Overview of selected analytical and decision-making tools for SEA

Source: OECD/DAC (2006)

1. TOOLS FOR PREDICTING ENVIRONMENTAL AND SOCIOECONOMIC EFFECTS

1.1 Carrying capacity analysis (CCA) determines the human population that can be "carried" by a particular area on given consumption levels, i.e., it identifies the limits to growth. The "capacity" concept is controversial, with continued debate on what exactly it is and how land can be managed to increase capacity. Ecological carrying capacity usually refers to the maximum population size of a species that an area can support without reducing its ability to support the same species in the future. More information at www.ilea.org/leaf/richard2002.html.

1.2 Network analysis (also called cause-effect analysis, consequence analysis, or causal chain analysis) explicitly recognizes that environmental systems consist of a complex web of relationships and that many activities' impacts occur at several stages removed from the activity itself. It aims to identify the key cause-effect links describing the causal pathway from initial action to ultimate environmental outcome. In doing so, it can also identify assumptions made in impact predictions, unintended consequences of the strategic action, and possible measures to ensure effective implementation. It is useful for identifying cumulative impacts. The technique involves, through expert judgement, drawing the direct and indirect impacts of an action as a network of boxes (activities, outcomes) and arrows (interactions). (Source: Therivel, 2004). For more information, see European Commission (1999).

1.3 Ecological (environmental) footprint analysis addresses the human impact on the Earth's ecosystems, measuring and visualizing the resources required to sustain households, communities, regions, and nations, converting the seemingly complex concepts of carrying capacity, resource use, waste disposal, etc. into an understandable and usable graphic form. An excellent handbook is Wackernagel and Rees (1996).

1.4 Social and economic analysis/surveys. Information on many of the key tools available for social analytical and survey work is described in the *PSIA User's Guide* for practitioners in developing countries. DFID has funded work on Tools for Institutional, Political, and Social Analysis of PSIA (TIPS Sourcebook) (soon to be available on the World Bank website). Most are available on the World Bank PSIA website (http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPSIA/0,,menuPK:490139~pagePK:149018~piPK:149093~theSitePK:490130,00.html).

Ministries of finance and other governmental bodies usually use general and partial equilibrium models for planning purposes. These predict how changes in the economy, due to for example fiscal reforms or exchange rate reforms, will affect demand, supply, and relative prices. In general, these models can indicate changes in the use of different natural resources, such as energy use and agricultural output. In some cases, models also include effects on different forms of pollution. For more information, see http://siteresources.worldbank.org/INTEEI/214584-1115794388939/20486164/ToolkitForAnalyzingEnvironmentalAspectsofPolicyLending.pdf.

1.5 Expert judgment of direct and indirect impacts: relatively quick and cheap, and can be used for applications including collecting data, developing alternatives from the strategic policy level to the detailed site level, analyzing and ranking them, predicting impacts, and suggesting mitigation measures. One or preferably several experts with specialist knowledge covering the range of impacts of the strategic action brainstorm/discuss/consider the relevant issue. This is sometimes formalized, e.g., through the Delphi Technique, which uses consecutive cycles of questionnaires of expert participants until agreement on a subject is reached (Source: Therivel 2004).

1.6 Geographical information system (GIS): a tool to organize and present information. It combines a computerized cartography system that stores map data and a database management system that stores attribute data. This allows links between the two data sets to be displayed. GISs are often only used to map data. However, they are also valuable analytical tools, e.g., for calculating areas and distances, identifying viewing areas from a point, constructing buffer zones around features, drawing contour lines using interpolated values between points, and superimposing maps of the above. For more information, see European Environment Agency (1998).

1.7 Land use partitioning analysis: assesses the fragmentation of land into smaller parcels that might result from linear infrastructure development. It involves comparing before and after scenarios. For more information, see European Environment Agency (1998).

1.8 Mapping of transmission channels: a component of Poverty and Social Impact Assessment that identifies the channels through which a particular policy change or other major intervention is expected to affect stakeholders. There are six main transmission channels: employment, prices (production, consumption, and wages); access to goods and services; assets (physical, natural, social, human, and financial); transfers and taxes; and authority. Impacts may be direct (from changes in the policy levers altered by the reform) or indirect (from reform through other channels). The nature of impacts may also vary over time, and so will net impacts on various stakeholders. More information at http://lnweb18.worldbank.org/ESSD/sdvext.nsf/81ByDocName/Approach3Understandingtransmissionchannels.

1.9 Modelling (also called forecasting): techniques predict likely future environmental conditions with and without the strategic action. Modelling involves making a series of assumptions about future conditions under various scenarios and calculating the resulting impacts. Models typically deal with quantifiable impacts: air pollution, noise, traffic, etc. Most models used in SEA have evolved from EIA techniques. Many are computerized. (Source: Therivel, 2004). The June 1998 issue of *Impact Assessment and Project Appraisal* (Vol. 16, No. 2) is devoted to modelling, though mainly in the context of EIA. See also European Commission (1999).

1.10 Overlay maps: obtained by superimposing maps of areas of constraint using transparencies (e.g., overlaying areas of importance for landscape, wildlife, and groundwater protection). The overlay maps can identify areas that would be appropriate or inappropriate for development and produce easily understandable results that can be used in public participation exercises. For more information, see European Commission (1999).

1.11 Participatory techniques for assessment: available for work with stakeholders and those likely to be directly or indirectly affected by a strategic action, so they can engage in the process of assessing impacts. They include, for example: participatory learning and action (PLA); participatory dialogues; focus groups and round tables; consensus-building, negotiations, and conflict resolution. A useful guide to such techniques is Pretty *et al*. (1995). A participatory poverty assessment (PPA) collects poor people's views regarding their own analysis of poverty and survival strategies. PPAs focus on poor people's capacity to analyze their situations and to express their priorities themselves. PPAs are an effective tool for obtaining direct feedback from the poor on a country's poverty profile and the impacts of policy reform. Guidance materials on PPA are available at www.worldbank.org/poverty.

1.12 Quality of life assessment (QoLA): aims to identify what matters and why in an area so that the good and bad quality of life consequences (environmental, societal, and economic) of strategic actions can be better considered. The technique involves identifying benefits and disadvantages that an area offers present and future generations, assessing:

- The importance of each, to whom, and why?
- Whether there will be enough of them;
- What (if anything) could substitute for the benefits?

The answers lead to a series of management implications from which a "shopping list" of things that any development or management of the area should achieve and their relative importance. (Source: Therivel, 2004). For more information, see Countryside Agency *et al*. (2002; www.qualityoflifecapital.org.uk).

2. TOOLS FOR ANALYSING AND COMPARING OPTIONS

2.1 Compatibility appraisal: ensures that a strategic action is internally coherent and consistent with other strategic actions. This is not strictly an SEA function, more one associated with good planning. Normally, two types of matrices are used:

- An internal compatibility matrix plots different components/statements of the strategic action on both axes, with compatibility/incompatibility between the actions marked in the cells with a tick or cross. It is usual to undertake a compatibility analysis between the objectives of the PPP and the SEA objectives;
- An external compatibility matrix plots the strategic actions (as a whole) against other relevant (normally higher- and equal-level) strategic actions. Matrix cells are filled by listing those statements of the strategic action that fulfill the requirements of the other strategic actions or explaining how the evolving strategic action should take the requirements into account. When no statements in the strategic action fulfill the other's requirements, or where they conflict, this may need to be addressed. (Source: Therivel, 2004).

2.2 Cost-benefit analysis, scenario analysis, and multi-criteria analysis to identify priorities and viable alternatives:

Cost-benefit analysis (CBA): A relatively simple and widely used technique for deciding whether to make a change. The technique adds up the value of the benefits of a course of action and subtracts the costs associated with it. Costs are either one-off or may be ongoing. Benefits are most often received over time. The effect of time is built into the analysis by calculating a payback period—the time it takes for the benefits of a change to repay its costs. In its simple form, CBA is carried out using only financial costs and financial benefits, e.g., a simple cost/benefit analysis of a road scheme would measure the cost of building the road and subtract this from the economic benefit of improving transport links. It would not measure either the cost of environmental damage or the benefit of quicker and easier travel to work. A more sophisticated approach to CBA is to try to put a financial value on these intangible costs and benefits. Guidance on the use of CBA is available at http://www.mindtools.com/pages/article/newTED_08.htm.

Scenario analysis/sensitivity analysis: Can be used to describe a range of future conditions. The impact of a strategic action can be forecast and compared for different scenarios—sensitivity analysis—to test the robustness of the strategic action to different possible futures. Forecasts based on current trends and/or scenarios representing trends outside the decision-makers' control are generated, and the strategic action's impacts are predicted based on these forecasts and scenarios. Sensitivity analysis measures the effect on predictions of changing one or more key input values about which there is uncertainty. The Stockholm Environment Institute has developed the Polestar Manual for scenarios (http://sei.se.master.com/texis/master/search/?q=scenarios&xsubmit=Search%3A&s=SS.).
Scenario planning is an example of a number of tools developed within the private sector (See, e.g., Shell International 2000). It is used to evaluate future, long-term, business environments and develop strategies that serve the traditional business goals of survival, maintenance, and growth in competitive markets. The intention is to develop strategies that are robust enough to be able to adapt the company to shocks and surprises in the business environment. It does this through a systematic process, usually engaging external stakeholders, to consider the nature and impact of uncertain futures and important drivers/influences on changes in technological, societal, environmental, economic, political, commercial, cultural, etc., environments.

The goal of scenario planning is to assist strategic planners and policy analysts to make more resilient choices through understanding a wide range of possible futures and designing pathways to arrive at desired positions.

Key stages in this process include:

- Agree the wide range of issues to address.
- Identify participants (lateral thinkers).
- Workshops and interviews of a "brainstorming" nature.
- Identify uncertainties and drivers of change.
- Develop matrices to describe possible combinations of critical uncertainties.
- Elaborate scenarios for each of the above combinations—again through group discussion.
- Describe requirements (PPPs) to move towards a preferred vision and constraints to be overcome in getting there.

Multi-criteria analysis (MCA): techniques can assess a variety of options according to a variety of criteria that have different units (e.g., $, tonne, km, etc.). This is a significant advantage over traditional decision-aiding methods (e.g., cost-benefit analysis), where all criteria need to be converted to the same unit (e.g., dollars only). They also have the capacity to analyze both quantitative and qualitative evaluation criteria (e.g., yes/no, pluses and minuses). MCA techniques have three common components: a given set of alternatives; a set of criteria for comparing the alternatives; and a method for ranking the alternatives based on how well they satisfy the criteria. An MCA manual is available at www.cifor.cgiar.org/acm/methods/mca.html.

***2.3 Opinion surveys to identify priorities*:** for methods go to http://gsociology.icaap.org/methods/surveys.htm.

2.4 Risk analysis or assessment: established itself as an essential tool for the management of environmental risk. An issue for environmental risk assessment is the lack of an easily defined measure of what constitutes *harm* to the environment. In some cases, definitions of environmental damage are laid down in statute, but in others, appropriate criteria will need to be selected on the basis of scientific and social judgments. For a comprehensive treatment of the basic principles of environmental risk assessment and management, see Calow (1998). Many sources provide guidelines for environmental risk assessment, e.g., http://www.defra.gov.uk/environment/risk/eramguide/index.htm.

2.5 Vulnerability analysis: assesses the impacts of a planned activity or different development scenarios on the vulnerability of an area. Vulnerability maps are produced showing the degree of vulnerability for selected targets (e.g., people, flora and fauna, landscape). These are overlaid and 'weighted' (using GIS and multi-criteria analysis) to indicate areas of high vulnerability and then related to expected levels of impact associated with different development options (e.g., noise increase, groundwater decline)—revealing the locations of negative impacts regarding different targets and the alternatives with the least impacts. For further information, see van Straaten (1999).

3. TOOLS FOR ENSURING FULL STAKEHOLDER ENGAGEMENT

3.1 General information, techniques, etc.: many guidelines are available for effective community involvement and consultation, e.g., www.rtpi.org.uk/resources/publications/ConsultationGuidelines_web.pdf; www.iap2.org/associations/4748/files/toolbox.pdf; www.unece.org/env/eia/publicpart.html.

3.2 Consensus building processes: a conflict-resolution process used mainly to settle complex, multiparty disputes. Since the 1980s, it has become widely used in the environmental and public policy arena but is useful whenever multiple parties are involved in a complex dispute or conflict. It allows them

to work together to develop a mutually acceptable solution. More information is at www.beyondintractability.org/m/consensus_building.jsp. A short guide to consensus building is available at http://web.mit.edu/publicdisputes/practice/cbh_ch1.html.

3.3 Stakeholder analysis to identify those affected and involved in the PPP decision: incorporates economics, political science, game and decision theory, and environmental sciences. Current models apply a variety of tools on both qualitative and quantitative data to understand stakeholders, their positions, influence with other groups, and their interest in a particular PPP. In addition, it provides an idea of the impact of the PPP on political and social forces, illuminates the divergent viewpoints towards proposed PPPs and the potential power struggles among groups and individuals, and helps identify potential strategies for negotiating with opposing stakeholders. Go to http://www1.worldbank.org/publicsector/anticorrupt/PoliticalEconomy/stakeholderanalysis.htm.

SOURCES OF FURTHER INFORMATION ON SEA TOOLS

- A modular Capacity Development Manual for the Implementation of the UNECE Protocol on Strategic Environmental Assessment is being developed by UNECE. It will be available at www.unece.org.

- Therivel, R. (2004). *Strategic Environmental Assessment in Action*, Earthscan: London contains an appendix with SEA prediction and evaluation techniques. It covers expert judgement, quality of life assessment, overlay maps, land use partitioning analysis, geographical information systems, network analysis, modelling, scenario/sensitivity analysis, cost-benefit analysis, multi-criteria analysis, life cycle analysis, vulnerability analysis, carrying capacity, ecological footprint, risk assessment, and compatibility appraisal.

- Rauschmayer F. and Risse N. (2005). A Framework for the Selection of Participatory Approaches for SEA, *Environmental Impact Assessment Review*, 25(6): 650-666. Covers: mediation, mediated modelling, consensus conferences, citizens' juries, and cooperative discourse.

- Finnveden G., Nilsson M., Johansson J., Persson A., Moberg A., and Carlsson T. (2005). Strategic Environmental Assessment methodologies: Applications within the Energy Sector. Environmental *Impact Assessment Review*, 23(1): 91-123. This paper covers: future studies, LCA, environmentally extended input/output analysis, risk assessment of chemicals and accidents, impact pathway approach, ecological impact assessment, multiple attribute analysis, environmental objectives, economic valuation, surveys, and valuation methods based on mass, energy, and area.