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1. Introduction

This is one of the first three public reports from the FP-7 project #212304 to design a Transactional Environment Support System (TESS). It will explain what TESS the project is about and how a "Model of information flows from local & regional to central" contributes to its aims. There will be provisional conclusions, from the material in this report, which confirm earlier work in the UK and are fundamental for the design process. The report should be read alongside reports D3.2, "Model of the local decision making process" and D3.3, "Central and local information for decision making requirements", which like it, derive mainly from preliminary enquiries made in a selection of partner countries during the first ten months of the project.

1.1. Background to TESS

TESS is not merely about studying environmental information. It 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. The first research in TESS

There are many sorts of environmental decisions, made by different parts of society, as indicated in D3.3 Section 2 (in future referred to as D3.3.2). There are also many sorts of information used in them, as indicated in D3.3.3. 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 needs to be able to handle 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. This is the purpose of the local case study projects in WP5. It is also important to identify and provide support for best governance practises. This identification started in GEMCONBIO and continues in WP5, through 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.

To start the design process, this first report:
1. Outlines the main actors in decision-making
2. Explains the way we are using conceptual models to assess information flows
3. Considers the information flows which occur for the high-level decisions
4. Draws conclusions for the further development of TESS

2.1. The Decision-Makers

D3.3.2 is constructed on the basis that 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 as shown in report D3.3.3.

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 D3.3.3, but needs to continue through an EU-wide survey and local case studies in WP5. It is chiefly the study of information flows

that we address here, for policy and statutory decisions at higher levels in the D2.2 report and for local and especially informal decisions in D3.2. There is a need also to consider the impact of information flows, which may be greatest where demand and supply are most poorly aligned (to be indicated by comparing demand found in D3.3 with supply being recorded in WP4), 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 (WP2) and by structured interviews in local case-study sites (WP3), 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 D2.2 report, and in the linked 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 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 the D2.2 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 in WP5, 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 Figures D3.3.2.1 and D3.3.2.7 are combined to show this in Figure 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.

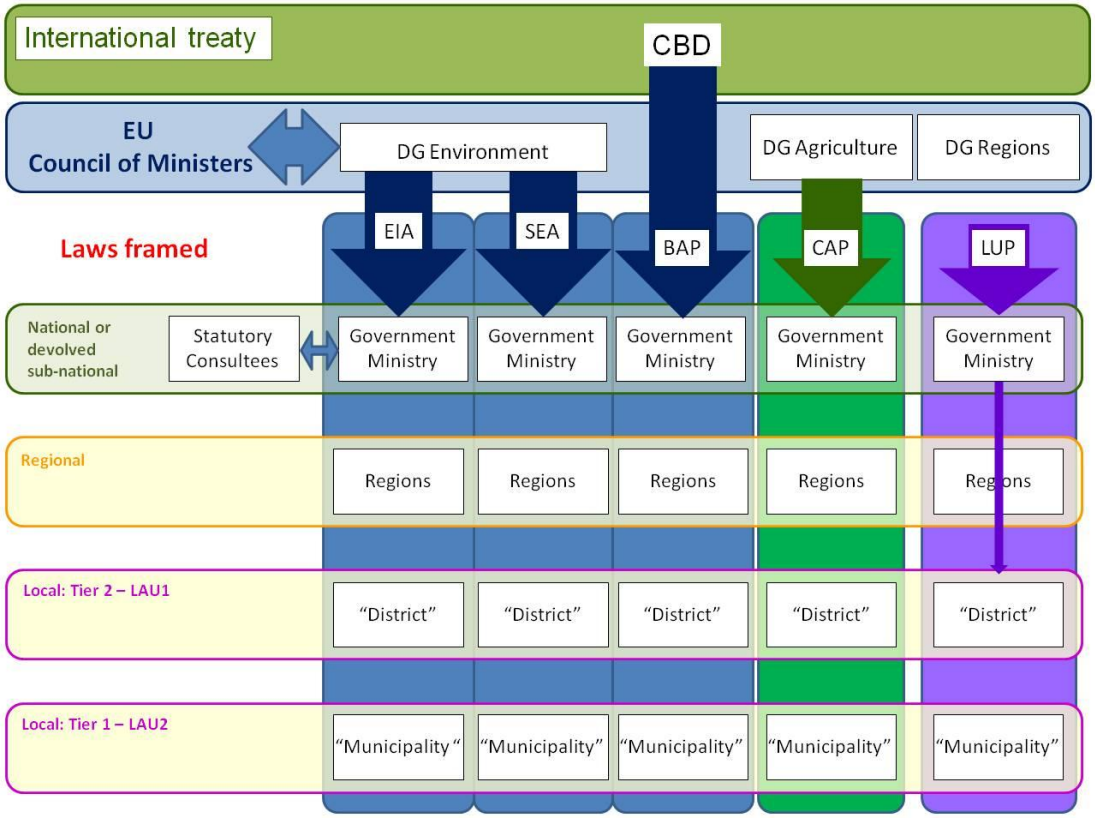

Figure 1. Except for Land Use Planning, instructions for framing environmental laws and procedures now come primarily from international level.

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, which combines Figures D3.3.2.2 and D3.3.2.3 from D3.3 to show where approvals are given for EIA, SEA, CAP and LUP, immediately indicates much more variation in the implementation of the instructions within each state.

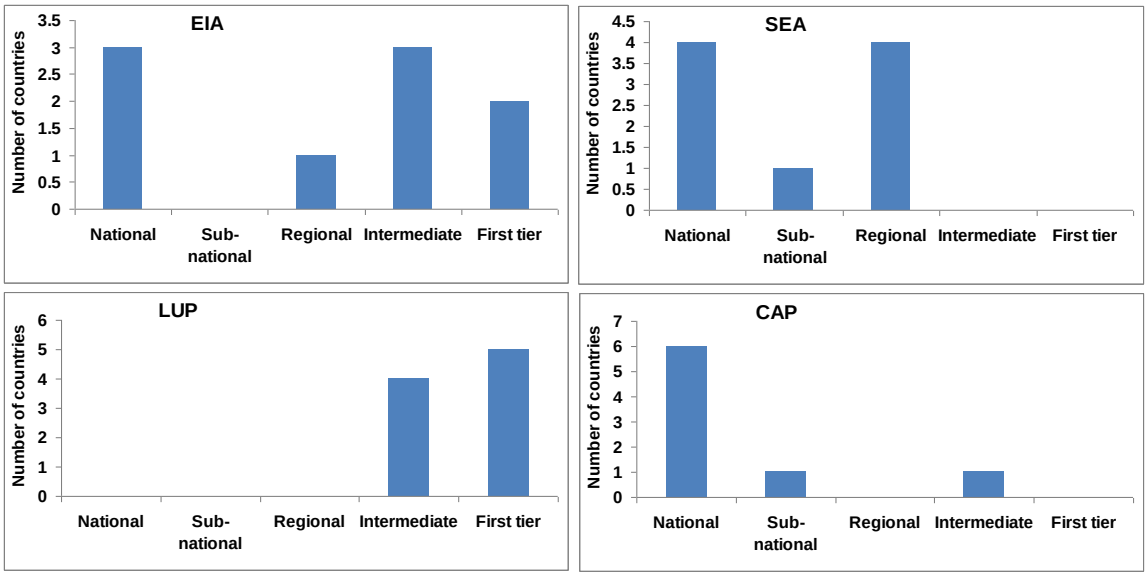

Figure 2. The variation between states in the lowest level at which approval is given for EIA, SEA, LUP and CAP subsidies. Data are available for 9 countries on the first three aspects but for only 8 on CAP which does not apply in Turkey.

The format of Figure 1 is used to combine all the information in Figure 2, and also on BAP processes from Figure D3.3.2.7, to display information flows in Figure 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.

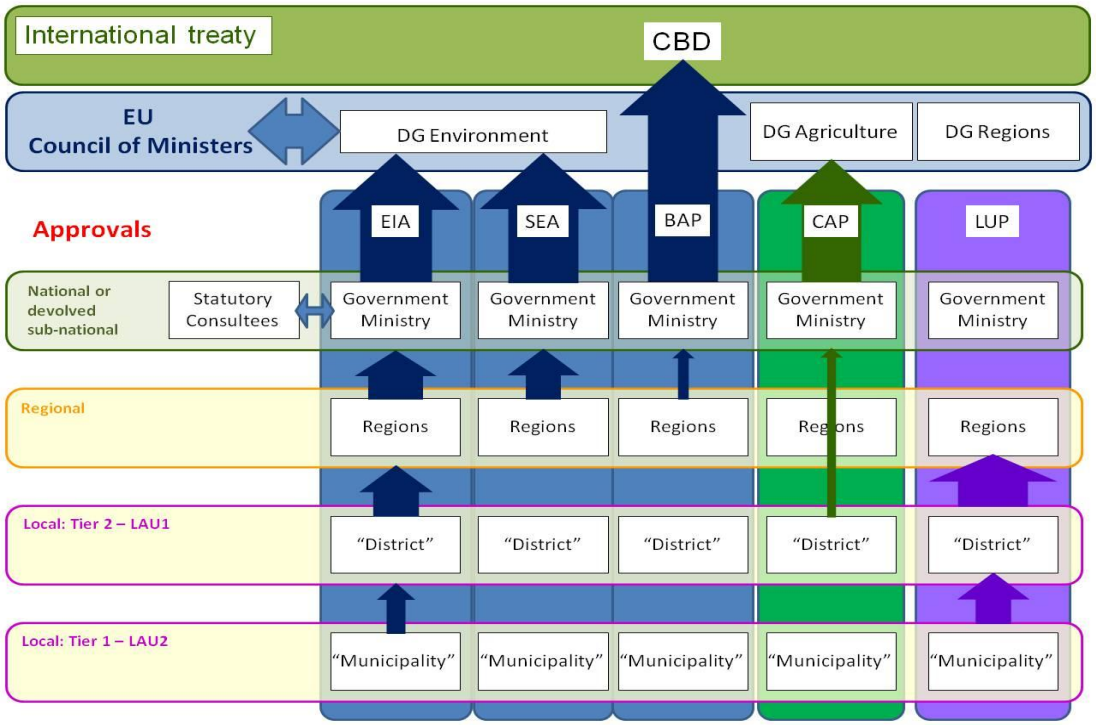

Figure 3. The reporting on EIA, SEA, BAP, CAP and LUP, to higher authorities.

The levels at which decisions are made is indicated better by the levels where consultation occurs, shown in Figure 4.

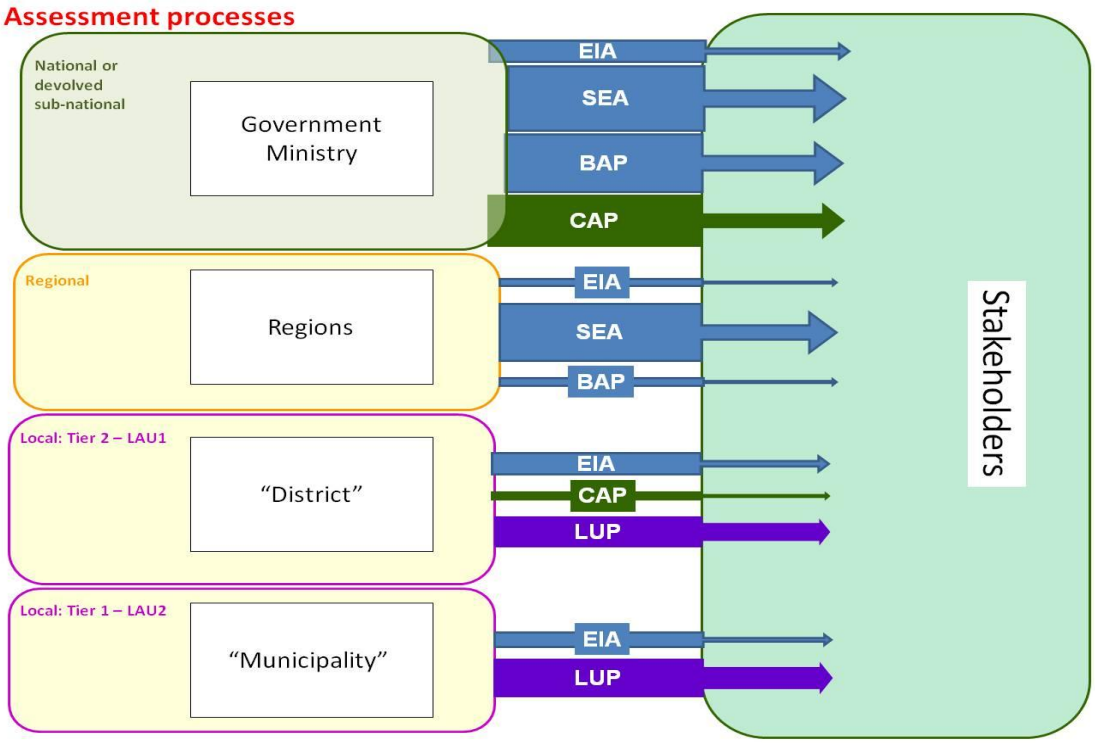

Figure 4. Levels at which consultation occurred for EIA, SEA, LUP, CAP & BAP

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 4), the information flows between stakeholders and government are more complex. These flows, together with other information sources used by stakeholders (as reviewed in D3.2 and D3.3) are shown in Figure 5.

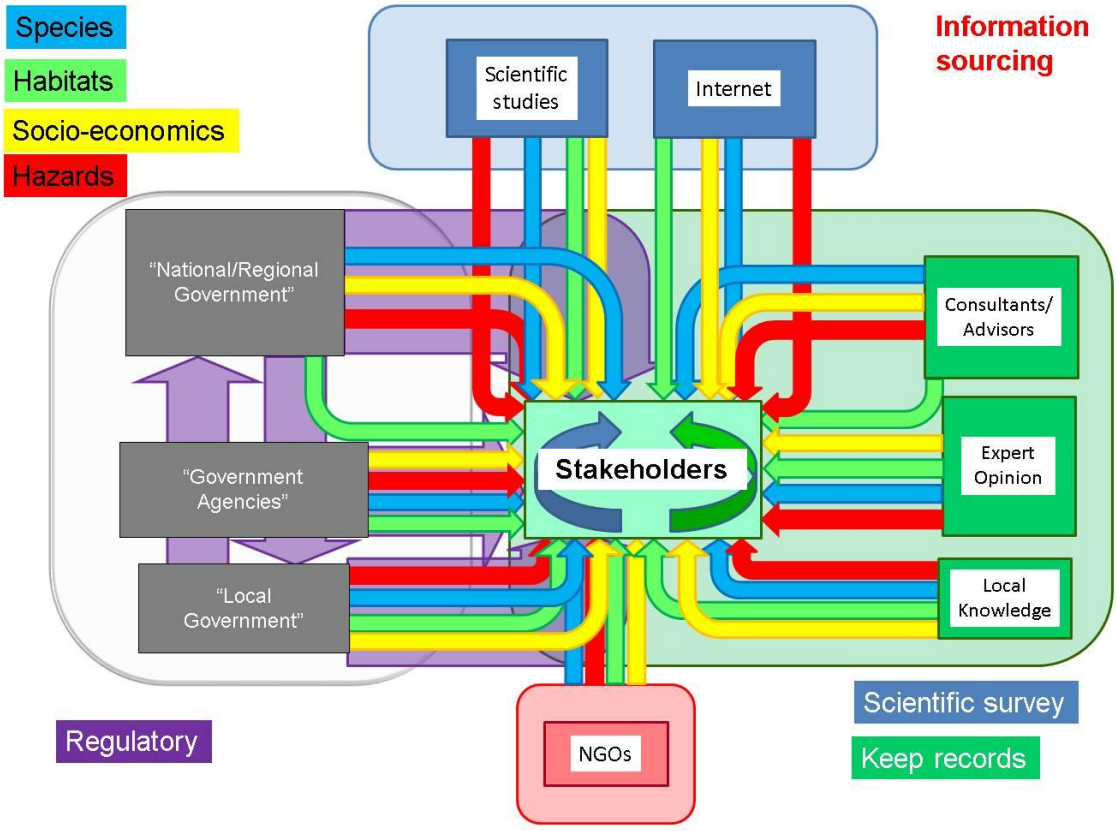

Figure 5. The information sources used by stakeholders when assisting government with statutory decisions and when making informal decisions within an envelope of government regulations.

Figure 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 1, 3 and 4 here, to reflect the number of countries for which each type of information flow was recorded.

3. Conclusions from modelling information flows for central policy

A conclusion from Figures 1 and 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 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 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 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.

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