The Value of Water Quality Improvements – an Economic Perspective

Alexandra Dehnhardt, TU Berlin, Germany

Economic values for better environmental decision-making

Water is an essential natural resource that is vital for ecosystem functioning and human well-being. According to the concept of ecosystem services (ESS), which is just the latest attempt to demonstrate the contribution of ecosystems to human welfare and to ensure that the value of the environment is reflected in decision-making, freshwater ecosystems provide a wide range of goods and services: provisioning services such as fish and drinking water, regulating services such as nutrient retention and flood protection and cultural services such as recreation, recreational fishing as well as aesthetic inspiration. At the same time, freshwater resources are still under considerable pressure, facing environmental stresses imposed by population growth and urbanization, climate change an intensive agricultural use. Despite the political attention brought about, for example, the European Water Framework Directive (WFD) and its requirements to improve the state of aquatic ecosystems, the majority of European freshwaters still fail the objective to reach a 'good ecological status'.

From an economic perspective, most of the ESS has the character of public goods. A public good is a resource that is non-excludable, non-rivalrous, and open to all in its consumption. These goods are not traded on markets (they are referred to as non-market goods) and therefore, they have no market price and there is no information about their economic value. Thus, in management decisions that impact environmental resources they are often not adequately recognized when balancing the costs and benefits of policy actions. This is regarded as a market failure and leads to an inefficient allocation of scarce resources that is sub-optimal for the society as a whole. The most efficient allocation is defined as a situation where no reallocation of resources can make anyone better off without making at least one person worse off. Given the fundamental precondition of scarcity, the rationale behind an economic valuation of ESS, which is putting a monetary value on ESS and include these values in economic cost-benefit analyses, is to allow for a better informed and ultimately more efficient resource allocation and thus, a 'better' environmental decision-making. The ESS framework is closely linked to the economic perspective providing a conceptual approach to assess trade-offs among alternative options of resource use and ultimately is seen as an important prerequisite for conserving the environment.

The economic concept of value is an anthropocentric one. Economic values, costs as well as benefits, are expressed in individual preferences: the 'utility' of any individual choice provides the conceptual basis. The monetary value of this utility is expressed in the individual willingness-to-pay (or willingness-to-accept), which represents the welfare measure applied in valuation studies for estimating the costs and benefits of any environmental quality changes. Thus, the economic approach assumes individuals always have well-defined preference and make choice to maximize their individual utility. Integrating (environmental) economic values would also imply a fundamental change in knowledge use in policy-making: from an expert-based assessment justifying conservation primarily on ecological and engineering science related discourses to integrating preference-based values, making underlying values transparent in the decision-making process.

Economic valuation of water quality improvements

An improved water quality provides two classes of economic benefits: withdrawal benefits, such as municipal water supply, domestic use benefits, agricultural irrigation and industrial process water

benefits, and instream benefits. The latter encompass use values such as recreational benefits (swimming, boating, aesthetic value), and non-use values, which occur whether or not individuals have a direct interaction with water (altruistic and existence values). Both the use and nonuse values arising from water quality improvements are public environmental goods, which can be estimated using direct or indirect economic valuation methods. Over the last decades, economic approaches and methods to elicit monetary values of ESS evolved and are meanwhile well established. Among them, stated preference approaches rely on directly asking people about their willingness-to-pay for a certain improvement in environmental quality, in this case in water quality. In recent years, the choice experiments (CE) – on example of a stated preference approach – are becoming a popular means of environmental valuation. CE is a tool to elicit individual preferences for a set of alternative environmental goods or policy alternatives, creating a hypothetical market for these goods. CEs build on random utility theory and the characteristics theory of value. The first states that the utility that individuals gain from a good depends on a systematic component (the attributes) and a random component. The latter states that individuals value a good in terms of its attributes. Specifically, the goods or services are defined in terms of their attributes that are expected to determine the value of the good, and the levels that these take. Based on the collected data, a choice model estimates the probability that respondents choose an alternative using the attributes in the experiment as independent variables. By making one of the attributes a monetary one (price or costs), the willingness-to-pay for changes in attribute levels can be estimated using econometric models. Finally, for combinations of attribute changes welfare estimates can be obtained.

Using CE for eliciting preferences comprise different steps: (a) Definition of attributes that contribute to the river quality (the environmental good in question): in-stream water quality (using the water quality ladder from poor to very good); other relevant attributes (e.g. river banks structure, or land use); monetary attribute; (b) Collecting spatial data to assess the status quo of the case study area; (c) Determine levels for each attribute; (d) Defining alternatives; (e) Determine experimental design (assigning choice sets); (f) Conducting the CE within an empirical survey using a random sample of the affected population and (g) Estimating the marginal willingness-to-pay for attribute changes.

The results of the CEs reveal citizens values for changing water qualities. These values can be integrated in environmental cost-benefit analysis to measure the effects of policy actions. The potential role of value estimates for actual river quality decision-making is to be ‘decisive’ (contributing significantly to a decision-making process for a specific project, such like a decision rule), or ‘informative’ (providing additional information that may have an indirect influence on the decision-making process).

Challenges

An important challenge for scientists, practitioners and policy-makers is to integrate such value estimates into decision-making processes and to better understand how this knowledge can be used. Simply creating more knowledge is no guarantee that it will be embedded into policy-making to contribute to a better protection of the environment. All in all, although cost-benefit thinking and economic approaches are increasingly prominent in environmental policy and ample research is done to improve the validity and reliability of valuation methods and benefit estimates, the actual influence on policy-making has thus far been limited, presumably due to an apparent reluctance to use cost-benefit analysis and benefit estimates in political-administrative decision-making.