Multi-criteria and Decision Support Systems in support of the Water Framework Directive in Ireland

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Introduction
The current challenge in the implementation of the Water Framework Directive in Ireland is to introduce programmes of measures that will address the targeted environmental objectives in each River Basin District (RBD). Introduction of such programmes requires that proposed measures be thoroughly evaluated and that decisions will involve multiple criteria and must include stakeholders preferences and opinions. Decision Support Systems (DSS) facilitate this process. Many such systems have been developed and used in relation to water quality. In addition to their technical, modeling, benefits, DSS can also form the basis of systems to communicate options, benefits and damages to stakeholders and to receive feedback on their attitudes and preferences. Such systems could also be involved in facilitating the subsequent negotiations and resulting compromises. In Ireland, a new research project, Wincoms, has commenced which will address these aspects and will provide recommendations for suitable systems to be used in Ireland.

Components of DSS
The technical part of the environmental management cycle is best described by the Driver-Pressure-State-Impact-Response (DSPIR) framework (Irvine et al., 2005). Therefore the appealing DST should have a flexible structure that can incorporate a series of mathematical models or methods describing the links between any two consecutive components in the DSPIR framework. The types of models that can be used are summarised in Table 1.

<table>
<thead>
<tr>
<th>DSPIR Components</th>
<th>Model/Method Type</th>
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<tbody>
<tr>
<td>Drivers-Pressure</td>
<td>Hydrological/Agronomical model</td>
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<tr>
<td>Pressure-State</td>
<td>River/Lake water quality model</td>
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<tr>
<td>State-Impact</td>
<td>Ecological model</td>
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<tr>
<td>Impact-Response</td>
<td>Consultation process</td>
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<td>Response-Drivers</td>
<td>Economic model</td>
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</table>

In addition to the model requirement, the DSS should contain state-of-the-art, transparent and logical methods for ranking alternatives in situations where clear-cut, unanimous, decisions, such as in environmental projects, are seldom possible. The use of several evaluation criteria to perform the ranking is desirable and due the presence of un-priced environmental impacts the multi-criteria
evaluation is an attractive approach. Many multi-criteria methods can also account for uncertainties in the information used in the decision process.

Another important requirement of the DSS is to provide an accessible web-based interface where the stakeholders can participate in the consultation phase of the decision process. This in turn requires that the DSS has a self-updating mechanism in order to accept new information and update the relevant database(s).

**Potential existing DSS for use in Ireland**

In Europe, the development and use of DSS for the purpose of the WFD implementation has been ongoing for a number of years and a number of projects have been established to serve this objective. However, successful applications of DSS in two projects, Trans-Cat (Horak and Owsinski, 2004) and Mulino (Mysiak et al., 2005), are particularly important to the development of DSS in Ireland. The relevance of the first project is primarily due to the experience provided in dealing with the management of trans-boundary RBDs such as the one shared between the Republic of Ireland and Northern Ireland. Whereas the issue, which has been dealt with in the second project (integrated catchment management), represents the back-bone of the DSS proposed for the Irish situation.

**Wincoms project**

The acronym stands for Water Framework Directive – InteGration, negoTiation and Communication of optimal Measures with Stakeholders and its principle objectives are;

- To produce a comprehensive scientific and technical description of all measures available to meet the requirements of the WFD together with a ranking on the basis of all relevant criteria, using formal multi-criteria methods. \(\Rightarrow\) ranked list of measures and criteria. These results are targeted principally at RBD decision makers, but will also add to stakeholder and general technical understanding of the performance, advantages and disadvantages of all measures.

- To survey existing decision support systems and identify a short-list of 2 or 3 of the most suitable for WFD decision-making. Implement, adopt and test these in a case-study situation (using the ERBD project), evaluate their performance (particularly in respect of interaction with stakeholders) and recommend the most suitable system or approach. \(\Rightarrow\) survey of DSS, ranked short-list and demonstration of recommended DSS in conjunction with Eastern RBD. These results will be of wide applicability in environmental decision support. However, their principle targets are stakeholders and decision makers involved in WFD activities.

- To identify and study the knowledge, opinions and preferences of all relevant stakeholders and integrate the results with the decision support systems implemented in objective 2.\(\Rightarrow\) report on stakeholders attitudes and preferences, on use of DSS as decision, negotiation and mediating tool in developing policy/measures.\] These results will be of wide applicability in the sociology of environmental opinions and preferences and the communication and influence of science knowledge. However, their principle targets are stakeholders and decision makers involved in WFD activities.

The project will produce state of the art outputs under all three major headings (assessment of measures, evaluation of decision support systems and stakeholder attitudes) and will integrate the knowledge and experience of existing EU-and USA funded projects and the existing work of the RBD Advisory boards and particularly of the Eastern RBD project to provide practical systems/methodologies for socially acceptable and sustainable decision making in the formulation of WFD policies and measures.
Current policy relating to public participation in water framework activities in Ireland is outlined in a consultation paper (DOEHLG, 2004) which makes it clear that most of these objectives can be assisted by a Decision Support System and also, from previous work, that the major challenges to be addressed are at the interface between the technical (modeling) part of the DSS and the stakeholders.

References