Background & Exec. Summary from **Kenward, R.E., Papathanasiou, J., Arampatzis, E. & Manos, B.A. (eds) 2013. Transactional Environmental Support System Design: Global Solutions. IGI-Global, Hershey, Pennsylvania, USA.**

Preface (**Background**)

Robert E. Kenward (Anatrack Ltd, UK)

This project, which was contracted to design a Transactional Environmental Support System (TESS) under the European Commission's Framework Programme 7, is deeply rooted in the Convention on Biological Diversity (CBD). This international convention, which stems from the "Earth Summit" in Rio de Janeiro in 1992, has three pillars: the conservation of biodiversity, its sustainable use, and the equitable sharing of the benefits of its genetic resources. The second pillar, sustainable use, is defined as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity", in other words as "use that conserves". CBD calls for sustainable use in 12 of its articles (5-8, 10-13, 16-18, 21). CBD calls for conservation by protection in one article (8), yet far more attention has been paid to conservation by protection than to conservation by sustainable use.

The use of biodiversity lies behind the myriad decisions made by individuals at local level, on what to remove or plant, and how and when to manage each species. Decisions that are made for farm fields and gardens are small-scale individually, but they summate to change the environment. Even if 17% of the land surface is protected by 2020, as recommended at the 10th CBD conference in Nagoya in 2012, most land will lie outside protected areas, but influence them through pollution, hydrology and fragmentation.

The International Union for the Conservation of Nature (IUCN), founded in 1948 and now with more than a thousand government and non-government organisations as members, was the initiator of CBD and many subsequent documents. These included the Ecosystem Approach, which stressed that humans too are a part of natural systems and was adopted at CBD's 6th conference in 2002. The previous year (2001), IUCN had also started work on a document which, at CBD's 7th conference in 2004, became the Addis Ababa Principles and Guidelines for Sustainable use of Biodiversity. Both documents stressed the engagement of local people for conservation, through applying local knowledge, monitoring and empowerment, with appropriate governance at all levels for adaptive management of wild resources.

Also in 2001, IUCN's European Sustainable Use Specialist Group delivered to the Council of Europe a paper on agri-environment innovation for the Kiev Inter-Ministerial Conference on the Environment. The paper concluded: "Optimising the enhancement of biodiversity through sustainable use will require integration of ecological, economic and social factors in complex models. Although such models must be developed centrally, the Internet can be used to disseminate knowledge in expert systems, so management decisions can be made locally, and to retrieve local knowledge to improve the models. Thus, modern technology can enable local communities to regain motivation and responsibility for managing their environment."

A third project also beginning in 2001, and which helped plan for TESS, was a survey in the UK Natural Environment Research Council (NERC) of opportunities for technology transfer. The survey revealed 41 software applications among 115 products with commercial potential in NERC's Centre for Ecology and Hydrology, with much software available outside CEH too. Discussion with government officers encouraged a mapping of this supply to the requirements of stakeholders. This led to a review of information needs of local council and landowners in Purbeck, UK, which later informed a similar process across Europe for the TESS project.

In 2005 members of European Sustainable Use Specialist Group won a bid in the EU's Framework Programme 6 for a project on Governance and Ecosystem Management for Conservation of Biodiversity (GEMCONBIO). The GEMCONBIO project gathered data that showed not only the importance of adaptive management, but also that annual private spending in Europe on fishing, hunting and watching wildlife in the EU was at least €40 billion. The evidence that local biodiversity-dependent recreation had so much value, combined with increasing recognition of the CBD concepts developing in IUCN and elsewhere around 2001, gave renewed impetus for the successful 2008 bid to design a TESS.

Overall Conclusions **(Exec. Summary)**

Robert E. Kenward (Anatrack Ltd, UK), **Jason Papathanasiou** (University of Macedonia, Greece), **Basil Manos** (Aristotle University of Thessaloniki, Greece), **Stratos Arampatzis** (Tero Ltd, Greece)

ABSTRACT

This chapter summarises the intentions, processes and findings of the project, funded by the Commission of the European Union, to design a Transactional Environmental Support System (TESS). It provides an Executive Summary for the book we have edited.

INTRODUCTION

Chapter 1 introduced the thinking behind this project, to design a Transactional Environmental Support System (TESS). It noted that decisions affecting the environment include not only high level policy and formal assessments, but also informal decisions by local stakeholders. These stakeholder decisions, for instance on what to remove or plant and how and when to manage it, are mostly made without expert advice yet summate to change the environment. After trial surveys in Chapters 2-3, data from 30 countries showed in Chapters 6-8 that the density of informal decisions by stakeholders averaged about 5 orders of magnitude greater than for statutory assessments. Chapter 1 also indicated that biodiversity-dependent recreation could be a cultural ecosystem service with high value for conservation, after which Chapter 9 estimated an annual private spend in Europe on fishing, hunting, gathering and watching wildlife of €62 billion, comparable with state spending of €57 billion (half of the EC budget) annually on the Common Agricultural Policy (CAP). Chapter 1 also noted the complexity of local decision making informed by wildlife ecology, state agri-environment spending and large biodiversity-dependant private spending. . Few socio-ecological models for case studies (Chapters 10-19) were identified in Chapter 3, and very little technology transfer using expert models and toolkits to provide the decision support needed by local managers of land and species were found in Chapter 20.

Local decision support also needs guidance from strategic planning at higher levels. Chapter 20 notes that modelling to predict populations of small species across wide areas, for planning biodiversity restoration, needs habitat mapping at much higher resolution than is currently available and should be complemented by *in situ* data. There are indications that effective high level biodiversity governance needs local people to be well informed about how to get the best from biodiversity: in Chapter 8 the intensity of formal environmental assessments was related to positivity to nature at local government level and other variables acting at local level. Moreover, data from a previous project showed that status and sustainability of biodiversity and ecosystem services depend strongly both on local adaptive management and on knowledge leadership from higher level. The concept in Chapter 1 of an internet system for better information flows between policy-makers and stakeholders, in order to benefit management of the environment at local level and policy-making at high level to help that management, gains support from the findings of this research project. A system could be a designed providing both adaptive management with knowledge leadership at local level, and adaptive governance at European and national levels.

FOUR FINAL QUESTIONS

Chapter 1 concluded by presenting, for consideration in Chapters 2-22, four final questions:

- Do local people require information that a transactional system can deliver?
- Can local people contribute enough data of use at higher levels?
- Can current technology build such a system?
- Can the building and long-term operation of such a system be supported?

It is time to answer those questions.

Local Information Needs and Capabilities

Local government and private land managers handle many decisions on local issues, with support from central government and agencies (Chapters 4 & 7) but have difficulty in finding & accessing recent information on habitats and species at fine scale (Chapter 3). A lack of simple information on socio-environmental issues (Chapters 5, 9 & 20) was especially unfortunate because factors most associated with frequency of statutory environmental assessments (Strategic Environmental Assessment and Environmental Impact Assessment) included the awareness of benefits of biodiversity and other ecosystem services (Chapter 8).

Nevertheless, there is wide use of digital mapping for CAP requirements (Chapter 7), much ability and enthusiasm of citizens for *in situ* mapping and more participation in recreational biodiversity-dependent activities than realised by administrations (Chapter 9). The success of citizen-science initiatives such as the Eye-on-Earth initiative from European Environment Agency (EEA) and Microsoft, and the UK's Open Air Laboratory (OPAL) give confirmation of interest and enthusiasm from outside TESS. Conditions are ripe to exchange decision support for the fine-scale local mapping that is needed to restore biodiversity.

TESS design focussed on local stakeholders also because other EC projects involved TESS partners in decision support for policy (FP7-SPIRAL and SCALES) and environmental assessment (FP7-LIASE). Moreover, both previous substantial British attempts to build socio-ecological decision support systems concluded that their outputs were too high-level and should be accessible for individual citizens.

GIS and Data Standards for Meeting Needs at All Levels

The integration of information on biodiversity and related environmental matters for planning and land-use decisions generally uses maps and, in digital format, Geographic Information Systems (GIS). This applies to statutory Environmental Assessments for strategy or of impacts (SEA, EIA) and other formal land-use planning processes, but often also to the myriad daily decisions made less formally by stakeholders who manage land or species. We found that about half the countries in Europe already had local authorities using GIS (Chapter 7). Indeed, GIS is a lingua franca accessible to all ; the mapping software for TESS was usable down to 6 years of age and even easy to provide across languages with translation of short words where symbols and intuition alone do not suffice (Chapters 9 and 20). GIS is inherently scalable: maps (of species, habitats and geo-referenced socio-economic data) at fine scale aggregate to cover all scales.

Local information in the form of maps will only integrate to give adequate coverage for predicting general trends in species, habitats and socio-economic factors if coverage is both extensive and yet detailed enough to predict the effects of management. A system that meets the challenge of good data coverage at local level can use the Infrastructure for Spatial Information in Europe (INSPIRE) standards of the European Commission (EC), possibly via the Environmental Information Observation Network (EIONET) of EEA, to link with the Biodiversity Information System for Europe (BISE) and Global Earth Observation System of Systems (GEOSS) to deliver relevant information for high level governance (Chapter 20).

Unfortunately there remain serious information gaps in the provision of this type of data across Europe. Excellent pan-European integration like CORINE (Coordination of Information on the Environment) Land Cover maps have little use at local level and there is no software to make its use really easy at any level (Chapters 5 and 20). Predictive modelling, incorporating habitat mapping and management, is used mostly by experts, by some consultants at the local level but not by individual stakeholders. Although local fine-scale mapping is done by stakeholders for CAP reporting (Chapter 7), and for planning on site and by consultants, privacy issues hinder its use by local authorities and there is no integration for use at high level.

Practicalities of Building a TESS

If government needs GIS data on land-use and species for policy planning and environmental assessments, and local managers need GIS-based decision support, there is scope for mutual benefit. Local knowledge from individuals could be exchanged for decision support from government. Moreover, a process that provides information which benefits local recreation and livelihoods (in exchange for data required by government at different levels for environmental assessments) is likely to encourage local people to maintain and restore biodiversity ecosystem services. This is the basis for proposing a Transactional Environment Support System (TESS).

In the long run, a TESS must be practical for communities and individuals needing knowledge, as well as for scientists who guide the knowledge process, and for government policy-makers. The technical design proposes intelligent web-GIS, linking knowledge to maps like word-processors link spelling and grammar checks in documents. The design novelty is not in creating the necessary code, but in combining components not found in previous designs for environmental support, including intelligent web-GIS, with modules for handling ownership, quality and uncertainty of data in models, for language translation and for automated scenario analysis to help solve environmental problems unanticipated by the user.

However, the design of a TESS cannot merely consider the technology for the tool, but also needs socio-economic assessment of the demand and supply of the information in that tool, its ease of use, motivation to use it and cost of maintaining it long-term. In order to obtain adequate local knowledge at a finely-mapped coverage for central policymakers in the long term, the design must provide information that local people want in ways they want, and therefore must consult them (as well as policymakers) during development (Chapter 20). A tool that is not desirable, as well as practical and durable, will not last.

Usefulness and Trust to Gain Coverage and Funding

In order to be desirable, software needs to be provided in a convenient context and be fun to use. Market research for a desirable socio-economic setting, with stakeholders at several meetings, identified the concept of a web-portal serving as a one-stop-site for ideas and knowledge which would be attractive to individuals and communities. Existing toolkits and decision support systems could be linked to such a portal, and later complemented by user-friendly and intelligent web-GIS. Two surveys found similar priorities between stakeholder organisations and individual stakeholders for desirable web-portal content: for information on best-practice in conservation through use of biodiversity, on protected species and habitat maps, and web-services for monitoring species, mapping and conservation news (Chapter 20).

Local information will only integrate adequately for policy and government assessments if coverage is excellent (as noted above) and for wide local private use if there is open access. Wide use and open access require trust. Sensitive handling is needed for system inputs (data and models) to include transparency (e.g. avoiding black-box effects), privacy (e.g. avoiding neighbourly prying), accreditation (e.g. for career or commercial benefit) and uncertainty (e.g. with Bayesian Logic). There must also be trust between stakeholders at all levels. Scientists are crucial stakeholders, for analysis and experiments that build decision support models, and for audit and quality assurance of volunteer data that provides confidence to government and local stakeholders. Social trust from governments and local information stakeholders is more likely if the system is perceived to operate equitably. For this reason, construction and operation should be a non-profit operation, in which all funding is used to improve the system. A base in the voluntary sector also reduces risk of politically-motivated shut down or commercial sell-off.

For the survey of individuals, commitments by non-profit organisations in agreement with commercial firms secured the build and operation of a portal (www.naturalliance.eu), with translation and content contributions from TESS partners. Steering involves a wide spectrum of organisations, without whom the trust of all countryside interests would be unlikely. Establishing the Naturalliance portal has also generated ideas for both rapid and gradual development through government contracts at all levels. Although it also found little scope for development by crowd-funding, the support of a visionary philanthropist would be an alternative to government support for providing the user-friendly and intelligent web-GIS needed to encourage widespread use of the system.

CONCLUSIONS ON TESS AS A TOOL FOR CBD AT ALL LEVELS OF SOCIETY

The TESS approach fits well with recommendations of the Convention on Biological Diversity. CBD objectives are conservation of biological diversity, sustainable use of its components and equitable sharing of its genetic resources. The 18th of 20 targets in the 2010 Nagoya-Aichi strategic plan, is that "By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels." The portal, built in conjunction with the TESS survey of individuals, addresses that target. It also addresses others. These include raising awareness of the values of biodiversity (target 1), integrating such values into development (2), keeping biodiversity-use sustainable (4, 6, 7), safeguarding essential ecosystem services (14) and not merely halving rates of loss of natural habitats (5) but restoring degraded ecosystems (15), not to mention transferring and applying the knowledge and science base relating to biodiversity functioning and trends (19). The TESS concept addresses half the "Aichi Targets", thus potentially making a substantial contribution to the EU's commitment to CBD implementation, provided it receives enough support to be useful for local people.