1. Introduction

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1 WETLAND DEFINITIONS

Wetlands provide many important services to human society, but are at the same time ecologically sensitive and adaptive systems. This explains why in recent years much attention has been directed towards the formulation and operation of sustainable management strategies for wetlands. Both natural and social sciences can contribute to an increased understanding of relevant processes and problems associated with such strategies. This volume examines the potential for systematic and formalized interdisciplinary research on wetlands. Such potential lies in the integration of insights, methods and data drawn from natural and social sciences, as highlighted in previous integrated modelling and assessment surveys (Bingham et al., 1995).

There is some disagreement among scientists on what constitutes a wetland, partly because of their highly dynamic character, and partly because of difficulties in defining their boundaries with any precision (Mitsch and Gosselink, 1993). For example, Dugan (1990) notes that there are more than 50 definitions in current use. Likewise, there is no universally agreed classification of wetland types. Classifications vary greatly in both form and nomenclature between regions; see Cowardin et al., (1979) for one influential classification system. Some features of wetlands, nonetheless, are clear. It is the predominance of water for some significant period of time and the qualitative and quantitative influence of the hydrological regime that characterizes and underlies the development of wetlands. The Ramsar Convention definition, widely accepted by governments and NGOs world-wide, is as follows: ‘areas of marsh, fen peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed 6m’.

While lacking scientific exactness, this definition conveys much of the essential character of wetlands, as well as implying the complexity involved. What it does not provide, however, is any guidance on the generic characteristics of wetlands that influence how wetlands actually function. Any integrated
wetland research approach has somehow to make compatible the very different perceptions of what exactly a wetland system is, as seen from a range of disciplinary viewpoints (Maltby et al., 1994, 1996b). In this volume the main characteristics of wetland processes and systems are reviewed in a cross-disciplinary way.

2 WETLAND LOSSES

Globally wetlands have been lost or are under threat, despite the existence of various international agreements (such as the Ramsar Convention which lists over 1000 sites of international importance covering almost 800 000 km$^2$) and national conservation policies. This situation has been caused by: (1) the public nature of many wetlands products and services; (2) user externalities imposed on other stakeholders; and (3) policy intervention failures that are due to a lack of consistency among policies being enacted across different sectors of the economy. All three causes are related to information failures, which in turn can be linked to the complexity and ‘invisibility’ of spatial relationships between ground and surface waters and wetland vegetation (Turner et al., 2000).

Integrated wetland research combining natural and social sciences can play a significant part in a strategy to reduce information failure and increase consistency and co-ordination across various government policies relevant to wetlands. An integrated wetland research framework suggests that a ‘mixed’ methodology based on a combination of integrated modelling, stakeholder analysis, economic valuation and multi-criteria evaluation can provide complementary insights into sustainable and welfare-optimizing wetland management and policy. Just such an approach is presented in this volume, with Part I covering methodological issues and Part II a series of applications across a spectrum of spatial scales.

According to the European Environment Agency, wetlands continue to be under particular pressure because of the extensive drainage of lowland areas for agriculture, forestry, peat exploitation and urban development, together with the impacts of river system regulation for power generation, water storage and flood control and the maintenance of navigation channels (European Environment Agency, 1999). The key to a better understanding of the wetland problem and its mitigation through more sustainable management lies in the recognition of the importance of the landscape ecology scale. A better scientific understanding of wetland structure and processes together with socioeconomic and cultural values and significance is predicated on an appreciation of at least catchment-wide systems. Thus wetlands have been and are being degraded or destroyed by eutrophication and acidification, the causes of which
lie ‘off-site’ and even beyond drainage basin boundaries. These pressures can be exacerbated by more local pressures such as over-consumption of surface and groundwater resources, or by the more ubiquitous effects of climate change, including sea level rise.

A more holistic approach to catchments and floodplain management requires administrative structures and appropriately refined scientific support that match the spatial and temporal scale of catchment and floodplain processes. These requirements are currently lacking in most European countries (Crooks et al., 2001). In the past, management of such systems has been sectoral, dominated by land-use pressures, local flood perception and management and to a lesser extent by environmental concerns. All too often the scale of flood interventions has been constrained by political and institutional considerations and has devolved down to the lowest common denominator, for example, local pressures focused upon short lengths of a river. The proprietary interests shown by local people in ‘their’ section of the floodplain is an extremely powerful force and one which democratic systems find difficult to accommodate. Yet natural floodplain systems are driven by processes that transcend the local ‘space’ and the short run timescale.

The precise configuration of wetland pressures and consequent damage varies across Europe. Generalizing, industrial development combined with agricultural intensification in North-western Europe has historically been responsible for the majority of wetland loss (around a 60 per cent loss of total wetland area). In Southern Europe, the long term occupation and exploitation of wetland goods and services has served to build up stress in these systems, lowering their resilience. This capacity to cope with stress and shock has been further diminished by low winter rainfall during the last decade. In Central and Eastern Europe and parts of Scandinavia, the less extensive spread of industrial, urban and high intensity agricultural activities has served to protect relatively large reserves of natural and semi-natural wetlands. Future development plans in these regions pose a potential threat to these remaining wild wetlands (European Environment Agency, 1999).

The contemporary plight of Europe’s wetlands is a classic example of what has become known as a ‘scaling mismatch problem’ (Boesch, 1999). This is that the juxtaposition of different spatial, ecosystem functioning and temporal scales is often inherent in any given environmental management problem. The scaling mismatch poses difficult challenges for both science and resource management/governance. In Spain, for example, over the last 30 years or so, ‘the la Mancha Occidental aquifer’ (encompassing some 5500 km²) has been heavily utilized to service irrigated agricultural regimes. This private extraction process has led to the establishment of more than 100 000 ha of new irrigated farmland, but is not in itself sustainable. The rate of abstraction often achieved (> 600 Mm³/year) was more than the recharge rate in a typical year...
The falling water levels in the aquifer damaged the ecological integrity of some important wetlands, including those in the National Park ‘Las Tablas de Daimiel’. The policy response was a controlled abstraction programme with compensatory payments to local farmers, but also a consequent negative economic multiplier effect in the regional economy.

But why should society be concerned about wetland loss? The simple answer is that wetland ecosystems are a component of our natural capital and wealth creation potential (Costanza et al., 1997). The many functions that wetlands provide – flood control, groundwater replenishment, coastal protection, sediment and nutrient retention, climate change mitigation, water purification, biodiversity storehouses, products such as fish, reeds etc., recreation and tourism and cultural and historical/symbolic services – are of significant economic and social value. While this is undoubtedly the case, aggregate (global scale) estimates of ecosystems’ value are problematic. Such macro-economic extrapolations are inconsistent with microeconomic theory and many policy decisions are made at the margin and so are more appropriately informed by marginal rather than total valuations (Balmford et al., 2002).

Economic valuation research can help in this context. Such research will provide findings that can help inform societal decision mechanisms trying to cope with the allocation of scarce resources (for example to conserve remaining wetlands more effectively) among competing demands (new schools, hospitals infrastructure and so on). Economic valuation is based on preference-related approaches (consumer and/or citizen preferences) and is compatible with a common monetary metric deployed across competing uses. The fundamental aim is not to put a ‘$ price tag’ on the environment, but to express the effect of a marginal change in ecosystem services provision in terms of a rate of trade-off against other things people value (van den Bergh, 1999). Economic, monetary valuation therefore is not applicable to ecosystems as a whole, but rather to relatively small changes in their structure and functions. They can be represented by realistic change scenarios that are readily and generally understandable. While we believe that there is a strong case in favour of environmental economic valuation as a decision aid, we also recognize that there are limits to its meaningful use (Turner, 2000).

Nevertheless, studies valuing multiple ecosystem functions and uses and studies that seek to capture the ‘before and after’ states as environmental changes (for example wetland degradation or conversion) take place, are relatively rare. More research of this type would aid rational decision-taking in wetland conservation versus development situations involving different stakeholders (local, national and global). The marginal valuation data that does exist suggests that net ecosystem service value diminishes with biodiversity and ecosystem loss (Balmford et al., 2002; Turner et al., 2002). New institutional processes and arrangements are also required in order to best realize...
benefits from multiple ecosystem use and non-use provision, across different (often competing) stakeholders.

Now is the time in Europe for the further strengthening of integrated water and wetlands policy, bringing together land-use planning, flood management and environmental pollution control and nature conservation. This policy should include the strengthening of planning controls to prevent unnecessary/inappropriate development on floodplains, creation of financial schemes to encourage reactivation of floodplains and component wetlands and management based on long-term rather than short-term perspectives. Positive action is required to remove public uncertainty and increase awareness of floodplain functioning. Mechanisms such as direct purchase of suitable land, mitigation banking and agri-environmental schemes designed to deliver multiple (including environmental) benefits to society, will serve to increase floodplain functionality and reduce social vulnerability. The implementation of a more holistic water management approach will of course be conditioned by prevailing and prospective economic, social and political networks and contexts, together with the regulatory system and underlying culture. The new EC Water Framework Directive provides a more or less positive regulatory context for greater holism, while at the same time allowing adaptation (subsidiarity principle) to be tailored to national/regional conditions and cultures (Crooks et al., 2001). Both the methodological and institutional issues surrounding the formulation and implementation of a more integrated water and wetlands policy in Europe are covered in this volume.

3 A FRAMEWORK FOR ECOLOGICAL–ECONOMIC ANALYSIS AND EVALUATION OF WETLANDS

The origins of the analysis presented in succeeding chapters lie in a research project funded by the European Commission (contract no. ENV4-CT96-0273) called ECOWET (Ecological–Economic Analysis of Wetlands: Functions, Values and Dynamics). This interdisciplinary project brought together teams of social and natural scientists from the UK, Netherlands, Sweden and Greece. The basic aims of the project were to provide an integrated methodology for wetland and water management policy, and to test the various elements of the overall methodology in national case studies (Turner, van den Bergh et al., 1999).

In order to scope the many issues, problems and arguments surrounding the scientific analysis, valuation and management of temperate wetlands in Europe, a simplified organizational and auditing framework was adopted which was an augmented version of a schema originally formulated by the OECD. This is the Driving forces–Pressures–State–Impact–Response
(DPSIR) approach, which although simple, is flexible enough to be conceptually valid across a range of spatial scales. It also serves to highlight the dynamic characteristics of ecosystem and socio-economic system changes, involving multiple feedbacks within a possible co-evolutionary process – see Figure 1.1.

Wetlands have traditionally been regarded by societies as having very little, or even negative, value, often being described as wastelands or sources of disease. As a result, wetlands have been actively drained and converted to other uses, while the essentially ‘open’ nature of wetland systems has made them susceptible to indirect damage from other human activities. This has led to the stock of wetlands, particularly in Europe, being substantially diminished.

Environmental pressure builds up via socio-economic driving forces – demographic, economic, institutional and technological – which cause changes in environmental systems ‘states’. These changes include increased nutrient fluxes, wetland habitat loss due to conversion, fragmentation and quality degradation; pollution of soil and water; and climate alteration. The processing and functioning capabilities of wetlands will be affected and this results in impacts on human welfare via productivity, health, amenity and other value changes. The impacts impose social welfare gains and losses across a spectrum of different stakeholders, depending on the spatial, socio-economic, political and cultural setting. Policy response mechanisms will then be triggered within this continuous feedback process.

It is now apparent that wetlands, far from being valueless, perform a wide array of functions that can be of considerable value of society. The physical assessment of the functions performed by a wetland is an essential prerequisite to any evaluation of a wetland’s worth to society, but simply identifying these functions is insufficient. Where a wetland is under pressure from human activity that provides measurable economic benefits to society, it will be necessary to illustrate the economic value of the functions performed by the wetland. The provision of such economic information is essential if an efficient level of wetland resource conservation, restoration or re-creation is to be determined.

Maintaining a wetland will almost always involve costs. There will be costs associated with forgoing other uses of the land or with limiting activities that might impinge upon the ability of the wetland to continue functioning. Hence the importance of making explicit the value of the multiple functions that wetlands perform to society, and of assessing this value within a framework which allows comparison with the gains to be made from activities that might threaten wetlands. This should serve not only to better protect these threatened ecosystems but also to improve decision making for the benefit of society. A framework for the ecological–economic analysis and evaluation of the functions and values of wetlands is presented in Figure 1.2.
**Figure 1.1 Driving forces—Pressure—State—Impact—Response framework applied to wetlands**

**Socio-Economic Drivers**
Urbanization and transport/trade, agricultural intensification/land-use change, tourism and recreation demand, fisheries and aquaculture, industrial development

**Environmental Pressures**
Land conversions and reclamation, dredging, waste disposal, water abstraction, agricultural runoff pollution, drainage network, congestion

**Impacts**
The changes in processes and functions of wetland ecosystems lead to consequential impacts on human welfare via productivity, health, amenity and conservation value changes

**Stakeholders:** gains/losses

**Climate Change and Wetland Structure and Processes/Functioning Variability**
Changes in nutrient, sediment water fluxes within and across wetlands, loss of habitats and biological diversity, visual intrusion, groundwater change/salt water intrusion, eutrophication/water pollution

**Policy Response Options**

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Introduction

Boundary conditions
- e.g. size, location, slope, substrate geology, water balance, water depth, pH, dissolved oxygen, precipitation, seasonal and annual variations

Structure
- biomass, soils, flora (trees, reeds, shrubs) fauna (fish, birds, terrestrial animals, macrofauna), water (surface, underground, minerals etc.)

Processes
- Photosynthesis, transpiration, biogeochemical cycling, decomposition, colonization, succession etc.

Environmental knowledge, history and cultural significance

Wetland uses
- Goods/Products
  - e.g. agriculture, fisheries, forestry, non-timber forest products, water supply, recreation
- Services
  - e.g. flood control, groundwater recharge, nutrient removal, toxics retention, biodiversity maintenance

Wetland Values and Valuation Methods
- Direct use value
  - market analysis; productivity loss; hedonic pricing; travel costs; replacement and restoration costs; contingent valuation
- Indirect use value
  - damage costs; production functions; hedonic pricing; defensive expenditures; relocation, replacement and restoration costs; contingent valuation
- Non-use values
  - existence, bequest and philanthropy contingent valuation
- Historical, cultural, symbolic values
- Social discourse methods

Option Values
- contingent valuation

‘Primary’, ‘glue’ value of the overall healthy system

TOTAL ECONOMIC VALUE (TEV)

DIFFERENT DIMENSIONS OF ECOSYSTEM VALUE

Key:
- systems related feedbacks
- economic/ecological linkages

Figure 1.2  Wetland functions, uses and values
At the core of the interdisciplinary analytical framework is a conceptual model, based on the concept of functional diversity, which links ecosystem processes and functions with outputs of goods and services, and which can then be assigned monetary economic and/or other values (see Figure 1.2). Functional diversity can be defined as the variety of different responses to environmental change, in particular the variety of spatial and temporal scales with which organisms react to each other and to the environment (Steele, 1991). This diversity concept encourages analysts to take a wider perspective and to examine change in large-scale ecological processes, together with the relevant socio-economic driving forces causing wetland loss. The focus is then on the ability of interdependent ecological–economic systems to maintain functionality under a range of stress and shock conditions. Another important facet of this approach is the derivation of scientifically valid and practical indicators of environmental change and sustainability. This approach also requires the coupling of economic, hydrological and ecological models (see Chapters 2 to 6 in this volume).

Wetland characteristics are those properties that describe a wetland area in the simplest and most objective possible terms. They are a combination of generic and site-specific features. A general list would include the biological, chemical and physical features that describe a wetland, such as species present, substrate properties, hydrology, size and shape. Adamus and Stockwell (1983) give 75 wetland characteristics (Table 1.1). However, in principle this list is endless and site-specific.

Wetland structure may be defined as the biotic and abiotic webs of which characteristics are elements, such as vegetation type and soil type. By contrast, wetland processes refer to the dynamics of transformation of matter or energy. The interactions among wetland hydrology and geomorphology, saturated soil and vegetation more or less determine the general characteristics and the significance of the processes that occur in any given wetland. These processes also enable the development and maintenance of the wetland structure which in turn is key to the continuing provision of goods and services. These ecological concepts constitute the upper part of Figure 1.2.

Ecosystem functions are the result of interactions among characteristics, structure and processes. They include such actions as floodwater control, nutrient retention and food web support. The concept of ecosystem functions and ecosystem functioning is essential in linking ecology and economy (that is, the step between wetland functioning and wetland values which is labelled ‘wetland uses’ in Figure 1.2). Although multiple definitions of (environmental) functions exist in the literature, they have in common that they all reflect an anthropocentric perspective on ecosystem functioning, where ecosystem characteristics, structure and processes contribute to human welfare and well-being.
Table 1.1  Examples of wetland characteristics

- Size
- Shape
- Species present
- Abundance of species
- Vegetation structure
- Extent of vegetation
- Patterns of vegetation distribution
- Soils
- Geology
- Geomorphology
- Processes (biological, chemical and physical)
- Nature and location of water entry and water exit
- Climate
- Location in respect of human settlement and activities
- Location in respect of other elements in the environment
- Water flow/turnover rates
- Water depth
- Water quality
- Altitude
- Slope
- Fertility
- Nutrient cycles
- Biomass production/export
- Habitat type
- Area of habitat
- Drainage pattern
- Area of open water
- Recent evidence of human usage
- Historic or prehistoric evidence of human usage
- pH
- Dissolved oxygen
- Suspended solids
- Evaporation/precipitation balance
- Tidal range/regime
- Characteristics of the catchment

Wetland ecosystem functions provide goods and services to society that are deemed valuable. These goods and services are the benefits derived from wetlands and they can be valued through various qualitative and quantitative valuation methods and techniques. An assessment of the complete range of benefits at a wetland site using a standard classification of benefits, as listed in Table 1.2, is an essential step before the overall value of the wetland can be derived. Table 1.2 also makes it clear that there are strong linkages between the various types of benefits.

While the adoption of a functional perspective is advocated in this volume as the correct way to identify wetland goods and services, if each of them is identified separately, and then attributed to underlying functions, there is a likelihood that benefits will be double counted. Benefits might therefore have to be allocated explicitly between functions. For instance, Barbier (1994) noted that if the nutrient retention function is integral to the maintenance of biodiversity, then if both functions are valued separately and aggregated, this would double count the nutrient retention which is already “captured” in the biodiversity value. Some functions might also be incompatible, such as water

### Table 1.2 Classification of wetland benefits (goods and services)

<table>
<thead>
<tr>
<th>Services</th>
<th>Goods</th>
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<tbody>
<tr>
<td>Flood control</td>
<td>forest resources</td>
</tr>
<tr>
<td>prevention saline intrusion</td>
<td>agriculture resources</td>
</tr>
<tr>
<td>storm protection/windbreak</td>
<td>wildlife resources</td>
</tr>
<tr>
<td>sediment removal</td>
<td>forage resources</td>
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<tr>
<td>toxicant removal</td>
<td>fisheries</td>
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<tr>
<td>nutrient removal</td>
<td>mineral resources</td>
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<tr>
<td>groundwater recharge</td>
<td>water transport</td>
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<tr>
<td>groundwater discharge</td>
<td>water supply</td>
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<tr>
<td>erosion control</td>
<td>recreation/tourism</td>
</tr>
<tr>
<td>wildlife habitat</td>
<td>aquaculture</td>
</tr>
<tr>
<td>fish habitat</td>
<td>research site</td>
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<tr>
<td>toxicant export</td>
<td>education site</td>
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<tr>
<td>shoreline stabilization</td>
<td>fertilizer production</td>
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<tr>
<td>micro-climate stabilization</td>
<td>energy production</td>
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<tr>
<td>macro-climate stabilization</td>
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<td>biological diversity provision</td>
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<td>cultural value provision</td>
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<td>historic value provision</td>
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<td>aesthetic value provision</td>
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<tr>
<td>wilderness value provision</td>
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</table>

Wetland ecosystem functions provide goods and services to society that are deemed valuable. These goods and services are the benefits derived from wetlands and they can be valued through various qualitative and quantitative valuation methods and techniques. An assessment of the complete range of benefits at a wetland site using a standard classification of benefits, as listed in Table 1.2, is an essential step before the overall value of the wetland can be derived. Table 1.2 also makes it clear that there are strong linkages between the various types of benefits.
extraction and groundwater recharge, so that combining these values would
overestimate the feasible benefits to be derived from the wetland. Studies that
attempt to value the wetland as a whole based on an aggregation of separate
values tend to include a certain number of functions although these studies do
not usually claim to encompass all possible benefits associated with the
wetland (see Appendix 4.1).

The conceptual model we advocate is not reductionist in the sense that it
neglects the overall systems perspective that is key to the understanding of the
environmental change process. Rather it is narrowly drawn in foundational
terms (at the level of individual ecosystem-functions) in order to provide
analytical rigour, as well as practical regulatory/policy relevance. At no time
is the overall value of a healthy evolving set of environmental systems lost
sight of. The term ‘total economic value’ is meant to describe, when appro-
priate, an aggregation of use values and other non-use (option and existence
value) values, in cases where it is feasible and meaningful to quantify such
values in monetary terms. Total economic value is therefore less than total
system value which incorporates the life support function and maybe other
dimensions of environmental value such as intrinsic value, that is the value of
a wetland that resides in itself, rather than of itself.

However, if wetlands perform many functions and are potentially so val-
uable, a reasonable question would be, why have these values been ignored and
wetland losses and/or degradation allowed to continue? To some degree, the
desirability of the flat, fertile and easily accessible land upon which wetlands
are often found, has inevitably put some of them under pressure from other
uses such as agriculture, industry and urbanization. Some conversion might
well have been in society’s best interests, where the returns from the compet-
ing land use are high, but wetlands have frequently been lost to activities
resulting in only limited benefits or, on occasion, even costs to society. This is
the result of what Turner and Jones (1991) refer to as interrelated market and
intervention failures, which derive from a fundamental failure of information,
or lack of understanding of the multitude of values that may be associated with
wetlands.

The multifunctional characteristic of wetland ecosystems makes compre-
hensive estimation and valuation of every function and linkages between them
a formidable task. Hence the need for a useful typology of the associated
social, economic and cultural values. In this book, we will mainly focus on
socio-economic values. These values depend on human preferences, that is
what people perceive as the impact wetlands have on their welfare. In general,
the economic value of an increased (or a preserved) amount of a good or
service is defined as what individuals are willing to forego of some other
resources in order to obtain the increase (or maintain the status quo). Economic values are thus relative in the sense that they are expressed in terms
of something else that is given up (the opportunity cost), and they are associated with the type of incremental changes to the status quo that public policy decisions are often about in practice.

Economic values will always be contingent upon the wetland performing functions that are somehow perceived as valuable by society. Functions in themselves are therefore not necessarily of economic value. Such value derives from the existence of a demand by society for wetland goods and services. While the total amount of resources society would be willing to forego for an increased (or preserved) amount of a wetland service reveals the total economic value (TEV) of this increase (or preservation), different components of TEV can be identified (see Figure 1.2). *Use value* arises from humans’ direct or indirect utilization of wetlands through wetland goods and wetland services, respectively. A value category usually associated with use value is that of option value, in which an individual derives benefit from ensuring that a resource will be available for use in the future. Another type of value often mentioned in the valuation literature is quasi-option value, which is associated with the potential benefits of awaiting improved information before giving up the option to preserve a resource for future use. Quasi-option value cannot be added into the TEV calculation without some double counting; it is best regarded as another dimension of ecosystem value. *Non-use value* is associated with benefits derived simply from the knowledge that a resource, such as an individual species or an entire wetland, is maintained. Non-use value is thus independent of use, although it is dependent upon the essential structure of the wetland and functions it performs, such as biodiversity maintenance.

Various components of non-use value have been suggested in the literature, including the most debated component, existence value, which can be derived simply from the satisfaction of knowing that some feature of the environment continues to exist, whether or not this might also benefit others. This value notion has been interpreted in a number of ways and seems to straddle the instrumental: intrinsic value divide (see Chapter 4 in this volume). Some environmentalists support a pure intrinsic value of nature concept, which is totally divorced from anthropocentric values. Acceptance of this leads to rights and interests-based arguments on behalf of non-human nature. The existence of such philosophical views is one reason why the concept of TEV should not be confused with the ‘total value’ of a wetland. Moreover, the social value of an ecosystem may not be equivalent to the aggregate private TEV of that same system’s components. The system is likely to be more than just the aggregation of its individual parts (Gren et al., 1994).

Finally, an important aspect of the economics–science interface is the existence of thresholds and the potential for irreversible change. Where the additional change in a parameter has a disproportionate effect, this might be
associated with relatively high economic values. And if the change is irreversible, account needs to be taken of the uncertain future losses that might be associated with this change, and the possible imposition of Safe Minimum Standards. While it may not be possible to identify exact thresholds or the precise effects of crossing those thresholds, it will be important to acknowledge the possibility of approaching limits of tolerance within the ecosystem.

4 THE ECOWET RESEARCH PROJECT

The valuation approach adopted in ECOWET encompassed a mixed methodology. Wherever feasible and meaningful, monetary valuation methods and techniques were deployed to assess wetland functional value and change. At this level, interdisciplinary insights can be derived and exploited, as economic theory is combined with geographic information systems and focus group work buttressed by psychosocial and cultural theory, in order to enrich the valuation process. In the context of ECOWET, spatial modelling was undertaken by the Dutch team to integrate descriptions of hydrological, ecological and economic systems and their interactions. Integration involved formulation of scenarios at the level of polders and grids, heuristic linking of models, and aggregation of spatial data in various performance indicators. The programme MODFLOW (a regional groundwater flow model) linked to ICHORS (a probability-based vegetation model) translates environmental change into impacts in terms of the likely spatial distribution of wetland plant/fauna species. The economic model was used to assess the efficiency and distributional equity implications of the environmental impacts. This was complemented by both multi-criteria and spatial equity assessment approaches (van den Bergh et al., 2001 and 2002). The resulting integrated modelling tool allows for an explicit matching of spatial characteristics of a region dominated by wetlands with policies – mainly focused on water management and land use – that aim to realize a particular trade-off between economic benefits, nature conservation and spatial equity.

ECOWET also identified and explored some of the systemic and intangible elements of local wetland value, which are less susceptible to economic valuation. A participatory appraisal method, that is, a structured process of learning with, and from people in a locality about their own situation, conditions of life, perceptions, aspirations and preferences, has been deployed in the UK case study (Burgess, Clark and Harrison, 2000). The Swedish team and the Greek team have also conducted focus group sessions with local stakeholders in order to analyse the effectiveness of Swedish wetland creation policy and links between tourism development pressure and pristine wetland areas respectively (see Chapters 7 to 10 in this volume).
Scenarios of environmental change and consequent wetland impacts were constructed and evaluated in order to derive policy-relevant findings for management. In the UK case different management strategies were assumed, in the Swedish case different nitrogen reduction policy scenarios were examined, and in the Dutch study land-use change scenarios were utilized (see Chapter 11 in this volume).

The case study work programme addressed a number of different problems across different temporal and spatial scales – from individual wetland function valuation, through whole area management in the context of a single (or small number) of environmental pressure(s), to catchment/landscape scale problems as highlighted in the Dutch polder study. A common policy analysis structure was adopted for all the case studies. It encompassed an examination of all the relevant environmental pressure trends, actual and potential stakeholder conflicts and the prevailing institutional and property right regimes, or lack of regimes, relevant for wetland management.

REFERENCES


