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1. Introduction

1.1. Background to TESS

TESS is about creating a decision support system to help humanity improve its environment, starting in Europe. The need for humans to protect desirable species and their habitats has been recognised in protection laws for more than a millennium in some nations (Gadgil & Guha1992, Bagader et al. 1994), and probably in local community taboos for much longer. In the modern era conservation supported by legislative and management measures began in the 19th century as a national initiative but rapidly became internationalised in the 20th century (Adams 2004). most notably in the form of the Convention on Trade in Endangered Species (1975), the Bern Convention for the Conservation of European Wildlife and Natural Habitats (1979), the Convention on Migratory Species (1979) and the Convention on Biological Diversity (CBD, 1992).

Some 17% of the land area of the EU is now designated as part of Natura 2000, which started life as the Bern Convention's Emerald Network. The EU has also introduced Directives for Environmental Impact Assessment (EIA) of defined projects, complemented by Strategic Environmental Assessment (SEA) of plans and programmes having a significant effect on the environment. Under the CBD, Biodiversity Action Plans at EU and national level have been instigated. Yet severe biodiversity decline continues at local level across Europe (Thomas et al. 2004) and will not be halted by the 2010 target date (Dimas 2009).

The current problem is not lack of protection from deliberate persecution or over-exploitation (except in the case of some marine fisheries), but of change in land-use outside protected areas. Farmed and forested ecosystems are being managed intensively for provisioning services that are provided by narrow numbers of species and genomes (e.g. Pain & Pienkowski 1997, Pretty 2001). Species vanish as natural colonisation across fragments cannot keep pace with loss of local wildlife-rich marginal habitats, the diversity of cultivated habitats declines and even amenity areas and gardens suffer from tidying by efficient machines adhering to uniform sets of advice from the mass-media. The provisioning services of ecosystems for humans are enhanced, but often at a cost of damaging the regulating and supporting services of those ecosystems (MEA 2005). The cultural value of those ecosystems has also declined with the biodiversity, which formerly offered people greater opportunity for hunting and fishing, as well as flowers, fruits and fungi to gather or simply a richness of animals and plants to admire. In landscapes devoid of biodiversity, people lose interest in the natural environment, as shown by fewer people engaging in wildlife-related activities in the most urbanised parts of Europe (Kenward & Sharp 2008), fewer in Europe than in the more rural USA, and as time progresses fewer in both these large developed areas (Martinez et al. 2002, USDI, FWS & USDC 2007).

The loss of interest in nature may also be detrimental to human survival. Well-informed people in democratic governments may wish to make environmentally beneficial decisions, but electoral support for increases in state expenditure and the taxes to enable them is now very difficult to obtain (even for supposed essentials such as health, education and defence). Human survival needs more people to care about their environment, and not merely to protect it as conservation requires positive actions too.

Studies across Europe have shown how relatively small changes in cultivation practices can often have major benefits for biodiversity with relatively little reduction in production, and sometimes even benefits through reducing pest damage (Boatman & Sotherton 1988, Reimoser & Reimoser 1997, Newton 2004). The EU has moved the budget that supports the Common Agricultural Policy, currently some €55 Billion annually, towards maintaining the supporting and regulating services of ecosystems,

though the original plan to allocate 20% of the funds to Pillar 2 (rural development) was modified to 12%. Moreover compulsory set-aside, well known for its positive environmental side-effects, was recently abolished thus giving the green light to more intensive farming. There is also private spending of more than €40 Billion annually on hunting, fishing and watching wildlife, equivalent to more than €200 per hectare of cultivated land (Kenward et al. 2009a,b). Thus there is funding available to manage land in ways that support more biodiversity, even though it may be under pressure. Enhanced biodiversity would support more cultural ecosystem services whose beneficiaries engage most frequently in other environmentally-friendly actions (Peyton et al. 1995, Ericsson & Heberlein 2002) and are most likely to help build support for governments that make biosphere-friendly decisions.

However, the management of land to optimise income from a high diversity of uses is more complex than either protecting it or maintaining intensive cropping. Adaptive management (Holling 1978, Walters 1986), which involves regular monitoring of results from science-based management, is an approach identified by ecologists for some three decades. Science-based management typically involves predictive modelling and then testing of outcomes by monitoring, as is the basis of work on climate change. In both cases the modelling is spatially specific, requiring maps. The most accurate models for species populations are individual based (Sutherland 1996, Goss-Custard & Sutherland1996), but to model a community of species from large to small also requires fine-scale mapping. Predicting the effects of use requires socio-economic inputs too, which has been done for relatively focussed systems such as grouse-moors (e.g. Redpath et al. 2004) but is even more challenging for multi-use farmland and forests.

The efficacy of adaptive management, which is fundamental to the CBD's Principles of an Ecosystem Approach (2000) and Addis Ababa Principles and Guidelines for Sustainable Use (2004), was shown in the TESS team's previous project on Governance & Ecosystem Management for Conservation of Biodiversity (Manos & Papathanasiou 2008). GEMCONBIO found that quality of ecosystem services, sustainability and biodiversity in local areas and wildlife-related activities was positively linked to adaptive management promoted in association with external knowledge leadership (Karacsonyi et al. 2008). The challenge of TESS is to build a system that is so effective in helping local communities to manage their land adaptively that it incentivises them to enhance the quality of their monitoring to the point where it can contribute information to central policy and decision making, where current indicators are underdeveloped and underinvested (Walpole et al. 2009). This would be akin to the community-central cooperation now recommended for conservation (Ostrom et al. 1999, Berkes 2007). It would give scope to go beyond protection, which merely seeks to halt biodiversity loss, by emulating the success of projects that have reversed loss and restored ecosystem services (Benayas et al. 2009). It would solve the problem identified by Pimm et al. (2001) that "Paradoxically we are not limited by lack of knowledge but failure to synthesis and distribute what we know." It could also, through promoting citizen-science for the environment, enhance understanding and support for necessary policies to combat climate change.

1.2. The TESS project

TESS aims to assist the integration of information about biodiversity and related environmental matters from the local level into planning and land-use decisions. At the same time it aims to encourage local people to collect such information in order to maintain and restore biodiversity ecosystem services. To achieve these aims, a decision support system will be designed to exchange information required in

environmental assessments at all levels for information that benefits local recreation and livelihoods.

Thus, a particular objective is to identify areas where governance, including consultation processes, and future provision of information, could best support not only government-based policy but also local decision-making that benefit both the environment and livelihoods. When people benefit from something, there is scope for a transaction, in this case the transmission of information between local and central governments and local stakeholders. In order for government at any level to require complex assessments to develop and implement policy (e.g. through SEAs), they need to integrate environmental outcomes of local decisions on development subject to EIA, on other land-use planning, or on the myriad daily decisions of those who manage land or species. In order for individuals to make small scale assessments and enlightened decisions, they need complex knowledge that government can provide to local communities. This two-way interaction is the basis for a Transactional Environment Support System (TESS).

To design such a TESS, it is important to understand flows of information, especially to:

1. Identify the information needs of policy makers and how this information is obtained.
2. Identify information needs for decision making at more local levels.

Thus, the first two scientific Work Packages of the TESS project (guided by an Administrative Work Package that runs throughout the project) were Work Package 2, on the Central Policy Environment, and WP3 on the Local Environment. As indicated by their names, WP2 directed its enquiries towards governance for policy development, whereas WP3 focussed more on information for local decision-making. The objectives of WP2 were to identify information needs of governments across Europe for SEA, EIA and other areas of biodiversity conservation and sustainable development, and to determine how that information is obtained. The objectives of WP3 were to identify information needs of local government for EIA, of local communities for managing their environment and of individuals for land management decisions and to determine how that information is obtained.

As explained above this D2.2 report, “Model of information flows from local & regional to central” is the first in a trio from both Work Packages, and must be considered together with D3.2 (Model of the local decision making process) and D3.3 (Synthesis report: Central and local information flows and decision making requirements). These reports provide conceptual models on information flows, which use data from the research to help visualise where information generation and use for environmental decision-making is currently most important.

2. Information requirements for environmental decision making

There are many sorts of environmental decisions, made by different parts of society. Much of this information is still on paper, and much still resides as “local knowledge” and will be lost unless recorded in a permanent and readily accessible form. TESS aims at handling all such data in a way that encourages its transfer to digital format. Land-managers and science field-workers, need not face the prospect that the knowledge they have acquired will eventually dissipate. Instead it can be used to benefit their work area and the biosphere and humanity living there.
To produce a system capable of handling such information, we need to be able to handle a variety of digital information, and we need to be able to deliver it to those who need it in a way that is easy for them to use. It will take many years to build a system that can predict a large range of environmental contingencies, and continuing human development will require constant updating of the system as well as the information in it.
However, in order to design a system that will be sufficiently attractive to fund its continued development the initial design needs to prioritise among many possible capabilities. This is to be done by attempting not only to identify where current issues already create high information flows, but also by predicting which nascent flows could develop quickly. It is also important to identify and provide support for best governance practises. This identification started in the FP6 project GEMCONBIO and continues in TESS, through a pan-European survey at national and local level by questionnaires, but also in local projects that bring in a little “learning through doing” from interactions with local communities.
The section below:

1. Outlines the main actors in decision-making
2. Explains the way conceptual models are used to assess information flows
3. Considers the information flows which occur for the high-level decisions
4. Draws conclusions for the development of TESS

2.1. The Decision-Makers

Environmental decisions may be broadly divided into two types. Formal decisions are based on statutory processes and reflect adopted policy. Some of the policy originates in the governance machinery of the European Union as Directives (e.g. on EIA and SEA) which are then implemented through national legislation which transposes their provisions into national law.. Other policy originates nationally in addition to those Directives, in some cases through adoption of wider international conventions such as the CBD and in some cases through Land Use Planning legislation that is not specifically regulated at EU level. The latter policy in particular may be varied in its implementation through special rules made at various levels of government.
The initiative for a land-use strategy or strategic planning framework requiring SEA will normally come from national or regional government and will involve consultation with those living in area, inviting participation from individuals, businesses, civic groups, groups with specific interests and other non-government organisations (NGOS), as well as government agencies with relevant responsibilities. Similar consultations will arise for impact assessment of specific projects and other land-use planning decisions (EIA, LUP), which in these cases will have been initiated by a person or group intending to carry out a particular development project. These formal, statutory decisions are subject to a variety of governance processes and involve many parties who need environmental information on the right scale and in

accessible form, making scientists and information suppliers, including the interested public, a part of the process.
Users of land and species for other purposes may be regulated, or subject to funding conditions, more directly as a result of governmental policy, for example through regulations under the Water Framework Directive or subsidies provided by Common Agricultural Policy (CAP). However, the decisions about what to grow in field or forests, how to manage that growth, or what species to encourage (and harvest) or discourage, are based on many other factors including topography, weather, markets and cultural interests, as well as characteristics of the cultivated, domesticated or wild species concerned. A wide variety of information is needed for these informal decisions, which is obtained in different ways by different stakeholder groups.
There is accordingly a plethora of people involved in making decisions that affect the environment, including policy-makers, those designing strategy and approving projects based on that policy, and those making less formal decisions informed by policy but also many other factors. To whom is it most important for TESS to supply information, and how should this be supplied, in order to guide those decisions?

2.2. The Analytic Approach

How can TESS decide where it is most important to supply information? A major consideration must be the impact of the decisions, in terms of effect, area involved and frequency. That should involve not just decisions to prevent detrimental actions, but also aiding decisions to encourage beneficial action such as restoration work. Another consideration for the viability of a system that encourages people to transact information, is where do governments, organisations and individuals have most need for information, and what are the economic factors that are likely to support its delivery. Such economic considerations involve both public and private funding, because governments need information for policy and strategy just as individuals do for livelihoods.
Thus, information is needed on decision impacts and on information flows. A start on assessing decision impacts has been made in TESS, and will continue through an EU-wide survey and local case studies. It is chiefly the study of information flows that we address here. There is a need also to consider the impact of information flows, which may be greatest where demand and supply are most poorly aligned, and where information generation will have the greatest benefit for policy making.
A variety of information flows, analysis approaches and decision processes used for environmental assessment and sustainability assessment for biodiversity were identified by enquiry on government practices nationally and by structured interviews in local case-study sites , across a range of 9 countries (Estonia, Greece, Hungary, Poland, Portugal, Romania, Slovenia, Turkey and the United Kingdom), where approaches were likely to differ. Standardised questionnaires provided comparability in both cases, between levels of government and across stakeholder groups at local level.
The standardised data are used in this report, and in the linked TESS D3.2 report from Work Package 3 to provide diagrams that illustrate the main patterns of information flow. Details of data collection are given in the TESS Synthesis Report D3.3 and not repeated here. Likewise, details of governance (e.g. consultation processes) and type and quality of information are to the found in that much more extensive report.
The strength of flows is illustrated by the width of arrows, which represent the proportion of records for that type of flow across the nine countries. Of particular interest in this analysis is the variation in widths shown across countries at different levels of government. This is important for planning collection of data later in the project. A thick arrow now only indicates where there is little variation to analyse

when seeking to identify best practice, but also where information delivery from local level may be useful for informing policy and other formal decision making.

2.3. The Information Flow Models

The most fundamental flows of information are directions for framing regulations. Data from TESS research are combined to show this in Figure 2.1. EIA, SEA and CAP legislation is proposed by the European Commission and adopted by the Council of Ministers and the Parliament, whereas Biodiversity Action Plans are a soft law requirement of the CBD and Land Use Planning laws are framed mostly at national level.

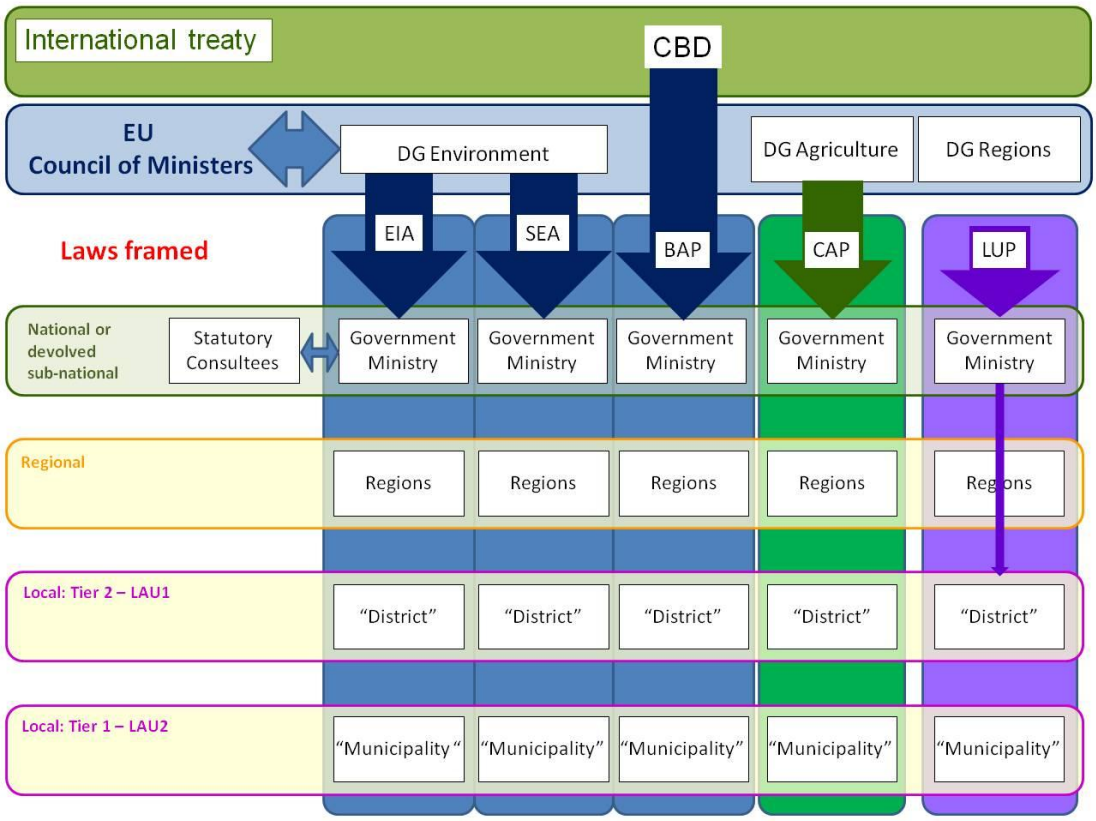

Figure 2.1. Except for Land Use Planning, instructions for framing environmental laws and procedures now come primarily from international level.

The low level of variation in these procedures gives little scope for analysis of best practice, but indicates that informing European Union policymakers about the effects of their policies on EIA, SEA and CAP at a local level is very important. Likewise, informing national governments about impacts of Land Use Planning is very important, partly due to their ability to make regulations on matters that are not subject to EU legislation and partly because they are able through the Council of Ministers to influence EU policy.
Figure 2.2 shows where approvals are given for EIA, SEA, CAP and LUP, and indicates much more variation in the implementation of the instructions within each state.

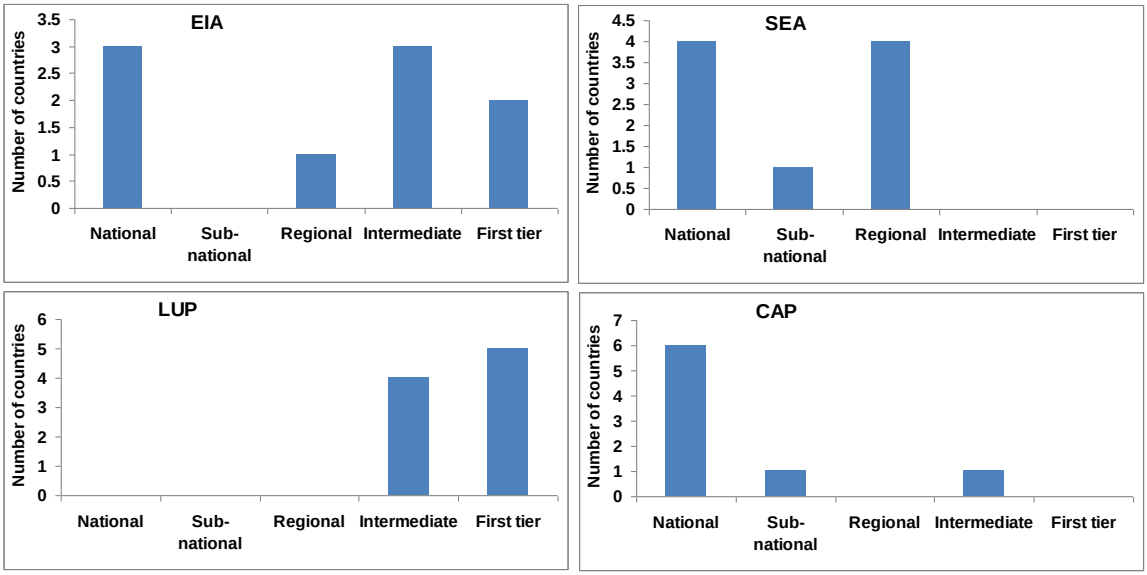

Figure 2.2 The variation between states in the lowest level at which approval is given for EIA, SEA, LUP and CAP subsidies. Data are available for 9 countries on the first three aspects but for only 8 on CAP which does not apply in Turkey.

The format of Figure 2.1 is used to combine all the information in Figure 2.2, and also on BAP processes to display information flows in Figure 2.3. These information flows reporting on completion of statutory decisions are in themselves relatively uninteresting for TESS. However, they indicate where the reporting process originates, and hence where the decisions are made. In the countries surveyed, this was entirely at local levels for LUP, substantially at local levels for EIA, but only at regional level and above for SEA, and predominantly at national level for CAP and BAP processes.

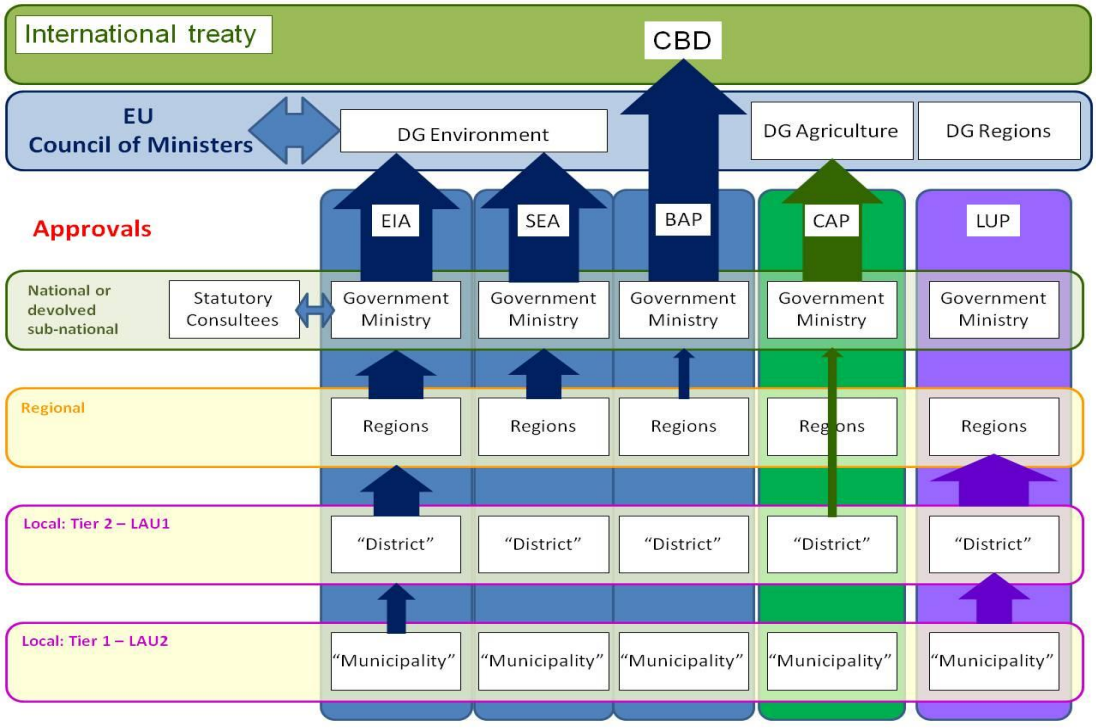

Figure 2.3 The reporting on EIA, SEA, BAP, CAP and LUP, to higher authorities.

The levels at which decisions are made is indicated better by the levels where consultation occurs, shown in Figure 2.4.

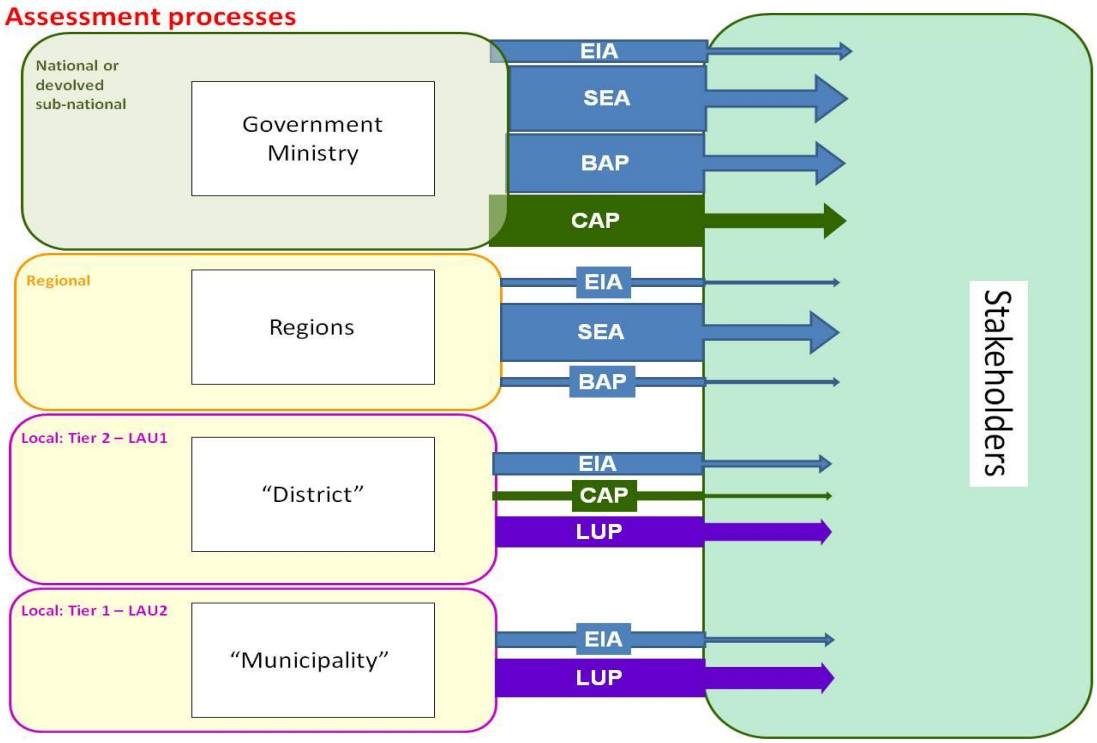

Figure 2.4 Levels at which consultation occurred for EIA, SEA, LUP, CAP & BAP

It is important to understand that, in terms of information sourcing for all local management decisions, as opposed to the consultation for statutory decisions (Figure 2.4), the information flows between stakeholders and government are more complex. These flows, together with other information sources used by stakeholders are shown in Figure 2.5.

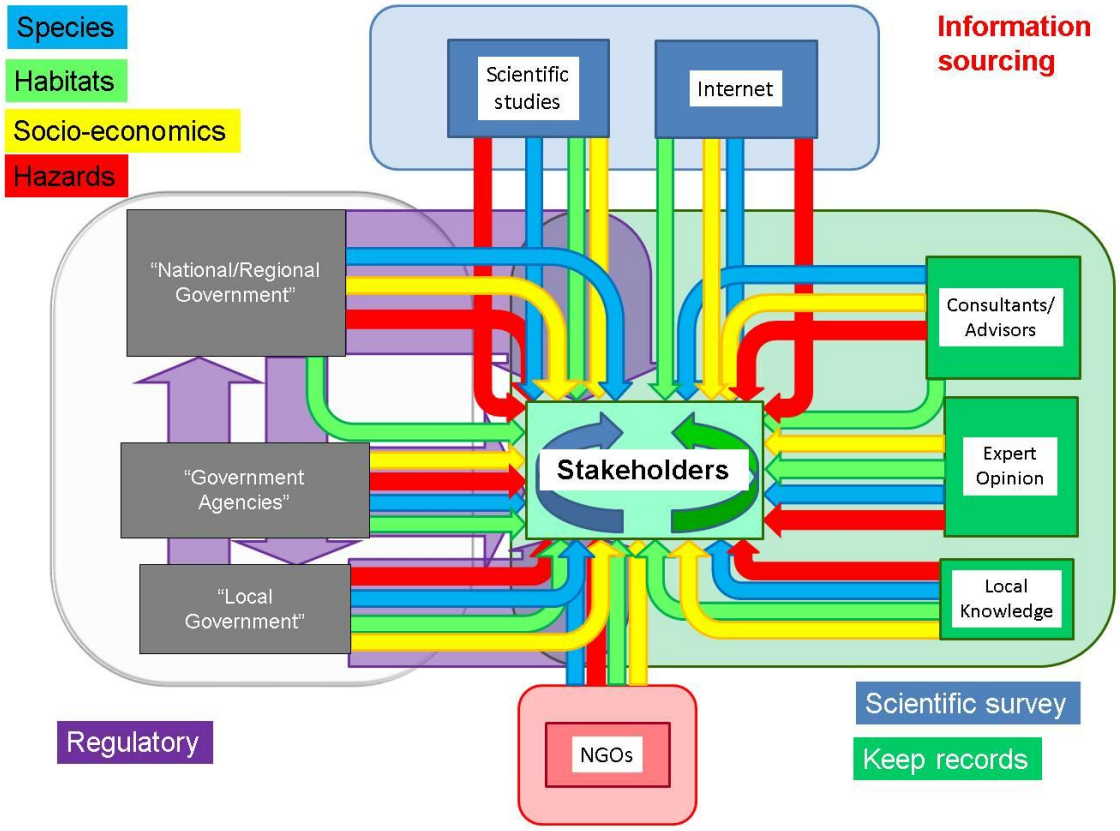

Figure 2.5 The information sources used by stakeholders when assisting government with statutory decisions and when making informal decisions within an envelope of government regulations.

Figure 2.5 shows that regulatory information affects stakeholders from central government (e.g. on nationally designated species and habitats), from local government (e.g. on EIA and LUP requirements) and from government agencies; agencies are also part of the processing of information between all levels of government. However, the stakeholders also obtain information on species, habitats, abiotic environmental factors (including fire, flood and weather hazards) and socio-economic factors from these sources, and potentially also from NGOs, researchers, the internet and a variety of advisors. In the context of scope for information transaction, the stakeholders also generate their own information, from keeping records as a form of local knowledge and in some cases by conducting systematic monitoring guided by scientists. In the linked report D3.2 "Model of the local decision making process", the width of information arrows will be varied, as in Figures 2.1, 2.3 and 2.4 here, to reflect the number of countries for which each type of information flow was recorded.

2.3. Conclusions from modelling information flows for central policy

A conclusion from Figures 2.1 and 2.3 is that much of the policy designed to ensure that the environmental impacts of formal decision-making (EIA, SEA, CAP, BAP) are assessed and acted upon is now adopted in the form of international rules and transposed into domestic legislation at national level. Thus it is policy makers at European level who have most need of information on the effectiveness of these various instruments. This underlines the importance of integration of data at European level, which is being promoted through the EIONET run by European Environment Agency (EEA) and plans to create a Single Environment Information Space (SEIS). It is EEA that will provide such information to decision makers at the European Union level and to ministries at national level, using data that are collected and maintained at national level.

However, predictive modelling for the environment requires spatially specific data, which can only be gathered at a sufficiently small scale at local level. Although remote sensing is increasingly able to supply some of this, it will be many decades before it can provide adequate data for all locations, at least in biodiversity contexts: neither satellites nor DNA sensing techniques can map flora and fauna distributions widely at the flower and insect scale. For economies of scale and as a single gateway for European level, it makes sense to integrate locally-collected environmental data at national level. Indeed, of 27 broad-based databases cited in TESS D3.3.2, there were 21 at national level. The UK was one of the first to have a National Biodiversity Network (NBN) and a Multi Agency Geographic Information Consortium (MAGIC) for environmental data. However, this information is not a flow to central government, which (as depicted in Figure 2.3) is mainly responsible for reporting completion of statutory processes to higher levels.

The focus for LUP decisions and most projects requiring EIA is at local level, which is also where the informal decisions made by stakeholders are much more numerous than statutory decisions (see TESS D3.3.3), although individually perhaps of less impact. This was the reason why a precursor to this survey, by Centre for Ecology and Hydrology in 2002-3 to examine the potential use of environmental models, concluded that the main points for delivery of environmental information needed to be at national level and locally, to help local communities and individual stakeholders manage land and species.

What seems to be changing rapidly is for much policy-making to move to European level, albeit with data integrated at national level. However, the data from local level for integration nationally is only just starting to be organised for EEA through EIONET, although remote sensing is further forward. In both cases the main player centrally is EEA, in partnership with national governments, so these should be high-level anchors for TESS. For local level, TESS needs to service the government levels that interact most with local individual stakeholders and their representative groups, which will often be at the lowest hierarchical level of local government (LAU2 in the Eurostat classification (NUTS 2009) but sometimes (especially where there is no effective LAU2 level or the lowest level authorities have few powers or responsibilities) at LAU1.

Information is of course used at other levels, notably for SEA processes relating to land use, which often inform LUP at regional level within countries, and for BAPs. CAP too may increasingly involve SEA at national and regional level. However, these planning processes at intermediate levels involve personnel capable of tapping and interpreting relatively raw data if integrated nationally. The challenge is (i) to deliver complex information in a simple way that motivates monitoring by communities and individuals, and (ii) to integrate data from the monitoring for high level. These are the

two priorities for the development of TESS, although tapping information at all levels of government between central and local levels will be encouraged.

2.4. References

Adams, W.M., 2004. Against Extinction: the story of conservation. Earthscan, London

Bagader, A.A., El-Sabbagh, A.T.el-C. Al-Glayand, M. as-S. & Samarrai, M.Y.I-D.1994. Environmental protection in Islam. IUCN, Gland, Switzerland & Cambridge.

Benayas, J.M.R., Newton, A.C., Diaz, A. & Bullock, J.M. 2009. Enhancement of Biodiversity and Ecosystem Services by Ecological Restoration: A Meta-Analysis. Science 325:1121-1123.

Berkes, F. 2007. Community-based conservation in a globalized world. Proceedings of the National Academy of Sciences 104: 15188-15193.

Boatman, N.D. & Sotherton, N.W. 1988 Agronomic consequences and costs of managing field margins for game and wildlife conservation. Annals of Applied Biology 17: 47-56.

Dimas, Stravros 2009. Speech to European Biodiversity Action Plan Conference in the European Parliament.
http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/09/54

NUTS 2009: Eurostat website:
http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/nuts_classification

Ericsson, G. & Heberlein T.A. 2002. Jägare talat naturens språk (Hunters speak nature's language): A comparison of outdoor activities and attitudes towards wildlife among Swedish hunters and general public. Zeitschrift für Jadgwissenschaft 48:301-8.

Holling, C.S. 1978. Adaptive Environment Assessment and Management. Wiley, London.

Gadgil, M. and Guha, R. (1992), This Fissured Land: An Ecological History of India. Delhi: Oxford University Press.

Goss-Custard, J.D. & Sutherland, W.J., 1997. Individual behaviour, populations and conservation. In: J.R. Krebs and N.B. Davies (Editors), Behavioural Ecology: An Evolutionary Approach. Blackwell Science, Oxford, pp. 373-395.

Karacsonyi, Z. Simoncini, R., Kenward, R. and Arampatzis, S. 2008. Chapter 6. Main Results - Conclusions from GEMCONBIO. Pp. 140-160 in Manos & Papathanasiou (2008).

Kenward, R. Manos, B., Arampatzis, S. & Papathanasiou, J. 2009. A transactional environmental support system for Europe. Pp. **-** in Hřebíček, J., Hradec, J., Pelikán, E., Mírovský, O., Pilmmann, W., Holoubek, I. & Legat, R. (eds.) Towards eEnvironment (Challenges of SEIS and SISE: Integrating Environmental Knowledge in Europe). European conference of the Czech Presidency of the Council of the EU.

Kenward, R. & Sharp, R. 2008. Use Nationally of Wildlife Resources across Europe (UNWIRE). Pp. 82-86 in Manos & Papathanasiou (2008).

Kenward, R., Sharp, R., Manos, B., Arampatzis, S., Brainerd, S., Lecocq, Y., Wollscheid, K. & Reimoser F. 2009. Conservation from use of biodiversity and ecosystem services. Pp. 68-83 in Proceedings of the XXIX International Union of Game Biologists Congress, Moscow, Russia.

Manos, B. & Papathanasiou, J. 2008. GEMCONBIO: Governance and Ecosystem Management for Conservation of Biodiversity. Aristotle University of Thessaloniki, Greece.

Martinéz, J., Viñuela, J. & Villafuerte, R. 2002. Socio-economic aspects of gamebird hunting, hunting bags, and assessment of the status of gamebird populations in REGHAB countries. Part 1. Socio-economic and cultural aspects of gamebird hunting. Workpackage 1 in Viñuela, J. (ed) Reconciling Gamebird Hunting and Biodiversity (REGHAB) EKV-2000-00637 (http://www.uclm.es/irec/Reghab/inicio.html).

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Newton, I. 2004. The recent declines of farmland bird populations in Britain: an appraisal of causal factors and conservation actions. Ibis 146: 579-600.

Ostrom,E., Burger, J., Field, C.B., Norgaard, R. & Policansky, D. 1999. Revisiting the commons: local lessons, global challenges. Science 284:278-282.

Pain, D.J. & Pienkowski, M.W. 1997. Farming and birds in Europe. Academic Press, London.

Peyton, R.B., Vorro, J., Grise, L., Tobin, R. & Eberhardt, R. 1995. A profile of falconers in the United States: falconry practises, attitudes and conservation behaviours. Transactions of the 60th North American Wildlife and Natural Resources Conference, pp. 181-192.

Pimm, S.L., Ayres, M., Balmford, A., Branch, G., Brandon, K., Brooks, T. Bustamante, R., Costanza, R., Cowling, R., Curran, L.M., Dobson, A., Farber, S., da Fonseca, G.A.B., Gascon, C., Kitching, R., McNeely, J., Lovejoy, T., Mittermeier, R.A., Myers, N., Patz, J.A., Raffle, B., Rapport, D., Raven, P., Roberts, C., Rodríguez, J.P., Rylands, A.B., Tucker, C., Safina, C., Samper, C., Stiassny, M.L.J., Supriatna, J., Wall, D.H.& D.Wilcove. 2001. Can we defy nature's end? Science 293: 2207-8.

Pretty, J.N. 2002. People, livelihoods and collective action in biodiversity management. In O'Riordan, T. & Stoll-Kleeman, S. (eds), Biodiversity, sustainability and human communities: protecting beyond the protected: 61-86. Cambridge University Press, Cambridge.

Redpath S.M., Arroyo B.E., Leckie F.M., Bacon P., Bayfield N., Gutiérrez R.J. & Thirgood S.J. 2004. Using Decision Modeling with Stakeholders to Reduce Human–Wildlife Conflict: a Raptor–Grouse Case Study. Conservation Biology 18: 350-359.

Reimoser, F & Reimoser, S. 1997. Game damage and game benefit – objective assessment of the ungulate impact on the forest vegetation. Zeitschrift für Jadgwissenschaft 43: 186-196.

Sutherland, W.J., 1996. From individual behaviour to population ecology. Oxford University Press, Oxford, UK.

Thomas, J.A., Telfer, M.G., Roy, D.B., Preston, C.D., Greenwood, J.J.D., Asher J., Fox, R., Clarke, R.T. & Lawton, J.H. 2004. Comparative Losses of British Butterflies, Birds, and Plants and the Global Extinction Crisis. Science 303: 1879-1881.

USDI, FWS & USDC. 2007. 2006 National survey of fishing, hunting and wildlife-associated recreation, US Department of the Interior Fish and Wildlife Service, Fish and Wildlife Service and US Department of Commerce Census Bureau, Washington DC.

Walters, K. 1986. Adaptive Management of Renewable Resources. Macmillan, New York.

Walpole, M. Almond, R.A.E., Besançon, C., Butchart, S.H.M., Campbell-Lendrum, D., Carr, G.M., Collen, B., Collette, L., Davidson, N.C., Dulloo, E., Fazel, A.M., Galloway, J.N, Gill, M., Goverse, T., Hockings, M., Leaman, D.J., Morgan, D.H.W., Revenga, C., Rickwood, C.J., Schutyser, F., Simons, S., Stattersfield, A.J., Tyrrell, T.D., Vié, J.-C. & M. Zimsky. 2009. Tracking Progress Toward the 2010 Biodiversity Target and Beyond.

3. Information on biodiversity required to conduct formal EIAs and SEAs in EU countries

Taking the UK as an example, four general* categories were distinguished under which biodiversity information is required to be incorporated into formal decision making systems. These are:

a) EIA of projects
b) SEA of plans and programmes
c) Proposals needing consent under the land use planning (LUP) system
d) Payments under the Common Agricultural Policy and national environmental schemes for agriculture.

In the case of (a) to (c) biodiversity information would only be needed where the proposal is expected to have a significant effect on fauna and flora or biodiversity.

In the UK arrangements for all four categories mentioned are 'devolved', which means that for England, Wales, Scotland and Northern Ireland the following instruments are done differently (even if only slightly) :

i) laws and policies for land use planning;
ii) regulations implementing the EIA and SEA directives;
iii) official guidance to local authorities operating the LUP system;
iv) practical guidance from official sources as to how to prepare or comment on EIA's or SEA's and how to take account of biodiversity in LUP applications.

However databases of biodiversity information may not be so divided but may cover the whole of the UK or at least more than one part of it. In a similar way unofficial guidance prepared by experts or NGO's and research studies may apply to the UK as a whole or just part of it.

For TESS purposes at this stage it was not necessary to understand or compile data about all the sub-national variations of laws, guidance, databases etc in any one country but information was sought on:

a) at what governmental level the laws/regulations are made;
b) for that level how the system works in one reasonably typical case; and
c) about sources of biodiversity information and research/analysis related to EIA's or SEA's which is relevant to TESS, which may cover wider areas of the country.

Therefore if a country makes the relevant laws, regulations or rules at national level then that level was the one about which information was sought. On the other hand, if a country has devolved EIA, SEA, LUP and CAP administration to its regions or provinces and has 10 such areas then information was wanted about the formal systems for just one of them – but information about databases, unofficial guidance and research/analysis could relate to wider areas.

3.1. National Enquiry Template: analysis of returns

3.1.1. Preliminary comments on governance systems

Among the group of countries studied the UK and Turkey stand out from the rest for different reasons. Turkey is not yet a member of the EU and has not therefore adopted all existing EU environmental legislation, though it is a candidate state and is moving towards adaptation. In the context of this study it should be noted that Turkey has not legally implemented either the SEA Directive or any parallel system, though

* NB appropriate assessments are also need for impacts on Natura 2000 sites and under aspects of the Water Framework Directive.

the decision to adopt the Directive was taken in 2002 by the Ministry of the Environment and implementation is foreseen for 2010 (Unalan & Cowell 2009). Secondly although agriculture is very important to Turkey, providing some 30% of jobs and 8% of GDP, and a host of measures are in train to align agricultural policy with the EU's CAP, the overall target for such alignment is around 2013-2014. Thirdly Turkey's administration is considerably more centralised than that of other countries in the study or the rest of the EU. Provincial governors and regional divisions of national ministries play an important role and often exercise powers which elsewhere belong to elected local government bodies. This is not dissimilar to the 'old' arrangements in France where prefects appointed by central government had major responsibilities.

The UK is different from the others because it has a national UK-wide elected parliament in Westminster which controls foreign, economic and immigration policy for the UK as well as domestic policy for England, while 'devolved' governments in Scotland, Northern Ireland and Wales answer to elected parliaments or assemblies for their area which legislate on different ranges of domestic affairs, including the environment. These devolved administrations are not strictly countries or regions, nor can the UK system be classified as federal, but significant differences are beginning to emerge in the legislation they enact on similar topics, not least those which are the subject of this present study. It would be too complicated to describe all the variations and so, for convenience, most of the governmental material relates to the position in England. It should not be assumed that the position in Scotland, Northern Ireland and Wales is the same. "England" is not shorthand for the UK in this study. However NGO's and databases are often organised at UK level, though with country, regional or even local groupings.

3.1.2. Capabilities for assessments and planning

The first group of questions was designed to discover (a) the governance level at which EU requirements for EIA and SEA were transposed into national law as required by the Directives and at which land use planning laws were made and the CAP administered; (b) the governance level for case by case approvals under these systems and whether in relevant cases national laws extended the application of EIA and SEA beyond strict EU requirements; and (c) mitigation and monitoring requirements flowing from environmental decisions.

Governance levels for law making

Noting the absence of a formal SEA system in Turkey, it was otherwise not surprising to find that all the countries make laws for EIA and SEA at national level (figure 3.1), except for the UK where they are made at sub-national level, e.g. England.

The same arrangements apply to the administration of the CAP, or in the case of Turkey, alignment with the CAP. In other words national or sub-national ministries with responsibility for agriculture administer agricultural policies and funds.

All the countries have a land use planning system, though this is not formally the subject of EU legislation. In all cases laws are made at national level, except for the UK where the level is sub-national. Additionally in Hungary some planning regulations are made by local municipalities.

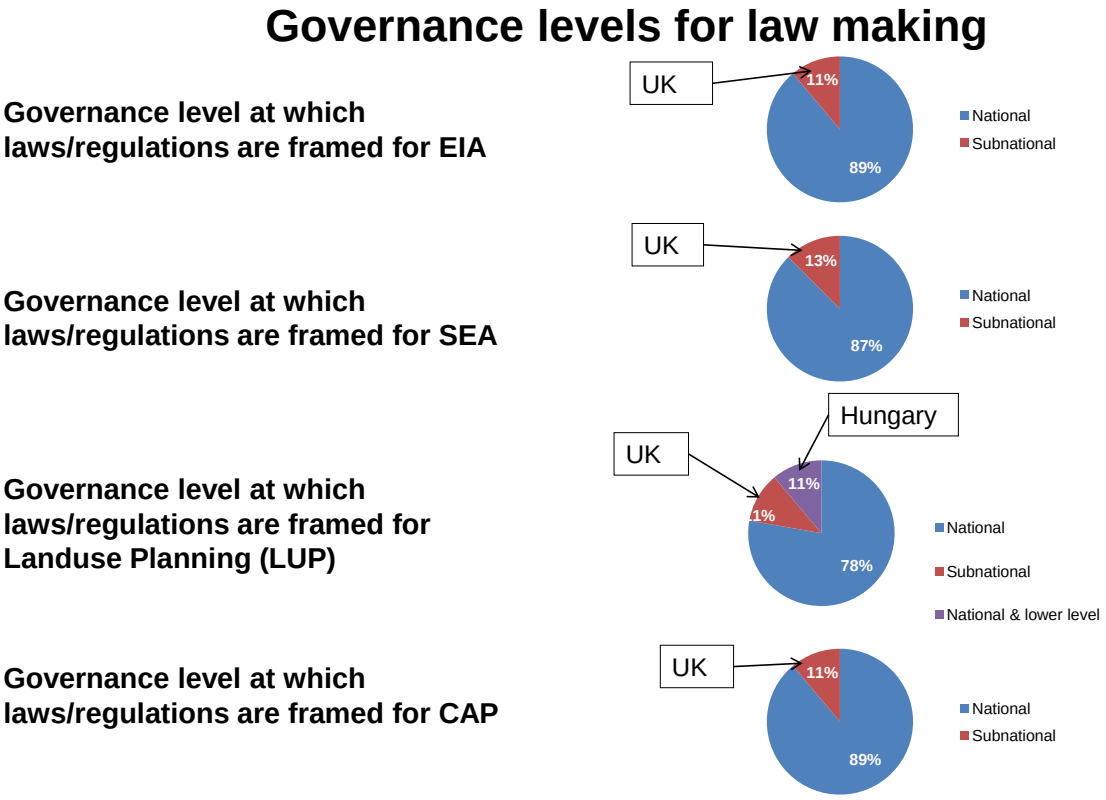

Figure 3.1. Governance levels at which laws/regulations are framed for environmental regulations, land-use planning and agricultural policy.

3.1.3. Governance levels for case by case approvals

When we turn the systems for approval of applications for permission or CAP funds the situation is slightly more complicated, although fairly clear patterns emerge.
In general project approval in cases where EIA is required is given at a governance level below national or sub-national. One partial exception to this generalisation is Portugal (figure 3.2). Although the EIA Directive does not require that environmental assessments given under the Directive should themselves be approved, in Portugal this is the case and the approval is given by national authorities (such as the Secretary of State for the Environment), after which the project itself is usually approved at local government level unless it is a large infrastructure development. In Estonia, approval of the EIA itself is at national level and is given by the Environmental Board.

Turkey also approves some cases at national level. In England (UK) approval in all cases is at district or equivalent council level, which is the level at which land use planning applications are approved, though on appeal cases are decided by or on the recommendation of inspectors appointed by a government department. In future the position in England may be complicated by very recent legislation which takes decisions on major projects such as airports and power stations out of the hands of local authorities and remits them to a nationally-appointed planning commission. In the remainder of the countries studied, approvals for projects where EIA is required are given variously by municipalities (1st tier), districts, counties, prefectures, voivodships or regions, or provincial departments of ministries in the case of Turkey.

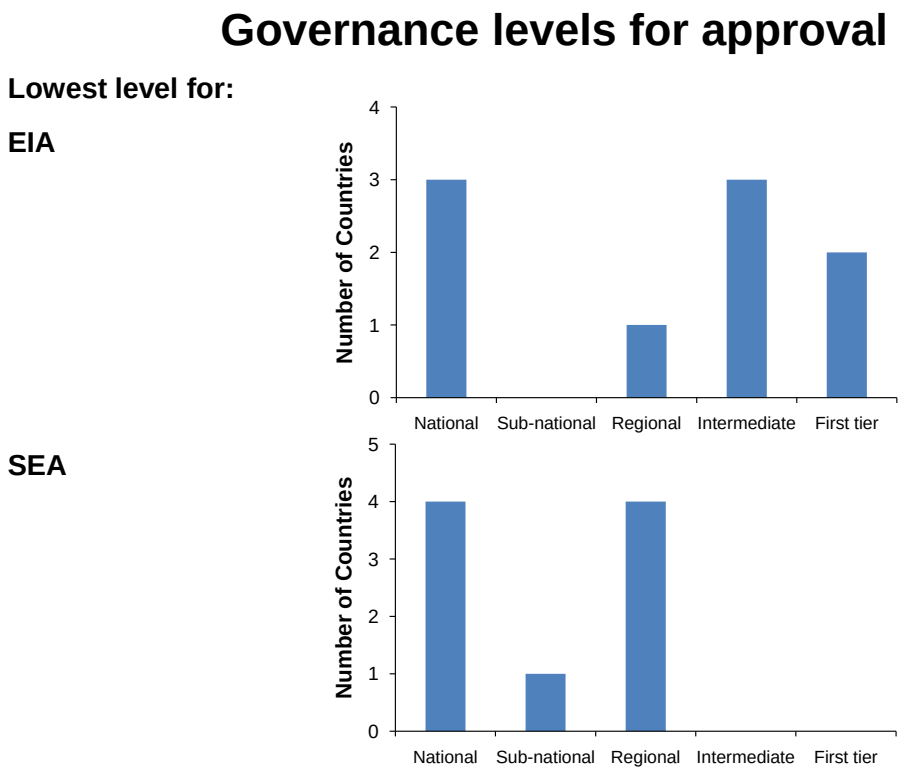

Figure 3.2. Lowest level for approvals of EIA's and Sea's in the eight (9 case studies) countries for which returns were received.

Plans or programmes requiring SEA are mostly approved at higher levels than is the case with EIA. An obvious reason for this is that the plans or programmes concerned often cover the areas of several authorities or deal with issues in which the authorities lack specific expertise. In this study only Portugal and Estonia approve SEA's or SEA cases exclusively at national level, but all the other countries do so through through sub-national or regional authorities or voivodships in the case of Poland.

Approval of land use planning applications is generally at local authority level, such as the district or equivalent authority in England or municipalities elsewhere (figure 3.3). Minor exceptions to this rule are that in Romania counties give approval, in Hungary regions or counties deal with certain cases and in Greece prefectures take the decisions, while in Turkey either ministries or provincial departments retain responsibility.

CAP project approval and support is almost universally a function retained by central government, whether national or sub-national, but an exception is Romania where

counties have responsibility, while in England the agency responsible for both nature conservation and the countryside, Natural England, deals with applications from and payments to farmers. In Turkey decisions on agricultural support are taken at national government level.

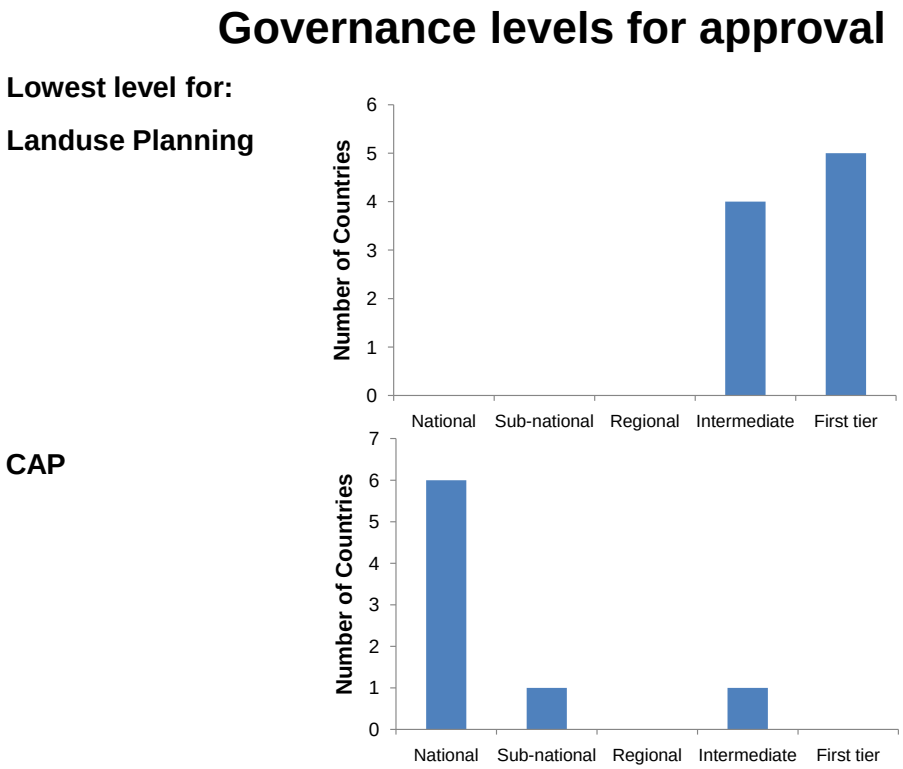

Figure 3.3. Lowest level for approvals of land-use planning and CAP applications in the countries for which returns were received

3.1.4. Extension of EIA & SEA Directives by national laws

As regards extension of the application of EIA to more cases than the Directive requires there is a roughly even split between the countries. In Poland, Hungary, Estonia, Slovenia and Greece application is extended, while in Portugal, Romania, Turkey and England it is not.

Partners were asked whether SEA is applied to 'plans and programmes' in their countries, as required by the Directive and to give examples of these. In all countries except Turkey, where SEA is not in force, the response was positive. The examples given covered the expected regional land use and urban spatial strategies or frameworks, as well as a good range of sectoral plans such as those for transport, energy, water management, hazardous waste disposal, rural development and National Parks and protected areas (figure 3.4).

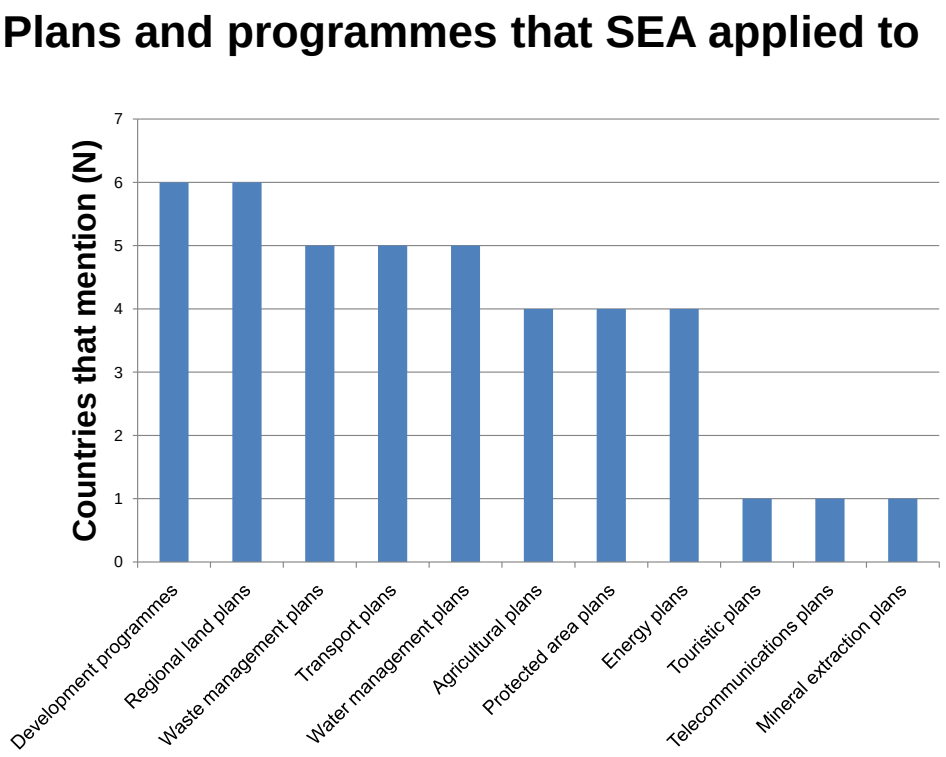

Figure 3.4 Examples of the types of plans and programmes that SEA was applied to in the seven countries where it is in force.

However some countries go further than strictly obliged in their application of the SEA Directive and require appropriate assessments to be applied to 'policies and/or strategies', though it needs to be acknowledged that the distinction between 'plans' and 'strategies' is a fine one. When partners were asked if their countries had extended SEA beyond plans and programmes, only Poland and Hungary had done so. In Poland SEA has been applied to energy policy to 2030 and to the National Development Strategy 2007-2015. Hungary has subjected its National Climate Change Strategy and the National Strategy for Sustainable Development to SEA.

3.1.5. An overview of numbers of EIA's and SEA's annually

The enquiry asked whether countries kept records of the number of EIA's completed annually and, if so, the actual or estimated numbers and any categories into which they might be broken down. It should be noted that although the Directive does not require central records to be kept the Commission urged Member States to do so in their 2003 progress report on the Directive. The same questions were asked in relation to SEA's. A further question was whether a sample of EIA's and SEA's could be obtained if needed to examine how biodiversity information had been used in the particular cases. Table 3.1 compares the results on a country by country basis.

Table 3.1 Numbers of EIA & SEA cases annually where recorded with an indication of whether or not information is available on the categories of EIA or SEA considered. Information is coded as: Y=yes, N=no, U=uncertain, N/A=not applicable and N/R=not recorded.

	EIA		SEA		Samples
	Number	Cat.	Number	Cat.	
UK	313	Y	N/R (500-600 est.)	N/A	U
Turkey	110	Y	N/A	N/A	Y
Romania	822	N	105	N	Y
Portugal	100	Y	10	Y	Y
Poland	N/R	N/A	N/R	N/A	Y
Hungary	N/R	N/A	N/R	N/A	Y
Estonia	N/R	N/A	N/R	N/A	U
Greece	1600*	N	N/R	N/A	U
Slovenia	250	N	50	N	Y

* Estimate from EC 2003.

3.1.6. National compliance, sustainability and ecological infrastructure

The issue of whether partner countries had been found to be non-compliant with any aspects of the EIA and SEA Directives was addressed. Only Romania was reported to be currently in breach – in relation to interactions with Article 6(3) and (4) of the Habitats Directive. In the case of the UK and Greece previous criticisms by the Commission were mentioned: in the case of the UK this related to inadequate transposition of EIA requirements relating to the conversion of land for intensive agriculture and in the case of Greece the omission of some project types from national law, including those relating to such conversion.

Respondents were asked if any laws on EIA, SEA or LUP require sustainable development or social and economic issues to be taken into account in assessments. This was broadly the position in all countries. Comments from Romania indicated that economic and social considerations could figure in SEA environmental reports and this was also the case for Portugal, though formal sustainability reports were not required. In Hungary only certain socio-economic aspects could be considered while in Greece LUP law strongly incorporates the concept of sustainable development.

A related issue was whether these laws require ecological infrastructure such as connectivity between designated areas to be taken into account. In most countries this is required but England and Greece are exceptions. The comment was made that in Romania projects which directly or indirectly affect protected areas must be screened with ecological considerations in mind. However this could be regarded as a requirement of the Directive, so should not be regarded as unique to this country. In England biodiversity issues must be considered but not ecological networks or infrastructure as such.

3.1.7. Operation of EIA Directive: Monitoring and Mitigation

Monitoring of environmental impacts of approved projects is carried out always in Turkey, Romania and Hungary and sometimes in the remaining countries (figure 3.5). In England, Portugal, Poland, Romania, Hungary, Slovenia and Estonia the developer is responsible and must report to the relevant authority such as the Environment Protection Agency in Romania, the National Biodiversity Conservation Authority in Portugal or the National Inspectorate for Environment, Nature and Water in Hungary. In other countries monitoring is by authorities, e.g. General Directorate of Environmental Impact Assessment in Turkey, and regional authorities in Greece.

Who is responsible for EIA monitoring?

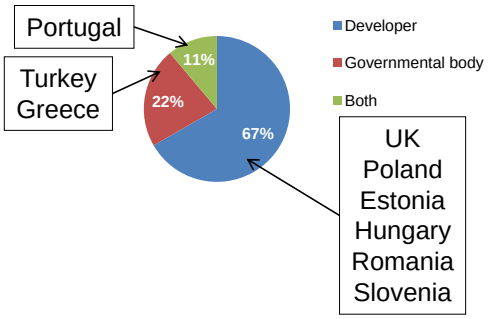

Figure 3.5 Responses to who is responsible for undertaking monitoring of the environmental effects of approved projects.

When the study examines whether mitigation in the form of restoration or habitat creation is required or encouraged in cases where significant damage to the environment occurs (through non-observance of EIA, SEA etc conditions or procedures) the findings are that in Poland, Slovenia and Hungary mitigation is mandatory; in Portugal it is mandatory in some cases; and elsewhere it is encouraged.

3.1.8. EIA and Agricultural Intensification

The EU EIA Directive requires assessment to be carried out on a case by case basis or above certain thresholds when uncultivated land or semi-natural areas are proposed to be converted into intensive agricultural use. After the original Directive was adopted in 1985 a number of Member States were slow to apply this provision, so partners were asked to discover whether it is now being applied in their countries and, if so, in relation to what thresholds or conditions. (N.B. Removal of field boundaries such as hedges for the purpose of agricultural reconstruction is also covered but partners were not asked expressly to look into this.)
All countries in the study except Greece do require EIA in these 'intensive agriculture' cases. However the thresholds for application have generally been set very high as shown in table 3.2 below:

Table 3.2. Thresholds for application of EIA to projects involving agricultural intensification.

	Area for EIA to be applied	Period of previous non-cultivation
England	100ha - less in designated areas	15 years
Turkey	500ha	-
Romania	No threshold	-
Portugal	100ha or 50ha in sensitive areas	5 years
Poland	300ha (re-parcelling)	-
Hungary	50ha but 1ha in designated areas; 30ha for deforestation	-
Estonia	100ha; also for forestation	-
Slovenia	no threshold	-

For England it was also reported that up to 4 km of field boundaries could be removed for restructuring of a holding before EIA is required. In Hungary the threshold for removal of boundaries for restructuring is 300 ha in normal situations but 10 ha in designated areas. The 300 ha mentioned for Poland in Table B presumably also relates to restructuring.

In most countries where the rule applies re-instatement is required if the rules are infringed. Similarly CAP cross-compliance payments would probably be lost in England, Slovenia and Hungary but not in Portugal, Estonia and Poland. The questions on sanctions for infringement were not answered in the return from Romania because the relevant information could not be obtained. It should be noted that the rules on applying EIA to agricultural intensification cases are complicated in themselves, added to which member states have considerable flexibility in applying them. It seems likely that the questions on thresholds and sanctions were over-simplified and that the results should be treated with caution, though it is clear that a number of states set high thresholds.

These provisions of the EIA Directive on the conversion of uncultivated or semi-natural land into intensive agriculture and the related ones on the removal of field boundaries such as hedges are potentially valuable for biodiversity because such agricultural practices in Western Europe during the heyday of the CAP have been seriously damaging to wildlife, especially outside protected areas. It is unfortunate that, on the basis of anecdotal evidence (e.g. the Commission's 2003 report on the operation of the EIA Directive), they appear to have been very little used. There is more than one explanation for this. On the one hand there has, since 1985, been less of a general trend towards intensification under the CAP and even, in more recent years, the gradual application of more environmentally friendly policies. A less satisfactory reason is that, except in Hungary, Estonia, Slovenia and Romania among the countries studied, the thresholds have been set so high that few if any cases are caught by them. Moreover it is possible that farmers considering conversions which could potentially be affected have been advised to break up their projects into smaller ones to avoid triggering off EIA procedures.

3.1.9. EIA's and NGO involvement

Partners were asked if certain environmental or biodiversity NGO's in their countries frequently comment on proposals where EIA is required and, if so, to provide names of some of the leading bodies, indicating if they were national, regional or local. Responses could only be impressionistic since in few, if any countries, are projects subject to EIA and all their attendant documents kept on a common database nor was it practicable within the parameters of this preliminary enquiry to approach individual NGO's directly. However partners in Greece and Turkey both commented that NGO's in their countries are only infrequently involved in EIA cases, but the opposite would be true for England. In Portugal NGO's do become involved in EIA's applying to large and potentially damaging developments such as airports and power stations. Table 3.3 provides an overall picture.

Table 3.3. Number of NGO's commenting on EIA's and at what level (*i.e.*national, regional or local – the same NGO can comment at more than one level).

	UK	Turkey	Romania	Portugal	Poland	Hungary	Estonia	Greece	Slovenia	Total
All NGO's	5	4	7	5	6	6	4	1	1	39
National	3	4	1	3	6	5	4	1	1	28
Regional	3	-	4	2	3	1	-	-	-	13
Local	3	-	2	-	-	-	-	-	-	5

It should be stressed that these samples of NGO's are not necessarily representative and that information about involvement by local NGO's will be harder for an individual research team to know about without conducting a formal survey. Nevertheless the preponderance of involvement by national level NGO's is striking and doubtless reflects the resources and technical expertise considered necessary to become involved in EIA procedures. Examination of the names of the NGO's listed by partners (see Table 3.4 below) reveals quite a wide spread of interests.

Table 3.4. Similar types of NGO's that comment on EIA applications across the countries surveyed.

	National bird groups	WWF Associates	Friends of the Earth
UK/England	Royal Society for the Protection of Birds		Friends of the Earth
Turkey	Nature Society (Birdlife affiliate for Turkey)	WWF-Turkey	
Romania	Societatea Ornitologica Romana (Romanian Ornithological Society) (Partner of Birdlife International)	Salvati Dunarea si Delta (Save the Danube and Delta)	
Portugal		Liga para a Protecção da Natureza	

Poland	Polish Society for the Protection of Birds (OTOP) (Part of Birdlife International)		
Hungary	Birdlife Hungary (Hungarian Ornithological and Nature Society)	WWF Hungary	National Society of Conservationists Friends of the Earth
Estonia		Estonian Fund of Nature (ELF)	Estonian Green Movement Fo-E (ERL)
Greece		WWF Greece	
Slovenia	Birdlife Slovenia		

3.1.10. Interaction of EIA with LUP system

The question was asked as to whether the 'development consent' required by the EIA Directive is always, partly or never administered as part of the LUP. For all countries the answer was 'partly'. Comments revealed that in all countries there are special arrangements for sectors such as agriculture, energy, harbours and forestry which are not fully covered by the LUP system. However information from elsewhere (EC 2003) indicates that the great majority of EIA cases are dealt with under the LUP system.

In view of the very wide variations between the number of EIA cases annually in different EU Member States partners were asked whether EIA is required in all cases where development proposals are made. If the response to this question was 'no' the consequent questions were whether in the other cases the LUP system or planning policy supports biodiversity conservation positively or requires negative effects on biodiversity to be taken into account. In cases where EIA is not required most countries include a requirement to support biodiversity conservation and to avoid negative effects in their LUP policies, though Hungary, Poland and Greece qualify this by responding "sometimes" (figure 3.6).

Figure 3.6. Where EIA is not required, does the land-use planning system support biodiversity?

3.1.11. Formal and informal guidance on the working of EIA, SEA and LUP

The enquiry sought information as to whether national or sub-national authorities had issued formal guidance to authorities who have the decision-making role in relation to EIA, SEA or the LUP system. For 7 countries the answer was 'yes', but in Estonia the guidance issued by the EC is relied upon, while in Slovenia workshops were organised. Respondents were asked to give the title of one such document, from which it was clear that most guidance documents were general in character. Hungary mentioned guidance on cross-compliance under the CAP. It was also asked if the authorities had issued practical guidance for developers and others who decided to become involved in EIA and similar processes. In 7 countries this was so, with Turkey and Slovenia as exceptions. Titles of practical guidance documents were supplied in the cases concerned.
Respondents were also asked if experts or NGO's had issued practical guidance on EIA, SEA or LUP procedures and for titles. In 7 countries such guidance documents had been issued, but not in Estonia or Slovenia. Examples given ranged from full scale books by such experts as Therivel and Partidario to NGO publications and guidance on consultants' websites.

3.1.12. Availability of biodiversity information for decision making

In 7 countries the guidance listed sources of environmental information, the exception being Greece. In 6 out of the 7 cases where sources are listed this includes biodiversity information, Hungary being the exception. A series of detailed questions was then asked about the accessibility and nature of the biodiversity information. With hindsight it was realised that responses on these details would have been useful even if the sources were not listed in guidance on EIA's etc. Efforts were made to overcome this problem after questionnaires had been returned. For the 8 countries able to respond to detailed queries on biodiversity information the picture is given in table 3.5 below.

Table 3.5. The availability & nature of biodiversity information in the eight countries that responded to queries on biodiversity information.

	Yes	No
Accessible to all	**7**	**1**
Accessible via the internet	**8**	**0**
Fragmented	**7**	**1**
Payment needed	**5**	**2**
List of protected areas	**8**	**0**
List of protected species	**8**	**0**
Species population/habitat extent	**6**	**2**
Baseline plus trend data	**4**	**4**

Portugal commented that generally biodiversity information is very limited and sometimes of poor quality. Greece observed that "conservation of biodiversity is constantly mentioned but without species or habitat references." In England where the volume of biological records is very large, much still in paper form only, baseline and trend information is not easily available except in the case of birds, where the British Trust for `Ornithology has maintained a number of national surveys over several decades. In so far as comments were made on the question of fees they were to the effect that simple information is generally available without charge but more complicated requests attract fees.

3.1.13. Biodiversity websites

Partners were asked to name up to 4 websites where important biodiversity information for EIA/SEA/LUP could be found and to indicate if the websites were national, regional or specialised such as taxon specific or run by NGO's or private bodies. Table 3.6 shows the number and type of website by country, noting that individual websites could be of more than one type. The lists were not meant to be exhaustive, so that if the number listed is less than 4 it does not follow that no more websites could have been listed.

Table 3.6. The number and type of biodiversity information websites in the eight countries responding.

	National	Regional	Specialist	Total
UK	3	3	1	3
Turkey	5	-	-	5
Romania	4	1	-	5
Portugal	1	-	1	2
Poland	2	1	1	4
Hungary	3	-	1	4
Estonia	1	-	-	1
Greece	2	-	2*	4
Slovenia	3	-	1	4
Total	**24**	**5**	**6**	**32**

* one of these was run by an NGO and the other by a private entity.

Finally in this section partners were asked if they were aware of any research in their country on EIA/SEA/LUP relevant to the use of biodiversity information and, if so, to provide a reference. A positive answer was given in respect of 4 countries (Turkey, Romania, Portugal and Greece) but the titles cited did not refer specifically to biodiversity and may be general overviews, suggesting that the question was not clearly expressed. The Commission's 2003 EIA progress report (EC 2003) devotes less than 2 pages out of 100 to impacts on biodiversity and it has not proved possible to find the one research report on biodiversity mentioned there.

3.1.14. Biodiversity Action Plans (BAP's)

Partners were asked to provide information about the availability of Biodiversity Action Plans at national and lower levels, who prepares them and whether they apply to species, habitats or both. All countries have Plans in operation or, in the case of Greece, in preparation. All Plans cover both species and habitats except those for Portugal and Slovenia which cover species only (figure 3.7).
Among partner countries, only the UK has what might be termed a super-abundance of BAP's. There is an overall UK Plan, plans for England, Scotland, Wales and Northern Ireland and some 160 plans for areas related to lower governance levels, often for counties in England or boroughs in urban areas. Under the UK and individual 'country' Plans there are several hundred species plans and rather fewer habitat plans. Within the lower level area plans there are typically a considerable number of action plans for individual species and habitats which help to support the 'country' and UK Plans. Most of these have targets and therefore rely on data collection for monitoring progress towards the targets. No country, apart from the UK, has BAP's at levels below the national. After the UK comes Hungary with 43 plans, all at national level. Portugal has more than 10.

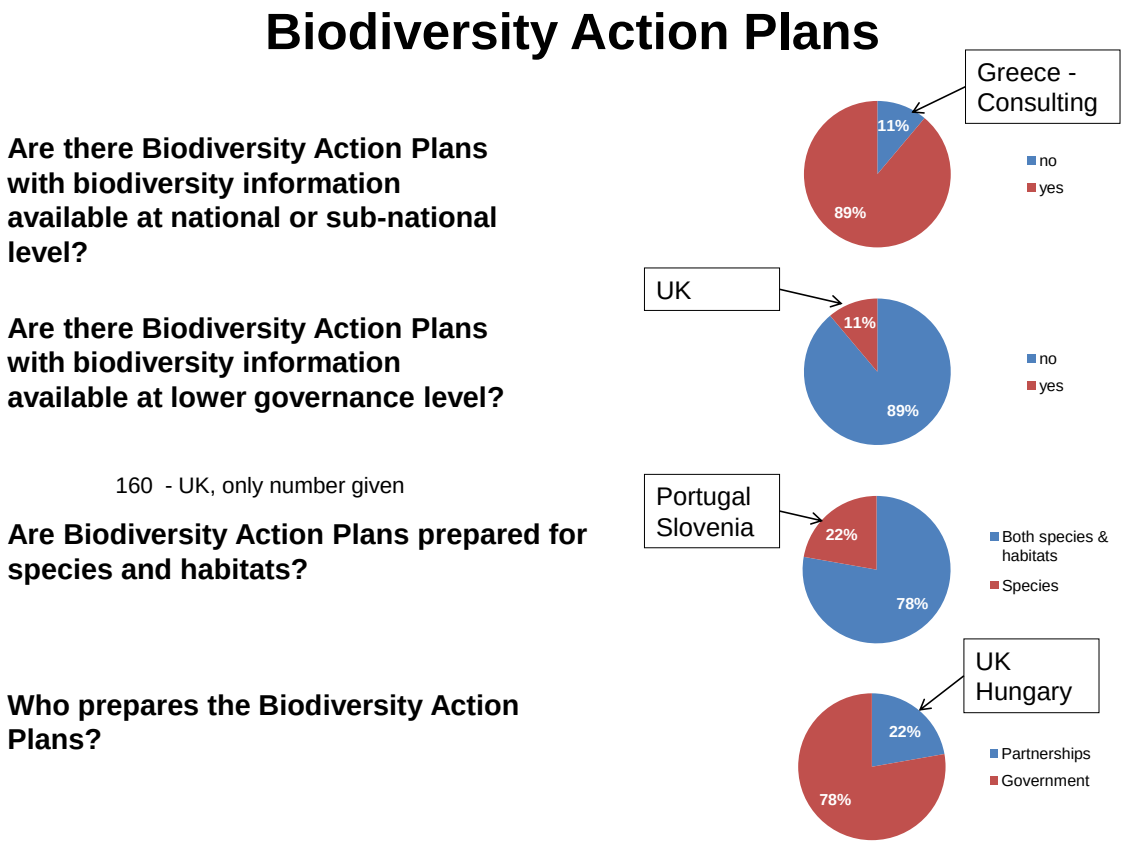

Figure 3.7. Information provided on the availability of Biodiversity Action Plans, whether they apply to species, habitats or both and who prepares them.

Governments prepare BAP's in 7 of the 9 countries (figure 3.7), the exceptions being Hungary and the UK where they are prepared by partnerships. The latter involves NGO's and the academic sector in Hungary. These sectors plus local government and relevant commercial interests are involved in the UK. In Greece, where a draft National Strategy for Biodiversity has only recently been issued for public consultation, the Government takes the lead in preparing the plan but with some assistance from the academic world.

3.1.15. Common Agricultural Policy (CAP) and environmental information

Turning to the CAP, respondents were asked whether to receive basic payments under the CAP farmers are required to provide prior environmental information from an independent source. In Estonia such information is required to establish cross-compliance but in all 8 other countries there is no call for prior independent information (figure 3.8). However in 8 of the countries there is subsequent independent checking by designated agencies, Turkey being the exception. In 3 cases the agencies appeared to have an environmental remit but in the other 5 the checking organisation was the agricultural payments agency. In England detailed environmental information (as opposed to ticking boxes) is not needed for the first level agri-environment scheme, called "Entry Level Stewardship" but it is required for the second "Higher Level Stewardship".

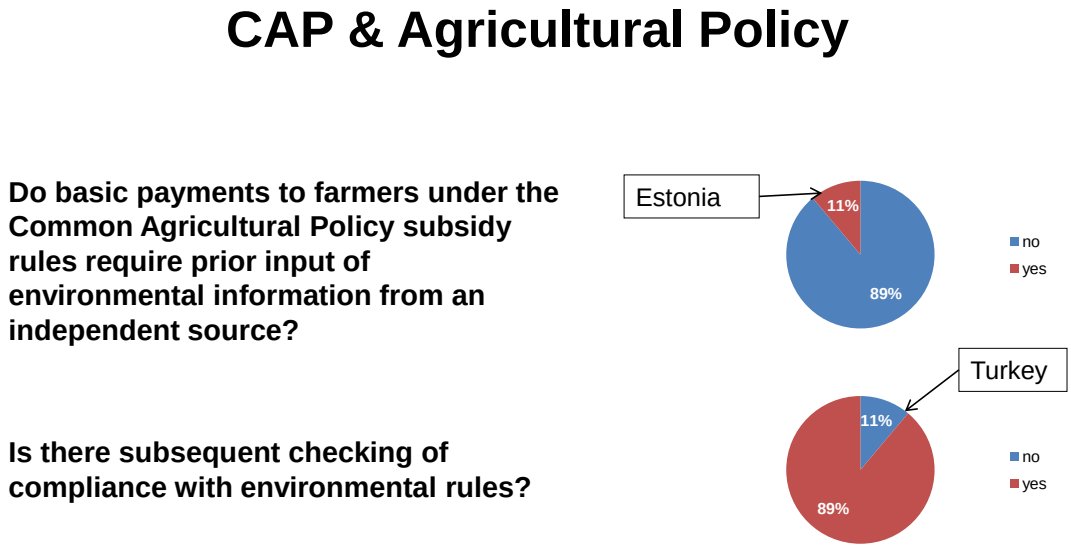

Figure 3.8. Agricultural policy and the environment.

Partners were asked about the existence of payments to farmers for planning agri-environment schemes. Initial responses for 3 countries were positive (England, Turkey and Romania) with the remainder being negative, but the responses for England and Romania were later modified to join the "no" responses. With hindsight it is clear that this question was not carefully worded nor well-related to a subsequent more detailed question about the existence and scope of agri-environment schemes in partners' countries. In fact all countries studied, except Greece, have agri-environment schemes. There is no scope for CAP funding for the planning of these schemes and it seems unlikely, though not impossible, that countries fund individual farmers' agri-environment planning activities out of their own funds without joint-financing from the EU. What does occur is the use of EU structural funds for workshops and general training on such matters. The position in England is that the taxpayer does not fund the planning and application process for such schemes. It is interesting to note that an environmental charity, Farming and Wildlife Advisory Group (FWAG), charges £400 (€452) per day for advising farmers on the schemes available and helping them to prepare applications related to conditions on their farms (see www.fwag.org.uk).

Respondents were asked if in their countries there was still support via government or EU funding for the planting of specific crops or to improve productivity generally. England, Estonia and Greece said there was not, with the other 6 countries saying there was. The position as expressed on the DG Agriculture website is that the 2003

reforms, implemented from 2005, have in principle, with minor exceptions for remote areas and the Aegean Islands, ended the system of direct payments for individual crops but in certain circumstances existing payments of this kind can be continued until 2012 subject to cross-compliance and to “degressivity” (reducing subsidies by increasing percentages annually). In practice a greater proportion of the CAP funds is still going into production subsidies (Pillar 1 – products and markets) than into single farm payments under cross-compliance or agri-environment schemes (Pillar 2 – rural development). In addition Portugal commented that in a number of Mediterranean countries expenditure on infrastructure such as dams to help increase agricultural production is being funded from other EU sources such as the cohesion and structure funds.

It was then asked if countries had payments above the basic level for agri-environment schemes and, if so, whether these were restricted to (i) Natura 2000 sites, (ii) Natura 2000 and other special habitats or (ii) everywhere provided special conditions are met. All countries except Turkey and Greece reported having such payments. In England, Poland and Hungary they were reported as being available everywhere, in Portugal, Slovenia, Estonia and Romania (from 2010) as available in Natura 2000 and other special sites (figure 3.9). In Portugal payments are conditional on farmers complying with obligations designed at the national level or at the level of special landscape units, usually Natura 2000 sites, and there are no agri-environment schemes tailored to the level of individual farms.

Agri-environment schemes – where available?

Do countries have payments beyond the basic level for agri-environmental schemes?

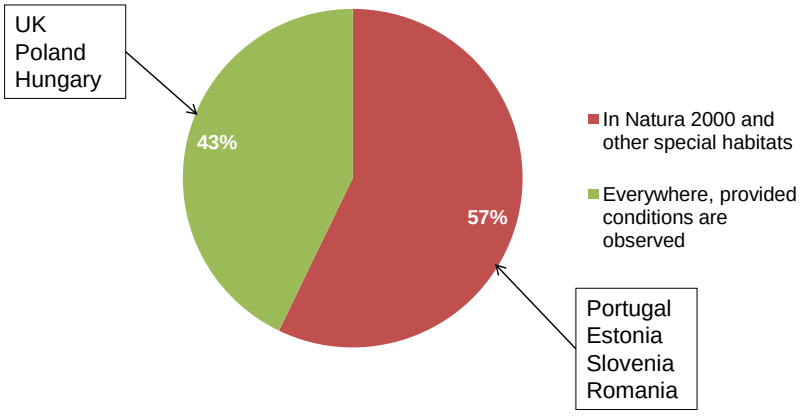

Figure 3.9. What countries have agri-environment schemes beyond the basic level?

Finally the question was whether farmers were required to provide maps to claim CAP payments and whether these could be submitted electronically. The response was that maps are required in 7 countries but not in Greece or Turkey, while they cannot be submitted electronically in Romania or Poland.

3.5. Some preliminary conclusions

Following are some conclusions relevant to the TESS project as it develops based mostly on the information from the National Level Enquiry in 8 countries, but to some extent on information in the Commission's reviews of EIA and SEA and other literature. Whether the comprehensive survey of all 27 EU member states and 4 other countries in Europe will support these conclusions remains to be seen.

- EU EIA & SEA Directives and national LUP laws are generally sound in theory
- They require input of biodiversity information where relevant
- They encourage public involvement and transparency
- But formal processes are often daunting, resulting in dominance by "experts"
- The wide variation in numbers of EIA's annually by country has not been explained – it must affect the quality of assessment & monitoring
- There is no obligation or governments or anyone else to ensure the availability or quality of environmental data need for EIA,SEA or LUP, , although the INSPIRE Directive (2007 EC) is a major effort to fill this gap at European Union level.
- Where EIA's and SEA's have assembled data, including biodiversity data, there is no obligation on member states to store and make this available for wider environmental monitoring by organisations such as the European Environment Agency or nationally
- There is plenty of biodiversity data on the internet but the geographical coverage and quality are generally poor for decision making
- Main contents are lists of endangered species and habitats
- There is an absence of policy responsibility for making it fit for use
- BAP's are useful tools where they exist but the absence of regional or local Plan's in most countries limits their relevance for decision support
- CAP is only at the beginning of using environmental and biodiversity information at farm level
- We need a better idea by country of the extent of land still farmed under production subsidies compared with land under single farm payments and more specialised agri-environment schemes
- Generally there is a lack of integration between biodiversity information providers and the decision making regimes we have been studying.

3.6 References

Please refer to section 4.11

4. Local environmental information in biodiversity management decision-making

4.1. Introduction and Aims

TESS Work Package 3 (WP3) was designed to gather information at the local level, in rural areas, to complement the information collected concerning the national level in TESS WP2. A local enquiry gathered data from 9 case study areas, in 8 countries, to characterise the use of information on biodiversity and ecosystem services in the environmental decision making process. Conducting the survey across the TESS partner countries allowed the consortium to research local requirements across a range of governance systems and bioregions in EU and accession states.

At the local level, the decisions include formal processes like SEA and EIA, as in WP2, but also local planning applications, and the myriad informal decisions made by communities and individuals that are small-scale individually, but summate to change the environment.

The enquiry at local level therefore considered (i) local administrations involved in formal assessment and planning decisions, including participatory processes, and informal decisions for managing public land or guiding community actions; and (ii) informal decisions by local stakeholders.

The enquiry addresses the following questions relating to the flow of information on biodiversity and ecosystem services at the local level:

- What are the information needs?
- What determines the information needs?
- What information is used?
- What information is needed but currently unobtainable?
- What are the barriers to obtaining information?

Analysis of the survey data will address these questions across the sample of countries. It will also provide preliminary insights into the potential for analysis of the relationships between the utilization of such information, and key differences between the case study areas. Such differences might include their environmental governance, the nature and extent of community participation, land-use, and status in terms of biodiversity conservation. These insights, and accompanying critique of the survey methods, will be used to plan and develop the following work packages of this project.

4.2. Environmental decision-making at the local level

The WP3 aims included identifying local environmental information needs. To do this, the survey needed to determine who was making local decisions, the key issues that concerned them, and the nature of their *perceived* information needs.

4.2.1. Who requires information?

Across the study areas, a great range of organisations and individuals were identified who would be involved in either making decisions about the environment due to their role as land managers or who would seek input to environmental decisions (table 4.1). The six stakeholder groups identified for the structured interviews (see Methods) provide a good representation across the range identified here.

Table 4.1. Categories of decision makers defines in the TESS case study areas – combined for all areas.

LAND MANAGERS			
Private	**Public**	**Community**	**NGO**
Farmers, Foresters, Horticulturalists, Extractive Industry, Sport fishery /Anglers Hunters Aquaculture Tourism Recreation	Government -all levels Government agencies: environment, nature, water, sustainability, heritage, agriculture and rural affairs National parks Forestry Research institute	Local associations: farming, fisheries, hunting, Local partnerships- e.g. for nature and heritage conservation Village boards and partnerships	Nature conservation Wildlife Ornithology Heritage Hunting
INTEREST GROUPS			
Commercial	**Environmental groups**	**Recreational groups**	**Community groups**
Tourism including ecotourism & agrotourism Extractive industries	Wildlife and nature conservation Green movement Ornithology	Tourism Recreation Access to land Outdoor sports (e.g. cycling, canoeing, skiing, horse-riding) Gardening	Residents association Women's groups Farming / forestry / angling and hunting associations Local heritage association Volunteer fire fighters

4.2.2. What activities occurred in the case studies that might require environmental information?

Within the structured interviews a range of questions were asked to determine levels of engagement with environmental management, and particularly, nature conservation. Both Tiers of government had responsibility for the management of some aspect of the environment. When questioned in detail, fewer engaged specifically in conservation management and protection of wild species/habitats and even fewer in restoration of species/habitats. Notably a higher number of Tier 2 local authorities engaged in environmental restoration and protection (figure 4.1).

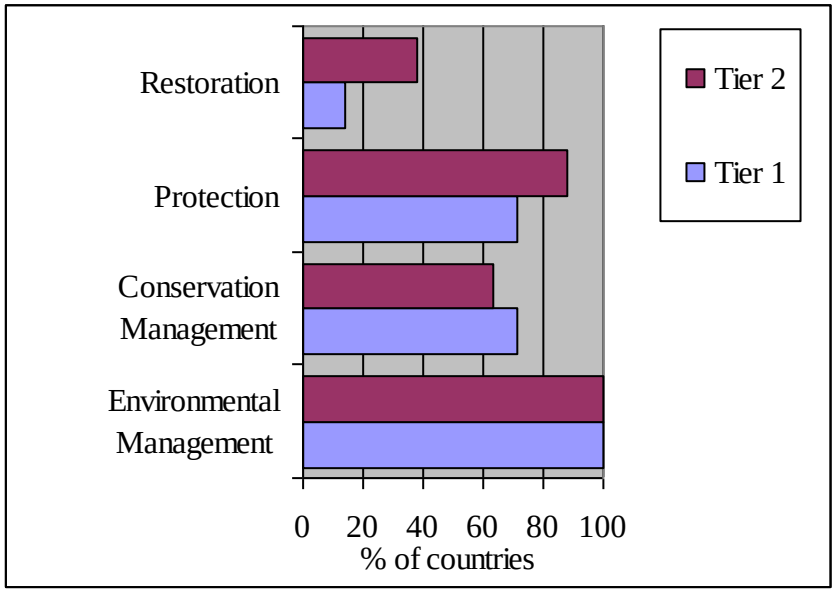

Figure 4.1. Proportion of local government representatives who perceive their tier of local government to be responsible for different aspects of environmental management.

Collectively, 75% of the individual stakeholders stated that they had responsibility for some form of environmental management. This proportion was lower for conservation management and protection of wild species (44%) and for restoration of wild species and habitats (30%). This reflects the general pattern shown by Tier 1 of Local Government. Forestry, hunting and nature conservation showed most engagement in all categories. A perceived responsibility for nature conservation management was recorded for fewer than half of the case studies for the stakeholder categories access, fishing (angling) and farming (figure 4.2).

Interpretation of the results may be aided by noting that the Nature Watching and Reserves category of stakeholders combined groups with considerably different needs. It may have been helpful to consider nature reserves separately for a clearer analysis. In this case, it is unlikely that the nature reserves category would have lower than 100% responsibility for conservation management, there might however, be differences in engagement with protection and restoration work.

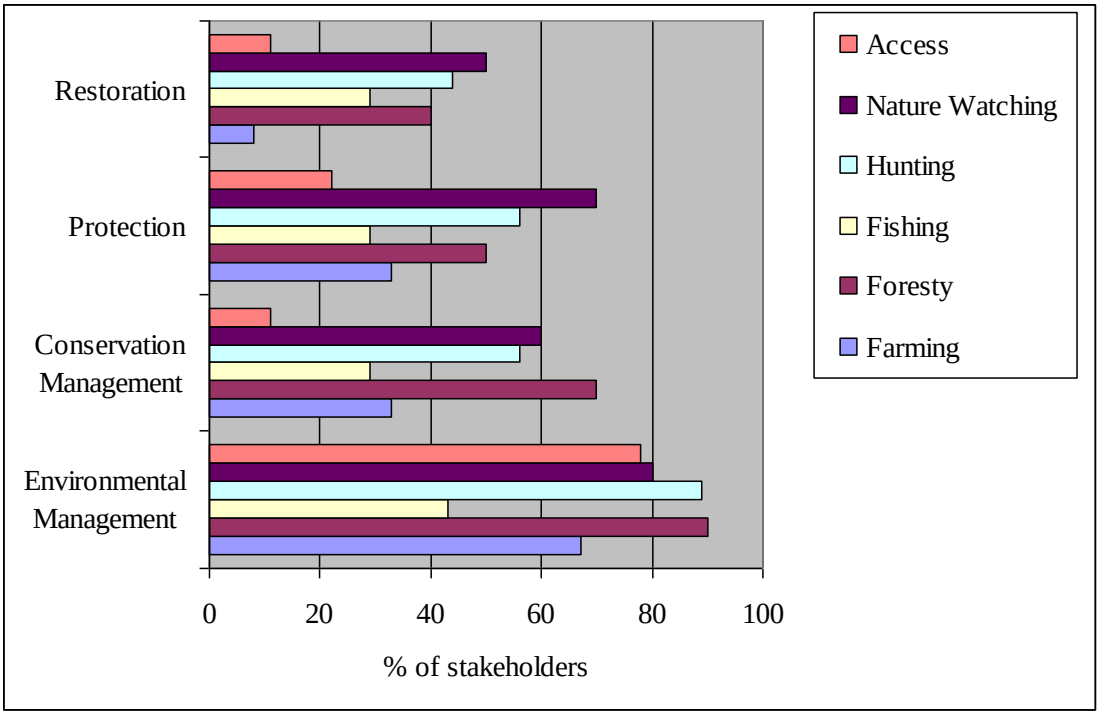

Figure 4.2. Proportion of individual stakeholders that stated responsibility for different aspects of environmental management.

Estimates of the numbers of environmental decisions made by interviewees and the organisations they represented varied considerably. This needs to be interpreted with caution, as although the interviewer would aim for consistency, there may be differences in the ways in which the decisions are estimated. For instance, there may be different definitions of what constitutes a single decision. Despite this caveat, it is clear that there were considerable differences between countries with some reporting zero or 1 decision and others very many, with median values between 6 and 33 per year. With regard to formal and informal decisions, a broad range of responses were found across both Tiers although one may discern a higher propensity for 'informal' decisions at Tier 1 level and a higher number of 'formal' decisions at Tier 2 level (Table 4.2).

Table 4.2. Estimated numbers of decisions on environmental matters made annually by local government and other stakeholders in the partner countries.

	Formal planning decisions			**Informal decisions**		
	Min	Max	Median	Min	Max	Median
Tier 1	0	50	10	0	300	16
Tier2	1	700	33	0	50	8
Stakeholders	n/a	n/a	n/a	0	365	10

The number of decisions made by the interviewees is likely to be affected by the characteristics of the area that they manage, including the total area. The area managed varied considerably from a minimum of 8 ha to a maximum of 42,000 ha. When the number of decisions is considered in the context of area, relative number of decisions made by farmers is by far the highest of any of the groups studied (figure 4.3). This also should be interpreted with caution due to the many possible interpretations of a decision. All decisions will not have equal importance and it may well be that a single decision made by a stakeholder managing a large area may have far greater consequence than a large number of minor daily decisions.

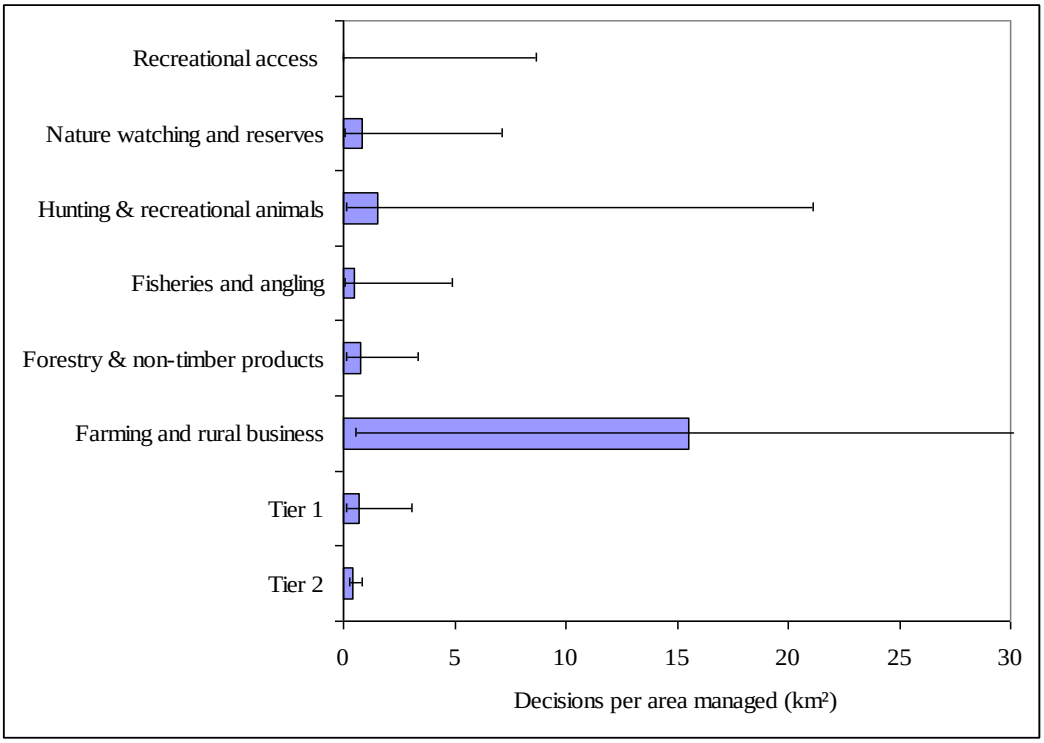

Figure 4.3. The number of decisions that affect the environment made per area managed for each stakeholder category and tier of local government.

Interviewees were asked, when making formal and informal decisions, what percentage of time is spent on consideration of the environment, society, jobs, costs and other matters. Tier 2 Authorities spent a higher percentage of time considering environmental matters whilst Tier 1 Authorities' considerations were dominated by societal issues. The greatest proportion of time, for the individual stakeholders, is spent on economic considerations (figure 4.4).

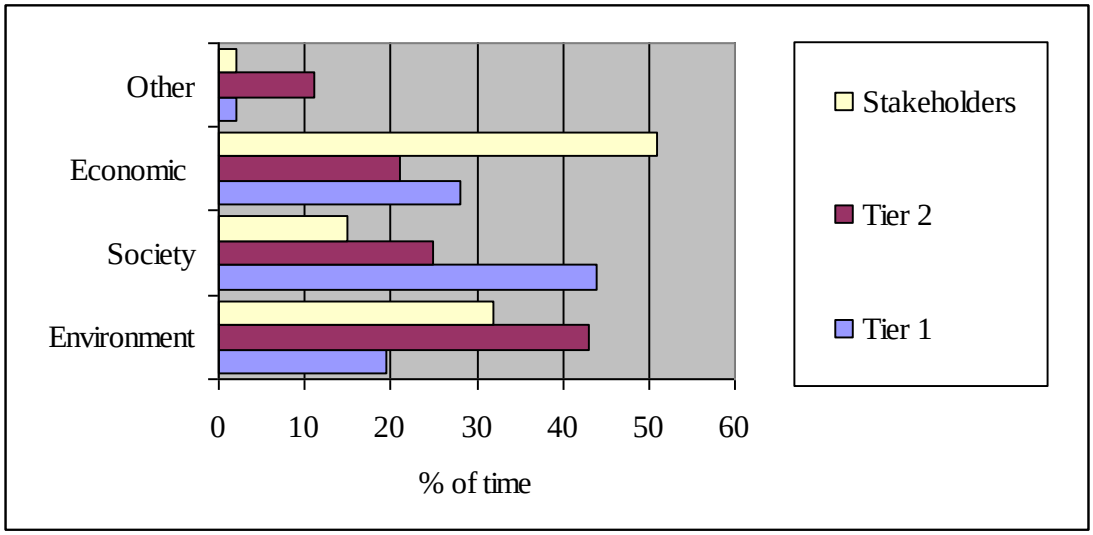

Figure 4.4. Proportion of time estimated by interviewees to be spent on environmental, social and economic considerations.

4.2.3 Engagement with statutory requirements for impact assessment

Tier 2 governments in the case studies indicted a higher propensity to engage with the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) processes (figure 4.5), much as would be expected, since these are statutory requirements requiring a degree of professional expertise and staffing not commonly employed at the very 'local' level of government.

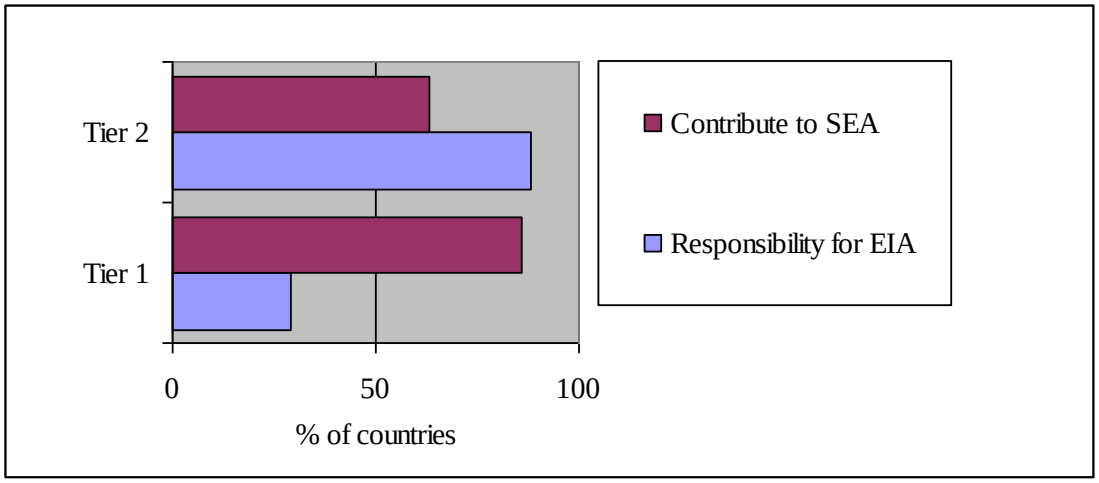

Figure 4.5. Proportion of local government interviewees who responded that their authorities were responsible for EIA and engaged with SEA.

4.2.4 What are the key issues in environmental decision-making?

In the structured interviews, respondents identified key issues for which environmental information would be needed to enhance decision-making capacity. These issues were clearly influenced by the natural and cultural environment of each case study, and typical examples included impacts of extractive industry, flood risk, water quality, water supply and tourism / recreation impacts. The issues could be categorised in a number of ways.

For the TESS project it was particularly pertinent to group the issues by subject categories that are compatible with *categories of predictive models* suitable for integration into the TESS decision support system design. This categorisation, used also in WP4, was based on increasing complexity from a basis of air, water and soil through associated fauna and flora, which combined in ecosystems and then added human social and economic categories. This categorisation indicated that the highest proportion of issues identified by both tiers of government were socio-environmental issues. This may somewhat reflect the greater breadth of this category in relation to the others. However, it does show that the interviewees framed their issues in a sense that acknowledged links between natural and cultural systems (figure 4.6).

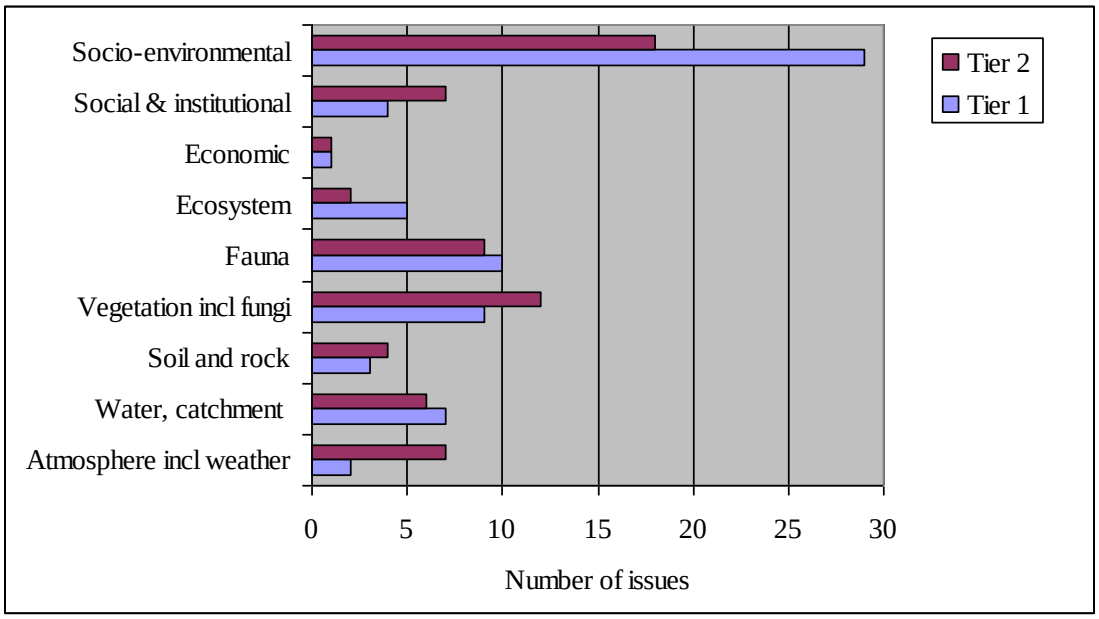

Figure 4.6. Environmental issues identified by representatives of local government in the partner countries sorted into subject categories compatible with categories of environmental models used to analyse and predict the impacts of decisions in TESS WP4. Each issue could be assigned to more than one category.

The issues identified by interviewees were also categorised into subject areas that relate to the provision of ecosystem services and environmental hazards. There were very strong differences in the number of issues in the different categories, with physical hazards rating by far the highest for the most local tier of government reflecting the need to respond to immediate needs of the local population. These hazards include flood or drought risk as well as water, air and noise pollution. Similarly the Tier 1 administrations showed a concern for amenity areas not reflected so strongly by the next tier of government. Biodiversity conservation issues and tourism / access were frequently listed as important issues by both tiers of government but heritage conservation, surprisingly, was not listed. Issues relating to the provision of ecosystem services (e.g. forestry, fishing) were also rarely reported by government, perhaps because seen as commercial concerns (figure 4.7).

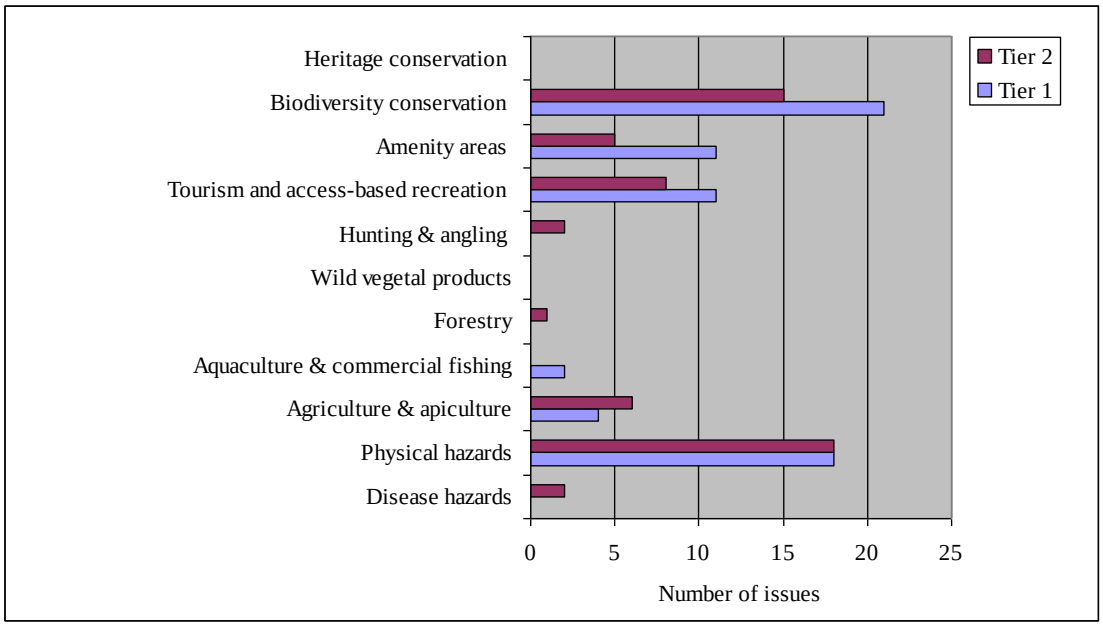

Figure 4.7. Environmental issues identified by representatives of local government in the partner countries sorted into subject categories relating to the provision of ecosystem services and environmental hazards. Each issue could be assigned to more than one category.

4.3. Participatory approach and community engagement

The nature and extent of community participation varied between countries, although the majority of local government respondents purported to engage to some degree with individuals, enterprises, NGOs and government agencies. Interviewees were asked to state the way in which they engaged in consultation and the participatory process with a choice of responses of never, occasionally, often, usually, always, and mandatory. This enabled a comparison to be made between the perceptions of the local governments and the individual stakeholders regarding the efficacy of this process.

The data were summarised using an index to represent each action (e.g. consultation, participation) for each data set.

Index = $\sum$ responses x weight,

Where weight = Never = 0, Sometimes = 1, Usually = 2, Often = 3, Always = 4 and Mandatory = 4[1])

At the lowest level of government (Tier 1) the highest response rate across case studies was 'usually', although two countries reported that they 'never' engaged in consultations and actions for participation with private individuals and enterprises. At the second level of government (Tier 2), three countries stated that consultation and participation were 'mandatory' and none claimed 'never' to consult or engage the community. This pattern of responses would suggest that there might be a greater commitment or compulsion in Tier 2 levels of government to embrace a participatory approach with individuals and enterprises (figure 4.8).

[1] NB. 'Always' and 'Mandatory' received the same score to avoid bias of a higher index to the local governance. The mandatory option was not available as a response on the 'individual stakeholders' survey forms.

In contrast, the highest response rate across all individual stakeholders to the same questions was 'occasionally' or 'never' thus representing a mis-match between the responses of local government and perceptions of the stakeholders. This pattern varied somewhat between groups of stakeholders with fisheries/angling and farming interests appearing particularly excluded (figure 4.8).
This raises the question of the efficacy of the participatory processes used by local government, although it should be recognised that when consultees are dissatisfied with decisions or policy outcomes, the perception is often that the consultation process is flawed and their views have not been taken into account. Also, local governments may have a perception of regular consultation based on their outreach activities across many stakeholder groups; however, each individual may perceive this as much less regular.

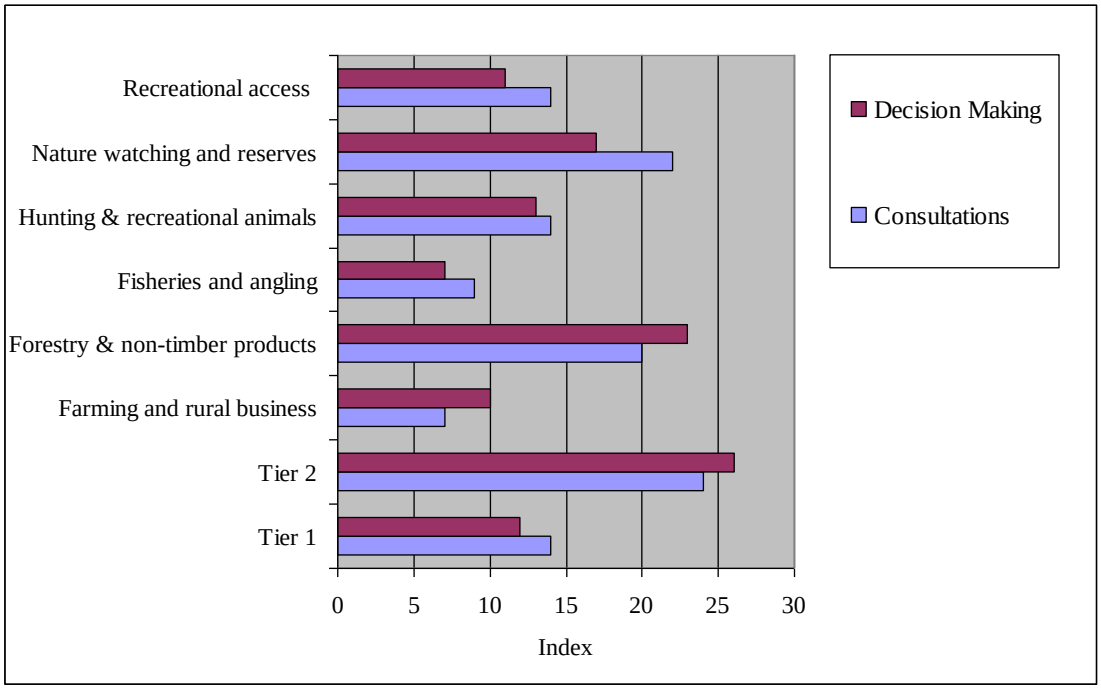

Figure 4.8. Perceptions on whether consultations are held and whether positive actions are taken to enable participation on environmental issues, using an index based on the individual responses where a high value indicates high participation. Responses are collated across case studies for representatives of local government (Tier 1 and Tier 2) and individual stakeholders.

The pattern of consultation fitted quite strongly (P = 0.02) with the proportion of respondents that were private, as opposed to public bodies, NGOs or non-profit organisations, in each stakeholder category. Although the samples of 6-10 stakeholders in only 6 categories is small, it seems that consultation tends to be least when the stakeholders are predominantly in the private sector (figure 4.9).

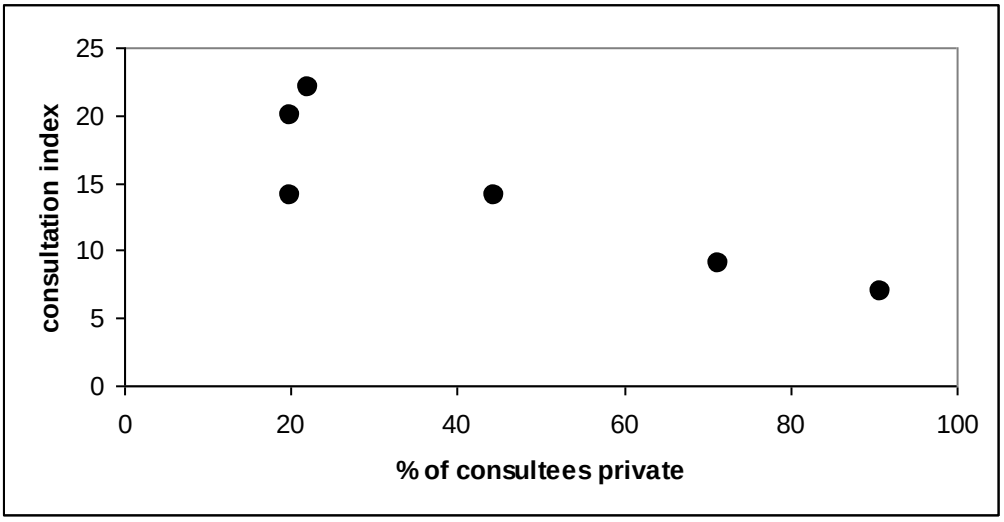

Figure 4.9. There was least consultation by administrations with stakeholder categories that were predominantly private.

Examination of the engagement of local governments and individual stakeholders with government conservation agencies and conservation NGOs was addressed using a similar set of response options and summary index (Never = 0, Sometimes =1 etc.) (figure 4.10). For areas designated for nature conservation, government conservation agencies were thought to be consulted to some degree by all countries, at both levels of local government. However, these responses showed a considerable range across the 9 case studies. For instance, consultation by Tier 2 government with government agencies was a mandatory requirement in 3 cases, but only occasionally conducted in another 4 cases. The responses for consultation requirements in non-designated areas were also diverse. All groups of individual stakeholders engaged to some degree with the government conservation agencies and conservation NGOs but this varied between groups, with Nature Watching/ Reserves and Forestry respondents showing greater likelihood of consultation (figure 4.10).

Engagement with conservation NGOs, was perceived to be less frequent than with government agencies across all groups of interviewees including local governments and individual stakeholders (figure 4.10). Engagement with these NGOs was most frequently perceived as “occasional” by all groups of stakeholders. Notably, 30% of the individual stakeholders said they ‘never’ engage with conservation NGOs in non-designated areas and 38% purported to ‘never’ engage with them in designated areas.

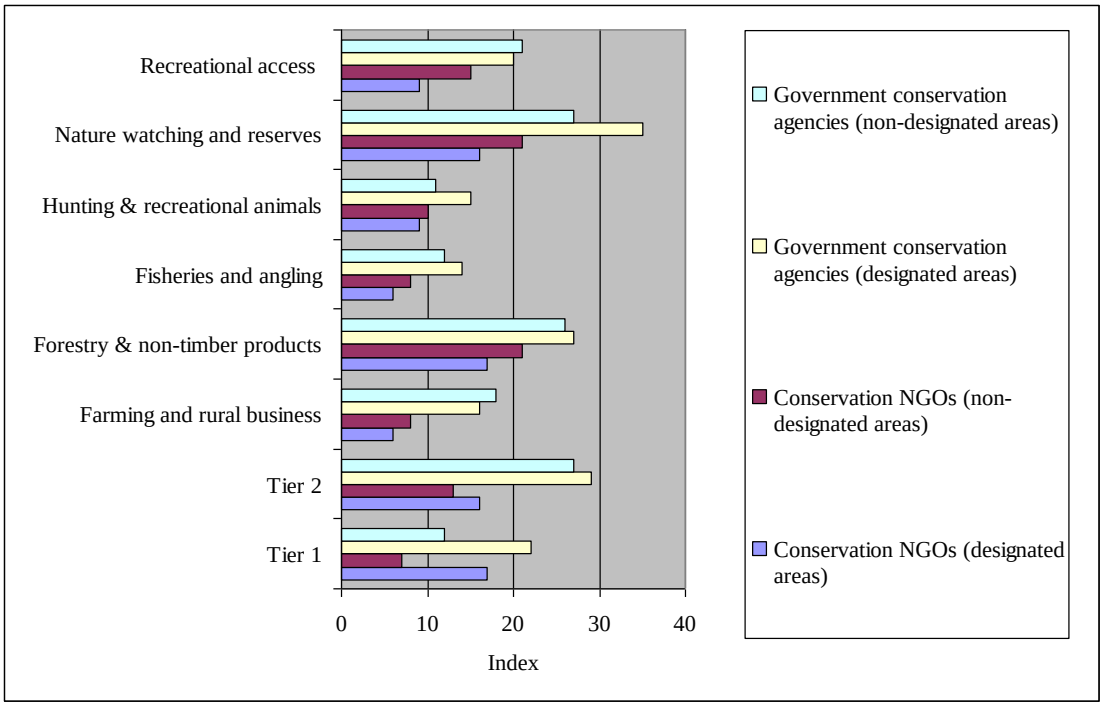

Figure 4.10. The degree to which local government representatives and individual stakeholders engage with conservation agencies and NGOs, using an index based on the individual responses where a high value indicates high participation. Responses are collated across case studies for representatives of local government (Tier 1 and Tier 2) and individual stakeholders.

When questioned on whether government agencies, conservation NGOs or pressure groups were able to exert *greater* influence on environmental decisions in relation to their own influence, a contrast was evident between local governments and the individual stakeholders (figure 4.11). Local governments, at both tiers, perceived that government agencies exerted some influence, NGOs were thought to have less (generally occasional) influence and pressure groups were rarely perceived as being influential. In contrast, stakeholders affirmed the influence of government agencies but indicated that they also considered pressure groups to be influential (figure 4.11). Interestingly, the individual stakeholders, in general, indicated that the influence of the various groups over environmental decisions was more significant than was reported by the local government respondents (figure 4.11). This probably reflects a feeling of exclusion from participation in decision-making experienced by some individual stakeholders.

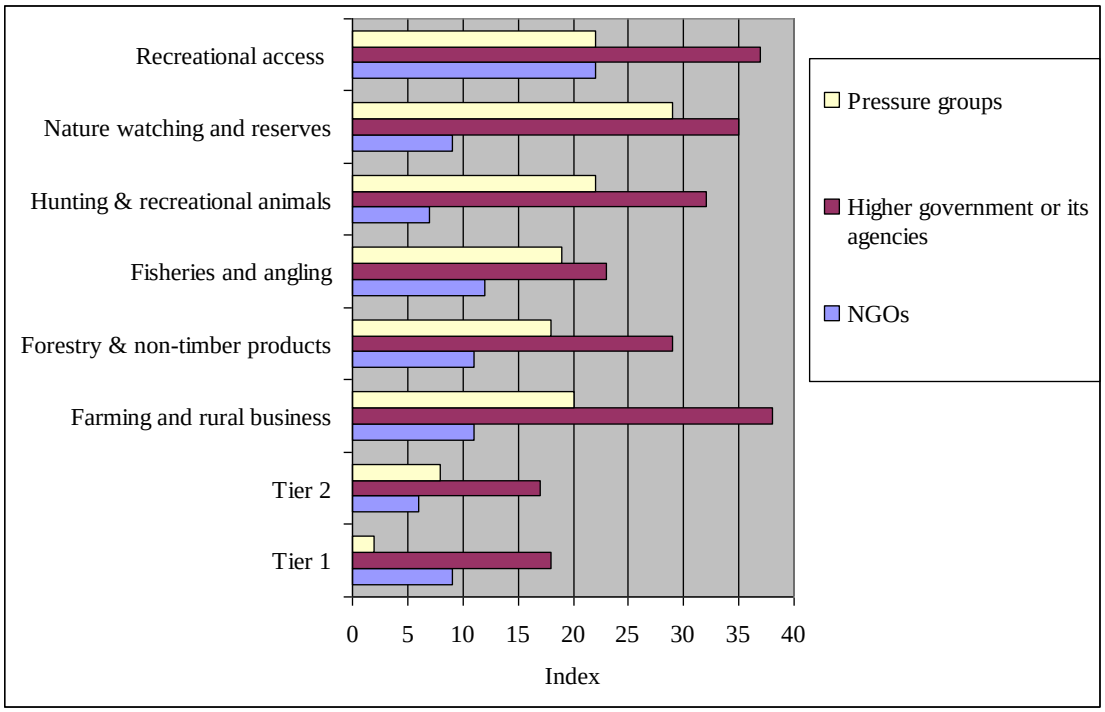

Figure 4.11. Degrees of influence by other groups (pressure groups, higher government and its agencies and NGOs) on local environmental decisions, using an index based on individual responses, where a high value indicates high participation. Responses are collated across case studies for individual stakeholders and representatives of local government (Tier 1 and Tier 2).

4.4. Information sources for environmental decision-making

For each partner country, the TESS survey examined the information sources that are available for environmental decision-making (table 4.3), and then used the structured interviews to determine the information that was used by the different societal sectors to approach a variety of local issues that were identified by the interviewees.
There were major differences in information provision between the partner countries at the national, regional and local levels (table 4.3). While national and regional databases of biodiversity and other environmental information are available in some partner countries (e.g. Portugal, UK), in others, the data were more fragmented in nature. Where national databases were available some limitations to their use may result from scale issues, such as aggregation to a scale too coarse for many purposes. Some data may be held by various government organisations and agencies but may not be available in databases that are accessible to all potential users. There are often partnerships between governmental ministries, agencies, and NGOs to develop environmental databases (e.g. Biodiversity Action Plans).

At the local level, many partner countries reported poor data availability, with uncoordinated data collection by disparate groups, resulting in a lack of compatibility and interoperability. Some data were subject to restricted access due to commercial restrictions or because it was not available in electronic format. Data in all countries originated from many local sources, including private commercial companies, NGOs and unofficial records kept by individuals. From the partner countries only Portugal and the UK reported coordinated data repositories at the local level for their study areas.

Table 4.3. The main information sources available for biodiversity conservation and other related environmental decision-making identified for each TESS partner country.

	Local	**Regional**	**National**
Estonia	Local government & enterprises (voluntary or compulsory)	No facilities for collecting, storing & providing biodiversity & other environmental data.	National environmental monitoring programme
Greece	Local municipalities, management authorities, local environmental groups & communities	The Prefectures keep official records mainly on hunting, tourism & forestry (about both species & services).	No national database. Forest inspection agencies, other government agencies, local municipalities, management authorities, environmental groups & NGOs.
Hungary	Poor & scarce data on local level. Databases MEPAR /forest management database /NATURA 2000) are not compatible on local level. **Local municipalities and environmental NGOs could have fragmented information**	National Parks, regional inspectorates for environment, nature and water.	Green-Point Service of the Ministry of Environment & Water & Vegetation Heritage of Hungary. Under development: The Conservation Information System
Poland	Do not currently exist. No comparable & comprehensive databases on local level. Major mapping efforts are planned for Natura 2000 areas	No specific facilities. Research institutes & regional authorities, administration of protected areas & NGOs.	Natura 2000 network & GRID Center of UNEP. Under development: Integrated Monitoring of Natural Environment & Biodiversity Clearing House Mechanism
Portugal	Local government (local Biodiversity Action Plans/plans in urban biodiversity), local business (Business & Biodiversity initiative) & eNGOs	Regional development & coordinating commission, although the information is not organized in accessible databases.	Portuguese network of protected areas, Natura 2000 network, national conservation agency (digital library), eNGOs & environmental consultancies.
Romania	Local public institutions (representatives of environmental authorities, national research institutes) & NGOs.	Regional agencies & institutes	National government agencies & national research institutes
Turkey	Local government agencies (local directorates of ministries etc.), universities, regional governmental research institutes, & stakeholder groups (eg. farmer unions)	Universities, regional governmental research institutes (eg. Eğirdir Fisheries Research Institute), regional government agencies, regional NGOs	Universities, governmental research institutes, national databases (Turkish Statistical Institute etc.), government agencies, national NGOs
UK	Local Record Centres (LRCs)	Regional information gateways & government agencies	National Biodiversity Network Gateway, online national databases (MAGIC / MarLIN)

4.5. Types of information required for environmental decision-making

Interviewees were provided with a matrix of types of information and requested to indicate which were required. These categories could be grouped into biodiversity and habitat information and the four types of ecosystem services as defined by the Millennium Ecosystem Assessment (MA 2005) (figure 4.12). It was evident that all of these broad categories of information were required to varying degrees by all the groups of stakeholders with the two tiers of local government and the nature watching and reserves stakeholder group and the forestry group showing the greatest overall need for information.

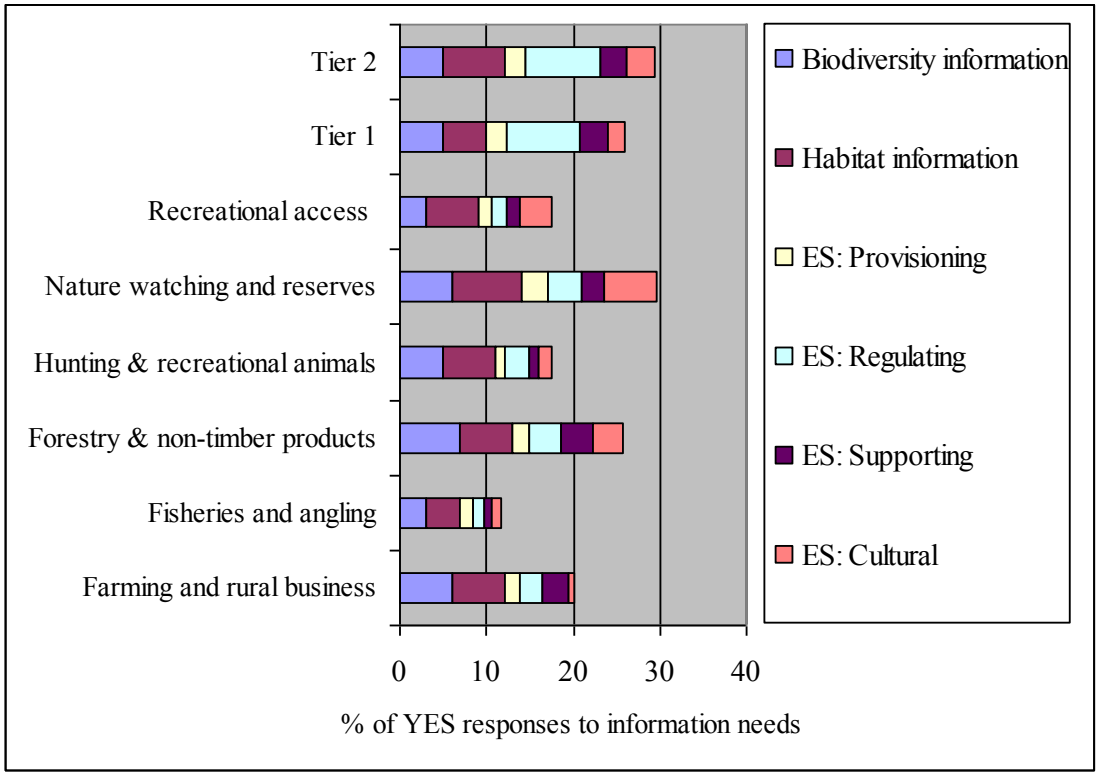

Figure 4.12. The types of environmental information needed by the different categories of stakeholders and representatives of local government (Tiers 1 and 2), categorized by biodiversity information and ecosystem services (ES). The results are combined for all case studies.

The data types within each of the broad categories varied in the level of perceived requirement. There was a frequent requirement for nationally or internationally protected species and habitat data but less for locally protected species and pests (tables 4.4 and 4.5). In terms of ecosystem services, commonly required information included that relating to water, wild meat and fish, and fibre (e.g. timber), disaster management (e.g. floods), and *capacity* for tourism and recreation. Less commonly required was information on wild plants and fungi, cultivated crops, soils and *impacts* of tourism and recreation (table 4.4 and 4.5). This is consistent with the generally greater emphasis in decision-making on social and economic than environmental factors (figure 4.4). Requirements across all data categories were higher in Tier 2 than in the most local level of government (Tier 1) (table 4.4).

Table 4.4. Categories of information selected by interviewees as required for their environmental decision-making. All interviewees including government representatives and other stakeholders are combined. Econ. = Economically.

	Data types more frequently required > 5 positive responses	Data types less frequently required < 5 positive responses
Biodiversity information	Species data (any) Protected species data (any) Nationally designated species Internationally designated species Native invasive species Non-native invasive species Habitat maps (any) Locally designated habitats Regionally designated habitats Nationally designated habitats Internationally designated habitats	Locally designated species Regionally designated species Wild pest species (agricultural) Wild pest species (health) Wild pest species (other)
Ecosystem Services: Provisioning	Econ. exploited wild species (mammals/birds) Econ. exploited wild species (fisheries) Cultivated forest products (timber, fuels) Livestock Aquaculture Air quality Water availability Water quality (and pollution)	Econ. exploited wild species (plant food/medicine) Econ. exploited wild species (plant materials) Econ. exploited wild species (fungi) Econ. exploited wild species (other, please state) Cultivated food crops
Ecosystem Services: Regulating	Flood risk / protection Fire risk / protection Risk of disease (wildlife to people) Risk of disease (wildlife to domestic animals)	Soil fertility Soil quality Soil retention (erosion risk) Pollination Pest control (e.g. predators of crop pests) Carbon storage potential
Ecosystem Services: Cultural	Amenity areas (parks, paths, verges) Tourism capacity Recreational capacity	Access Impacts of tourism Impacts of recreation

Table 4.5. The percentage of each of the categories of interviewees stating that they required specific information types with all countries combined and information categories combined / sampled* for brevity. Shaded cells show highest requirements (>60%).

		Tier 1	Tier 2	Farming	Fishing	Forestry	Hunting	Nature watching	Access
Biodiversity information	Species data (any)	71	63	50	40	75	67	80	67
	Protected species data (any)	57	75	25	40	75	56	80	67
	Locally designated species	43	38	8	10	50	22	40	33
	Regionally designated species	29	38	8	10	38	22	30	33
	Nationally designated species	29	63	17	30	63	44	60	33
	Internationally designated species	43	75	25	30	50	56	70	33
	Wild pest species (all)**	43	38	25	30	50	33	20	33
	Invasive species**	29	38	33	30	63	44	50	22
	Habitat maps (any)	71	88	50	30	88	56	60	33
	Locally designated habitats	57	63	33	10	100	44	50	33
	Regionally designated habitats	57	63	25	0	63	33	40	22
	Nationally designated habitats	43	75	17	10	63	33	70	33
	Internationally designated habitats	29	75	25	20	50	44	70	22
Ecosystem Services: Cultural *	Amenity areas (parks, paths, verges)	86	50	0	10	50	22	60	44
	Tourism capacity	86	63	0	10	63	11	70	44
	Recreational capacity	71	75	8	20	38	11	60	44
Ecosystem Services: Provisioning*	Economically exploited wild species (all)**	57	38	25	50	63	67	60	33
	Cultivated crops/ forest products **	29	38	33	10	88	33	30	11
	Livestock/Aquaculture **	71	63	25	20	25	11	30	11
Ecosystem Services: Regulating*	Flood risk / protection	100	63	25	30	50	22	70	33
	Fire risk / protection	86	75	42	20	100	44	60	33
	Risk of disease from wildlife to people	71	50	8	10	50	44	40	22
Ecosystem Services: Supporting*	Soil quality	57	63	42	0	75	22	30	22
	Soil retention (erosion risk)	57	63	25	0	75	22	20	22
	Water	71	38	8	30	38	0	40	33

** Maximum % values are cited for the group of categories (e.g. maximum of 2 categories for cultivated crops and forest products)

4.6. The determinants of information needs

The survey was designed to investigate the determinants or 'drivers' behind the information needs identified by the interviewees. For instance, local governments may have a requirement for information to inform EIA or SEA or land use planning (LUP) decisions.
The need for environmental information may be driven by a number of factors e.g.

- to comply with policy requirements
- land management
- nature conservation
- control of wild species / habitats e.g. agricultural pests or scrub encroachment

There was little difference between the groups of interviewees in their perception of the determinant of information requirements (Figure 3.13). It was interesting that all groups appeared to feel that statutory requirements and local policy requirements were important reasons behind their need for information. It may be that redesigning the survey could refine this result. Some interviewees may have given answers reflecting their perception of the reasons that would *in theory* influence data requirements without reflecting on the actual drivers behind their information needs *in practice.* Only just over 50% of the interviewees felt that nature conservation needs determined their information requirements (figure 4.13).

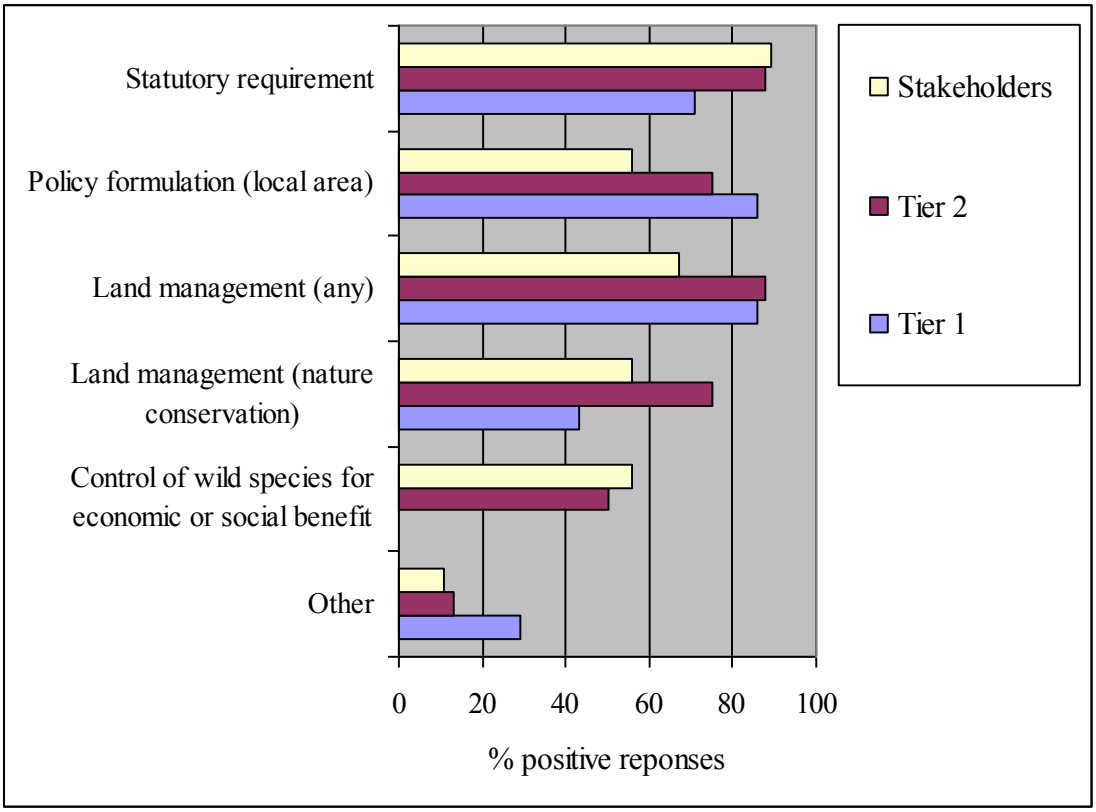

Figure 3.13 Determinants of environmental information needs with data combined for all case studies.

4.6.1. Requirement for EIA

The survey also considered to what extent local governments perceived a need for information to inform EIA. For each of the data categories (biodiversity and ecosystem services), interviewees were asked to consider whether the data they required was *also* needed for EIA. Notably, a relatively small proportion of the total required data was also required for EIA. Overall, only 23% of the required data were also required for EIA (Figure 4.14).

Biodiversity (species and habitat data) and provisioning ecosystem services data were required by many countries for EIA – however, even for these categories, more than half of the case studies responded that they were not required for EIA. Data that fell within the remaining three broad categories of ecosystem services (regulating, supporting, cultural) were rarely perceived as required for EIA (Figure 14). The low perceived need for data for this purpose is clearly related to the low degree of involvement in EIA and SEA in the Tier 1 governments. A large proportion of Tier 2 government interviewees, however, expressed a responsibility for EIA (Figure 3.5). It is therefore more surprising that many appeared to have a lower need for information for this purpose. This may be a function of interpretation. Interviewees may have assumed that they did not require the data because consultants perform the survey as assessment work. Further work would need to ensure clarification of this point to capture information needs even when these are mediated through consultants. However, administrations clearly felt a much greater need for environmental information for other purposes than for EIA.

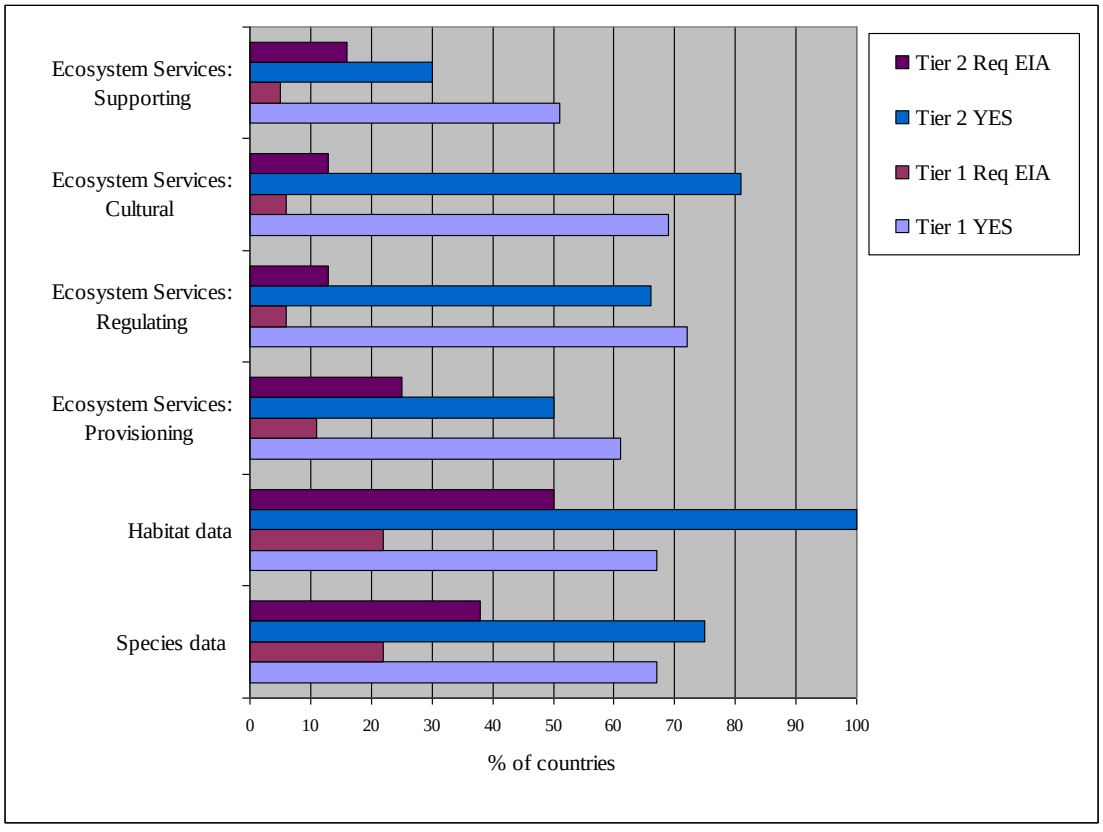

Figure 4.14. Data categories that were noted as required by interviewees for any purpose (YES) and that were felt to be necessary for Environmental Impact Assessment (Req EIA).

4.7. Information used for environmental decision making

The information sources used for addressing the environmental issues identified were categorised into sources of environmental data in order to investigate where the decision-makers were acquiring the necessary information. The main source of information for both tiers of government came from records held within the local governments themselves, closely followed by legislation and information held at the national and regional level of government. Local knowledge was used more in Tier 1 than Tier 2, who relied more upon private consultants and advisors. Government agencies and NGOs were used more by the Tier 1 administrations (figure 4.15).

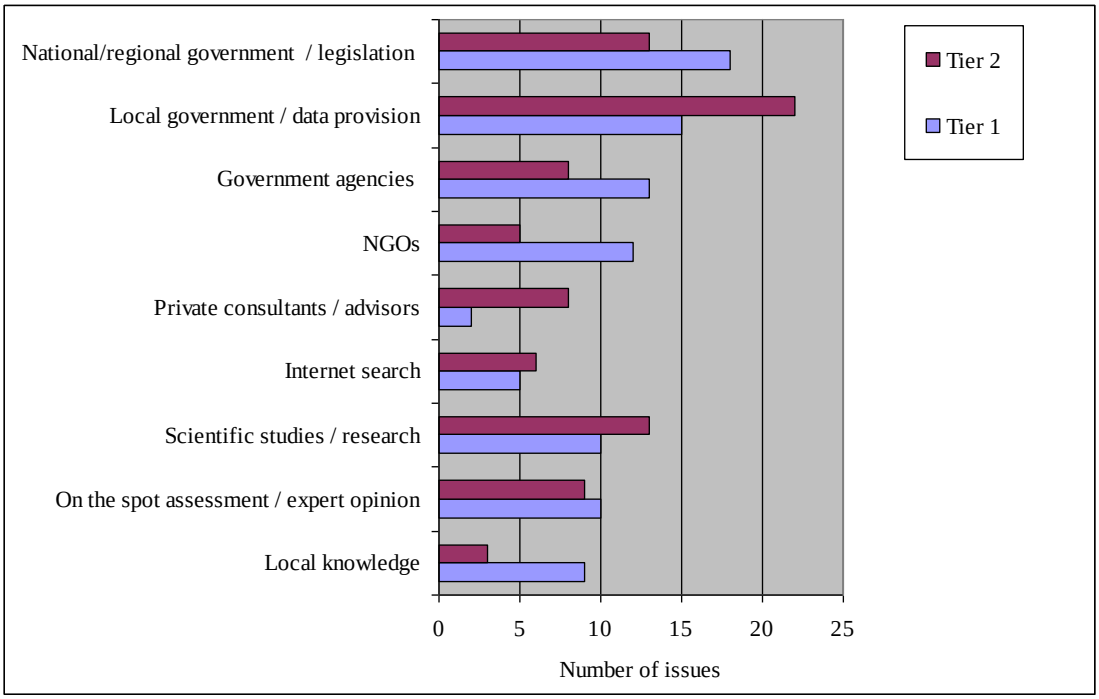

Figure 4.15. Sources of information used by representatives of local government to address the key issues that they identified for environmental decision-making. Multiple categories of information sources may have been selected for each environmental issue identified.

When comparing the use of different data sources by government representatives and individual stakeholders, it is not surprising to find that the largest proportion of respondents used the Internet to source species and other environmental data. All stakeholder categories, except Tier 1, kept their own records of species and other environmental data, ranging from 10% of respondents in the "farming and rural business" category to 100% in the "hunting and recreational animals" category.

Investigation of the characteristics of the information used in local government (Tier 1 and 2) revealed that a substantial proportion of the data used was not available in a digital format and was not regularly updated. For example, only 69% of environmental data used by Tier 1 was stored on a computer and only 63% was regularly updated. Only 23% of data used by Tier 1 and 29% of data used by Tier 2 was considered by the interviewees to be spatially referenced. Comparison between countries of local level government reveals similar patterns (figure 4.16).

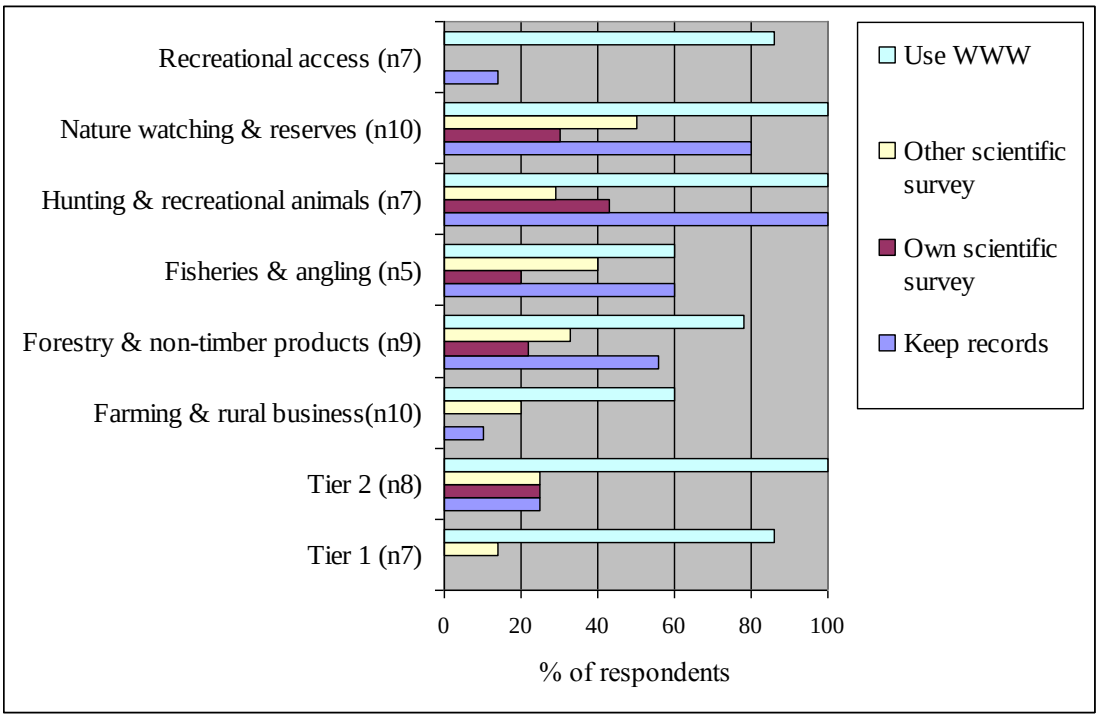

Figure 4.16. Comparative usage of different data sources. The proportion of interviewees in the government and stakeholder categories using species data or other environmental data and the source of those data.

The degree of availability of data in digital format or spatially referenced varied considerably between countries, and spatial referencing was particularly lacking in many countries (figure 4.17). The case studies with highest proportion of data available in regularly updated digital format to their Tier 1 governments were Turkey (Firtina) and Portugal. Romania, Turkey Egidir and Greece reported the same for their Tier 2 government (figure 4.17).
Although this may identify a need for data to be more accessible and available in a more user-friendly format, care should be taken in the interpretation of these results as the response rate was poor, with between many between 11% and 38% of non-responses to the questions on the accessibility of data in the interviews.

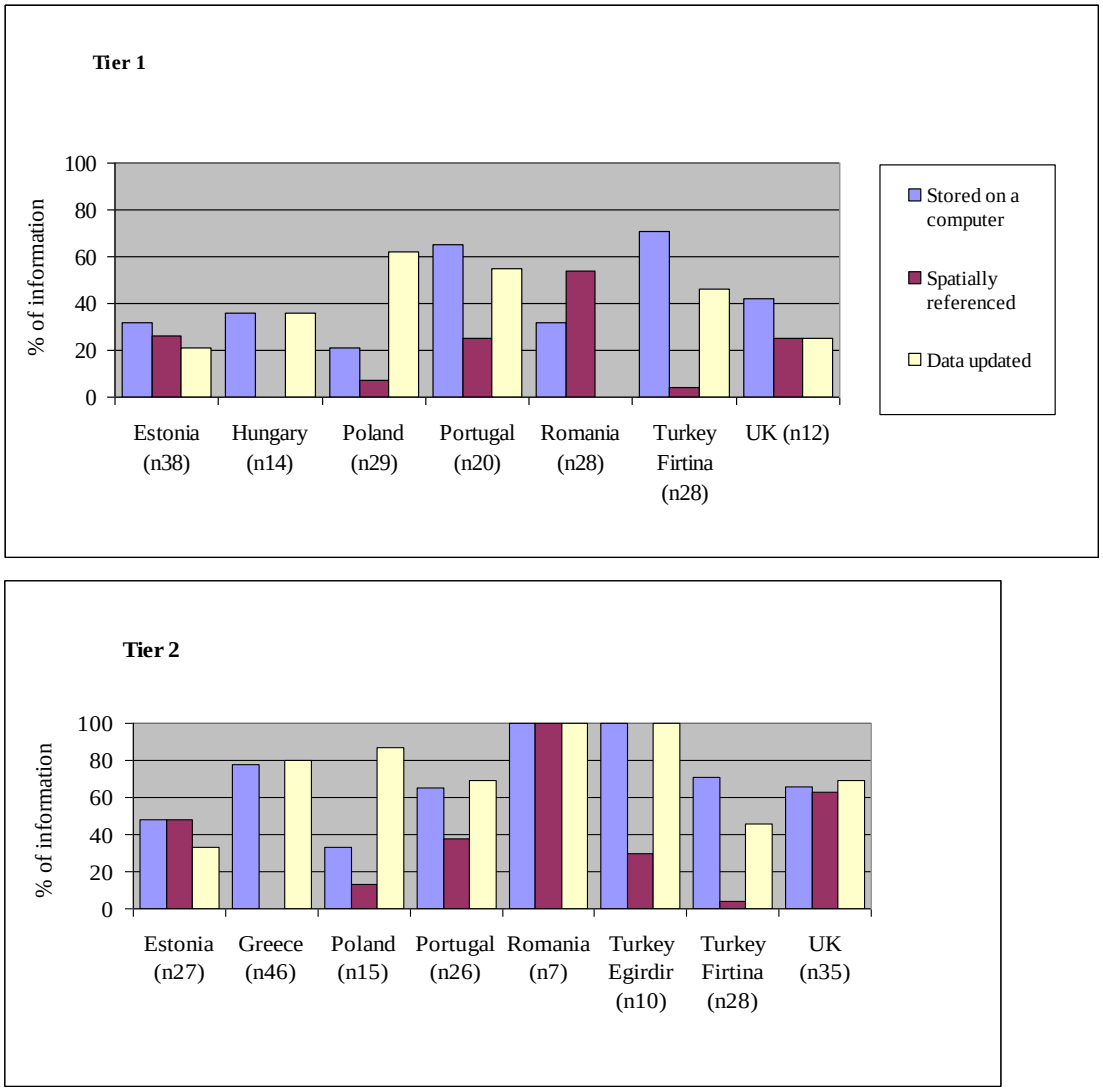

Figure 4.17. Proportion of accessible environmental information that is stored on a computer, updated and spatially referenced. Comparison between Tier 1 and Tier 2 local governments of TESS partner countries where n = the number of categories of required information.

4.8. Availability of required data

The survey asked interviewees whether they were able to obtain the environmental information that they needed. A substantial proportion of responses for both tiers of local government and for the individual stakeholders indicated that either “most” or “all of the required data was available. However, up to 15% of respondents indicated that “none” of the required information was available, highlighting a major obstacle to effective decision-making (figure 4.18).

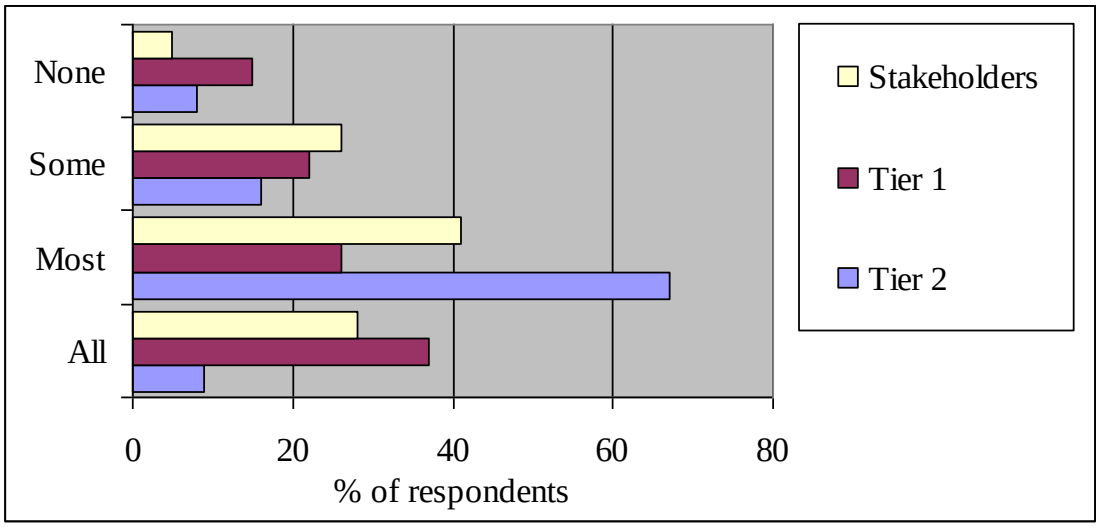

Figure 3.18. Proportion of stakeholder interviewees and government representatives that could access the required data for environmental decision-making. Possible responses regarding data availability were “none”, “some”, “most” or “all”.

To investigate differences in accessibility for different types of information, the responses for all groups of stakeholders were grouped using a Data Acquisition Index (DAq), which applied a ‘weight’ to each response depending on the degree of availability. Percentage, rather than sum of responses was used to avoid positive bias to those categories that were simply required more regardless of relative availability.

DAq_i = % responses x $weight_i$

Where weight: None = 0, Some = 1, Most = 2, All = 3

When all responses were grouped, the DAq Index revealed that local & regional biodiversity data was particularly lacking, whereas national and international data was the most easily acquired Interestingly, information on the four broad categories of ecosystem services was perceived to be more readily available than local biodiversity data (figure 3.19).

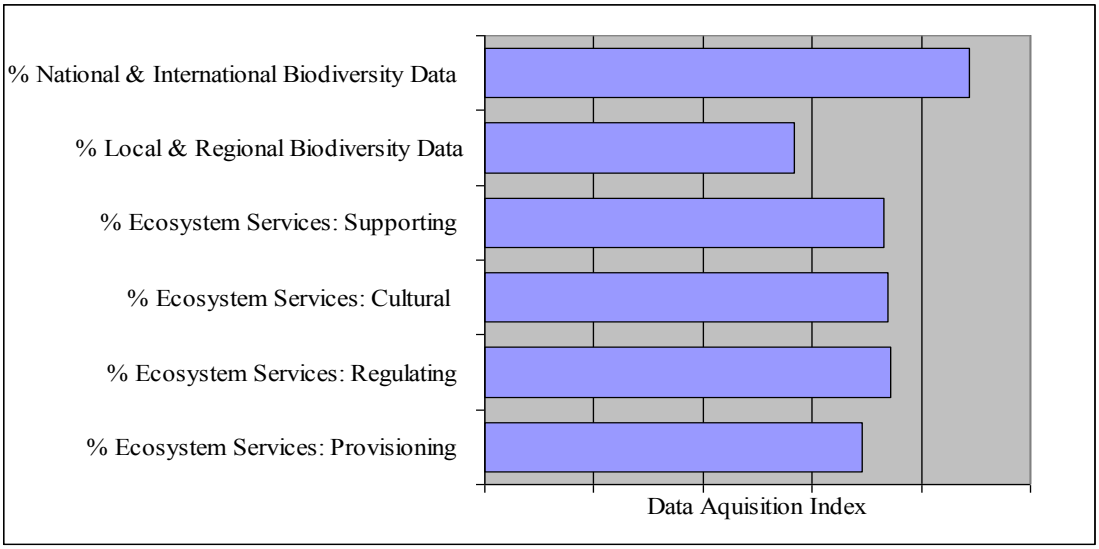

Figure 3.19. Accessibility of environmental information grouped according to Biodiversity and Ecosystem services using a Data Acquisition Index (DaQ). Responses are collated for tiers of local government & stakeholder groups.

There was some variation between countries, and stakeholder groups, in terms of the degree to which needs were met. Romania and the UK (except Tier 2) indicated that they

were able to acquire a relatively high proportion of information required, whereas both tiers of local government in Estonia indicated relatively low acquisition. Interestingly the individual stakeholders in Estonia expressed very different views – showing a much higher satisfaction with information access. It is important to note that perception of the completeness of information to aid decision-making will depend on the demand for these data as well as their supply. Interviewees will have considerable differences in their concepts of the appropriate information needed to make an informed decision affecting their environment.

4.9. Barriers that impede access to adequate environmental information

All categories of stakeholders and both levels of local government encountered barriers that impeded access to adequate environmental information. Notably the groups with the greatest perceived *need* for environmental information also reported the greatest difficulty with obtaining the data that they required (figure 3.20). This suggests that there may be a motivational effect with barriers only being encountered when effort is made to acquire the information. Forester interviewees lowest reported the least difficulty obtaining data perhaps reflecting the availability of certain types of information. This aspect would merit further clarification in future work.

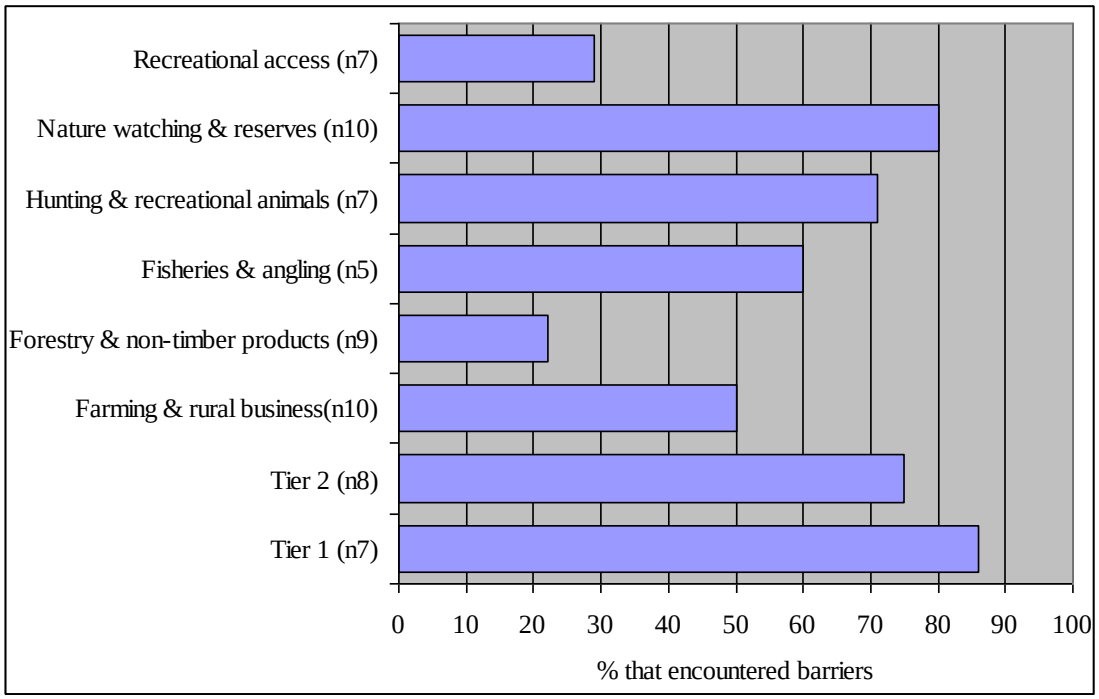

Figure 4.20. Proportion of stakeholder interviewees and government representatives encountering barriers that impeded access to adequate environmental information

Differences in the degrees of difficulty in obtaining suitable information were evident between countries. Hungary, Poland and the UK indicated the highest number of problems when obtaining data, experiencing up to 7 out of the 9 potential issues identified for both tiers of local government and 100% of the individual stakeholders in Greece and Poland encountered some barriers.

In contrast, none of the Romanian local government, or other stakeholder interviewees except for the representative of the “hunting & recreational animals” category, reported any impediments to information access; the Romanian category was an exception to this pattern. On average across countries, 52% of the individual stakeholders’ encountered barriers to prevent access to information (figure 4.21).

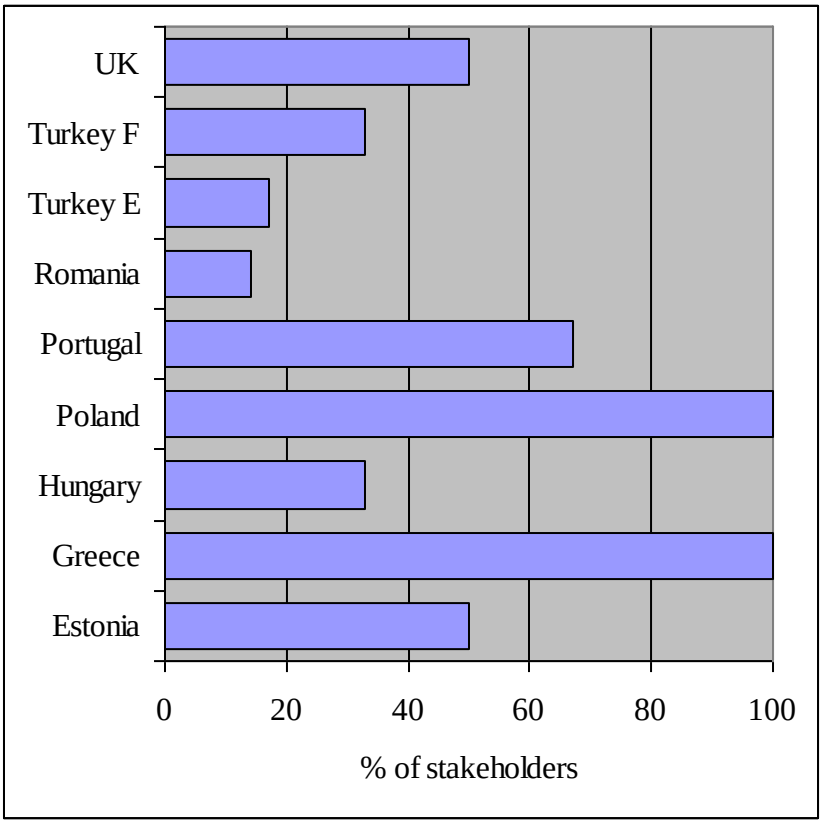

Figure 4.21. Proportion of individual stakeholders that encountered barriers to prevent access to adequate environmental information, grouped by country.

Difficulty in 'finding the information' was the category most commonly selected as the reason for difficulty in acquiring adequate information. However, each factor identified in the survey design as a potential barrier was encountered by most of the stakeholder groups, with accuracy, scale, access & age identified as the most important barriers. The factor that considered motivation of the interviewee, 'not likely to make a difference' was the least commonly selected (figure 4.22). This suggests that there is an enthusiasm as well as a need for adequate information, which is currently thwarted, to some extent, by a number of barriers to acquisition, with difficulty in locating the information presenting the most frequent impediment.

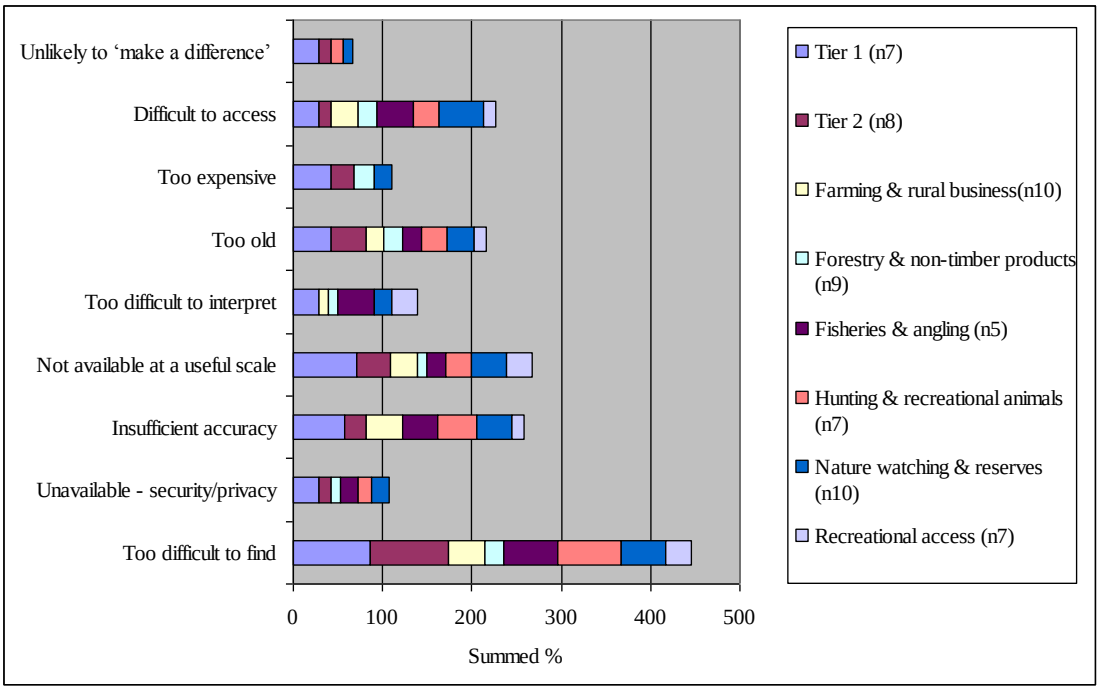

Figure 4.22. The proportion of interviewees for each stakeholder category and the proportion of government representatives in each partner country who indicated a factor that caused problems when obtaining data.

4.10. Summary and recommendations

The aims of TESS Work Package 3 were condensed into five questions regarding the supply and demand of environmental information to local governments and selected groups of individual stakeholders.
These were:

i. What are the information needs?
ii. What determines the information needs?
iii. What information is used?
iv. What information is needed but currently unobtainable?
v. What are the barriers to obtaining information?

An important caveat to interpretation of these results is that they represent a pilot stage in the TESS project leading to a much more extensive survey in TESS WP5. They are therefore based on a small sample of case studies and it is the range of responses that is generally of more interest than other statistics (such as averages) that would require a much larger sample.

4.10.1. What are the information needs?

The survey found that all groups of interviewees spent a substantial proportion of time considering environmental matters when making management decisions (figure 4.4) although the greatest needs for environmental information were in government, nature-watching/reserve management and forestry (figure 4.12). The demand for environmental information varied between the groups of interviewees but almost all categories of information that were surveyed (biodiversity and ecosystem services) were required (figures 4.6 & 4.7), to some degree, by all categories of stakeholder (figure 4.4). Notably information on heritage conservation was an exception. Information on physical hazards such as flood and fire risk, biodiversity and tourism capacity were key issues for local governments across the case studies. In particular, Tier 1 tended to put more priority and need more information

on ecosystem services and socio-economic considerations generally than Tier 2, which was in turn more focussed on biodiversity issues than Tier 1 (figures 4.1, 4.4, 4.6, 4.7 and 4.12).

4.10.2. What determines the information needs

All of the possible 'drivers' that might determine information needs that were identified in the survey were rated as important factors by the interviewees from all sectors. These included a statutory requirement to inform management decisions, a need for information for local policy formulation and a need to inform management decisions (figure 4.13). Despite recognition of the importance of statutory requirements in driving information needs; local government interviewees tended to report a fairly low level of direct involvement in EIA and, especially SEA processes. This was particularly notable in the most local level of government (Tier 1). Nevertheless, the relatively low requirement reported for specific data types to inform EIA that was reported by Tier 2 as well as Tier 1 (figure 4.14) is a little surprising.

The number of decisions being made might also drive information needs. When viewed in terms of the area managed, it was evident that the individual stakeholders in the farming and rural business category reported more decisions annually than the other categories (figure 4.3). Further work in this area would be required for more robust interpretation that allows comparability between decisions. In other words a decision to trim 50m of hedge by a one farmer is not equivalent to a decision to trim all the hedges in a large estate by another farmer, or indeed, a decision by a local government department to grant planning permission for a major development. If this approach is to be used in future surveys, the 'decisions' need clear and specific definition.

The extent of involvement in the decision making process may also influence perceived needs. The survey indicated a disparity in the perception of the participatory process between local government and individual stakeholders. The stakeholders generally felt that they had little involvement and influence, whereas the local government responses reflected a perception that the mechanisms for engagement with local communities were in place. If individuals do find it difficult to engage with local environmental decision-making processes, this perceived disenfranchisement is likely to reduce their demand for information.

4.10.3. What information is used?

A reliance on Internet sources of information was reported across all government & other stakeholder categories and in all of the case studies. In contrast, there was a limited use of local survey data and especially of information derived scientific survey (figure 4.16). This raises the question of the quality and validity of information that may be being used to make decisions affecting environmental management right across the sample of case studies and should be noted as an important factor for emphasis in future work within TESS.

It was apparent that much of the information accessed by local governments was not stored on computers; even less was regularly updated or spatially referenced (i.e. mapped). Another point of interest, and importance for design of information systems, was that although most information was needed by government, forestry and nature-watching/reserves (figure 3.12), four of the stakeholder groups (especially hunting and nature-watching/reserve-management) were at least as active as Tier 2 governments in generating their own environmental information, as demonstrated by the proportion of their information requirements that were met through their own survey and record keeping as (figure 3.16).

4.10.4. What information is needed but currently unobtainable?

A substantial proportion of interviewees in all government and other stakeholder groups, and across all case studies, reported difficulties in obtaining adequate information for their

decision-making purposes (figure 4.20). Although biodiversity information at the National level (e.g. national figures for biodiversity and habitat) was relatively accessible, species and habitat data collated at the local & regional level appeared to be the most difficult category of information for interviewees to access (figure 4.19).
Notably, the highest perception of these impediments to data access occurred in the stakeholder groups (local government & nature watching and reserves) that also indicated that greatest requirements for information (figure 4.12), although foresters seemed to have adequate access. Perhaps the motivation of interviewees affected the likely perception of barriers. In other words, stakeholders who expressed little need for information were unlikely to encounter barriers to obtaining data.

4.10.5. What are the barriers to obtaining information?

Many potential barriers to obtaining adequate information were reported in the surveys and this occurred in all of the case study countries and all of the stakeholder groups (figure 4.22). The most frequently cited problem was a difficulty in finding & accessing information. Other key issues encountered by the interviewees were the accuracy of the data, availability at an appropriate spatial scale, and the age of data.

4.11. References

Anon 1994 *Biodiversity The UK Action Plan.* Cm 2428 HMSO London.

Anon 2005 *A Practical Guide to the Strategic Environmental Assessment Directive 2001/42/EC* Office of the Deputy Prime Minister (now Department of Communities and Local Government)

Anon 2006 *Planning for Biodiversity and Geological Conservation – a Guide to Good Practice* ODPM (now Department of Communities and Local Government), Defra and English Nature (now Natural England).

Arnstein, S. 1969. A ladder of public participation. *Journal of American Institute of Planners* **35***:* 216–224.

Broberg, L. 2003. Conserving Ecosystems Locally: A Role for Ecologists in Land-Use Planning. *BioScience* **53**: 670-673.

COWI 2009a. *Study concerning the report on the application and effectiveness of the EIA Directive* carried out by COWI consultants, Kongens Lyngby for the European Commission DG Environment.

COWI 2009b. *Study concerning the report on the application and effectiveness of the SEA Directive (2001/42/EC)* carried out by COWI consultants, Kongens Lyngby for the European Commission DG Environment.

Creighton, J. 2005. *The Public Participation Handbook: Making Better Decisions Through Citizen Involvement: A Practical Toolkit*. Jossey Bass, San Francisco

European Commission 2003. *Report from the Commission to the European Parliament and the Council: On the Application and Effectiveness of the EIA Directive: How successful are the Member States in implementing the EIA Directive?* (http://ec.europa.eu/environment/eia/eia-support.htm)

Gontier, M. 2007. Scale issues in the assessment of ecological impacts using a GIS-based habitat model -- A case study for the Stockholm region. *Environmental Impact Assessment Review* **27**:440-459.

Jansky, L and Uitto, J I.2005. *Enhancing Participation and Governance in Water Resources Management: Conventional Approaches and Information Technology.* Tokyo: United Nations University Press

João, E. 2007. A research agenda for data and scale issues in Strategic Environmental Assessment (SEA). *Environmental Impact Assessment Review* **27**:479-491.

Luz, F. 2000. Participatory landscape ecology—a basis for acceptance and implementation. *Landscape and Urban Planning* **50**:157–166.

Millennium Ecosystem Assessment 2005. *Ecosystems and Human Well-Being.* Synthesis Island Press Washington D.C.

Morgan-Davies, C., T. Waterhouse, M. L. Pollock, and K. Smyth. 2005. Local area farming plans - A common reality for farmers and conservationists in the Scottish Highlands? *Scottish Geographical Journal* **121**:385-400.

Odum, W. E. 1982. Environmental Degradation and the Tyranny of Small Decisions. *BioScience* **32**:728-729.

Partidário, M.R., 2007 *Strategic Environmental Assessment:good practice guide.*

Partidário,M.R., 2009 Environmental Assessment, an international perspective. Presentation to TESS Workshop, London September 2009. www.tess-project.eu .
Peepson, A., and M. Mick. 2008 Assessing the Impact of Rural Development Policies (RuDI) Work package 1 Priorities in rural development policies Country profiles on rural characteristics http://www.rudi-europe.net/uploads/media/Estonia_WP1_Report.pdf

Reed, M. 2008. Stakeholder participation for environmental management: A literature review *Biological Conservation* **141**:2417-2431.

Theobald, D. M., T. Spies, J. Kline, B. Maxwell, N. T. Hobbs, and V. H. Dale. 2005. Ecological support for rural land-use planning. *Ecological Applications* **15**:1906-1914.

Therivel, R. 2004 *Strategic Environmental Assessment in Action* Earthscan, London and Sterling,VA.

Tippett, J., J. Handleya, and R. J. 2007. Meeting the challenges of sustainable development-conceptual appraisal of a new methodology for participatory ecological planning *Volume Progress in Planning* **67**:9-98

Unalan, D. and Cowell, R. 2009, Adoption of the EU SEA Directive in Turkey, in *Environmental Impact Assessment Review 2009 pages 243-251.*

Wheatley, M., and C. Johnson. 2009. Factors limiting our understanding of ecological scale. *Ecological Complexity* **6**:150-159.

5. Gap analysis on existing models for local biodiversity management

5.1. Introduction

Transactional Environmental Support System (TESS) is an RTD project which, among other expected results, must collect and analyse the existing modelling and data sources to enable concept generation, together with social and technical design for a decision support software platform. The aim of the gap analysis was to map the existing and missing resources for the generation of decision support software solutions in the TESS areas of interest. Hence, these gaps might be missing knowledge, concepts, software, data, links etc.
The scoping phase of WP4 revealed that the database of models should be targeted at activities where local ecosystem management decisions bring via improved ecosystem services direct benefits to the manager (Aruvee & Piirimäe, 2010). Of various types of ecosystem services, this project is targeted on the management of ecosystem services which generate local benefits through long-term sustainability as well as any immediate gains. Thus, the database focuses on health of terrestrial ecosystems.

5.2. Methodology

Preliminary gap search was based mostly on the database of models, delivering preliminary gaps. These were rechecked, using web search, leading to additional models to the database and to the final gap identifications.

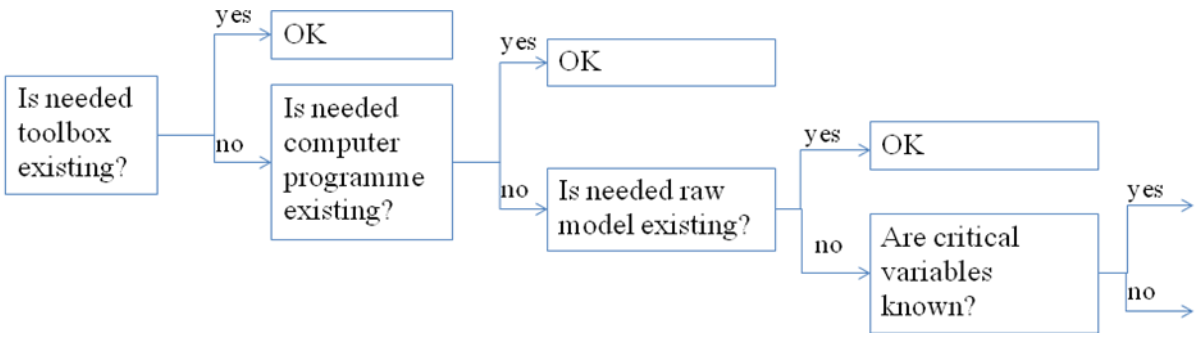

Figure 5.1 Vertical strategy in gap search

A. Vertical gap search.
On the basis of providing resources for three toolboxes for local management of terrestrial ecosystems, we started with searching for readily available tools. If such tool(s) were already existing and meeting all the user requirements, no gaps were identified in that management area (). Otherwise, the existing tools were either imperfect or missing. In such case, a 'toolbox gap', or 'integration gap' was identified and gap search moved to one order more detailed level – to check which of the needed computer programmes are already existing. In case of missing or imperfect software model, a 'software gap' was identified, directing the gap search again to a more detailed level – to search for knowledge from literature, identifying 'knowledge gaps'. More specific information about stakeholder needs for information on various environmental issues was acquired from Hodder et al. (2009).

B. Mismatch search.
Vertical and thematic gap search could not indicate if models can be pipelined with each other. Due to conceptual incommensurability or technical incompatibility with other tools, a model in the database might appear inconsistent. Hence, we classified all models to eight potential clusters within which the models should adapt well to pipelining with each other, but not between clusters. Models in small clusters could hence appear incoherent as components in integrated tools, indicating additional gaps – 'mismatches'.

5.3 Results

5.3.1. Integration gaps

Although the database contains 25 items, reported as 'decision support systems, organizing or enabling several modelling tools', our expert assessment qualified only seven real toolboxes: InVEST, RAT Toolkit, DSSAT, Apollo, MicroLEIS DSS, SFM Toolkit and BAP Toolbox (Table). Of them, RAT Toolkit (www.alarmproject.net), however, is targeted on large-scale management and policy issues, falling, thus, out of the TESS project scope. All the other references in the database fell finally into the category of 'computer models'.

Table 5.1. Integration gaps in the existing decision support toolboxes

Field Health Toolkit	Forest Health Toolkit	Recreational Site Management Toolkit
DSSAT Apollo MicroLEIS DSS	SFM Toolkit BAP toolbox	*Integration gap!*

InVEST (Tallis et al., 2008) is a toolbox which models and maps natural capital: the delivery, distribution, and economic value of ecosystem services (life-support systems) and biodiversity. The tool, being developed in the United States, helps users visualize the impacts of potential decisions, identifying tradeoffs and compatibilities between environmental, economic, and social benefits.

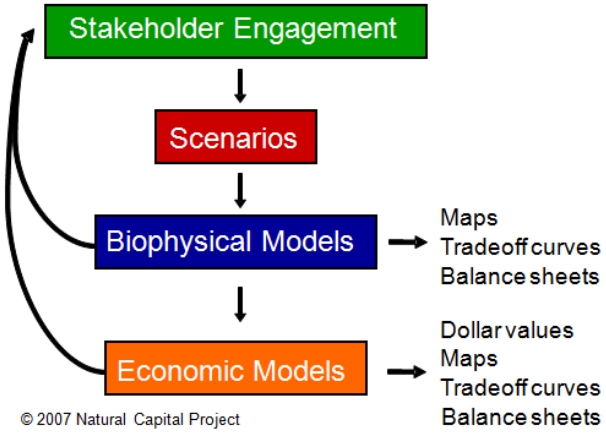

Figure 5.2. InVEST toolbox collects various decision support models for the management of various ecosystem services

InVEST models run as script tools in the ArcGIS ArcToolBox environment. InVEST 1.0 includes models for carbon sequestration, pollination of crops, managed timber production, water pollution regulation and sediment retention for reservoir maintenance. It also includes a biodiversity model so that comparisons and tradeoffs between biodiversity and ecosystem services can be analyzed. The next release of InVEST will probably include a suite of new ecosystem services: flood mitigation, agriculture production, irrigation, open access harvest and hydropower production. The tool is modular in the sense that you do not have to model all the ecosystem services listed, but rather can select only those of interest.

The individual models in InVEST 1.0 are very simple. Hence, the toolbox remains very limited in its ability to provide effective decision support for the environmental management in the EU. However, the conceptual comprehensiveness of the InVEST project is striking, providing a sound integral framework for the provision of more useful versions of the toolbox.

5.3.2. Integration of Field Health Toolkit

InVEST, although having a simple crop pollination model, still lacks a comprehensive field health toolkit, although an agricultural production model is under development. Until that time, other agricultural production toolkits remain more functional. Of them, the most prominent are DSSAT and MicroLEIS.

Decision Support for Agrotechnology Transfer (DSSAT).

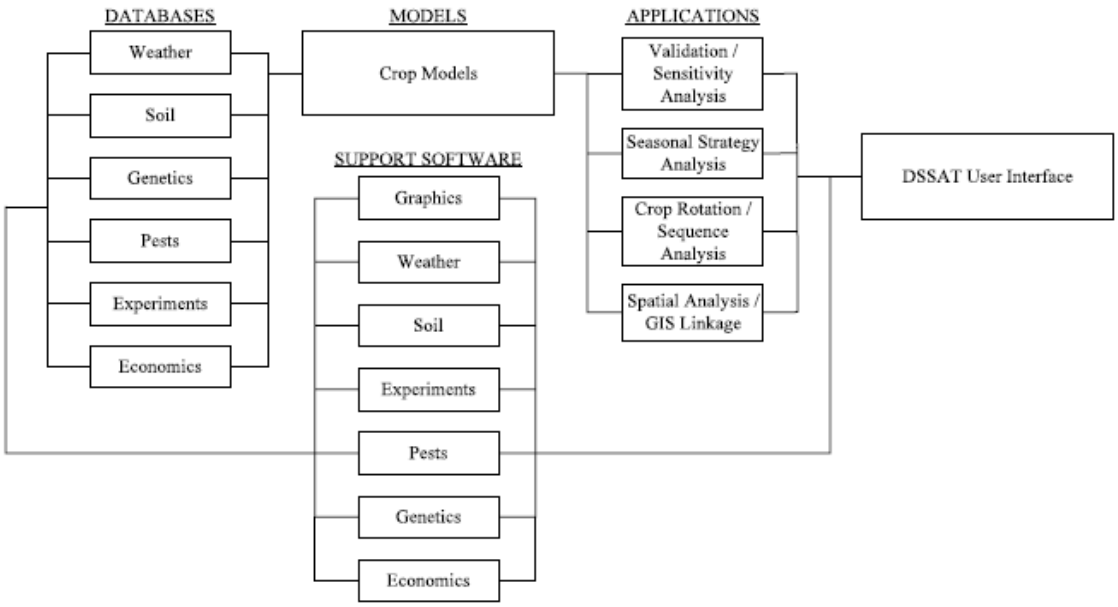

Figure 5.3. Diagram of database, application, and support software components and their use with crop models for applications in DSSAT (from Jones et al., 2003)

DSSAT has been developed by the International Consortium for Agricultural Systems Applications (ICASA, www.icasa.net). The Cropping System Model (CSM), released with DSSAT Version 4, incorporates all crops as modules using a single soil module and a single weather module (Fig). CSM contains models of 17 crops derived from the old DSSAT CROPGRO and CERES models. The major modules are land module, management module, soil module, weather module, soil-plant-atmosphere module, CROPGRO plant growth module, CERES Plant Growth Module, SUBSTOR Plant Growth Module, and Soil Organic Matter Module.
CROPGRO plant growth module simulates the following crops:

- Grain Legumes - Soybean, peanut, dry bean, chickpea, cowpea, velvet bean, and faba bean
- Vegetables - Pepper, cabbage, tomato
- Grasses – Bahia, brachiaria

CERES Plant Growth Module simulates Grain Cereals: Rice, maize, millet, sorghum, wheat, and barley
SUBSTOR Plant Growth Module simulates potato.
A SOM–residue module from the CENTURY model has incorporated in the DSSAT crop simulation models, including a residue layer on top of the soil. By incorporating the CENTURY SOM–residue module, DSSAT crop simulation models is suitable for simulating low-input systems and conducting long-term sustainability analyses.

DSSAT allows consistent access to the crop models, data, input and output tools, and analysis programs. The hierarchy is commodity-based within a tree structure where model inputs can be created and results analyzed.
A suite of tools is supplied for data management and analysis. XBuild is used to create and modify experiment files (X-Files). The suite of tools includes (but is not limited to) ATCreate (observed data), Weatherman (Weather data), GBuild (Graphing of outputs), and SBuild (Soil database).
In addition to the suite of applications installed with DSSAT, a number of accessory tools can be installed. These tools (ICSim, Stats, EZ Grapher and others) are applications that access the data in DSSAT for applications designed by the developers. The functionality exists for users to dynamically add their own application to the DSSAT toolbar.
DSSAT has been in use for the past 15 years by researchers all over the world, for a variety of purposes, including crop management (Fetcher et al., 1991), climate change impact studies (Alexandrov and Hoogenboom, 2001), sustainability research (Quemada and Cabrera, 1995), and precision agriculture (Paz et al., 2001, 2003), and is well validated for a number of regions and crops. Included in the DSSAT family are modules which simulate the growth of 16 different crops, including maize, soybeans, wheat, rice, and others. DSSAT uses common modules for soil dynamics and soil–plant–atmosphere interactions regardless of the plant growth module selected. Data requirements include weather inputs (daily maximum and minimum temperature, rainfall and solar radiation), soils classification, and crop management practices (variety, row spacing, plant population, fertilizer and irrigation application dates and amounts). While the DSSAT family of crop growth models provides many opportunities for critical analysis, it is tedious to use for precision agriculture studies and decision support because the model is built for simulation of a single homogeneous field unit. In order to facilitate the use of DSSAT for precision agriculture decision support, automated procedures and related tools are needed to implement crop growth simulations spatially across field-level management zones. Additional information about the model can be found in http://www.icasa.net/dssat/.

Apollo

Apollo, a prototype decision support system (DSS) was developed to assist researchers in using the DSSAT crop growth models to analyze precision farming datasets (Thorp et al., 2008). Because the DSSAT models are written to simulate crop growth and development within a homogenous unit of land, the Apollo DSS has specialized functions to manage running the DSSAT models to simulate and analyze spatially variable land and management. The DSS has modules that allow the user to build model input files for spatial simulations across predefined management zones, calibrate the models to simulate historic spatial yield variability, validate the models for seasons not used for calibration, and estimate the crop response and environmental impacts of nitrogen, plant population, cultivar, and irrigation prescriptions.

A land evaluation decision support system for agricultural protection (MicroLEIS)

MicroLEIS system is interactive software with comprehensive documentation for anyone planning, researching or teaching the sustainable use and management of rural resources, with especial reference to the Mediterranean regions (Rosa et al., 2004; www.microleis.com). This agro-ecological system provides a computer-based set of tools for an orderly arrangement and practical interpretation of land resources/agricultural management data (figure 5.4). The design philosophy follows a toolkit approach, integrating many software tools: databases, statistics, expert

systems, neural networks, Web and GIS applications, and other information technologies. Its major characteristics are:

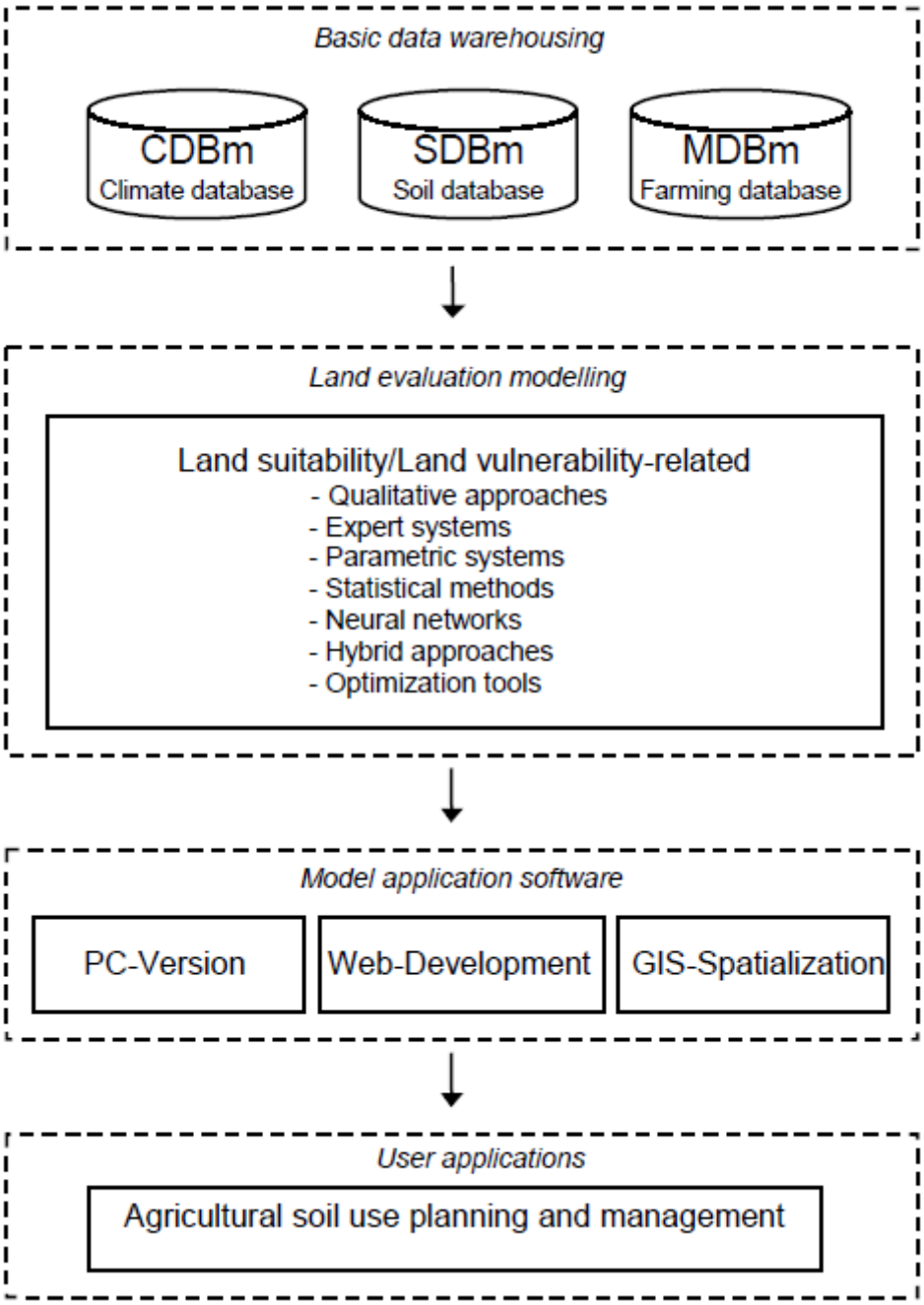

Figure 5.4. Conceptual design and component integration of the current status of MicroLEIS DSS land evaluation decision support system (from Rosa et al., 2003)

- data and knowledge engineering through the use of a variety of databases and innovative modelling techniques;
- scaling-up of process knowledge from the micro-scale to the landscape-scale (regional, national and continental);
- land evaluation by using the following study-units: place (climate), soil (site+soil), land (climate+site+soil), field (climate+site+soil +management)

- use of monthly meteorological data and standard information as recorded in routine land resource surveys; integrated agro-ecological approach, combining biophysical data with agricultural management experience;
- incorporating the soil quality and sustainable agriculture concepts, towards an agro-environmental decision support system;
- and software development for PC platforms, and Web- and GIS-based versions.

Conclusion
As InVEST, a global ecosystem management toolbox, still fails to work as a toolbox in field health management, providing only one tool for pollination management, more specialised toolkits are needed. Of them, DSSAT with its extension, Apollo, as well as MicroLEIS DSS well cover sustainable agricultural management areas. However, some agricultural issues may still be left out from these toolkits.

5.3.3 Integration of Forest Health Toolkit

InVEST toolbox contains a **managed timber production model**. This model analyzes the amount and volume of legally harvested timber from natural forests and managed plantations based on harvest level and cycle. The valuation model estimates the economic value of timber based on the market price, harvest and management costs and a discount rate. and calculates its economic value. This model is very simple and designed for cases where little data on harvest practices and tree stand management exists. Although the project is developing an open access harvest model, the current toolkit outputs only roundwood, ignoring other services which forest provide. Hence, to our knowledge, nowadays there exists just one management toolkit which addresses health of forests. This is Sustainable Forest Management (SFM) Toolkit.

Sustainable Forest Management (SFM) Toolkit
SFM Toolkit integrates nine models of various scales and themes (figure 5.5; Sturtevant et al., 2007). For example, SORTIE, an individual tree model, gives information about growth and yield of uneven-aged trees and complex successions. In the same time, SORTIE, in the toolbox, receives from D19aLM (SELES) model information about disturbance patterns. Such metamodeling strategy enables forest managers to deal with diverse objectives. The toolkit has been applied for the management of 2.1 million hectare forest planning in Labrador.

Biodiversity Assessment Project (BAP) Toolbox
BAP Toolbox, a part of SFM Toolkit, is a suite of indicator models used to assess diverse forest management strategies at three levels of biodiversity: landscape patterns, ecosystem diversity, and habitat supply for specific vertebrate species (Dolter, 2006). The toolbox translates a time series of landscape conditions output from landscape models into habitat types that serve as spatial units for ecosystem and the landscape biodiversity (i.e., coarse-filter) assessment.

Conclusion
InVEST, a global ecosystem service management toolbox, remains too general to aid local decision-making in forestry. Hence, a special forest health toolkit, named Sustainable Forest Management Toolkit, seems much more practical. The biggest challenge remains the adoption of this Canadian toolbox to the European conditions.

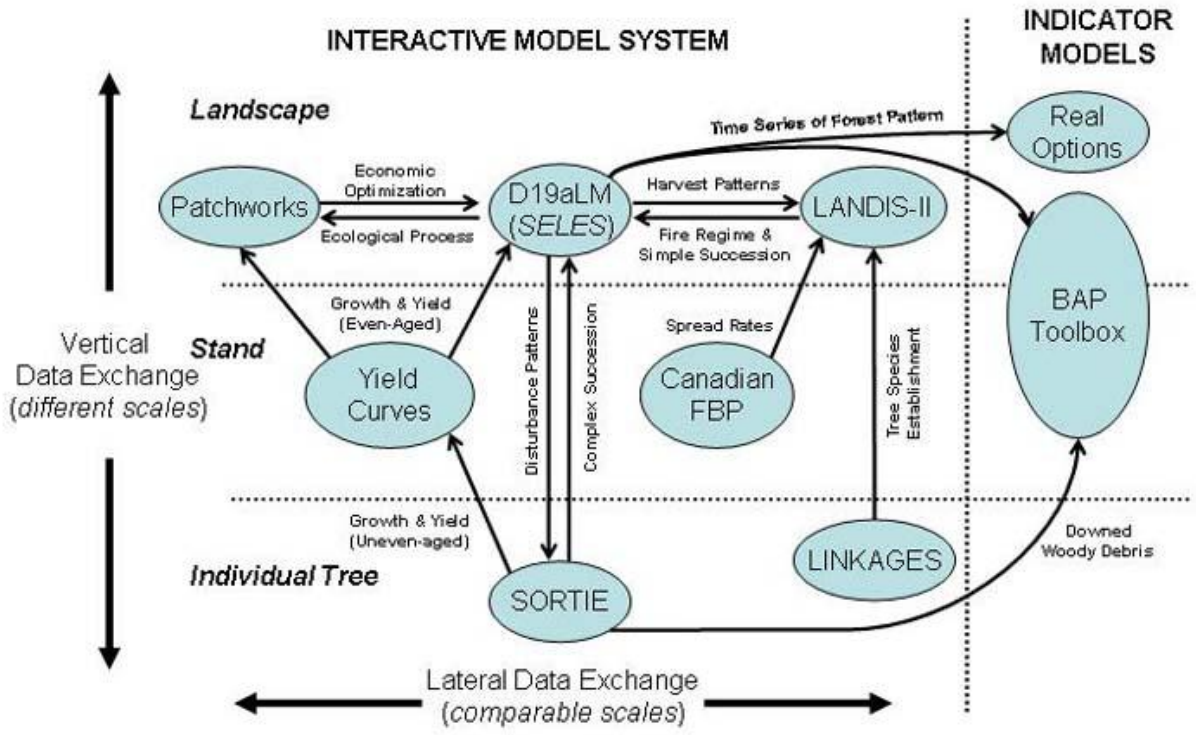

Figure 5.5. Information flow between models in SFM Toolkit (from Sturtevant et al., 2007)

5.3.4. Integration of Recreational Site Management Toolkit

To our knowledge, no recreational site management toolkit yet exists. InVEST toolbox does not address that issue either.

Comparing the number of issues identified by stakeholders with the number of models in the database, the best fulfilled needs seem in water, geological, economic and ecosystem subjects (figure 5.6). Social and atmospheric issues are relatively poorly covered. As atmospheric issues, such a climate change and pollution are mostly large-scale problems, the database for local management does not specifically need such models. Lack of social models, however, may form a real gap.

Of various management areas, the best met information needs seem to be in forestry, agriculture & apiculture and aquaculture & commercial fishing (figure 5.7). Most critical gaps appeared in ‘tourism and access-based recreation’, ‘biodiversity conservation’, and ‘amenity areas’.

More detailed analysis revealed that the most critical gaps remain is issue items ‘roads, transport, traffic, mobility’, ‘mining’, ‘waste management’, and ‘wastewater’ (Annex 1). All of these issues were indicated at least eight times while no models addressed these issues.

5.4. Software gaps

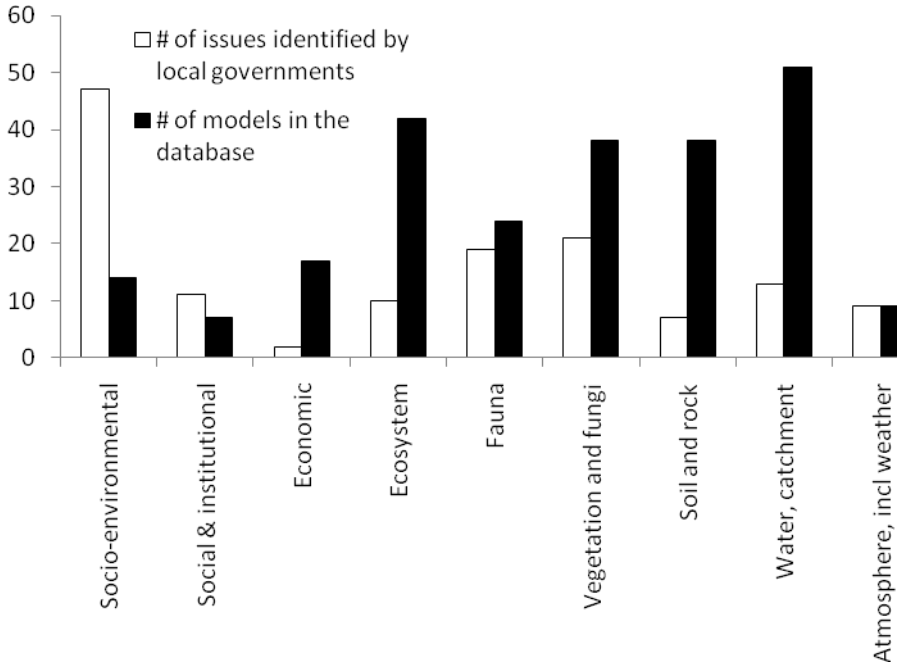

Figure 5.6. Supply of stakeholder needs for environmental information along various subject fields

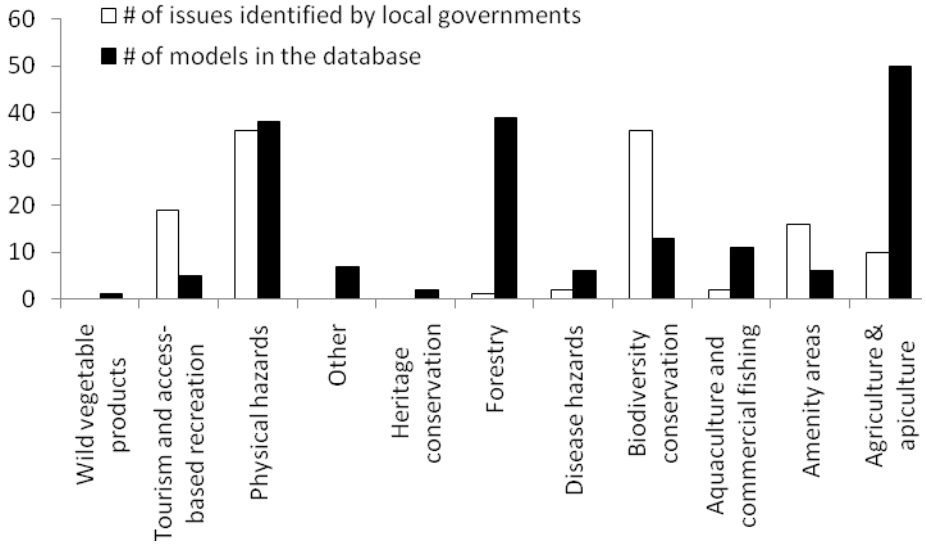

Figure 5.7. Supply of stakeholder needs for environmental information along various management areas

5.4.1. Field Health Software gaps

DSSAT and its GIS-solution Apollo, globally the most widely used agricultural DSS, has been used to model the effects of irrigation and no-till farming to crop productivity and nutrient leaching (Dillon & Shockley, 2010). Also, DSSAT has been used to model long-term effects of changes in soil organic carbon (Jones et al., 2003). However, according to our knowledge, DSSAT has not been used for the management of buffer strips, pollinators, GMOs, or biocontrol agents. Hence, DSSAT lacks sufficient environmental character to classify as comprehensive 'field health software'.

MICROLEIS DSS is more targeted to environmental and sustainability issues (Rosa et al., 2003). The main focus is not on crop productivity but rather on the quality of soil and agricultural land. Drivers of soil quality include also rooting depth, tillage operations, treatment of residues etc. The main indicators of land quality are plant water use efficiency, water- and air-filled pore space, nutrient availability, plant root penetration, water infiltration, and crop growth. The DSS pays much attention to land vulnerability, analysing runoff and leaching potential, erosion resistance, soil structure, cover protection, pesticide absorption and mobility, and subsoil compaction. The model also addresses restoration of marginal areas. Arena and Pantana expert systems assess field contamination.
MICROLEIS, however, is designed primarily for Mediterranean fields. In other European ecoregions, it may work less well.
InVEST Pollination model focuses on the resource needs and flight behaviors of wild bees, the most important group of pollinators. The model uses information on the availability of nesting sites and flower resources, as well as flight ranges of bees, to map an index of bee abundance across the landscape. In a second step, the model uses this map and bee flight ranges again to predict an index of the number of pollinators likely visiting crops in each agricultural cell on the landscape. If one opts to also estimate value indices, the model then takes a third and fourth step. In the third step, it uses a simplified yield function to translate bee abundance into crop value on each agricultural cell. And in the fourth step, it attributes these cell values back to cells “supplying” these bees.
However, InVEST model does not yet consider other pollinators such as birds, bats, moths and flies. InVEST neither considers other mobile agents providing services for agricultural production, especially biocontrol agents (enemies of pests). Above all, InVEST is an extremely simple model which does not consider population dynamics of the bees, sizes of their habitats, existence of small habitats etc.
GMO risk models. GMO cross-pollination risks have been considered in non-toolboxed isolated software solutions. For instance, **MAPOD** model (Matricial Approach to Pollen Dispersal, Klein et al., 2008) predicts cross-pollination between GM and non-GM maize. **GeneSYS** model has been used to evaluate the influence of cropping systems on transgene escape from rapeseed crops to rapeseed volunteers (Colbach et al., 1999).
Information supply gaps. Of field health issues, the most critical supply gaps appeared for hogweed (and presumably other noxious plants, as well as animal pests) and soil protection & erosion prevention (table 5.2). Although some agricultural models may indirectly consider these, none of the models provide specific decision support in these issues. Similarly, the database has failed to address land use, livestock & impacts hereof, quality of soil for farming community, hedge management, animal pests, lopping of olive trees, horticulture rehabilitation and development, plantations, playing fields for agricultural circuit, and burning of agricultural residues. The models are focussed primarily on productive services in agricultural ecosystems.

Table 5.2. Gaps in supplying models about field health issues identified by local stakeholders (issues extracted from Hodder at al., 2009)

At least as many models as issues | At least one model | No models

Issue	# of issues	# of models	Supply rate
Hogweed	5	0	
Soil protection, erosion prevention	4	5	
Agricultural changes	3	50	
Impact of agriculture & industry changes in land use on environment/people	3	4	
Impact of agriculture on environment	2	51	
Land use	2	3	
Livestock and impacts hereof	2	2	
quality of soil for the farming community	1	3	
Gardens restoration	1	1	
Animal pests (mammals, birds, insects)	1	0	
burning of agricultural residues in the fields	1	0	
Hedge management- cutting, laying (costs, impacts)	1	0	
Horticulture rehabilitation and development	1	0	
Lopping of olive trees/burning of agricultural residues in the fields	1	0	
Plantations	1	0	
playing field for agricultural circuit	1	0	

5.4.2. Forest Health Software gaps

SFM Toolkit addresses most of forest health issues including prediction of fire spread and behaviour (with FBP model, Forestry Canada Fire Danger Group, 1992), disturbance impacts on various tree species, effects of wind storms and pathogens (with LANDIS-II, Scheller et al., 2007 and SORTIE model, Coates et al., 2003), biodiversity issues (with BAP toolbox, Doyon and Duinker, 2003). BAP Toolbox comprises following criteria and indicators of sustainable forest management:

- Conservation of Biological Diversity
- Maintenance and Enhancement of Forest Ecosystem
- Condition and Productivity
- Conservation of Soil and Water
- Forest Ecosystem Contributions to Global Ecological Cycles

Socio-economic criteria and indicators focus on the last two titles:

- Multiple Benefits to Society;
- Accepting Society's Responsibility for Sustainable Development (CCFM, 1995)

Bio-indicators used in the analysis of ecosystem diversity are:

- Area-weighted Stand Age
- Tree Species Distribution
  - Species distribution by broad habitat type
  - Species presence
  - Species dominance
- Habitat Diversity

These three indicators enable BAP to track the changes in forest composition due to management practices being projected.

SFM Toolkit and BAP Toolbox have been effectively used in Canada. However, adaptation of it to the European conditions, particularly to non-boreal regions, might appear challenging.

Information supply gaps. SFM Toolkit does not address deforestation (table 5.3).

Table 5.3. Gaps in supplying models about forest health issues identified by local stakeholders (issues extracted from Hodder at al., 2009)

At least as many models as issues At least one model No models

Issue	# of issues	# of models	Supply rate
Deforestation	2	0	
Forest fire prevention	1	8	
Afforrestation	1	1	
FOREST EXPANSION	1	0	

Recreational Site Management Software gaps

The database comprises only six models, reported for the management of tourism and access-based recreation (figure 5.8). Such a low number comprises a clear gap in the context of high demand for such information by local managers (Kenward *et al*., 2010; Hodder *et al*., 2009).

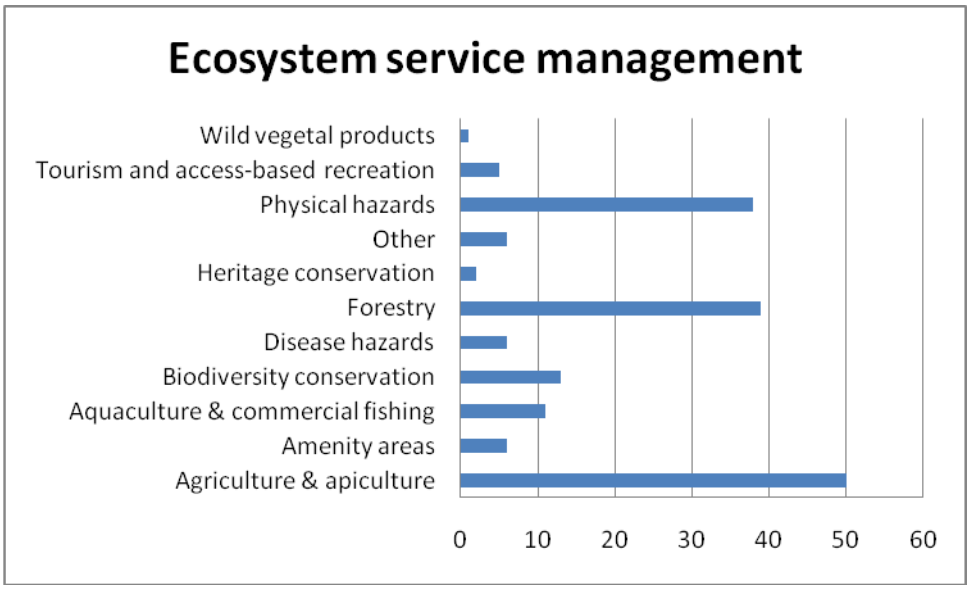

Figure 5.8. Number of models in the database according to different ecosystem service management areas

Recreational Behaviour Simulator (RBSIM)

RBSim is a computer program that simulates the behaviour of human recreators in high use natural environments. RBSim developed as a synthesis of work over a ten year period by researchers in the U.S. and Australia. Randy Gimblett, an Associate Professor of Landscape Architecture in the School of Renewable Natural Resources, The University of Arizona has been studying recreation behaviour in forest land in the western U.S. Specifically RBSim uses concepts from recreation research and Artificial Life and combines them with geographic information systems to produce an integrated system for exploring the interactions between different recreation user groups within real geographic space. RBSim joins two computer technologies:

- Geographic Information Systems to represent the environment
- Autonomous Human Agents (see text box) to simulate human behaviour within geographic space.

RBSim is experimental at this stage, but demonstrates the potential of combining the two technologies to explore the complex interactions between humans and the environment. The implications of this technology should also be applicable to the study of wildlife populations and other systems where there are complex interactions in the environment.

The main output of RBSIM is movement, location and concentration of visitors. However, RBSIM does not yet simulate environmental impacts. Further information about the model can be found at www.srnr.arizona.edu/~gimblett/rbsim.html

An autonomous agent is a computer simulation which is based on concepts from Artificial Life research. Agent simulations are built using object oriented programming technology. The agents are autonomous because once they are programmed they can move about the landscape like software robots. The agents can gather data from their environment, make decisions from this information and change their behavior according to the situation they find themselves in. Each individual agent has it's own physical mobility capabilities, sensory capabilities, and cognitive capabilities. This results in behavior that echo's the behavior of real animals (in this case humans) in the environment.

The process of building an agent is iterative and combines knowledge derived from empirical data with the intuition of the programmer. By continuing to program knowledge and rules into the agent, watching the behavior resulting from these rules and comparing it to what is known about actual behavior, a rich and complex set of behaviors emerge. What is compelling about this type of simulation is that it is impossible to predict the behavior of any single agent in the simulation and by observing the interactions between agents it is possible to draw conclusions which are impossible using any other analytical process.

Simulation of Disturbance Activities (SODA)

With conservation awareness and the demand for wildlife preservation increasing, ecotourism and outdoor recreational activities are becoming more popular. If such activities go unmanaged, the disruption to many species may have implications on their breeding success, survival and abundance and these, in turn, may have cascading ecosystem effects. By developing management strategies, through the application of simulation models, to simultaneously maintain recreational opportunities and sustain wildlife populations, these detrimental impacts can be minimised. Simulation of Disturbance Activities (SODA; Bennett et al., 2009) is a spatially explicit individual-based model designed as a flexible and transferable practical tool to explore the effects of spatial and temporal patterns of anthropogenic disturbance on wildlife.

SODA is a tool designed specifically to explore the repercussions (for example, variations in foraging rate, sleep deprivation, increased energy expenditure and decreased time spent feeding or in contact with young) of ecotourism and other outdoor recreational activities (such as dog-walking, bird watching, mountain-biking, snowmobiling and kayaking) on wildlife (figure 5.9). As such, SODA makes predictions regarding the implications of wildlife behavioural rules in novel circumstances (e.g. alternative pathway locations within a park). The model can therefore be used to provide insight into the relative impacts of alternative strategies for human recreation (spatial configurations and/or intensity of human activities) upon habitat use by wildlife (e.g. breeding, foraging and sleeping) in diverse settings (such as pedestrians in urban parks and off-road vehicles in national forests).

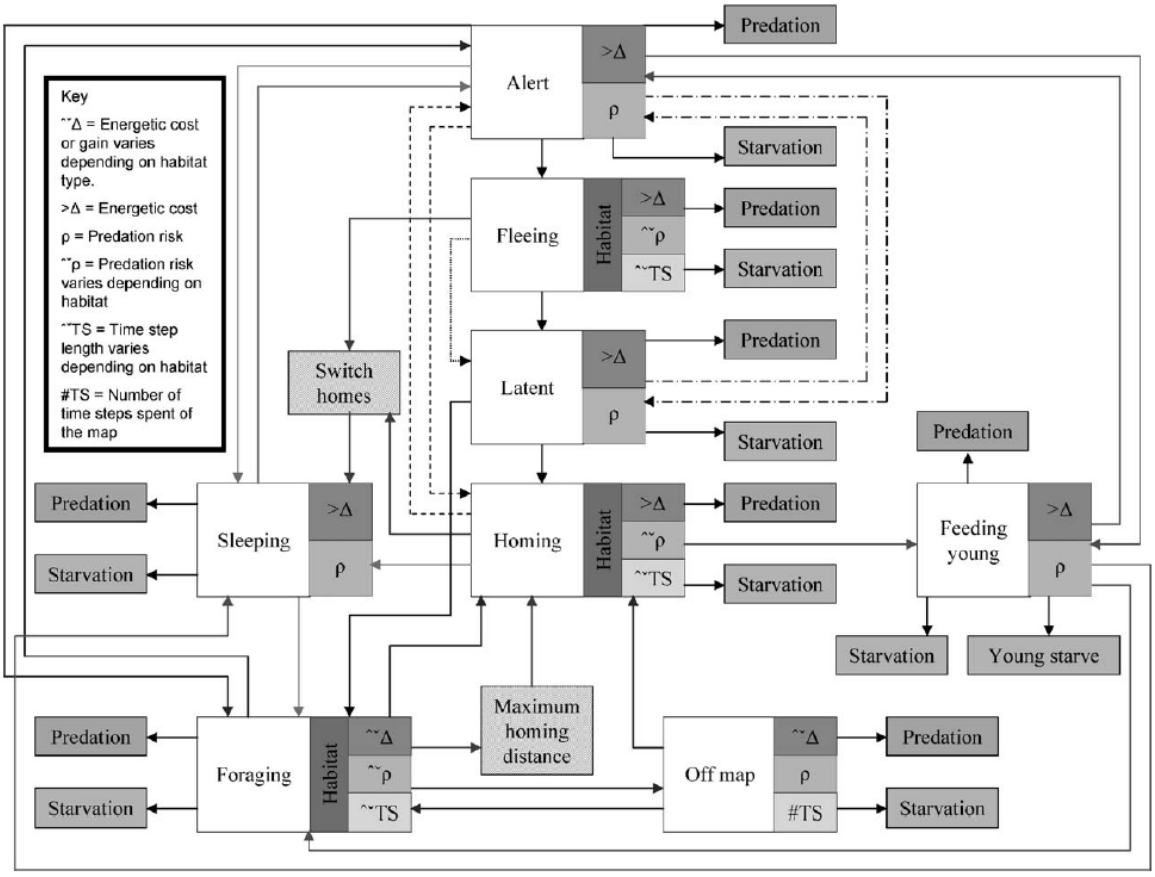

Figure 5.9. Conceptual delineation of the main wildlife processes employed by SODA to simulate the interactions between wildlife individuals, human recreationalists and habitats. It includes the eight different behaviour modes exhibited by wildlife mobile objects, movement patterns with and without disturbance, energetic status and predation potential. (From Bennett et al., 2009)

SODA has been applied: (1) to explore the effect of potential park designs on a nesting population of yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) in Calumet, Illinois, USA (Bennett et al., 2009); (2) to investigate the influence of visitor frequency on the breeding success of barbastelle bats (*Barbastella barbastellus*) in the south west of England (Bennett et al., 2009).

Other recreational models

TourSim (Johnson & Sieber, 2009), is software which considers capacity of recreational objects to accommodate tourists. However, it does not simulate the environmental impacts.

Wilderness (Smith et al., 1976) is Spanish model which represents the travel behaviour of wilderness recreationists. The model shows the relationship between the natural, undisturbed purity of a wilderness and the human influence that affects it. However, the model has not been modernised.
WUSM (Wilderness Use Simulation Model; Underhill et al., 1986) was designed to make management decisions for peak season boating. However, the model does not address environmental impacts.
Landscape Management Checklist (Lindenmayer et al., 2008) assesses six major themes in the ecology and conservation of landscapes. The checklist identifies 13 important issues that need to be considered in developing approaches to landscape conservation. They include recognizing the importance of landscape mosaics (including the integration of terrestrial and aquatic areas), recognizing interactions between vegetation cover and vegetation configuration, using an appropriate landscape conceptual model, maintaining the capacity to recover from disturbance and managing landscapes in an adaptive framework.
Cudgen Lake Bn (Ticehurst et al. 2007) is a **Bayesian network (Bn)** for the management of small lakes. Bns were used to assess the sustainability of eight coastal lake-catchment systems, located on the coast of New South Wales (NSW), Australia.

Table 5.3. Gaps in supplying models about recreational site management issues identified by local stakeholders (issues extracted from Hodder at al., 2009)

● At least as many models as issues ● At least one model ● No models

Issue	# of issues	# of models	Supply rate
Amenity areas	6	7	●
Public access	6	1	●
impact of tourism and recreation	3	5	●
Impact of camping on environment	3	1	●
Impacts of resort, holiday and business properties	2	0	●
Visual Impact on Environment	1	8	●
Recreational areas and routes	1	7	●
Relative values of different habitats for wildlife and humans	1	4	●
Impact of recreational/housing/business building development on environment	1	1	●
Trails and exposure to wear on nature areas	1	1	●
Ecotourism development	1	0	●
Green area maintenance (cost, impact)	1	0	●
Impact of holiday/residential/business properties	1	0	●
Impact of skiing slope on habitats of protected species	1	0	●
Permanent damages related to horses left uncontolled	1	0	●
The negative effect from permanent residential buidings for recreation and tourism	1	0	●

ALMaSS (Topping et al., 2010) evaluates demographic constraints of grey partridge *Perdix perdix*, a valuable game bird in many European countries. The model integrates agriculture, predation, hunting and weather as drivers. Management of its population, hence, depends on land use changes and hunting.
Information supply gaps. The database has failed to address over 30 issues identified by local stakeholders (**Table 5.3** and see also Annex I). Of these issues, the most wanted were public access as well as impact of camping, resorts, holiday and business properties.

Conclusion

The existing models for recreational site management are relatively patchy, not integrated. The most promising heart for the envisaged Recreational Site Management Toolkit might be a combination of RBSIM and SODA. As RBSIM simulates location and concentration of visitors, it might be technically relatively easy to add environmental impacts of these visitors.

5.5 Knowledge gaps

From the analysis of the existing toolkits and independent software models, we conclude that forest health management has no dramatic software gaps although they might appear during adaptation of the existing tools to e.g. Mediterranean forests. In field health management, the biggest gap seems to be effects of ecosystems surrounding a field. In recreational site management, there are many critical software gaps. To bridge the software gaps, these effects and relationships may need to be found in published material. However, research literature may also contain gaps in describing these problems. Here we present results from such literature survey.

Effects of surrounding ecosystems to long-term crop yields

The concept of 'field health', adopted by the TESS project, appears relatively new in the context of decision support. The existing concepts are mostly limited to 'soil health', which is defined as the continued capacity of soil to function as vital living system, within ecosystem and land-use boundaries; to sustain biological productivity; promote the quality of air and water environments; and maintain plant, animal, and human health (Doran et al., 1997). Rosa & Sobral (2008) use term 'soil quality' which consists of soil health (dynamic soil quality) and soil suitability (inherent soil quality). However, for sustainable management of arable land, such approach seems still too narrow. For instance, in addition to soil quality, long-term crop production depends also on grassy field margin, pollinators, biocontrol agents and other biota which inhabit green areas near the fields. Except for the very simple pollination model of the InVEST toolkit, the existing reports ignore services of these surrounding ecosystems. Hence, a comprehensive decision support tool for managing ecosystems above the soils is still missing.

The existing information on services provided to agricultural fields by surrounding ecosystems, remains far from being a comprehensive quantitative model. However, most agricultural crops are dependent on insects which pollinate crops and control pests (an overview in Kremen & Chaplin-Kramer, 2007). MABES, a conceptual model (*mobile-agent-based ecosystem service*; Kremen et al., 2007) describes the effects of land-use changes to animal-mediated pollination and other ecosystem services provided by mobile agents. Ricketts et al. (2008) attempted to quantify the decline of crop yields with distance from natural/semi-natural habitat. They also quantified the effects of size of such habitat patch. However, the long-term effects of changes in these habitats on crop productivity still remains unclear as there are substitutes for wild pollinators and pollinator-dependent crops (Balmford et al., 2008). Their report admits that there is not enough empirical data on which to base a global model to evaluate how biological control services are affected by changes in wild nature. This model could be obtained following the same lines as for pollination (probably with leadership by the same group) but they suspect this would not be possible within the near future. They nonetheless recommend that further advice is obtained from experts on the feasibility of this particular task.

A solution to this gap might be non-quantitative decision support: either dialectic approach, reasoning support, expert system or any other alternative.

Management of recreational small lakes

Apparently, one economically viable sector of tourism in Europe is angling (see e.g. Steinback, 1999; Smith et al., 1999). However, as waterbodies and angling sites are very different while their management depends on diverse factors, including much uncertainty, a comprehensive model will remain missing in the near future. A solution to this gap might be also non-quantitative decision support: either dialectic approach, reasoning support, expert system or any other alternative. For instance, Ticehurst et al. (2007) proposed to apply Bayesian networks. Such approach has been widely applied recently (an overview in Castelletti & Soncini-Sessa, 2007).

Ecological implications of harvesting forest fruits

Sustainable harvesting of non-timber forest products has been addressed by many research papers (an overview in Ticktin, 2004). Ticktin (2004) indicated a large data gap in that ecological sector, calling for further long-term monitoring. In addition, very few studies have assessed the effects of harvest on genetic structure and diversity of harvested populations. Also, we have little information to date on the mechanisms underlying the observed effects of harvest.

5.6. Mismatches

In the classification of models (Aruvee & Piirimäe, 2010), it was concluded that computationally all models might break into eight clusters according to graphical mapping technology, time horizon and simulation technology. Non-GIS, non-spatial and steady-state or static models fell simultaneously into more than one cluster.

As all the discussed cartographic models as well as InVEST toolbox work in ESRI ArcGIS, their spatial integration might be relatively easy.

As the **Sustainable Forest Management Toolkit** (SFM) is already operational, it cannot suffer from serious mismatch problems. However, the current InVEST works as a simulation system while SFM provides different types of decision aid, such as teaching. Consequently, an attempt to pipeline InVEST and SFM would require rebuilding of InVEST on a more flexible basis.

For a **Field Health Toolkit**, InVEST, DSSAT, Apollo and MicroLEIS might be integrated as well as extended by GMO models (MAPOD, GeneSYS) and DSSs addressing ecosystem services of surrounding areas. Apollo has already integrated DSSAT. All cartographic models in this list use raster-GIS and prefer ESRI ArcGIS software. MicroLEIS DSS is a loosely connected toolkit system which could possibly involve DSSAT and Apollo as one component. All these models run in MS-Windows. From an integration perspective, we therefore do not see any commensurability or principal mismatch issue. However, similarly with forestry issues, MicroLEIS and InVEST contradict conceptually: while MICROLEIS provides a wide spectrum of various tools, including expert systems, neural networks and optimisation tools, InVEST provides a broader concept of ecosystem services. Their pipelining would require rebuilding of InVEST on a more flexible basis.

A **Recreational Site Management Toolkit** has been proposed by combining RBSIM and SODA. RBSIM is a stochastic autonomous agent-based model which has reported flexibly working in any GIS format. SODA, written in C++, runs in time steps between 5 min and 6 h. Both are individual-based models. Although we have not found any incommensurability or technical mismatch, both models are relatively narrowly built. Hence, challenges in pipelining these two models would need further assessment.

5.7. Conclusions

The InVEST project has provided a good integral framework for the development of a comprehensive ecosystem management toolbox. However, the first version of the

toolbox provides little practical decision support. This gap has partly been bridged by some more specialised toolkits.
The existing crop management toolkits cover soil health issues well but remain very limited in wider field health issues such as ecosystems around the fields (grassy field margin etc.) providing biodiversity, biocontrol agents, pollinators and other services. An existing Sustainable Forest Management Toolkit addresses forest health issues well. However, it has been applied mostly in Canada. Hence, adaption to the European conditions might appear challenging. There's no comprising recreational site management toolkit yet (figure 5.10). Thus, such a toolkit needs to be created. The core models for that might be RBSIM and SODA.

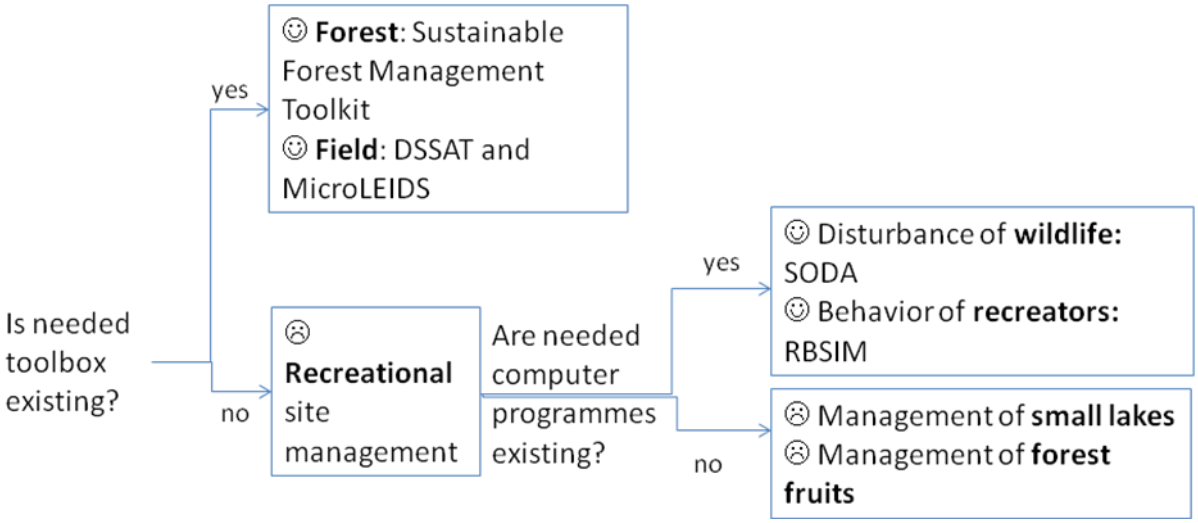

Figure 5.10. Results of vertical gap search

Considering the need for information for the management of various types of ecosystem services (Hodder et al., 2009; Kenward et al., 2010), the database seems adequately to provide models about some provisioning and supporting services (table 5.4). The serious gaps have been identified for biodiversity, regulating and cultural services. However, a search of all 2400 models scanned, of which only the 165 considered fit for the 3 pre-selected toolkits were added to the meta-database, might fill some of these gaps.

Table 5.4. Results of thematic gap search

Biodiversity	high	low	thematic gap!
Provisioning	low	high	ok
Regulating	medium	low	thematic gap!
Supporting	medium	high	ok
Cultural	medium	low	thematic gap!

5.8. References

Alexandrov, V.A., Hoogenboom, G., 2001. The impact of climate variability and change on crop yield in Bulgaria. Agric. Forest Meteorol. 104, 315–327.

Aruvee, E. & Piirimäe, Kr. 2010. Database of models that relate species and incomes to land use. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

Balmford, A., Rodrigues, A., Walpole, M., ten Brink, P., Kettunen, M., Braat, L., de Groot, R. 2008. Review on the economics of biodiversity loss: scoping the science. Final report, produced for the European Commission under Contract ENV/070307/2007/486089/ETU/B2.

Bennett, V.J., Beard, M., Zollner, P.A., Fernandez-Juricic, E., Westphal, L., LeBlanc, Ch.L. 2009. Understanding wildlife responses to human disturbance through simulation modelling: A managent tool. Ecological Complexity 6: 113-134.

Coates K. D., C. Messier, M. Beaudet, and C. D. Canham. 2003. SORTIE: a resource mediated, spatially explicit and individual-tree model that simulates stand dynamics in forest ecosystems. *Forest Ecology and Management* 186:297–310.

Castelletti, A. & Soncini-Sessa, R. 2007. Bayesian networks in water resource modelling and management. Environmental Modelling & Software 22: 1073 – 1074.

Colbach, N., Meynard, J.M., Clermont-Dauphin, C., Messean, A. 1999. GENESYS: A model of the effects of cropping system on gene flow from transgenic rapeseed. In: Gene flow and agriculture: relevance for transgenic crops. British Crop Protection Council, Farnham, ROYAUME-UNI. Pp 89-94.

Commons, M.L., Trudeau, E.J., Stein, S.A., Richards, F.A., Krause, S.R. 1998. Hierarchical complexity of tasks shows the existence of developmental stages. Developmental review. 18: 237-278.

Dillon, C.R., Shockley, J. 2010. Precision management for enhancing farmer net returns with the conservation reserve program. http://www.icpaonline.org/finalpdf/abstract_225.pdf

Dolter, C.S. 2006. Using biodiversity indicators to assess the success of forecasting adaptive ecosystem management: the Newfoundland and Labrador experience. USDA Forest Service Proceedings RMRS-P-42CD: 448 – 454.

Doran, J.W., Safley, M. 1997. Defining and assessing soil health and sustainable productivity. In: Pankhurst, C., Doube, B.M., Gupta, V.V.S.R. (Eds.), Biological Indicators of Soil Health. CAB International, Wallingford, Oxon, UK, pp. 1–28.

Doyon, F. and P. N. Duinker. 2003. Assessing forest-management strategies through the lens of biodiversity: A practical case from Central-West Alberta. Pages 207-224 *in* G. J. Arthaud, and T. M. Barrett, editors. *Systems analysis in forest resources*. *Proceedings of the Eighth Symposium* (Snowmass Village, Colorado, U.S.A 2000). Kluwer Academic Publishers, Dordretch. Series: Managing Forest Ecosystems, Volume 7.

Fetcher, J., Allison, B.E., Sivakumar, M.V.K., van der Ploeg, R.R., Bley, J., 1991. An evaluation of the SWATRER and CERES-Millet models for southwest Niger. In: Sivakumar, M.V.K., Wallace, J.S., Renard, C., Giroux, C. (Eds.), Soil Water Balance in the Sudano-Sahhellian Zone. International Association of Hydrological Sciences, Wallingford, UK, pp. 505–513.

Forestry Canada Fire Danger Group. 1992. Development and structure of the Canadian Forest Fire Behavior Prediction System. Forestry Canada, Science and Sustainable Development Directorate, Information Report ST-X-3, Ottawa, Ontario, Canada. (online.) URL: http://warehouse.pfc.forestry.ca/HQ/10068.pdf.

Hodder, K.H., Sharp, R.J.A., Perrella, L., Butters, J., Kenward, R.E. & Ewald, J. 2009. Synthesis report: Central and local information flows and decision making requirements. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

Hofman, D., 2005. LIANA Model Integration System – architecture, user interface design and application in MOIRA DSS. Advances in Geosciences 4: 9-16.

Johnson, P.A., & Sieber, R. 2009. Agent-based modelling: a dynamic scenario planning approach to tourism PSS. In: S. Geertman and J Stillwell (eds). Planning support systems best practice and new methods. Springer Science+Business Media B.V. Pp 211 – 226.

Jones, K., Hoogenboom, G., Porter, C.H., Boote, K.J., Batchelor, W.D., Hunt, L.A., Wilkens, P.W., Singh, U., Gijsman, A.J., Ritchie, J.T. 2003. Europ J. Agronomy 18: 235 – 265.

Kenward,, R.E:.& Sharp, R.J.A., 2010. Report on pan-European survey of assessment processes. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

Klein, E.K., Choimet, C., Gauffreteau, A., Lavigne, C., Messean, A., Meynard, J.M., 2008. Modelling impacts of cropping systems and climate on maize cross-pollination in agricultural landscapes. European Journal of Agronomy 28: 471 – 484.

Kremen, C. & Chaplin-Kramer, R. 2007. Insects as providers of ecosystem services: crop pollination and pest control. In A.J.A. Stewart, T.R. New and O.T.Lewis (eds) Insect conservation biology. The Royal Entomological Society..

Kremen, C., Williams, N. M., Aizen, M. A., Gemmill-Herren, B., LeBuhn, G., Minckley, R., Packer, L., Potts, S. G., Roulston, T., Steffan-Dewenter, I., Vázquez, D. P., Winfree, R., Adams, L., Crone, E. E., Greenleaf, S. S., Keitt, T. H., Klein, A.-M., Regetz, J. and Ricketts, T. H. (2007), Pollination and other ecosystem services produced by mobile organisms: a conceptual framework for the effects of land-use change. Ecology Letters, 10: 299–314

Lindenmayer, D., Hobbs, R. J., Montague-Drake, R., Alexandra, J., Bennett, A., Burgman, M., Cale, P., Calhoun, A., Cramer, V., Cullen, P., Driscoll, D., Fahrig, L., Fischer, J., Franklin, J., Haila, Y., Hunter, M., Gibbons, P., Lake, S., Luck, G., MacGregor, C., McIntyre, S., Nally, R. M., Manning, A., Miller, J., Mooney, H., Noss, R., Possingham, H., Saunders, D., Schmiegelow, F., Scott, M., Simberloff, D., Sisk, T., Tabor, G., Walker, B., Wiens, J., Woinarski, J. and Zavaleta, E. (2008), A checklist for ecological management of landscapes for conservation. Ecology Letters, 11: 78–91. Moore, R.V., Tindall, I., 2005. An overview of the Open Modelling Interface and Environment (the OpenMI). Environmental Science and Policy 8: 279 – 286.

Paz, J.O., Batchelor, W.D., Tylka, G.L., 2001. Estimating potential economic return for variable rate management in soybeans. Trans. ASAE 44 (5), 1335–1341. Paz, J.O., Batchelor, W.D., Jones, J.W., 2003. Estimating potential economic return for variable rate soybean variety management. Trans. ASAE 46 (4), 1225–1234.

Piirimäe, Kr. 2011. Provision of decision support in environmental management. Int. J. Sustainable Society. X: xxxx.

Quemada, M., Cabrera, M.L., 1995. CERES-N model predictions of nitrogen mineralized from cover crop residues. Soil Sci. Soc.Am. J. 59, 1059–1065.

Ricketts, T. H., Regetz, J., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C., Bogdanski, A., Gemmill-Herren, B., Greenleaf, S. S., Klein, A. M., Mayfield, M. M., Morandin, L. A., Ochieng', A., & Viana, B. F. 2008. Landscape effects on crop pollination services: are there general patterns? *Ecology Letters* 11: 499-515.

Rosa, D. De la, Mayol, F., Diaz-Pereira, E., Fernandez, M., Rosa Jr., D. De la. 2004. A land evaluation decision support system (MicroLEIS DSS) for agricultural soil protection. With special reference to the Mediterranenean region. Environmental Modelling & Software 19: 929 – 942.

Rosa, D. De la & Sobral, R. 2008. Soil quality and methods for its assessment. In: A.K. Braimoth and P.L.G. Vlek (eds), Land Use and Soil Resources. Springer Science + Business Media B.V.

Scheller, R. M., J. B. Domingo, B. R. Sturtevant, J. S. Williams, A. Rudy, E. J. Gustafson, and D. J. Mladenoff. 2007. Design, development, and application of LANDIS-II, a spatial landscape simulation model with flexible temporal and spatial resolution. *Ecological Modelling* 201:409-419 .

Smith, V.K., Webster, D.B., Heck, N.A. 1976. The management of wilderness areas: a simulation model. Decision Sciences 7: 524 – 537.

Smith, Ph.A., Mos, B., Carvalho, L., Williams, A.E., Howard, B.J. 1999. Toward a quantitative basis for the management of freshwater fisheries in sites of nature conservation interest. Psesented at the Institute of Fisheries Management 30th Annual Study Course held at Sparholt College.

Steinback, S.R. 1999. Regional economic impact assessment of recreational fisheries: an application of the IMPLAN modelling system to Marine Party and Charter Boat Fishing in Maine. North American Journal of Fisheries Management 19: 724 – 736.

Sturtevant, B. R., A. Fall, D. D. Kneeshaw, N. P. P. Simon, M. J. Papaik, K. Berninger, F. Doyon, D. G. Morgan, and C. Messier. 2007. A toolkit modeling approach for sustainable forest management planning: achieving balance between science and local needs. *Ecology and Society* 12(2): 7.

Tallis H.T., Ricketts T., Ennaanay D., Nelson E., Vigerstol K., Mendoza G., Wolny S., Olwero N., Aukema J., Foster J., Forrest J., Cameron D., 2008. InVEST 1.003 beta User's Guide. The Natural Capital Project, Stanford.

Ticehurst, J.L., Newham, L.T.H., Rissik, D., Letcher, R., Jakeman, A.J. 2007. A Bayesian network approach for assessing the sustainability of coastal lakes in New South Wales, Australia. Environmental Modelling & Sofware 22: 1129 – 1139.

Ticktin, T. 2004. The ecological implications of harvesting non-timber forest products. Journal of Applied Ecology 41: 11-21.

Thorp, K.R., DeJonge, K.C., Kaleita, A.L., Batchelor, W.D., Paz, J.O. Methodology for the use of DSSAT models for precision agriculture decision support. Computers and Electronics in Agriculture 64: 276-285.

Underhill, A.H., Xaba, A.B., Borkan, R.E., 1986. The wilderness use simulation model applied to Colorado River boating in Grand Canyon National Park, USA. Environmental Management, Volume 10, Issue 3, pp.367-374.

6. Pan-European Survey of information flows on biodiversity management decisions.

The following sections of this report describe the methodology applied in the TESS WP5 Pan-European survey of information flows on biodiversity management decisions. It compares the relative abundance of informal decisions made by local managers to the formal environmental assessments, and shows the information sources currently used by government authorities and other stakeholders for these decisions. Finally, it describes indicators derived from the governance processes that are being taken forward to be combined, with data from a previous FP6 project (GEMCONBIO) and indicators on environmental impact (e.g. the Streamlined European Biodiversity Indicators).

6.1. Survey Methodology

31 Country Coordinators, from the 27 EU states plus Norway, Switzerland, Turkey and Ukraine, were recruited to act as focal points for surveys in their countries. They were drawn from TESS partners in Belgium, Estonia, Hungary, Greece, Poland, Portugal, Romania, Turkey and the United Kingdom for the countries concerned, while for the remaining countries members or associates of ESUSG kindly agreed to act as Co-ordinators. They worked under the direction of the central team based in the UK who are the authors of this report. Illness and other personal factors affecting Co-ordinators meant that eventually usable returns were received from 24 EU and 3 non-EU countries. Due to the short time period within which the survey was carried out it was not feasible to find replacement Co-ordinators.

For their willingness to participate and their contributions to this work we thank: Professor Werner and Ms Joanna Pleschberger (Austria), Ms Mirian Lima (Belgium), Ms Sonya Zlatanova (Bulgaria), Mr Eleftherios Hadjisterkotis (Cyprus), Mr Frantisek Urban (Czech Republic), Mr Niels Kanstrup (Denmark), Professor Mari Ivask (Estonia), Professor Mikael Hilden (Finland), Dr Sylvie Vanpeene (France), Dr Melanie Mewes (Germany), Ms Olympia Papadopoulou (Greece), Dr László Szemethy (Hungary), Mr Des Crofton and Mr David Scallan (Ireland), Dr Guiseppe Micali (Italy), Ms Ligita Labane (Latvia), Dr Pranas Mierauskas (Lithuania), Mr Frank Wolff (Luxembourg), Mr Mark Dimech (Malta), Dr Hans de Iongh (Netherlands), Mr Vidar Holthe (Norway), Dr Zenon Tederko (Poland), Dr Pedro Beja (Portugal), Dr Ion Navodaru (Romania), Mr Peter Straka (Slovakia), Mr Borut Jerše (Slovenia), Dr Miguel Delibes (Spain), Mr Anders Grahn (Sweden), Dr Beatrice Senn-Irlet (Switzerland), Ms Basak Avcioglu, Mr Ercan Sutlu and Mr Engin Gem (Turkey), Ms Bridget Kenward (UK) and Dr Tetiana Gardashuk (Ukraine). We are also very grateful to the many officials in national and local governments, and individual farmers, foresters, and managers of fisheries, hunting areas and nature reserves who gave their time so that questionnaires could be completed. We thank also Ms Penny Holgate and Mr Chris Wheatley who helped to define sample areas, extract data and prepare diagrams for this report.

6.1.1. Survey levels and types of question

The survey was based on 3 questionnaires, (i) for National Level governments); (ii) for government at the lowest administrative level; and (iii) for the individual managers of land and species. In each case, Country Coordinators were required to approach appropriate officers or other individuals and ask them to provide the information for the questionnaires.

At national level, questions were on decision-making for Strategic Environment Assessment (SEA) and Environmental Impact Assessment (EIA) which are conducted to conform with the relevant EU Directives or parallel legislation, Biodiversity Action Plans and Strategies (BAP's, NBSAP's) which are carried out to fulfil obligations agreed by Parties to the Convention on Biological Diversity, allocation of resources from the budget of the EC Common Agricultural Policy (CAP) and other decisions made for Land Use Planning (LUP) that operates within a legislative framework set by government at national level. The questions concerned the department responsible for the decisions of each type, the tier of government at which assessments were made and decisions taken, the guidance provided for administrators and the sources of other information used in decision-making, the data collected in the process of decision-making and the roles of parties involved in this and any monitoring of decision outcomes, and the reporting on numbers and outcomes of decisions.

At local level, questions concerned responsibilities for SEA, EIA, Land Use Planning and any other decisions being made by local authorities; these responsibilities were for protection, management or restoration of biodiversity and ecosystem services on land managed by the authority or others in the administrative areas. Details were required on numbers of decisions and on areas of land affected and on priorities for environment, economics and other social factors when making decisions. Data were also requested on administered population and area, and proportions of land cultivated for farming or forestry. Other questions concerned the extent of consultation about decision-making with higher government, non-government organisations and individual managers of land and species. There were also questions on costs and benefits of wild species as perceived by local people, and on benefits for biodiversity from activities that involved use of land and species, in order to provide indicators of attitudes to natural biodiversity and those using these wild resources. Local authorities were also asked about categories of ecosystem services on which they required information, whether it was available and if so from what sources and in what format.

Individual stakeholders managing land and species were asked about numbers of decisions and areas concerned. Questions to the farmers, foresters, and managers of fisheries, hunting areas and nature reserves also concerned the types of environmental issue that they needed to address most frequently.

Most of the questions used in the survey had been piloted in the original 10 partner countries (also including Slovenia at that time), as reported in D3.3. This permitted a reduction in the number of final questions, by elimination of those that were too hard to answer usefully or that gave answers that were too invariable to be useful in comparative analyses. It also enabled a refining of the questions to minimise scope for ambiguous answers. However not all difficulties were avoided and with hindsight it would have been desirable to complete each questionnaire in full in one country before they were finalised.

The questionnaires were applied by Country Coordinators in slightly different ways at the different levels, with some variation between countries. Country Coordinators typically used personal knowledge to identify individuals responsible for the different decision areas at national level (SEA, EIA, BAP/NBSAP, CAP, LUP) and then approached these individuals by e-mail, telephone phone or in person for help completing the appropriate sections; a few coordinators were able to complete the forms mostly from personal knowledge. Due to the way in which government departments and agencies operate there were few if any cases where one focal point within government was aware of all the responsible officials of interest to the survey.

The questionnaires for local administrations were translated by Co-ordinators into national languages to ensure full understanding of the questions. Although questions had been reduced at both national and local level, reduction was maximised at local

level to aid their completion with minimal explanation (and hence scope for unwitting bias) required from the Country Coordinators. Local questionnaires were provided to administrations for review, accompanied by a standard introductory letter, either by e-mail or post. They were then completed remotely, by telephone or in a very few cases by personal visit.

6.1.2. Sampling Issues

The variation in cultural history and governance processes across Europe provides a rich field for analysis of associations between social institutions and impacts on the environment. However, robust analyses need statistically representative information and finding a basis for this presented a serious intellectual challenge.
In most of the countries surveyed environmental policy is administered at national level. In these cases at national level, only one ministry or agency was needed to answer specific questions. This was not the case where environmental policy is strongly devolved (e.g. Germany, Spain, UK) where representative but not necessarily comprehensive answers were given.
For the local surveys it was decided at the outset that in each country the aim would be to obtain five completed questionnaires, irrespective of the country's population size, from the lowest level of public administration involving elections, while ensuring that these administrations came from different regions. This would produce c.150 responses to each question, widely spread across Europe and the individual countries. Although TESS, as a decision support system, is relevant to all areas it was considered desirable to target rural areas in order to address the various land management activities mentioned above. Finally these areas would need to have a minimum population size in order for there to be a reasonable prospect of representative activities and attitudes. For example an area consisting wholly of mountain peaks could have almost no resident population and host only a ski facility: this would not be fruitful for the TESS survey.
Although it would have been easier for Country Co-ordinators to make their own selection of administrations on a representative basis, it was decided that to avoid bias and secure statistical rigour lists of the lowest level administrations in each country should be sampled with a stratified, randomised approach. The starting point for this exercise was the classification of regional and local authorities in Europe maintained by Eurostat, the Commission's statistical service. In this classification the most recent terminology for the lowest level is LAU2, with LAU1 being the tier above. The most common terminology for these lowest level units is "municipality", though historically they have been known as communes, gemeinde or parishes and have their origins in the medieval period. Lists of LAU2s were obtained from the Eurostat web site (NUTS 2009) arranged in geographically separated regions for each country and 5 regional lists were selected to give stratification based on landscape and/or culture in nationally recognised regions. For each selected region, a list of 5 LAU2s was produced by random sampling, using the first five that had a population of at least 200 (to achieve a representative administration) and a population density of <150 inhabitants per square kilometre (defined as rural in ESPON 2009, which makes clear that there is no standard definition of rurality for EU policy or statistical purposes). Because Eurostats felt unable to release density information, due to the basis on which it been obtained, it had to be gathered, at considerable cost in project time, by searching Wikipedia and national web-sites for the population and area information (Table 6.1). Another problem was that not all LAU2 units corresponded with administrative units with some form of governance. Some were merely electoral wards within larger authorities.

Table 1. Difficulties overcome in the LAU2 sampling:

- Lists for all countries not available from Eurostat
  - http://ec.europa.eu/eurostat/ramon/nuts/lau_en.html
  - Missing: Turkey, Switzerland
  - Solution: Wikipedia most up-to-date list
- Area and/or population of LAU2 not available from Eurostat
  - Solution: Wikipedia (some other online sources)
- Area and/or population of LAU2 not available from Wikipedia
  - In particular: Malta, Turkey, UK
  - Solution: Country Coordinator procured data from countries national statistics office
- Restructuring of LAU2 and other administration levels
  - In particular: Denmark
  - Solution: New list published on Wikipedia

Country Coordinators were instructed to ask for participation from the first LAU2 on each list. If that administration was unwilling, the next on the list was approached. If there was no willing partner amongst the five random LAU2's, re-sampling was used to get additional random LAU2's. There were substantial differences in refusal rates. These were still being analysed at the time of the report, with some follow up still necessary where survey fatigue continues to be an issue. Another problem arose for a small number of countries (e.g. Czech Republic, Germany) where LAU2s were not involved in EIA, SEA or LUP processes at all. In these cases the Country Coordinators also interviewed the LAU1 administration one level above the randomly selected LAU2 in order to obtain information specific to these topics.

Although it was possible to sample consistently in areas with population densities below 150/km^2, apart from the very high density communities on Malta and Greek islands (Figure 6.1), there was a huge range of population size among the LAU2 administrations in different countries, ranging from around 10 to 67,000 (Figure 6.2). Generally, there seems to have been a tendency to abolish very small authorities or to encourage them to combine with neighbouring authorities for the delivery of services and professional support. As the small administrations are closest to people, there is a very real tension between democracy and efficiency, the consequences of which are far from clear.

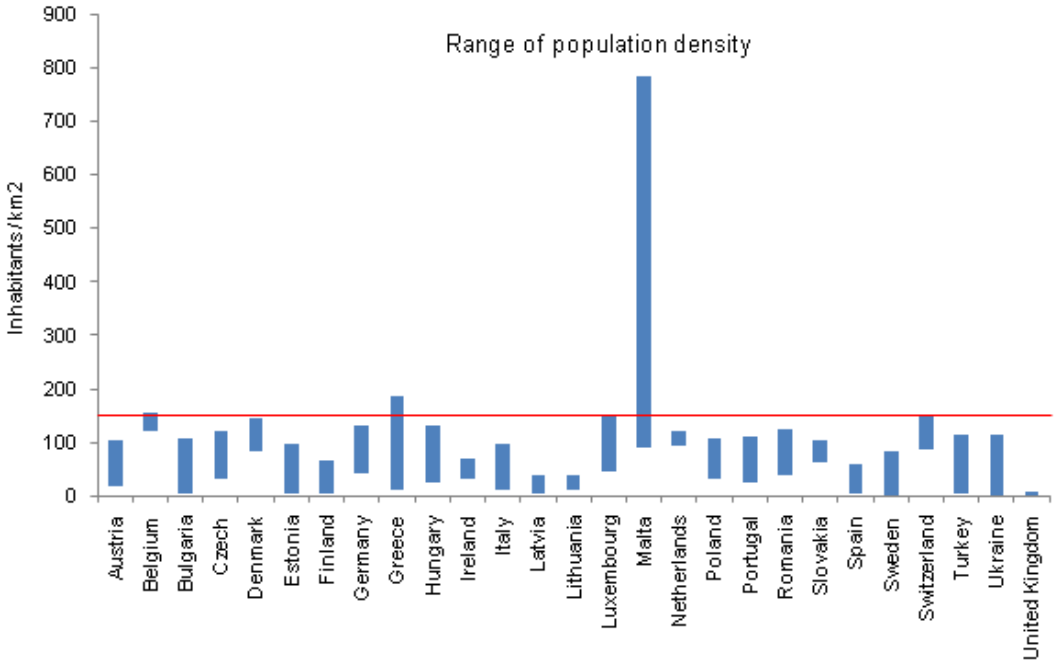

Figure 6.1. The range of human population densities in surveyed local administrations (LAU2).

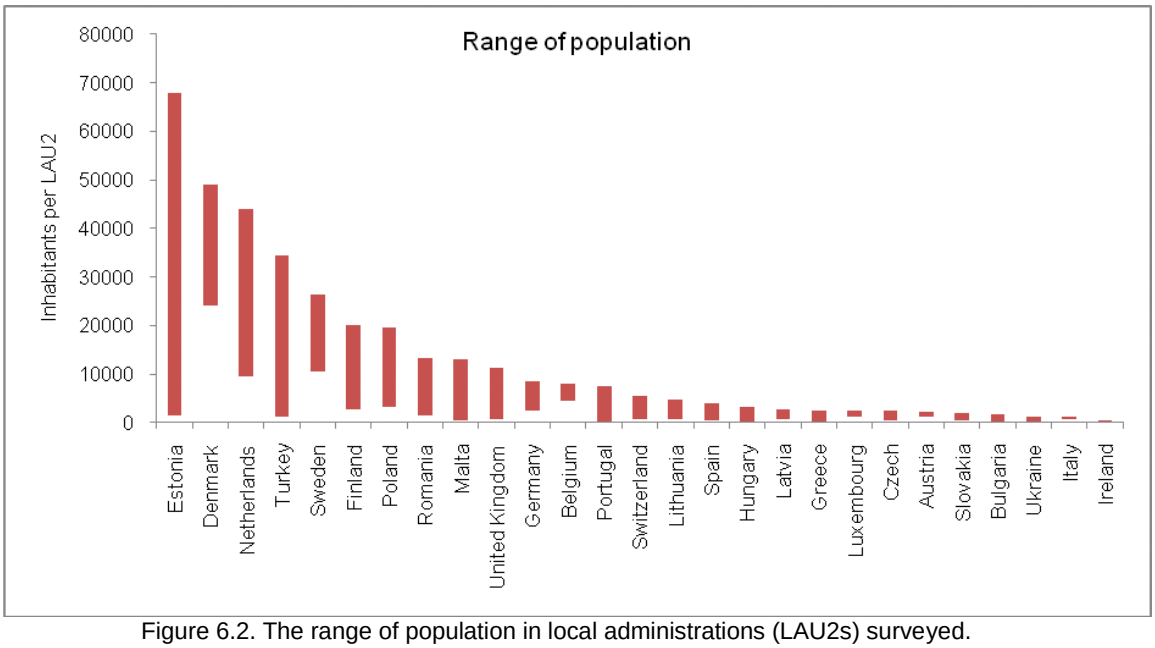

Figure 6.2. The range of population in local administrations (LAU2s) surveyed.

Sampling of individual managers of land and species depended on recommendation by the administration of one of the LAU2s. This was likely to bias the sample in favour of the more knowledgeable and responsible individual stakeholders, but should not have greatly affected the number of annual decisions per area of land managed. Analysis of decision intensity was based also on number of managers estimated for each LAU2, using the average area of each management unit and the area of land estimated from the proportion in each LAU, of farmland for farmers, forest for forest managers and both these plus semi-natural habitat for hunters. It was assumed that an average LAU2 would not contain more than one fishing management area or nature reserve. These analyses used only countries with responses from both administrations and individual managers.

6.1.3. Analytic Framework

The derivation of indicators for the analysis matrix in Task 6.1 was based on the analytic framework (Figure 6.3) developed in the preceding project on Governance and Ecosystem Management for Conservation of Biodiversity (Manos & Papathanasiou 2008).

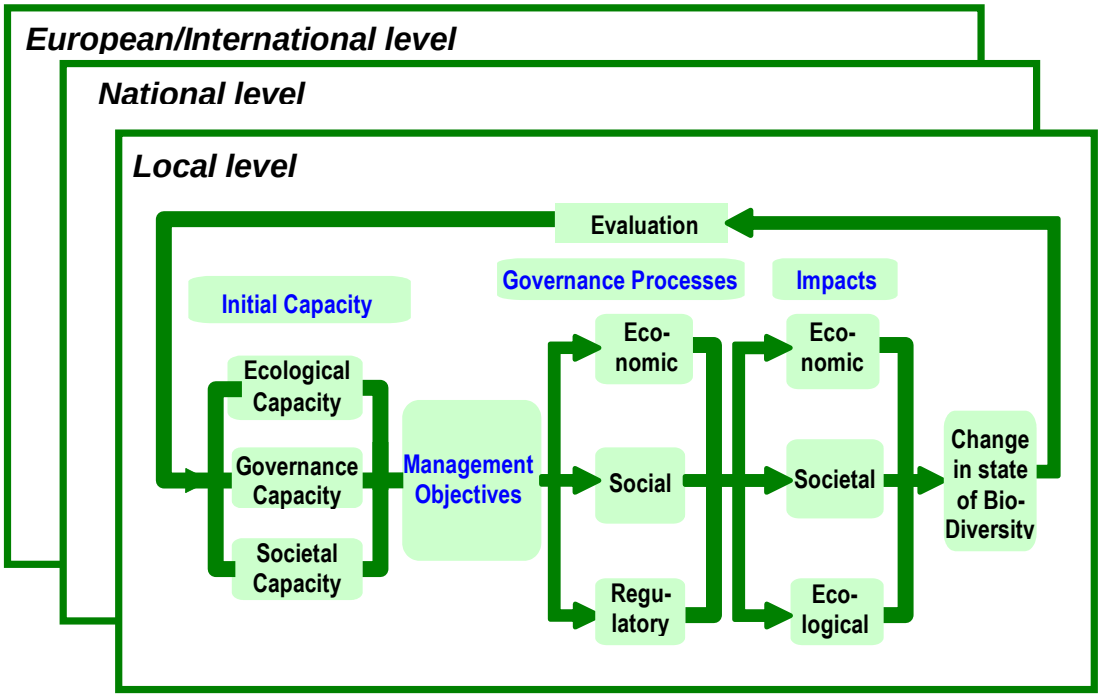

Figure 6.3. The analysis Framework from GEMCONBIO that is used as a basis for the governance indicators derived by the TESS Pan-European survey.

Broadly speaking, the availability of particular institutions and of information in various categories (indicated by its current use) are measures of Governance Capacity, with numbers of stakeholders in various interests as an index of Social Capacity and the proportions of land of various types as an index of Ecological Capacity. These have Management Objectives about which questions were asked directly and indirectly. Economic, Regulatory and other Social Processes are indicated, respectively and *inter alia*, by the provision of agri-environmental funding under the CAP, by the levels at which decisions are made and by presence or absence of different consultation practises. Societal impacts are indicated in these questionnaires by attitudes of local administrations to wildlife costs and benefits, whereas ecological and economic variables come from other sources. Examples are presented in this report for illustration, prior to separate delivery as a data matrix and its analysis in Work Package 6.

6.1.4. Time-frame

Country Coordinators, most of whom had assisted in the UNWIRE study of the preceding GEMCONBIO project, were recruited during the first half of 2009 and invited to the London TESS workshop in September 2009 to discuss draft questionnaires. Revisions then proceeded until mid-November, followed by translation and survey launch on 4 December 2009. Provisional end-dates were set at 31 January 2010, but holidays, weather and illness delayed the work appreciably. By the time of the Krakow TESS meeting in March 2010, completion at all three

levels had been achieved by 14 countries, with an estimated 75% of the information available from another 12; five countries had not started the survey. By the end of May 2010, the survey was complete in 23 countries, four still had some information to provide at national level and 1 at local level, and 3 countries were unable to undertake the work due to illness or other indisposition of Country Coordinators.

6.2. Decision Levels and Numbers

6.2.1. Decisions recorded at National Level

Authorities at National level were asked to specify the level (National, Sub-National, Local or between Local and Sub-National, here called Regional) or at which decisions on SEA, EIA, BAP, CAP or LUP are approved in their country (Figure 6.4). Clearly, approvals for CBD and CAP processes are given mainly at national level, whereas SEA and EIA approvals occur at all levels (with a tendency for strategic assessments to be approved at slightly higher levels. Other formal Land Use Planning proposals are approved locally.

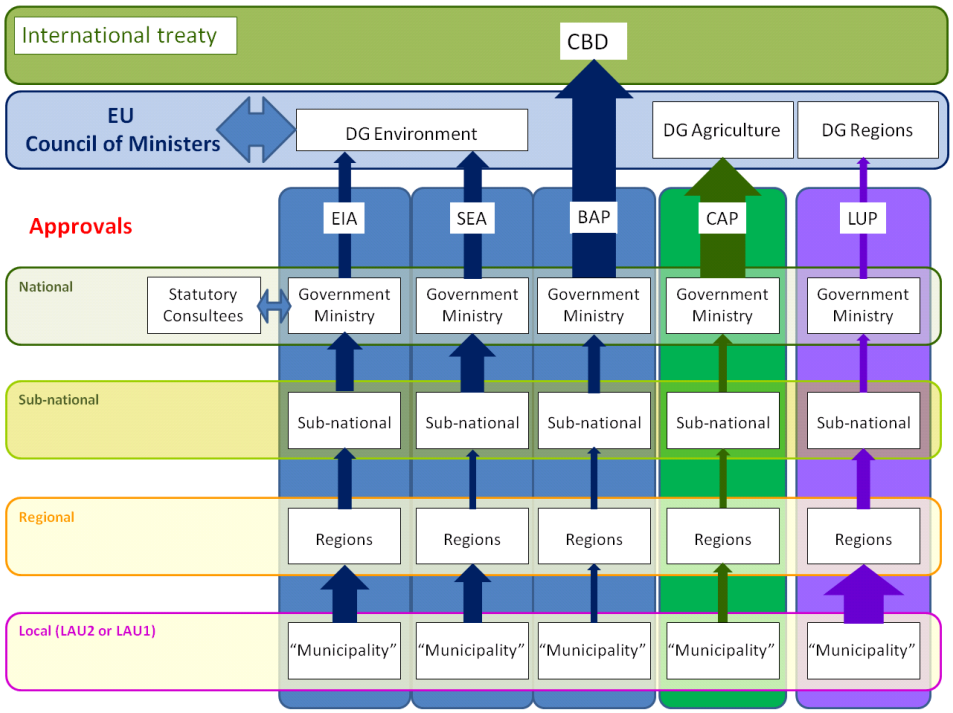

Figure 6.4. Arrow width reflects the lowest level at which decisions are made across countries. Decisions for CBD and CAP commitments occur mainly at national level, SEA and EIA at all levels and other formal Land Use Planning locally.

The numbers of SEA and EIA decisions registered in the 24 countries that reported (Table 6.2) were extremely variable and where Country Co-ordinators obtained figures these did not always correspond with those reported to COWI consultants who carried out EU wide enquiries for the Commission as part of its latest periodic review of the implementation of the Directives (COWI 2009a and COWI2009b). EIAs are for projects and might therefore be expected to relate to economic activity and population density. SEAs typically relate to sectoral plans of administrative areas and should therefore correlate with the total area of countries. However, some countries reported numbers of SEAs far greater than both their own EIAs and the SEAs in other countries, and at the same time few EIAs relative to other countries. Perhaps would be EIA in some countries may have been subject to strategic consideration in

others. To investigate potential for using formal assessments as a governance process indicator, which would require correction for country size (as this would influence population and hence EIAs as well as SEAs), in the short term we summed EIAs and SEAs. However, further analyses should use the average of both indicators (or EIAs alone where these are the only available data), probably also correcting up to the COWI value if that is larger because that would suggest that case numbers were under-reported in the TESS survey.

Table 6.2. Number of SEAs and EIAs completed annually within surveyed countries.

Country	SEAs (years covered)	EIAs (years covered)
Austria	77[ab] (2002-2008)	8[ab] (1994-2005)
Bulgaria	33[ab] (2007-2008)	157[ab] (2007-2008)
Czech Republic	50[a] (2009)	2394[a] (2009)
Denmark	No data	128[ae]
Estonia	30[c] (2009)	100[c] (2009)
Finland	1500[cd] (2006-2008)	45[ab] (2006-2009)
Germany	No data	775[c] (2005)
Greece	No data	1600[c] (1996 - 2009)
Hungary	90[c] (2006)	475[c] (2006)
Ireland	50[c] (2007-2009)	190[a] (2007-2009)
Latvia	60[ab] (2005-2009)	15[a] (2005-2009)
Lithuania	180[a] (2009)	1200[a] (2009)
Luxembourg	4[a] (2009)	30[c] (2009)
Netherlands	70[b] (2000-2009)	150[bc] (2000-2009)
Poland	No data	No data
Portugal	10[c] (2009)	102[a] (2000-2009)
Romania	84[c] (2006-2007)	179[c] (2006)
Slovakia	120[c] (2009)	565[a] (2009)
Spain	No data	215[be] (2002-2006)
Sweden	1600[a] (2006)	1750[bc] (2005-2006)
Switzerland	Not applicable	350[c] (2009)
Turkey	Not applicable	200[a] (2009)
UK	450[bc] (2006)	313[a] (2007)
Ukraine	13[bc] (2007-2008)	600[c] (2009)

a. Precise figure provided; b. Figure based on average of numbers or median of ranges depending on which were provided; c. Estimated figure provided; d. Includes land use plans; e. From COWI report Table 6.2– Annex 1 plus Annex II, if given.

It might be expected that the index of formal assessments would relate to land area in the countries, and in broad terms this was true (Figure 6.5). However, there was still a great deal of variation, and the strength of the relationship (P = 0.005) was highly dependent on results from the two smallest countries.

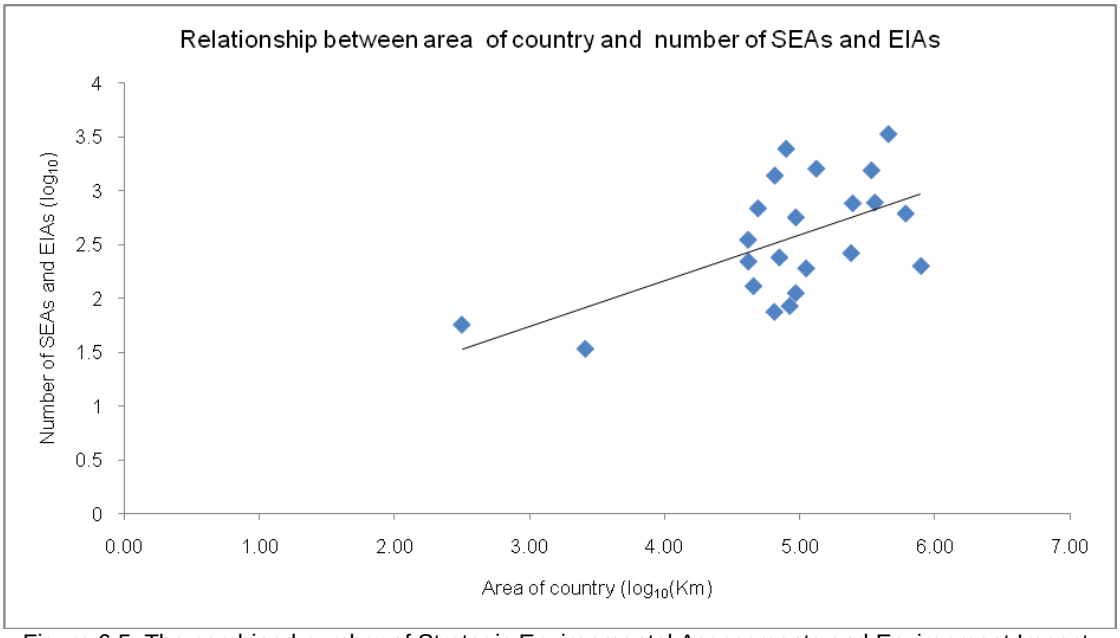

Figure 6.5. The combined number of Strategic Environmental Assessments and Environment Impact Assessments (from Table 6.2) increased with size of country.

Another factor that might associate with numbers of the statutory assessments is the level to which their approval was devolved, because at lower level there were more administrations to handle the decisions. This effect (Figure 6.6) also occurred (P = 0.025).

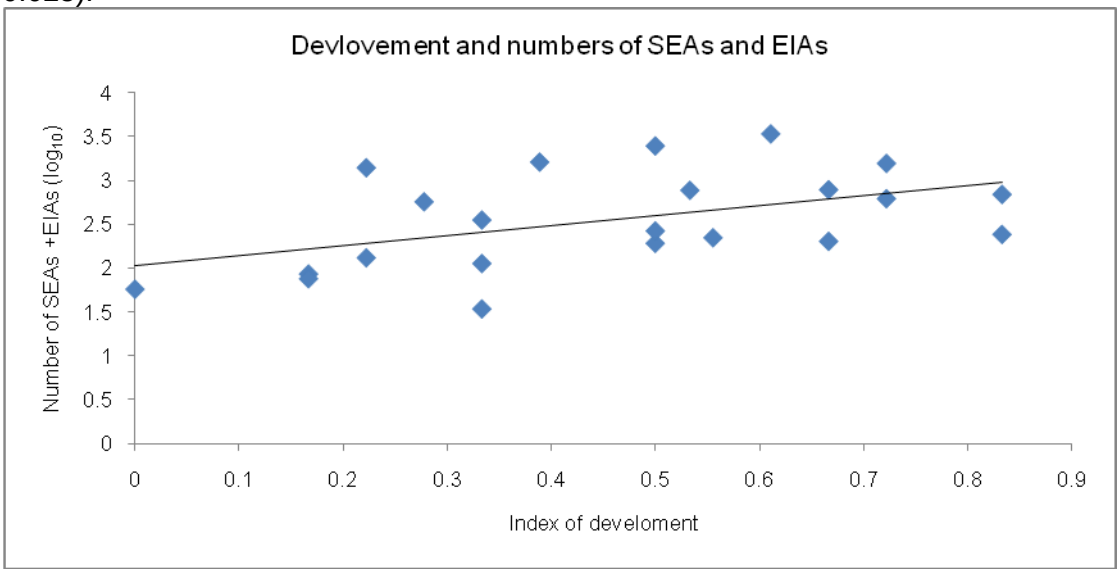

Figure 6.6. The combined number of Strategic Environmental Assessments and Environment Impact Assessments (from Table 2) increased with the extent of devolvement (with all decisions at local level =0 and at national level =1).

However, size of country and devolvement were also related, and attempts to separate the effects of size and devolvement on numbers of formal environmental assessments were not productive. Further analysis is required to discover what other governance factors may be associated with variation in numbers of these assessment processes. It is to be noted that the latest Pan-European surveys for the Commission (COWI 2009a and COWI2009b) throw no light on the large variation between EU member states in annual numbers of assessments carried out.

6.2.2. Decisions at local level

Local authorities recorded responsibility for formal (statutory) decisions separately from informal decisions involved in managing land and species in areas owned by the government or elsewhere. There was considerable variation on the responsibility of local authorities for informal decisions likely to affect biodiversity (Figure 6.7).

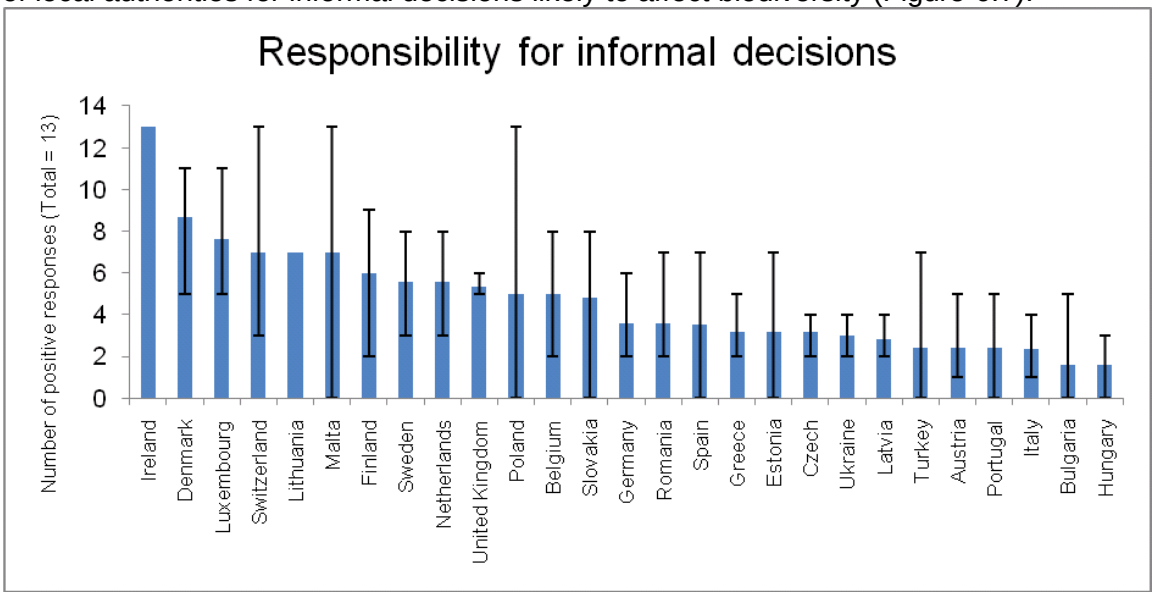

Figure 6.7. Index of local (LAU2) administration's level of responsibility for informal decision making, with a maximum score of 13 if there was responsibility for all listed matters on private land as well as land owned by the local authority. Error bars show the range of responses between 3-5 different LAU2s in each country.

Overall, hunters and reserve managers tended to make more informal decisions than local authorities. However, when formal environmental assessments were included, both government and private stakeholders averaged some 9-50 decisions/year (Figure 6.8).

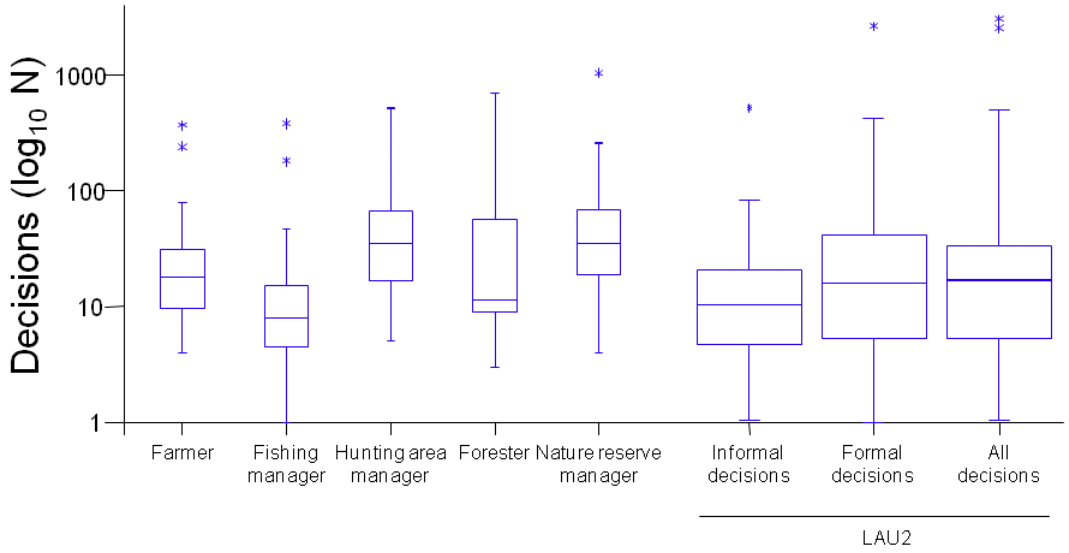

Figure 6.8. Numbers of management decisions affecting the environment that are made annually by private stakeholders & local councils (or their representatives). Data are shown as means with quartile boxes, decile bars and outlying values.

At local level, decisions were also assessed in terms of the areas estimated to be affected per decision. Informal decisions, probably mostly in council amenity land, affected much smaller areas than statutory assessments, so that average council decisions affected smaller areas than other stakeholders (Figure 6.9).

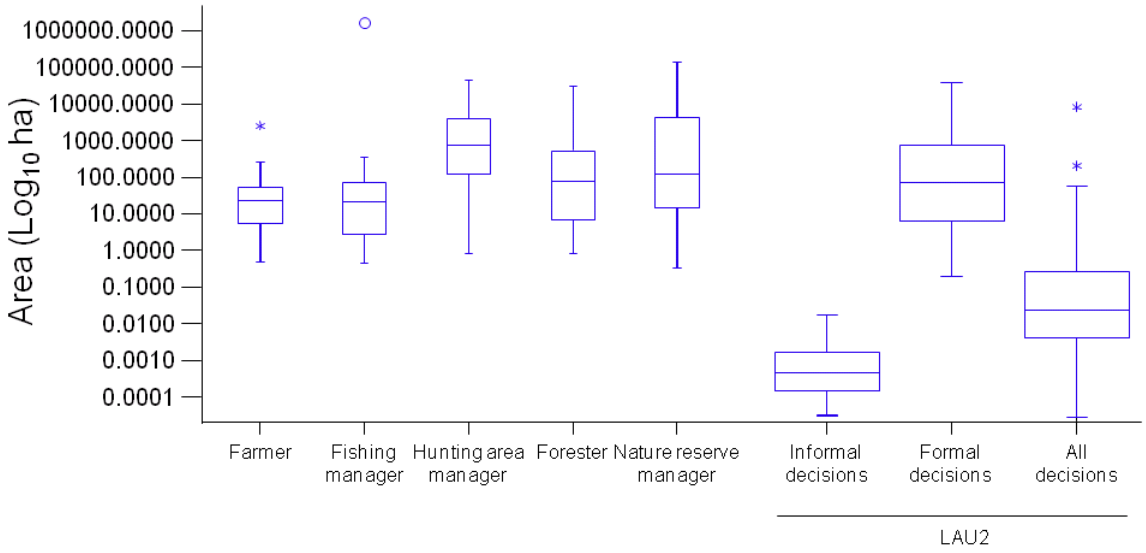

Figure 6.9. Area affected per decision, combining size categories of decisions made by managers and including all decisions of local authorities, as the sum of areas affected in each category divided by the number of decisions in all categories.

Taking into account the greater average areas affected by decisions of private managers and the greater number of them than of councils, all except managers of fisheries had a decision density 4-5 orders of magnitude greater than for local authorities (Figure 6.10).

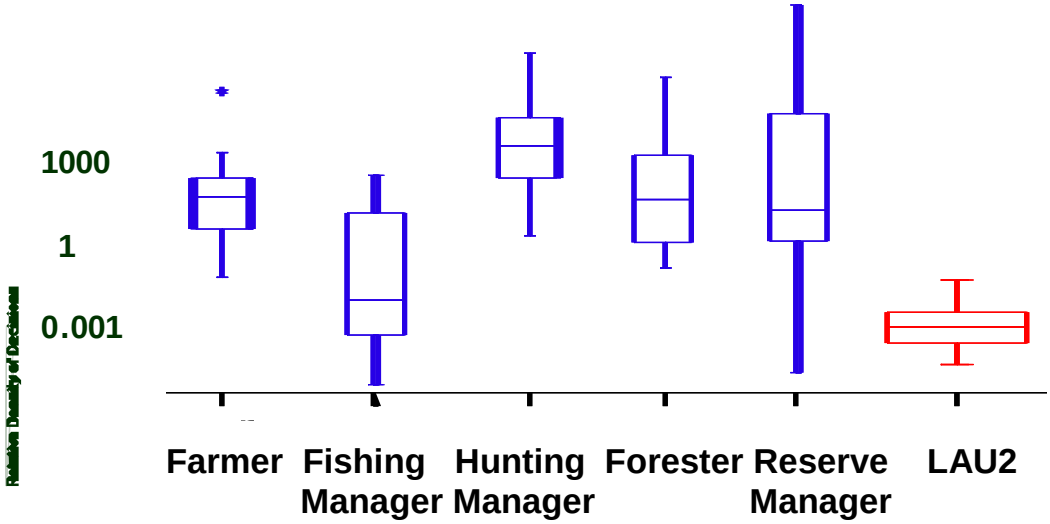

Figure 6.10. The intensity of decisions, taking account not only of decision numbers per management unit but also area covered by each decision and relative abundance of different management units, indicates greater importance of private than state decisions.

6.3. Information sources and types

Respondents at each level were asked to indicate all the sources used for information on biodiversity and ecosystem services. All respondents estimated that between a quarter and a third of their information came from government sources, including agencies. However, the proportion of information from other sources varied appreciably between levels. Information from published sources, including the internet, and from NGOs or consultancy firms, declined from 50% in total at national level to 38% for the average private manager and 29% for hunters (Figure 6.11). At the same time, use of local information increased from 16% to 35% for the average private manager and 42% for managers of hunting areas, who used most local knowledge, plans and records.

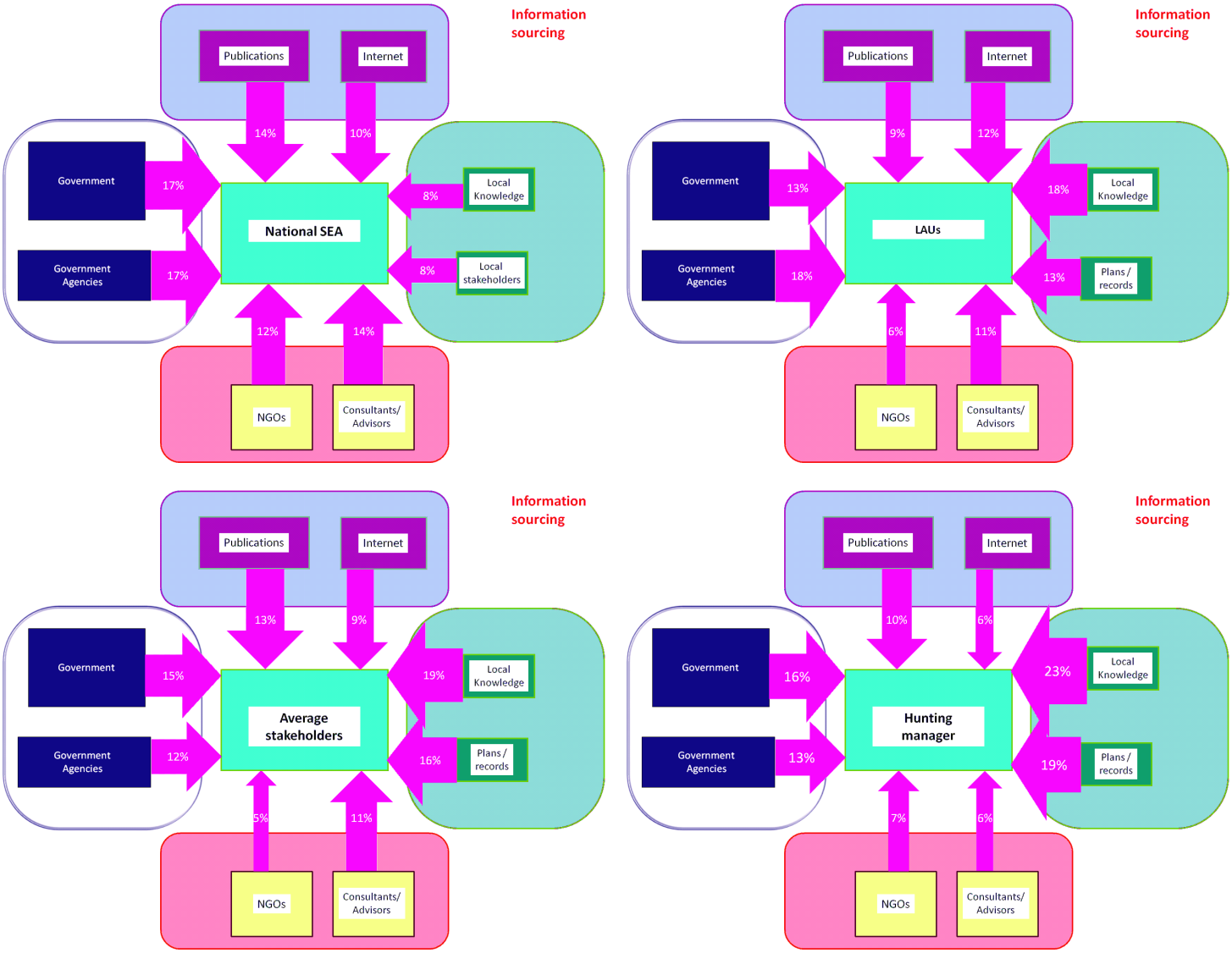

Figure 6.11. The proportion of information on biodiversity & ecosystem services that was reported from different sources by (in central boxes) (i) national government, (ii) local authorities, (iii) private managers of land and species in general and (iv) hunters in particular.

If the information from each of the eight sources is partitioned into that required for managing habitats, species, socio-economic considerations and hazards, it becomes clear that, compared with national governments, local authorities and managers are depending especially on their own information regarding habitats. At local level there is also dependence on government agencies and consultancy firms for information on socio-economic factors and environmental hazards (Figure 6.12), though this effect varies considerably between different private managers of land and species (Figure 6.13). In the case of managers of fisheries and nature reserves, it was information on species that came especially from consultancies and government or government agencies.

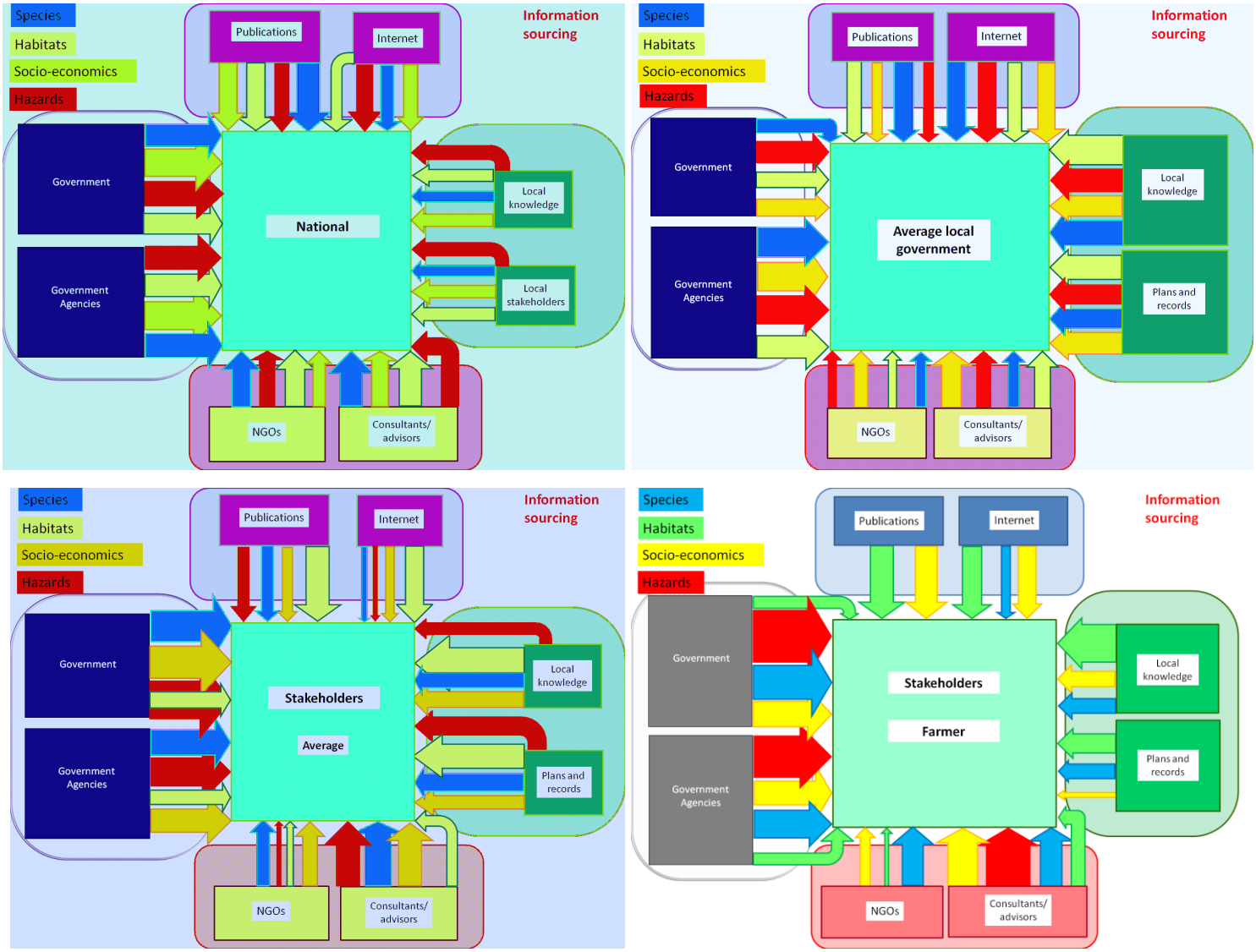

Figure 6.12. The proportion of information on species, habitats, socio-economic considerations and hazards that were reported from different sources by national government, local authorities, private managers in general and farmers in particular.

Although there are similarities in all groups, LAU administrators tended to report using Government agencies more than government itself, as well as getting more information from the internet and local sources. Farmers reported the highest use of the internet among the non-government stakeholders. These stakeholders used

publications more than was the case for LAU administrators, with the exception of hunting managers. The greatest use of NGO information was by managers of nature reserves.

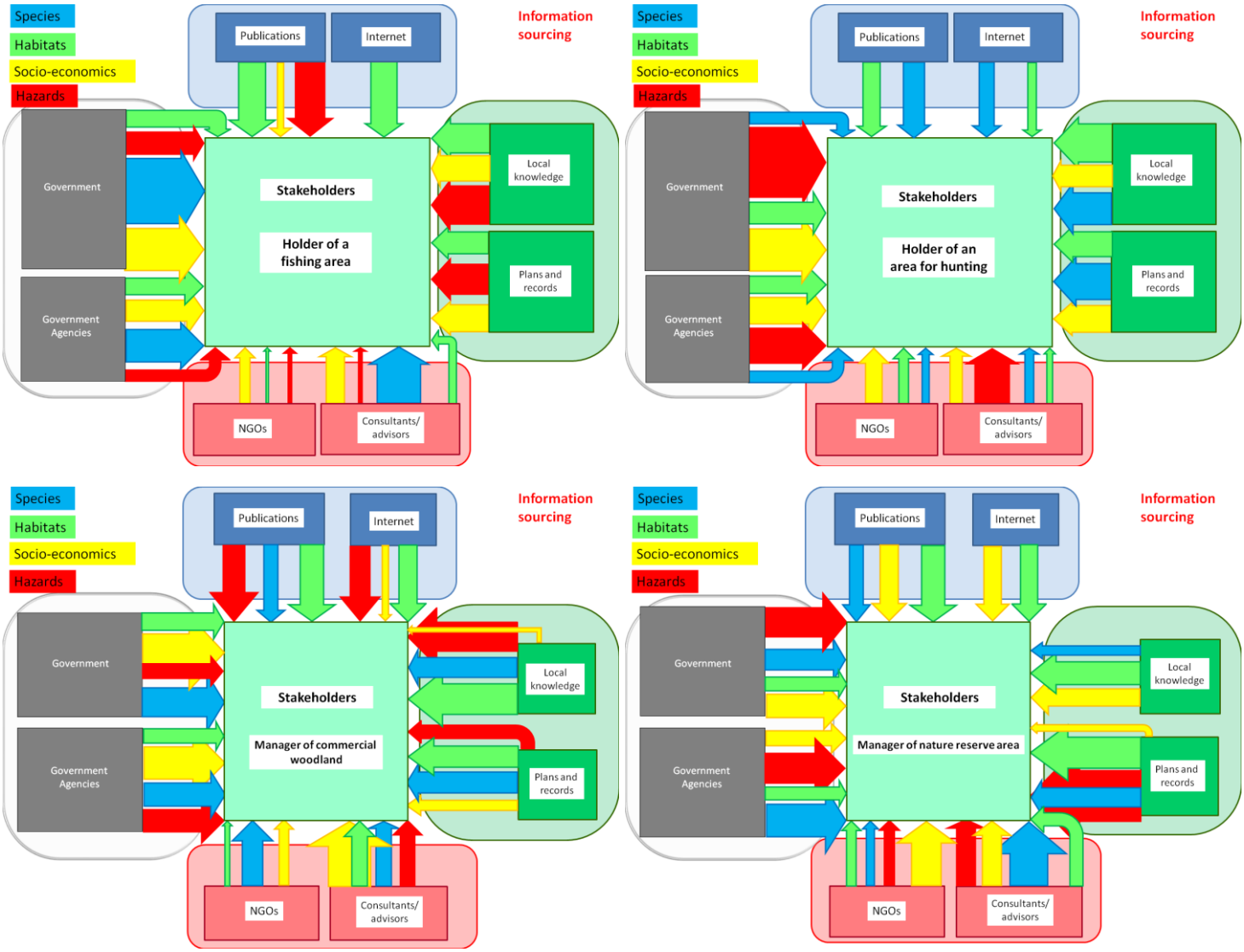

Figure 6.13. The proportion of information on species, habitats, socio-economic considerations and hazards that were reported from different sources by local managers of fishing, hunting, forestry and nature reserve areas.

Local authorities also recorded the information on biodiversity and ecosystem services that was needed and what was actually available. There was very great variation in both the need and the availability of necessary information (Figure 6.14a). The Czech Republic, Sweden and Switzerland stood out in requiring a great deal of information and having much of their needs met, with Germany, Luxembourg and the Netherlands well served in relation to more modest demand. Bulgaria, Greece, Ireland, Latvia, Malta and Portugal had large unmet demands for information, while the needs of Austria, Italy, Hungary and the UK were the most modest.

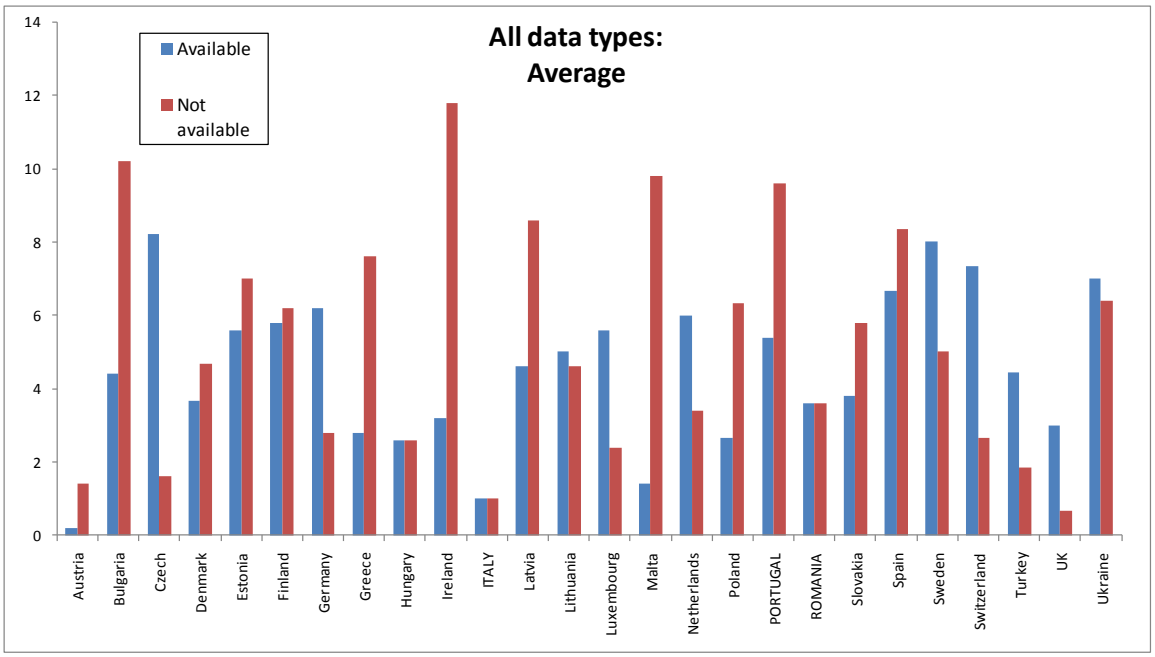

Figure 6.14a. The relative demand for data needed to make environmental decisions that was available, and unavailable, in local administrations across Europe.

Information requirement on ecosystems for provisioning (crops, medical, biofuels), regulating (flood/fire/disease hazards) and supporting (water/air/ soil quality) services was also highly variable (Figure 6.14b), whereas information on cultural services (amenity, recreation, tourism) was generally in high demand (except for Italy, which was most interested in natural hazards). Information on biodiversity (protected and harmful species and habitat maps) was also generally in high demand, except for Hungary, Italy and Lithuania.

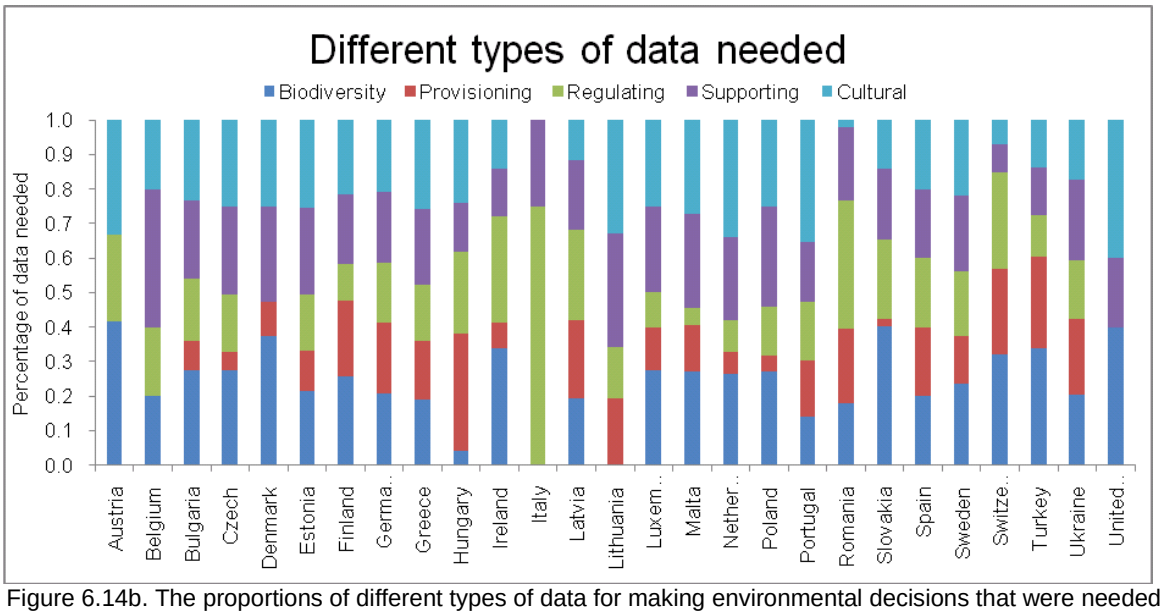

Figure 6.14b. The proportions of different types of data for making environmental decisions that were needed by local administrations.

6.4. Governance Indicators for further Analysis

Information from the previous sections, on the prevalence of decisions and the information currently used for them, is important for informing TESS design directly. This section considers indicators that will be used to assess factors that may contribute to best practise in conservation of biodiversity and other sources of ecosystem services, by association with least adverse changes in services across countries. These indicators, including those on devolvement of decision-making and Environmental Assessment density, local authority responsibilities and need of information, will therefore inform TESS design after further analysis in Work Package 6. Capabilities and processes indicated by that analysis may inform TESS design, and some of the indicators themselves may be useful for adaptive governance in future.

6.4.1. At National Level, for SEA and EIA

Consultation is an important part of the process for SEAs and EIAs, with a requirement for government departments responsible for policy to nominate statutory consultees, i.e expert national bodies, who must be consulted by those compiling assessments for EIA projects or SEA plans and strategies The number of these consultees was very variable, and it is notable that 5 states were apparently not fulfilling this obligation (Figure 6.15).

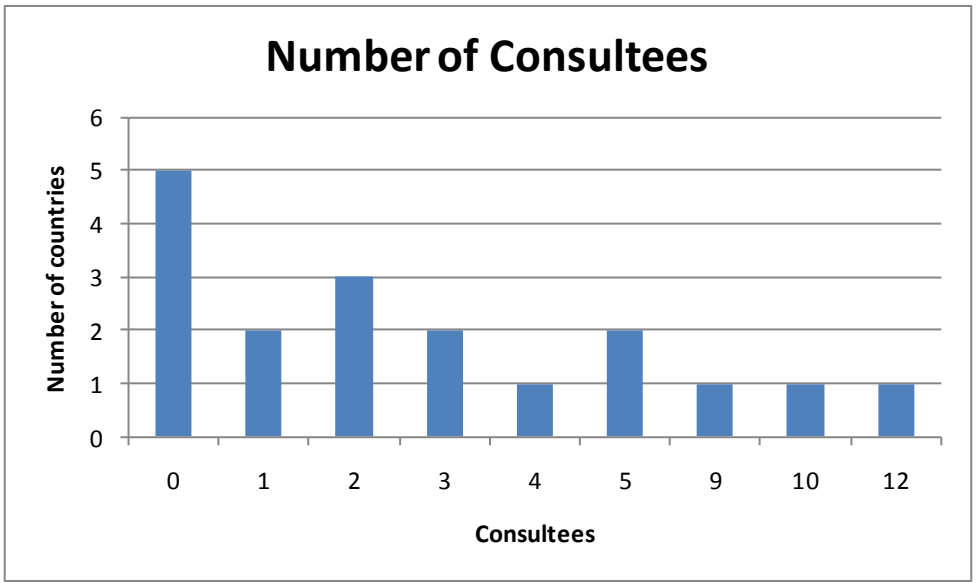

Figure 6.15. The number of statutory consultees for formal environmental assessment processes.

Only a minority of countries (8) reported referring to European level government for guidance on their SEAs. However, noting that 9 countries reported referring to European level government for guidance on EIAs (1-2 times annually in all cases except one state that reported taking advice from European Commission about 6 times a year), there is scope for combination in an index of international consultation. Of 21 countries, 14 combined standard guidance literature with a requirement for reference from lower levels to national level for these assessments, with either literature or referral alone in 5 more (Figure 6.16).

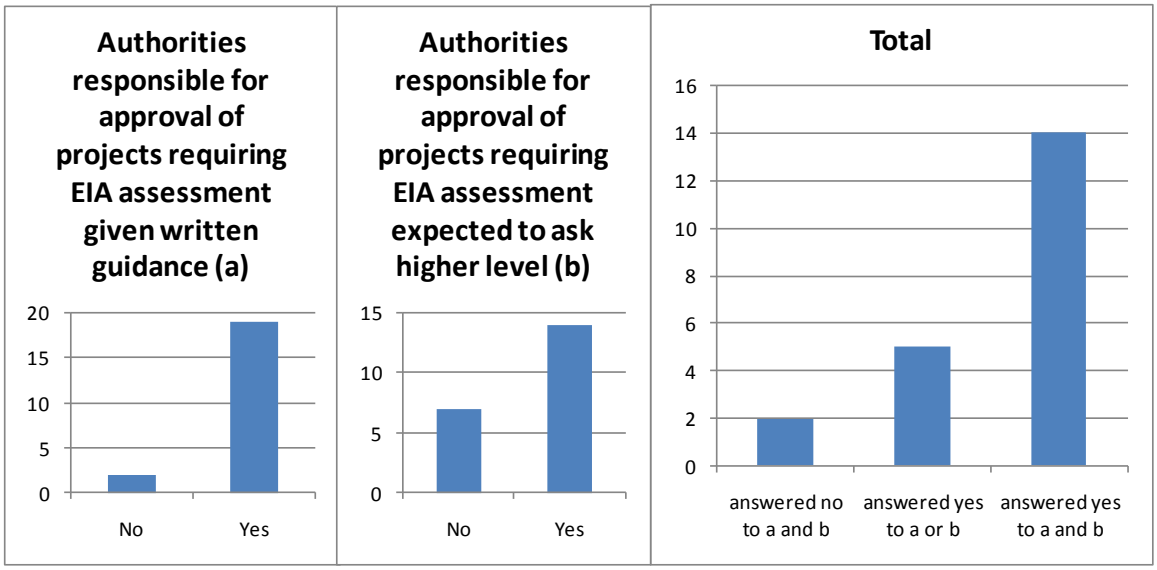

Figure 6.16. Extent of knowledge leadership provided by higher authorities for Environmental Impact Assessment in survey countries.

Since 2002, SEA has been applied to plans and programmes covering (i) Sustainable development, (ii) Ecological infrastructure, (iii) Waste management, (iv) Transport, (v) Energy, (vi) Climate change, (vii) Agricultural, (viii) Forestry, (ix) other sectors. The majority of countries addressed 7-9 of these nine possible topics for SEA, although assessments in three countries considered only 2-4 of them. The lack of variability makes this a poor process variable for further analysis.

It was also usual for NGOs to be able to comment on EIAs, with 1-2 NGOs being routinely consulted in 7 countries and 4-6 in 14 countries. This distribution was quite strongly bimodal with peaks at only 1-2 and also with a full list of 6 NGOs (Figure 6.17).

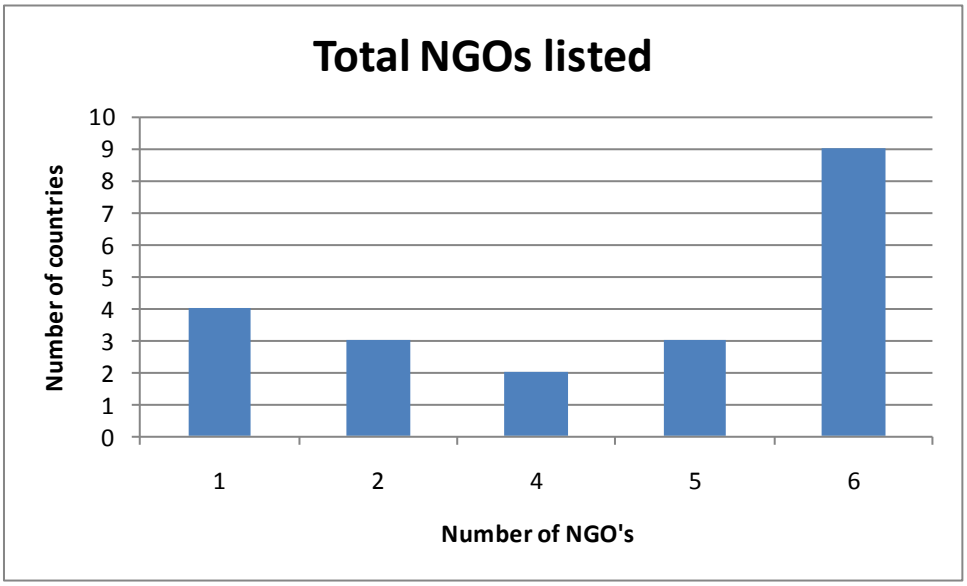

Figure 6.17. Extent of higher authority consultation on Environmental Impact Assessment with NGOs in survey countries.

All countries reported requirement in EIA processes for developers to present alternative development approaches and to offer mitigation, through creation of conservation benefit elsewhere, such as habitat creation, and in many cases this was mandatory. Similarly, there was a general requirement, often mandatory for monitoring of the results of the decision if development followed. However, there was

appreciable variation in whether these conditions were always mandatory (Figure 6.18).

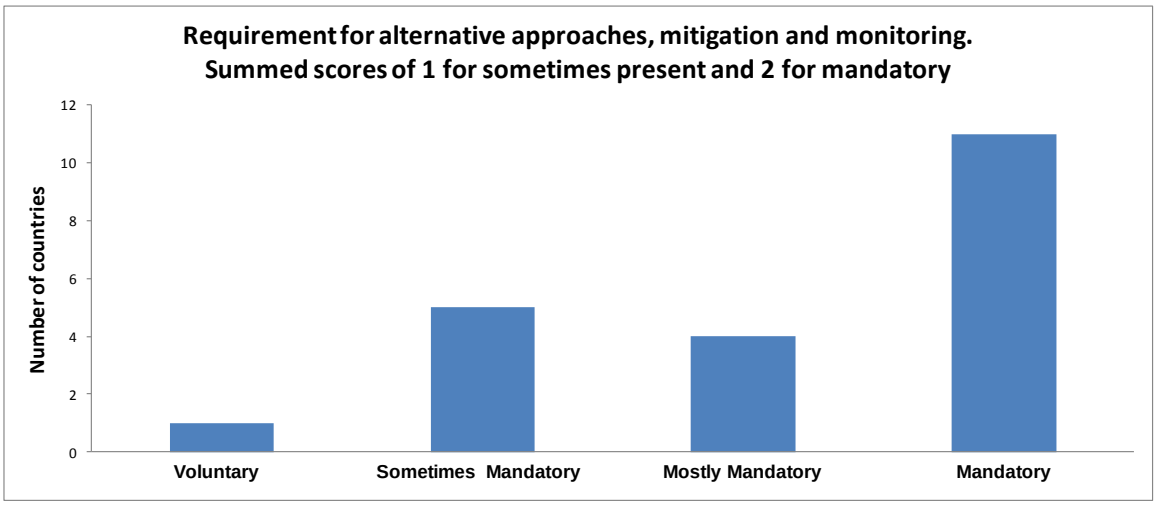

Figure 6.18. Provision of alternative approaches, mitigation and monitoring was always mandatory for EIAs in 11 countries, sometimes in 9 and never in 1.

In all countries the developer paid for the EIA, and in all cases except one was involved in collecting the information, albeit it 9 cases together with government and NGOs. Responsibility of the developer in any monitoring was more varied (Figure 6.19).

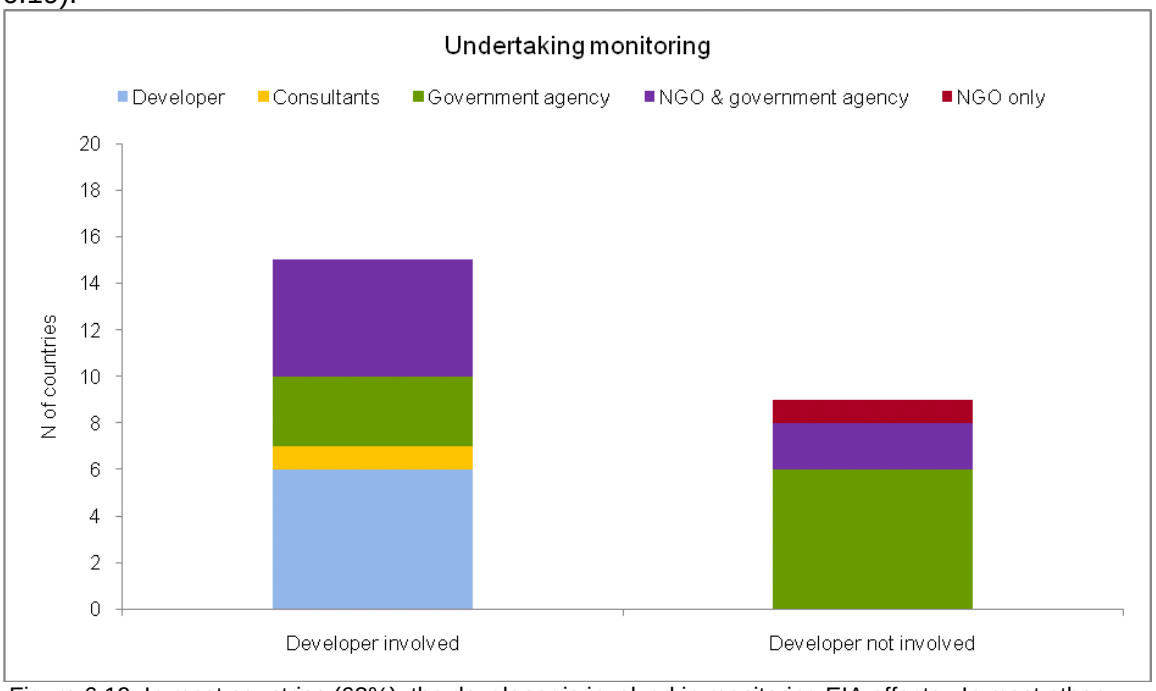

Figure 6.19. In most countries (63%), the developer is involved in monitoring EIA effects. In most other countries, government agencies are strongly involved.

It is interesting to note that the developer is also not always responsible for paying for the monitoring of EIA outcomes. In most countries (75%), the developer is involved in paying for subsequent monitoring, although in just under half of these there is some costs borne by NGOs or government agencies. In the 25% of countries where there is developers do not pay for monitoring, the total cost is met by government (Figure 6.20).

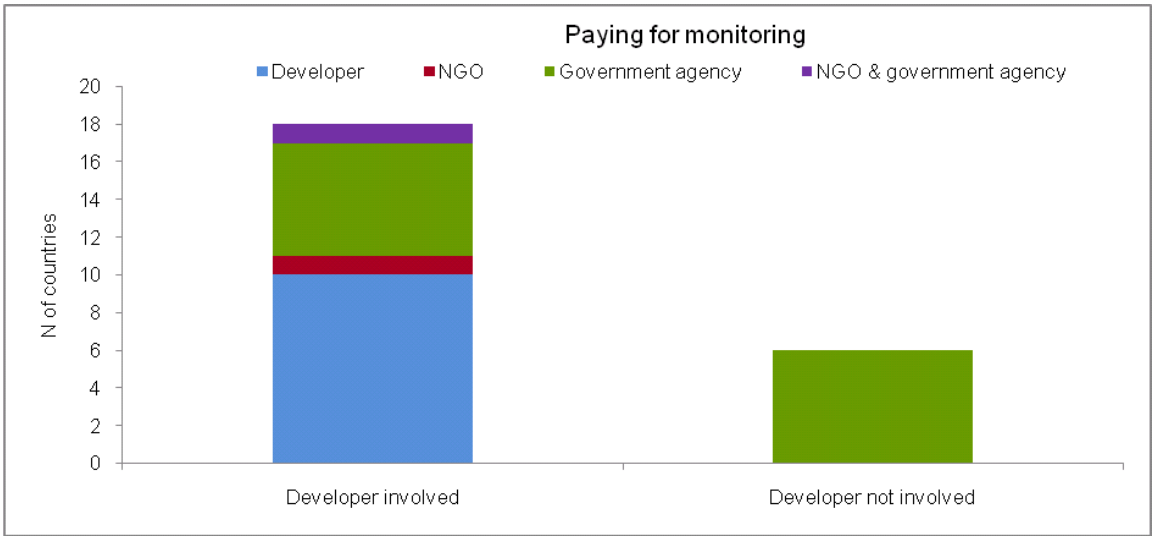

Figure 6.20. Payment for monitoring EIA outcomes is not always by the developer.

Indices for payment and monitoring showed that developer influence was highest relative to government and NGOs in Netherlands and Portugal (Figure 6.21). An index of relative responsibility of developer and government for payment (e.g. +1=developer alone, 0=developer+government, -1=government alone) should perhaps be separated from one for monitoring based on the relative responsibility of developer and NGOs (e.g. +2=dev+consult, +1=dev+gov, 0=dev+gov+ngo, -1=gov, -2=gov+ngo).

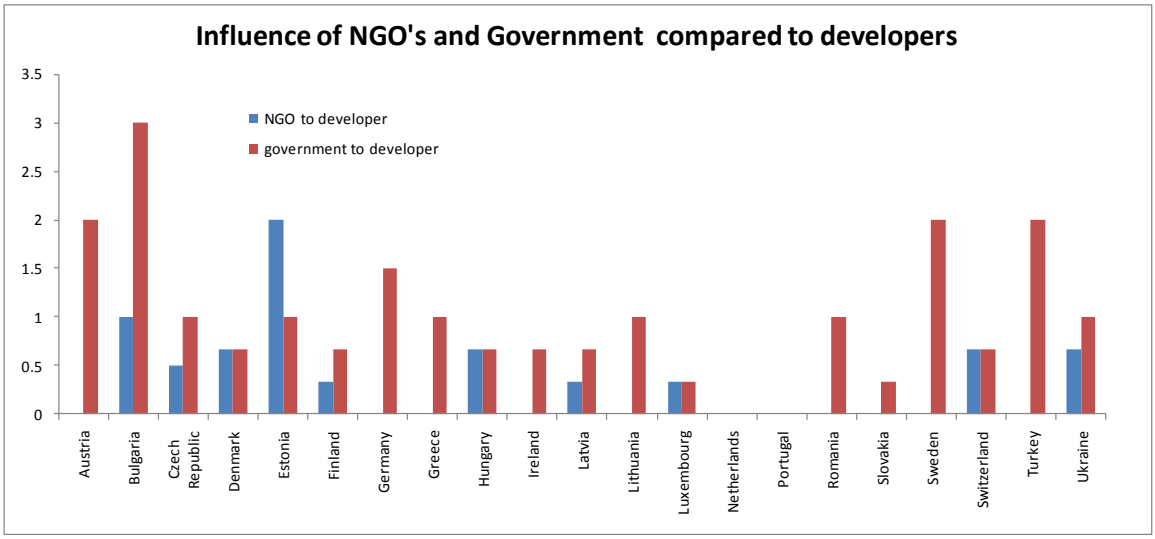

Figure 6.21. Scores for influence of government and NGOs to developers in EIA.

There is also some variation in the availability of information from EIAs (Figure 6.22). Of 24 countries, 6 (25%) restrict information availability to government.

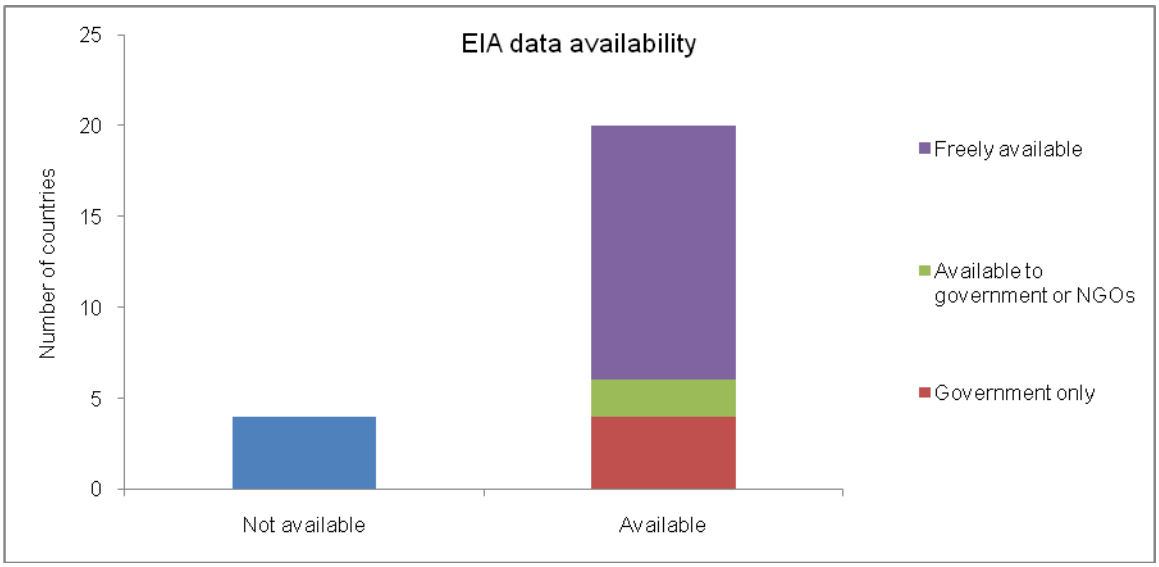

Figure 6.22. Ten of 24 countries do not release EIA information outside government.

6.4.2. At National Level for BAP/NBSAP

To comply with commitments to the Convention on Biological Diversity, countries are required to produce National Biodiversity Strategy Action Plans (NBSAPs), sometimes just called Biodiversity Action Plans (BAPs). In 10 cases this involved government alone (Figure 6.23); in 13 cases there were partnerships (with a strong government role in 6).

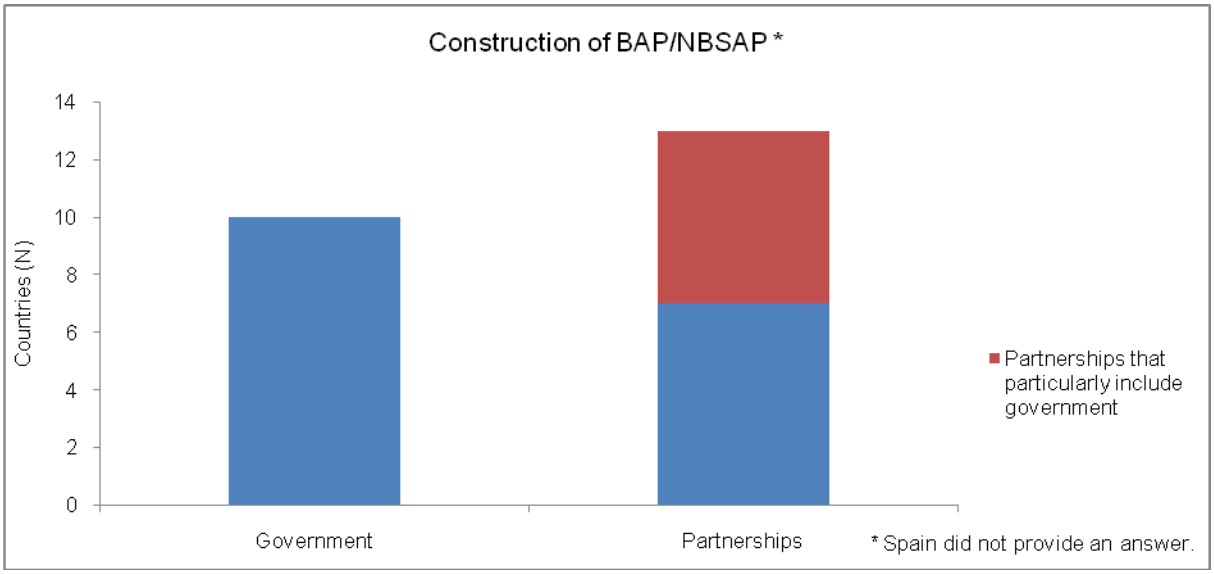

Figure 6.23. The institutions involved in preparing Biodiversity Action Plans.

Most countries have done plans only at national level. In one case the plans were only for habitats, in two cases only for individual species, and in six cases only for individual species and individual habitats. In 8 countries, all plans were composite for species and their habitats, and in 3 a mix of individual species and habitats or

composites, with 4 countries having no plans (Figure 6.24a). Only 6 of 24 countries were conducting local biodiversity action plans, in 2 cases only for individual species (Figure 6.24b).

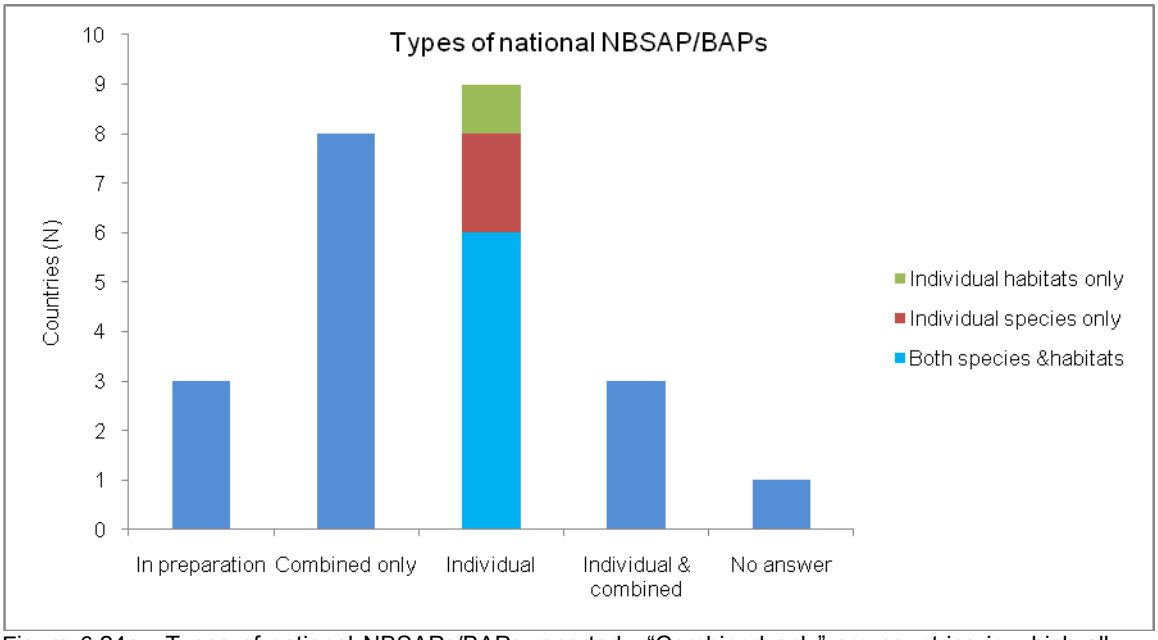

Figure 6.24a. Types of national NBSAPs/BAPs reported. "Combined only" are countries in which all plans considered both species and habitats simultaneously, whereas individual plans considered species separately from habitats.

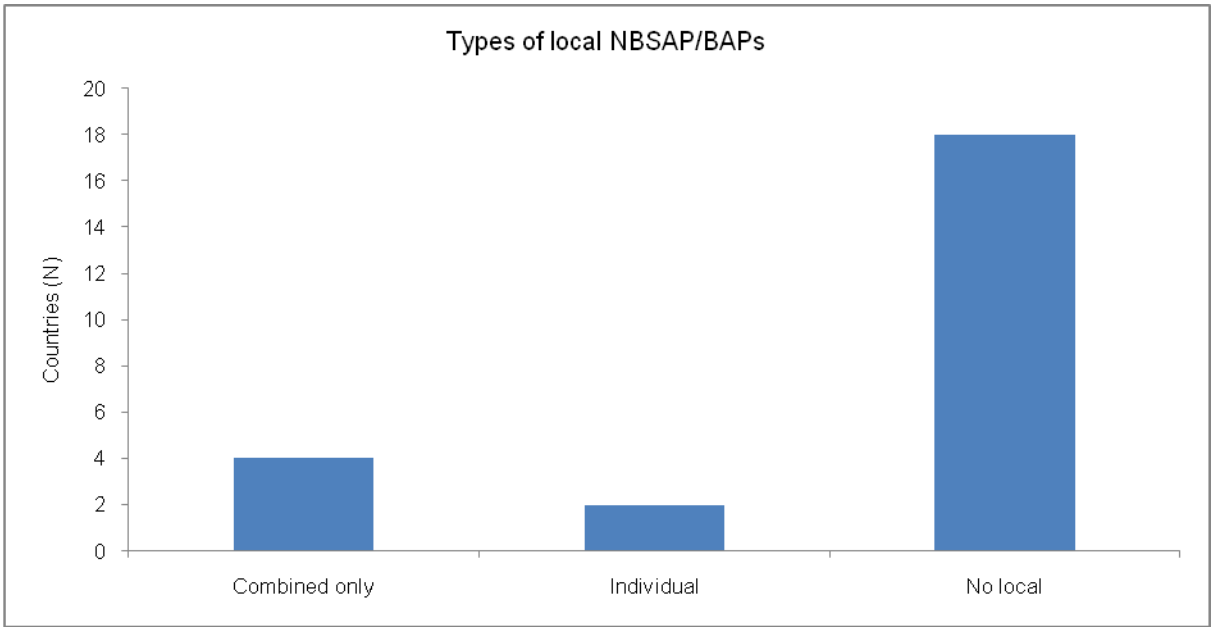

Figure 6.24b. Types of local NBSAPs/BAPs. "Combined only" are countries in which all plans considered both species and habitats simultaneously, whereas individual plans considered species separately from habitats.

6.4.3. At National Level for Agri-Environment Schemes

Agricultural Environment Scheme (AES) payments have been available in most countries (75%) for all land where appropriate conditions are observed; most other countries only provide payments in Natura 2000 sites (Emerald Network outside the EU), although Bulgaria makes payments for these and other designated land (Figure 6.25). Most countries require a map from applicants before giving funding and in only

3 cases (Netherlands, Slovakia and the Ukraine) do not accept a digital map (Figure 6.26).

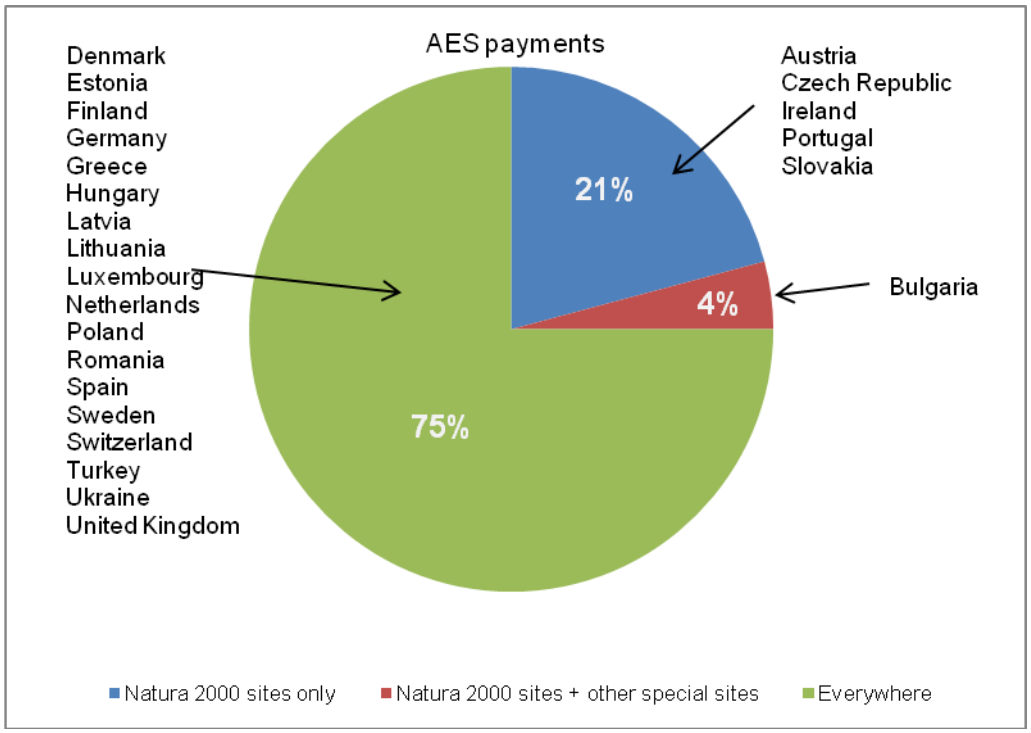

Figure 6.25. The designation of land for which AES payments are available.

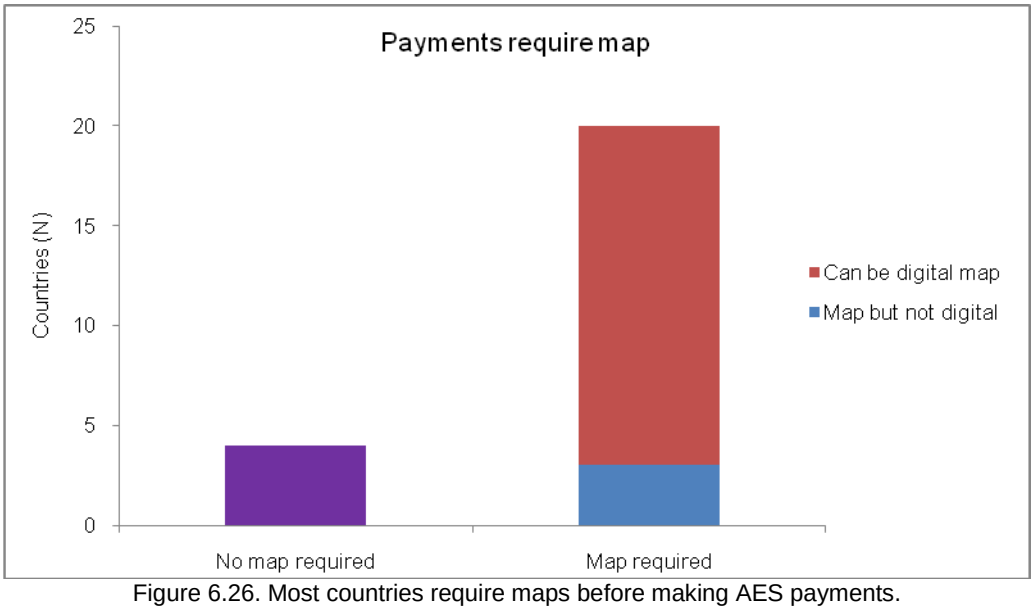

Figure 6.26. Most countries require maps before making AES payments.

Most countries also require information on species or habitats before making payments (Figure 6.27). As the countries without map requirements are Austria, Greece, Switzerland and Turkey, it is only Greece requires neither the biodiversity information nor a map.

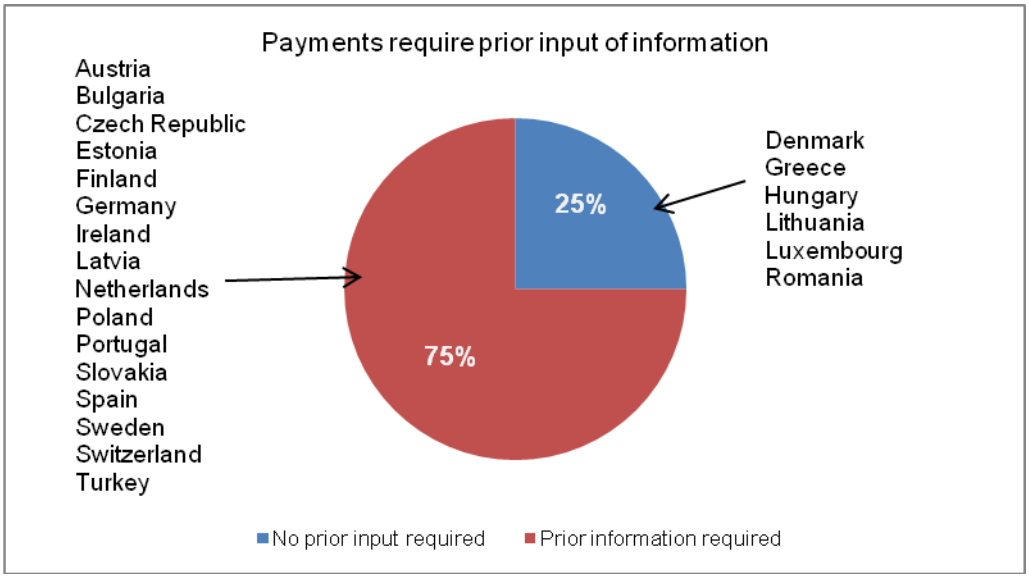

Figure 6.27. Countries that require species or habitat information for AES payments.

Of 24 countries, all monitor compliance in AES schemes except for Lithuania and Slovakia. Hungary, Luxembourg, Sweden and Turkey only check compliance, but in 18 countries (75%) there is also monitoring of environmental outcomes (Figure 6.28).

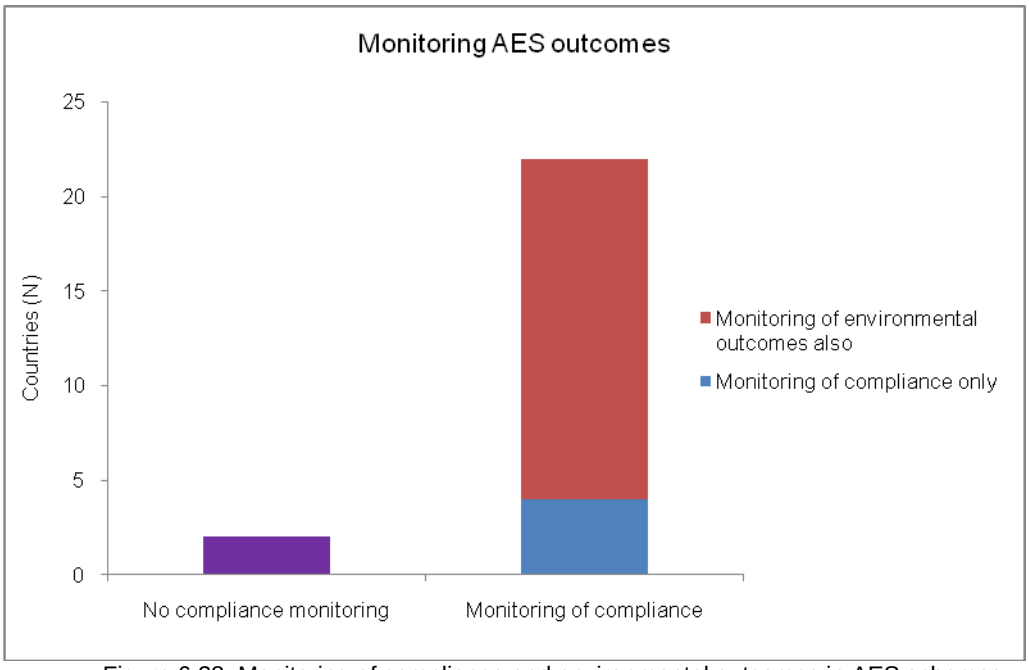

Figure 6.28. Monitoring of compliance and environmental outcomes in AES schemes.

6.4.4. At National Level, for all Land Use Planning

The ability to make consistent environmental decisions is likely to be influenced by whether government issues guidance (a) to those making decisions for statutory assessments and on land use, and (b) to those who comment on the process. The sum of guidance documents is a simple indicator of such guidance (Figure 6.29).

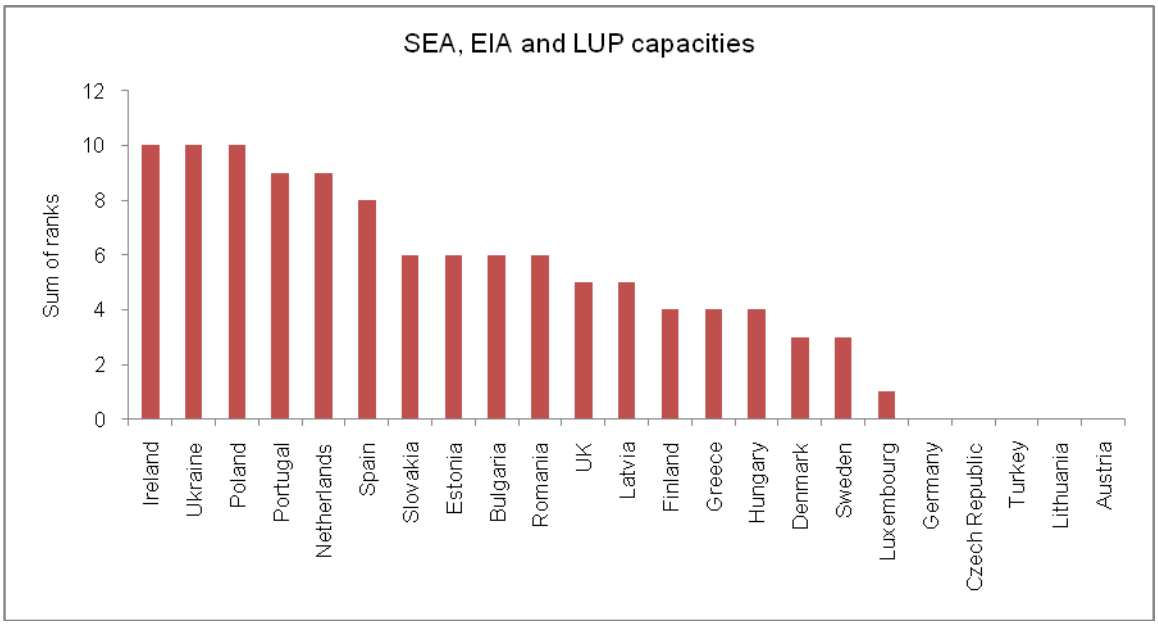

Figure 6.29. Presence and number of guidance publications for SEA, EIA and LUP.

Other measures of capacity were the accessibility and quality of data for environmental assessments and land use planning. Scores of accessibility were based on whether all or some of the date were (a) accessible to anyone concerned, (b) accessible via the internet (c) fragmented (i.e. are there multiple sources) and (d) only available after payment of charges. Scores for quality were similarly based on responses to questions of whether data were (e) reasonably up-to-date, (f) available at a local scale, (g) of sufficient accuracy, and including (h) habitat maps, (i) species populations distributions and (j) any density and trend information in relation to (h &/or i). Accessibility was especially poor in Hungary, Ireland, Netherlands and Portugal (Figure 6.30).

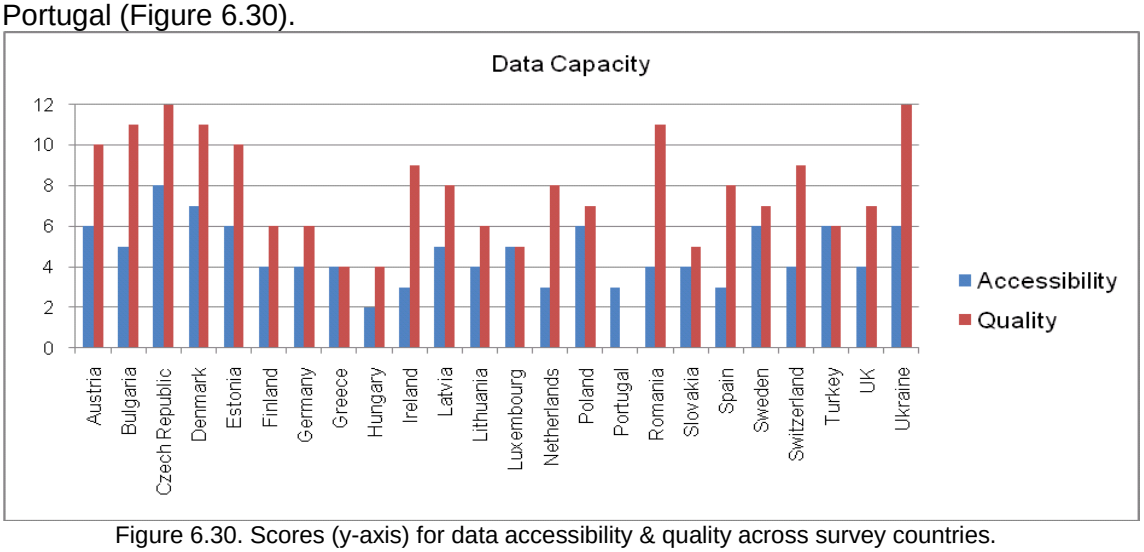

Figure 6.30. Scores (y-axis) for data accessibility & quality across survey countries.

Another question was whether or not national laws covering SEA, EIA or LUP required ecological connectivity beyond a development site to be taken into account (Figure 6.31).

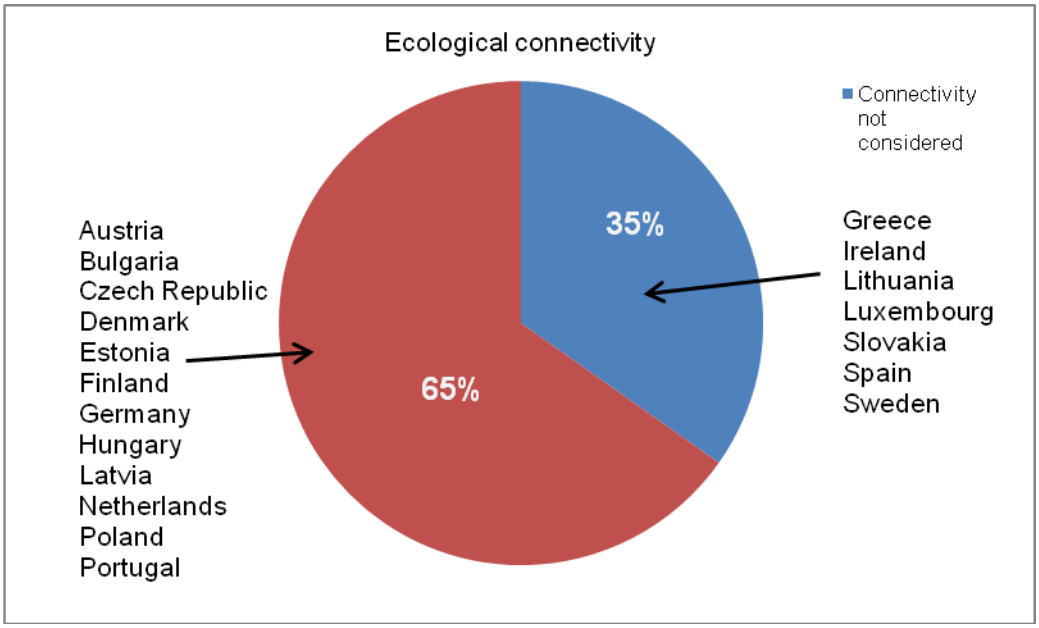

Figure 6.31. Of 23 countries responding, 65% reported this type of legislation.

All countries required significant negative effects on biodiversity to be taken into account during planning processes other than SEA and EIA, although in six cases this was only sometimes considered; similarly, all except one country claimed to support biodiversity positively at least some of the time during planning.
Finally, as an indicator of the complexity of process for environmental decision-making at national level, a count was made of all the ministries involved in decisions about use of land and species (including permits for hunting and fishing). There were mostly 2-3 ministries involved, although 6-8 for 6 of the 21 countries (Figure 6.32).

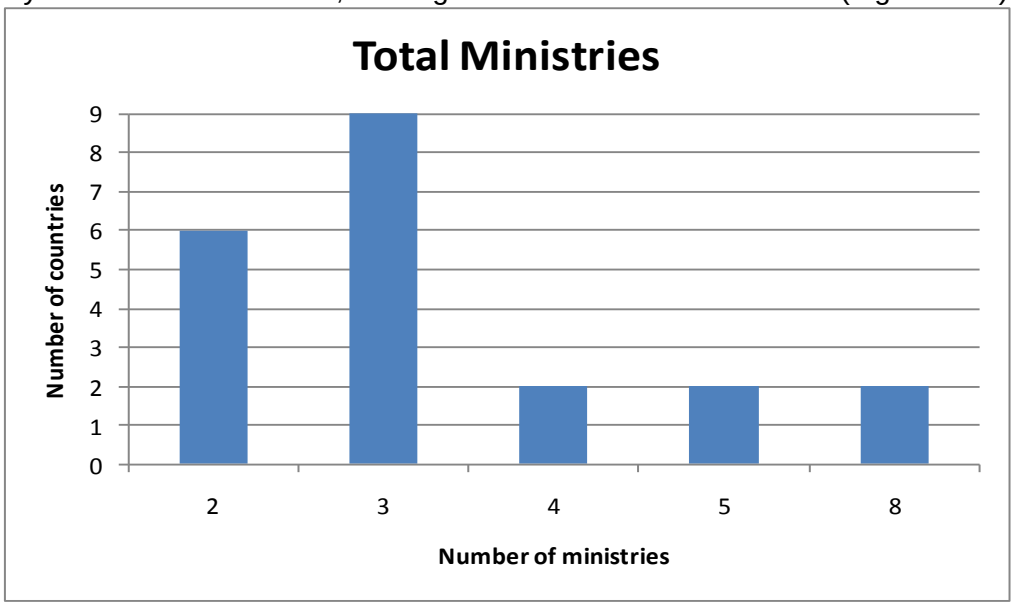

Figure 6.32. Number of ministries involved in decisions on use of land and species.

6.4.5. At Local Level

As well as assessing the numbers of formal and informal decisions of local authorities and their and their information requirements, the survey considered the degree of digital capability for monitoring. They were asked whether they took part in scientific study of species or habitats (scoring 3), kept records from systematic survey (scoring 2) or kept occasional records (scoring 1) or both; they also scored two points if they used and could name a GIS and one point if they used GIS but could not name it, for a maximum score of 5. This was averaged across the 3-5 local authorities that were surveyed in each country (Figure 6.33).

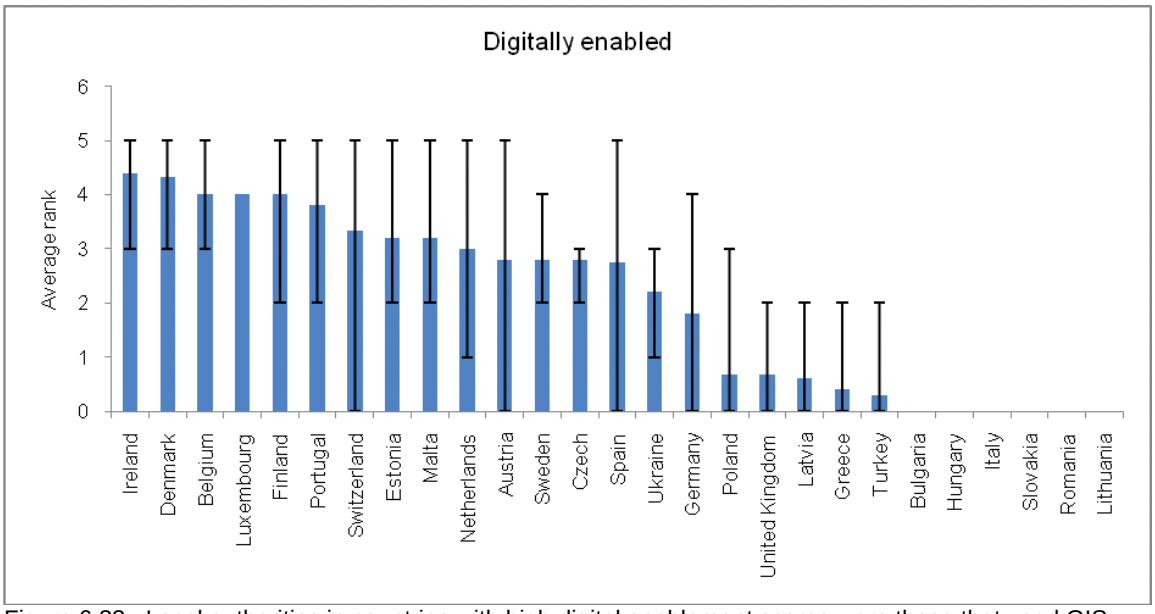

Figure 6.33. Local authorities in countries with high digital enablement scores were those that used GIS and regularly surveyed some species or habitats. Histograms show means and bars show range of scores across LAU2s in each country.

The remaining data from local authorities were more subjective in nature. Thus, as an index of objectives, local authorities were asked to estimate the proportion of their time for statutory decisions on land use (SEA, EAI, LUP) was spent assessing either (a) the economic, (b) the social or (c) the environmental aspects. Countries with most emphasis on the environment were the Czech Republic, Denmark, Germany, Ireland, the Netherlands, Sweden and the UK (Figure 6.34), with Italy and the Ukraine putting much more emphasis on economic or social issues.

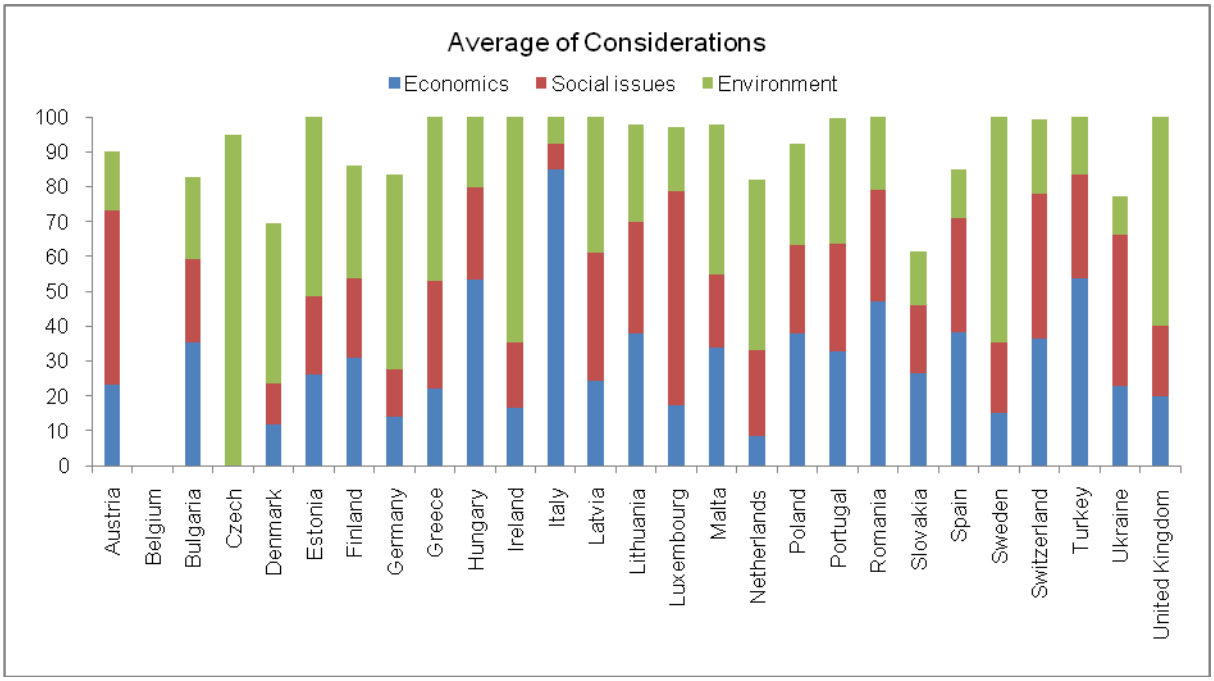

Figure 6.34. Administrative effort (%) when making formal decisions at local level.

Consultation is an important function of local authorities in some countries, and was very variable in extent for the countries surveyed (Figure 6.35).

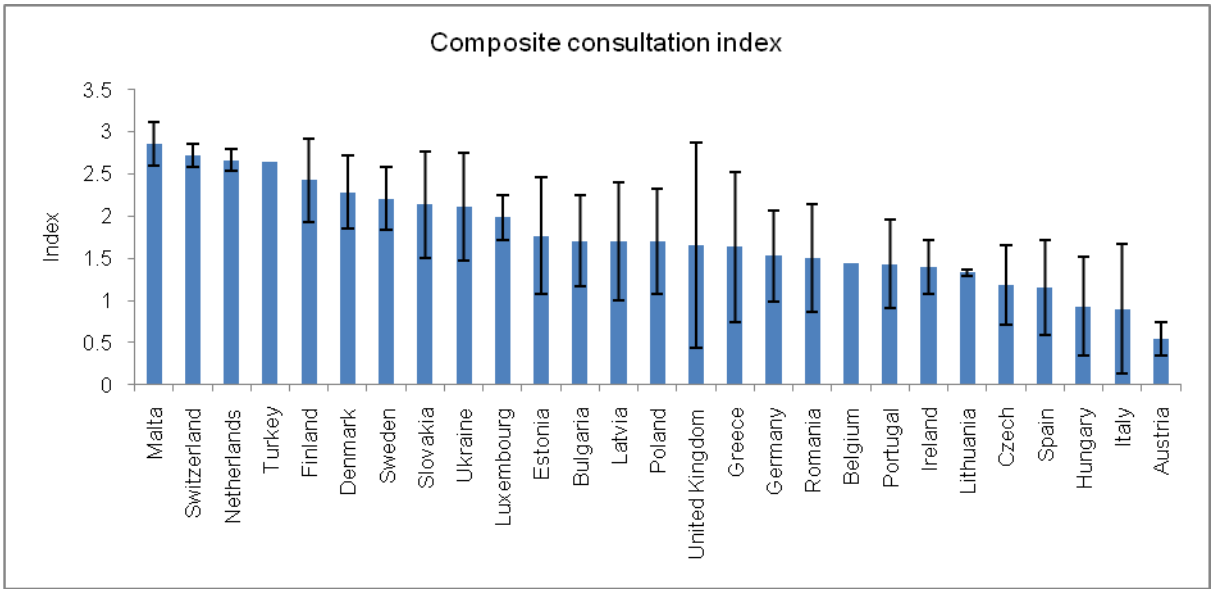

Figure 6.35. A composite index in which high values denote frequent consultation with many organisations and low values rare consultation with few organisations.

The consultations involved higher levels of government, government agencies and non-government organisations, with countries also different in the extent of consultation with NGOs (Figure 6.36).

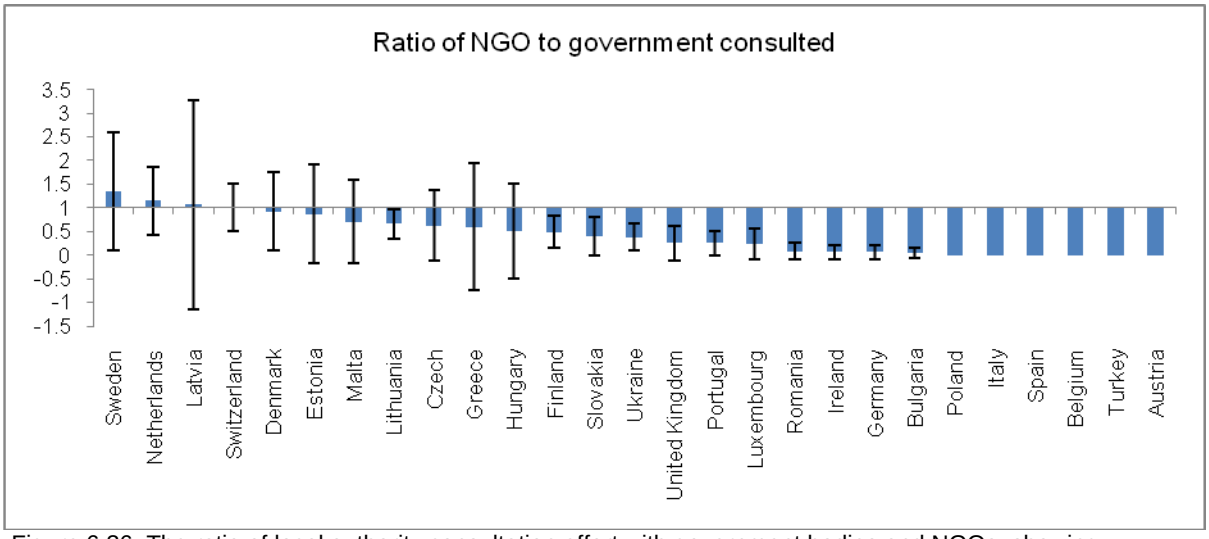

Figure 6.36. The ratio of local authority consultation effort with government bodies and NGOs, showing high variability at the left side and consultation only with government for 6 countries on the right.

The local authorities were asked to assess, on 5-point scales, the extent NGOs influenced decisions as well as the frequency of consultation. This gave evidence that frequent consultation of NGOs associated with high influence of them (Figure 6.37).

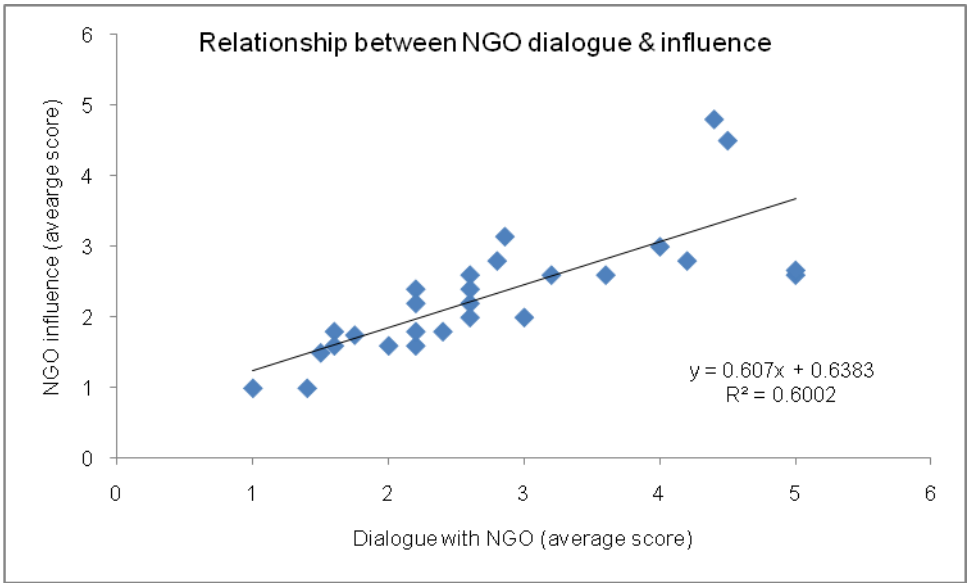

Figure 6.37. The strong relationship between the intensity of NGO dialogue with local authorities (x-axis) and the influence of NGOs on decisions (y-axis).

Deviation from the trend line indicated that NGOs in Denmark, Finland, Germany, Netherlands, Sweden and Switzerland had high influence relative to the consultation frequency (Figure 6.38), whereas those in Greece, Ireland, Malta and Turkey did not.

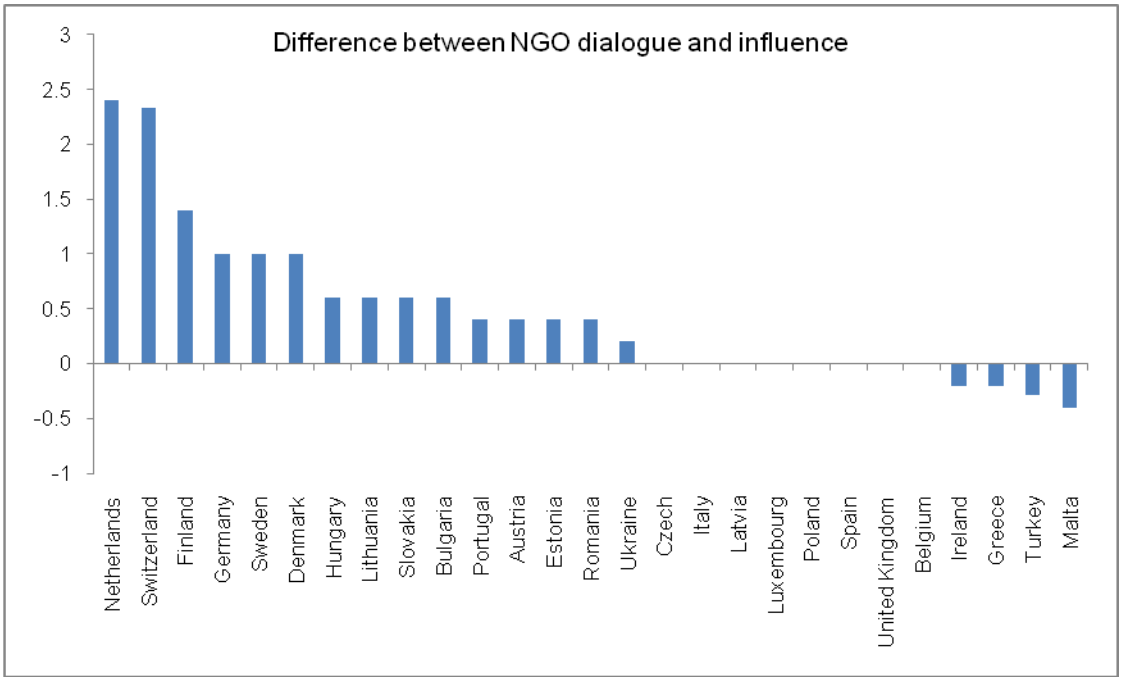

Figure 6.38. In countries with scores above the line, NGOs influenced local authorities relatively highly compared with the frequency of consultation.

The data provided two indices of attitudes of local authorities to wildlife and to the people that managed land and species. The first is a wildlife positivity index (Figure 6.39).

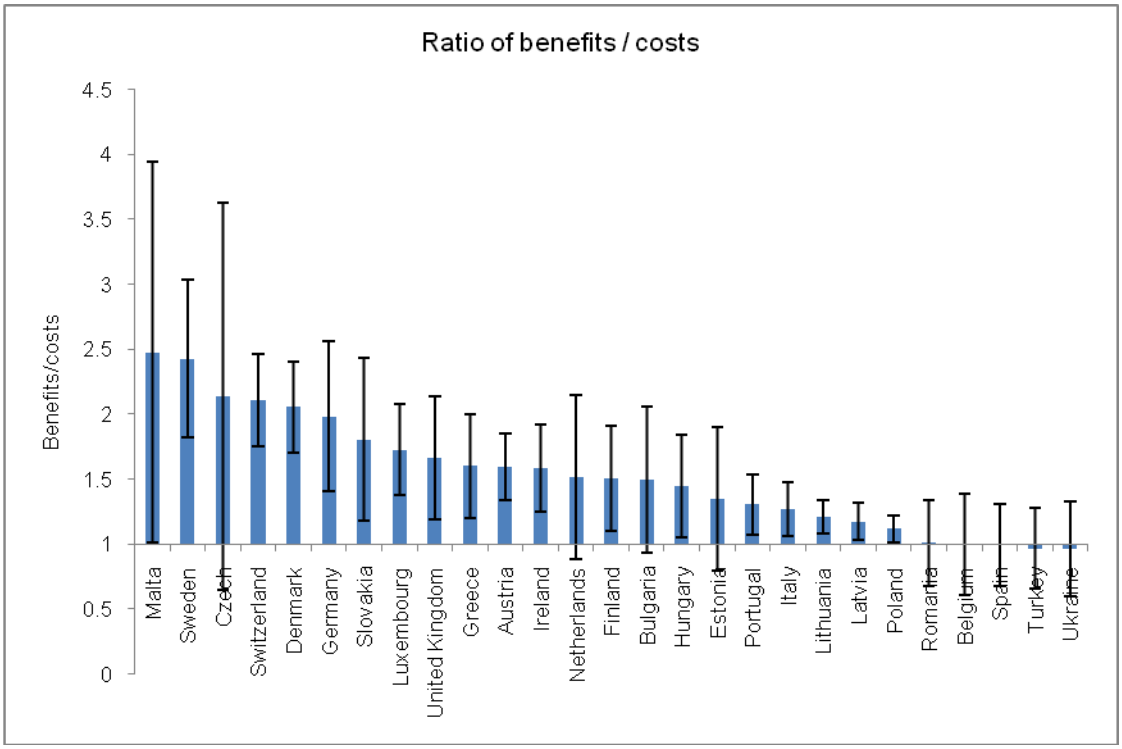

Figure 6.39. Local authorities considered that local households in countries on the left valued benefits from wild species highly relative to costs from wild species.

A related index of social attitudes was an assessment by local authorities, on a 5-point scale, of whether those using species consumptively or managing land (e.g. farmers, foresters, anglers, hunters) contributed more to conservation of species and

habitats than those watching nature or merely visiting natural habitats (e.g. for walking, climbing, canoeing, riding), as shown in Figure 6.40.

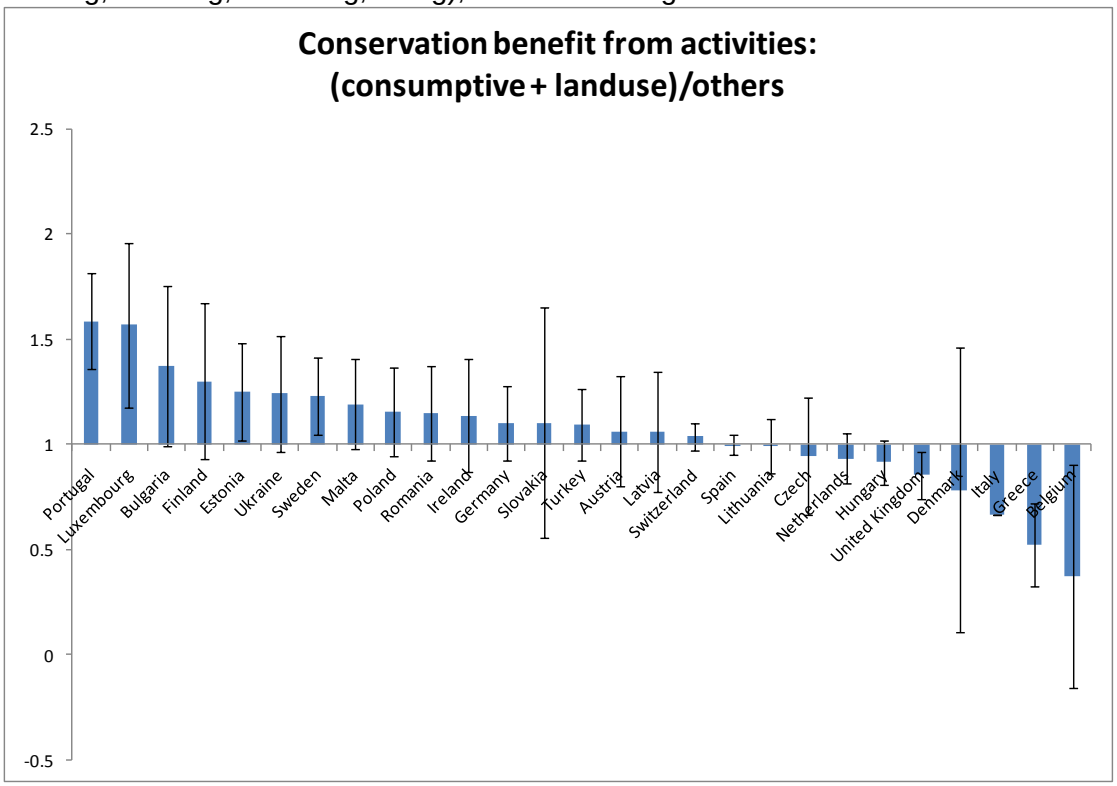

Figure 6.40. Local authorities in countries on the left considered that those using species consumptively or managing land contributed more to conservation of species and habitats than those watching nature or merely visiting land.

The local authorities also produced estimates of the prevalence in their communities of households conducting all these activities, for which the most abundant are shown in Figure 41 on the next page. There was very considerable variation between countries in the estimates for every activity. However, the averaged estimates across countries were for 43% of rural households to engage in gardening, compared with 23% in farming, 16% in gathering wild fruits, fungi and invertebrates, 11% in fishing, 8% in hunting and 7% in forestry. Although on average only 5% were thought to go on excursions to watch wildlife, 11% were thought to feed birds at home. The smallest proportion of households (3%) was thought to have members riding horses, but 23% were estimated to use the countryside for other exercise activities. As these figures are averages or averages based on ranges of numbers, they are likely to be very approximate as absolute estimates, but may well be effective at ranking the prevalence of engagement in different activities. The ranking of watching, hunting, fishing and gathering was the same as in the UNWIRE study (Kenward & Sharp 2008).

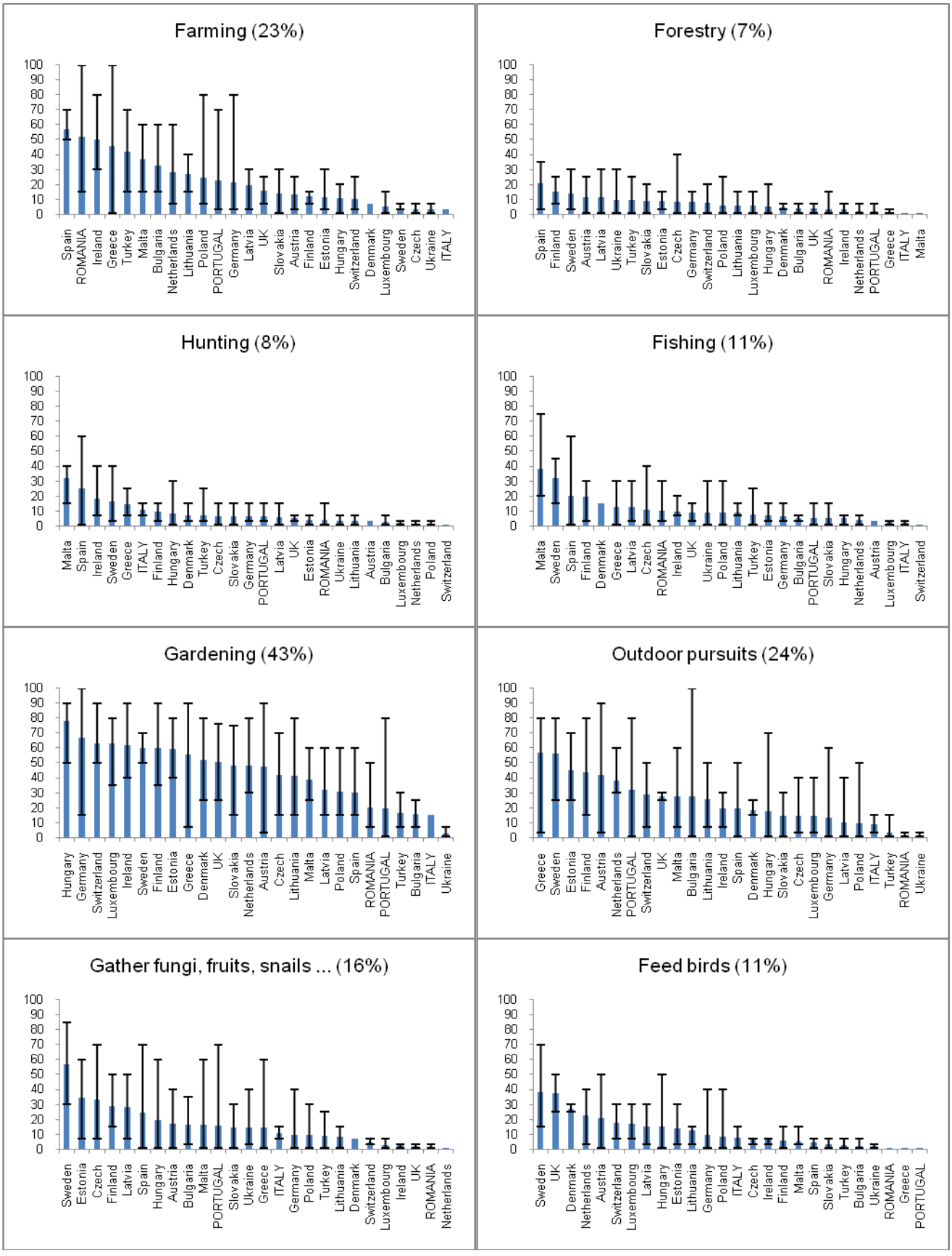

Figure 6.41. Histograms show the average % of local households estimated by LAU2s to have participants in activities dependant on land or species (bars are range of values).

6.3. Conclusions for Analysis of Environmental Assessments & TESS design

Requirements to be met in the Pan-European survey can be summarised as:
a) identify information needs for decision taking in policy development and at local level;
b) identify governance that aids biodiversity and thus that such a system should support. Before considering these requirements, three conclusions can be drawn from processes used in the survey itself:

(i) Internet tools (e.g. www.surveymonkey.com) now exist for answering up to 10 simple survey questions and, being automated, can accommodate very many respondents; however, for more sophisticated survey the use of Microsoft Excel workbooks and Access database provide a powerful tool, simplifying translation (if cells for the text are large enough) and enabling automated data extraction.

(ii) The network of Country Coordinator system pioneered by the European Sustainable Use Specialist Group of IUCN/SSC in the UNWIRE survey (www.gemconbio.eu) again proved its worth for expert translation and extraction of necessary information both at national level and also in linking with local communities and managers of wild resources on land and in water.

(iii) European Environment Agency and Eurostats both have Environmental Topic Centres with responsibility for using information as surveyed in this study; EEA advice has been most helpful, and the Streamlining European Biodiversity Indicators (SEBI) will be valuable in WP6; the Eurostats topic centre on Natural Resources could find to it useful to note the prevalence of environmental decision-taking by managers of land and species (Section 2.2) and high spending on these topics (Kenward et al. 2009), and hence perhaps choose to contribute socio-economic sustainable use indicators on these stakeholders towards the 2010 targets (thereby adopting procedures used in the USA since the 1980s).

6.3.1. Identifying information needs for decision taking

The number of decisions made at EU level as Directives, and as regulations by policymakers at national and sub-national levels, are necessarily relatively few compared to the decisions made by local stakeholders in the use of land, water and species, simply because local stakeholders are far more abundant. However, the very wide influence at high level, in setting constraints and incentives for those at local level who affect the land and species makes it crucially important that those policymakers are well informed, in a way that cuts across departments of government. This is recognised by the many projects and initiatives aimed at assisting policy-makers.
However, large numbers of decisions affecting biodiversity are also made annually by local authorities and private managers or users. Moreover, in making decisions about what to cultivate and how to manage crops of wildlife, decisions by private managers have 10,000-100,000 times the density of those made by local councils (Figure 8). Even though a decision by a council to develop an area may appear to have more long-term effect than a change in use of a field, that field may gradually have become the last local habitat patch for a particular species that will then take decades to re-

colonise the area naturally. The monitoring of land-use, to guide conservation of habitat linkages and replace species opportunistically where linkages are broken, therefore seems at least as important as formal processes of environmental assessment and land-use planning.

These managers often have good knowledge of how crops and domesticated species respond to weather and hence changing climate, how to maintain soil quality and avoid hazards, requiring less information on these than local authorities (Hodder *et al*. 2009, Figure 3.12). They even record appreciable information on these (Section 2.2 above). However they require as much information as local authorities on wild species and habitats, and more on statutory requirements and benefits, for instance affecting the control of species for economic or social benefit (Hodder *et al*. 2009, Figures 3.12, 3.13).

The internet is not yet being used strongly across Europe as a source of information for environmental decision making, especially by local land-managers. At local level it is government agencies and private consultancies which provide much of the information required, other than local knowledge. Thus, it is important for the TESS design to aim to deliver to government agencies and consultancies at local level, as well as to local authorities and stakeholders. As farmers and hunters affect land with the highest density of decisions (Figure 8 above), it is encouraging that the former are the most frequent internet users among stakeholders and the latter the post prolific sources of local data.

Nevertheless, it is encouraging that about half the countries in the European Union showed appreciable systematic recording and/or use of GIS by local authorities (Figure 28 above), and the proportions also using the internet for information were high both for local authorities and managers of land and species in the local case studies chosen by TESS partners (Hodder *et al*. 2009, Figure 3.16). Moreover, two thirds of countries could use maps in digital format for agri-environment payments (Figure 6.24 above). Thus, there are plenty of instances of good practice available and conditions exist to expand this across countries and across Europe using an appropriate TESS design that interfaces its decision support with existing GIS capabilities.

Another factor that must inform TESS design is the degree of digital enablement shown at local level (Figure 6.28 above). In terms of directing scarce resources to achieve rapid roll-out, it may be most efficient to focus on countries with a high enablement at local level. However, in terms of ensuring rapid uptake of a system to encourage biodiversity restoration while avoiding further loss, the priority may be to support countries where there is good biodiversity status perhaps causally associated with less technological advance. If private funding must prioritise economic efficiency, perhaps state funding can contribute to promoting the system, together with digital capabilities where these are less advanced.

6.3.2. Identifying governance that aids biodiversity

The final and very important conclusions from the Pan-European Survey concern the variables to be used in the analysis of factors associated with conservation of biodiversity and ecosystem services. In a analysis in the previous GEMCONBIO project (Manos & Papathanasiou 2008), it became clear that maintenance of biodiversity and ecosystem services in local case studies associated most strongly with capacities for adaptive management and knowledge leadership, as well as with appropriate objectives, with effects of regulations that tended to be positive for biodiversity but negative for sustainable use of ecosystem services.

In GEMCONBO, the Use Nationally of Wild Resources across Europe(UNWIRE) study, mentioned above, was a Pan-European survey at national level of ecosystem services that were mostly cultural uses of biodiversity (hunting, angling, gathering

plants and fungi and watching birds). UNWIRE provided some socio-economic impact indicators, in terms of changing numbers of participants and attitudes of interest groups. An especially interesting finding was a tendency of bird-watcher numbers to increase most strongly where their national representatives gave hunting most credit for habitat benefits (Kenward & Sharp 2008). UNWIRE also assessed changes in numbers of some taxa. These data are available for TESS.

The social attitude indicators in TESS, obtained by asking local authorities about attitudes of local people to biodiversity and their own assessment of habitat benefits from different interest groups (Figures 6.34, 6.35), were sampled more robustly than in UNWIRE. Attitude indicators are important because uses of ecosystem services need to be socially sustainable as well as ecologically sustainable (WSSD 2002). Other impact indicators are available in the SEBI data and in direct analyses of CORINE data for 1990, 2000 and 2006 to assess habitat conversion rates.

The Figures and Tables in this report also provide a number of variables on capacity, and process for governance that may affect biodiversity and ecosystem services. These are summarised in Table 6.3, as categorised from the analysis matrix in Figure 6.1.

Table 6.3. Variables available for the WP6 Analysis Matrix

Variable Type	Category	Source
CAPACITY	Societal	National knowledge leadership (Figure 16), National consultation/influence of NGOs (Figures 17, 21)
	Governance	National number of Consultees (Figure 15), National number of Ministries (Figure 32), Local digital enablement index (Figure 33), World Bank governance indices (UNWIRE)
	Ecological	Data supply (Figure 14a), Country area (UNWIRE), Human population density/urbanisation (UNWIRE), National landcover (CORINE)
OBJECTIVES	Social	Local data demand (Figure 14b), Local considerations index (Figure 34)
	Economic	
	Ecological	
PROCESS	Social	Local responsibility for informal decisions (Figure 7), Local consultation indices (Figures 35-38)
	Economic	Local stakeholder density/decision density (Figures 8-10), Agri-environment payment density
	Regulatory	National number of assessments (Table 2), National assessment regulatory intensity (Figure 18), National AES regulations (Figures 25-28)
IMPACT	Societal	Local authority attitudes (Figures 39, 40)
	Economic	Participant numbers (UNWIRE)
	Ecological	Change in species & habitats (UNWIRE, CORINE, SEBI)

6.4. References

D2.2 Sharp, R.J.A., Ewald, J. & Kenward R.E. 2009. Model of information flows from local & regional to central. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

D3.2 Perrella, L., Ewald, J., Kenward R.E. & Hodder, K.H. 2009. Environmental information supply and demand at the local level: Conceptual models of information flow. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

D3.3 Hodder, K.H., Sharp, R.J.A., Perrella, L., Butters, J., Kenward, R.E. & Ewald, J. 2009. Synthesis report: Central and local information flows and decision making requirements. Report to the European Commission from FP7 Project #212304 (Transactional Environment Support System).

COWI 2009a. *Study concerning the report on the application and effectiveness of the EIA Directive* carried out by COWI consultants, Kongens Lyngby for the European Commission DG Environment.
COWI 2009b. *Study concerning the report on the application and effectiveness of the SEA Directive (2001/42/EC)* carried out by COWI consultants, Kongens Lyngby for the European Commission DG Environment.

ESPON 2009. First Interim Report of ESPON Typology Compilation, ESPON 2013 Programme:
http://www.espon.eu/main/Menu_Projects/Menu_ScientificPlatform/typologycompilation.html

Kenward, R. Manos, B., Arampatzis, S. & Papathanasiou, J. 2009. A transactional environmental support system for Europe. In Hřebíček, J., Hradec, J., Pelikán, E., Mírovský, O., Pilmmann, W., Holoubek, I. & Legat, R. (eds.) Towards eEnvironment (Challenges of SEIS and SISE: Integrating Environmental Knowledge in Europe). European conference of the Czech Presidency of the Council of the EU.

Manos, B. & Papathanasiou, J. 2008. GEMCONBIO: Governance and Ecosystem Management for Conservation of Biodiversity. Aristotle University of Thessaloniki, Greece.

NUTS 2009. Eurostat website :
http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/nuts_classification

WSSD 2002. World Summit on Sustainable Development.
www.johannesburgsummit.org