosion from fallow land by maintenance of hedges, special ploughing methods and cultivation of winter crops.
- A framework for spatial planning in the river basin has been established, because "every land-use decision is a water management decision". Land-use decisions typically meet short-term demands but may harm long-term interests because they change the physical, chemical and ecological characteristics of the river basin (ASCE, 1998). In this respect, certain ratios of agricultural and built-up areas are defined by the cooperating administrations to control sediment mobility and flood propagation and to promote a natural development of the aquatic ecosystem.

CONCLUSIONS

The process of vision building is a way to overcome the lack of common goals and fragmentation in planning and implementation if based on a multi-stakeholder problem analysis. It must be organized in such a way that the system analyses yield information on (1) the interdependence of problem situations, in terms of the (mis) match of demand and supply for the different river functions; and (2) strategic goals; and (3) distribution of the problem-solving capacity (Fig. 1). The students vision for the Scheldt River basin demonstrates that implementation of specific measures requires actions not only from a Scheldt River Basin Committee but also from stakeholder networks that are found (partially) outside the river basin (e.g. international shipping companies, other river basin committees, ecological corridor networks). The EU Water Framework Directive does not yet address these boundary issues of river basin management. Nevertheless, international river commissions will have to deal with this aspect of planning, seeking cooperation outside their area of jurisdiction. The river commissions can facilitate this cooperation across the different system boundaries and address the problem solving capacity of stakeholders by formulating the constraints within which solutions must be sought.

When formulated in terms of objectives and constraints for development, the vision can be used as a communication tool saying: the future of the Scheldt basin concerns all of us.

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