

# Developing and Applying a User-friendly Web-based GIS for Participative Environmental Assessment

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## 1. Introduction

The strong spatial and temporal dimensions of development plans necessitate certain requirements in relation to the analytical tools applied to support Strategic Environmental Assessment (SEA) processes. The nature of plans and, subsequently, spatial data requires presenting them in graphic format. Similarly, temporal variation can often be represented in visual form by spatially illustrating changes over-time. Furthermore, it is estimated that up to 85% of all data have a spatial component and, therefore, can be mapped using Geographic Information Systems (GIS) (Chan and Easa, 2000). In this context, the graphic display and analytical potential of GIS can significantly contribute to SEA of development plans by facilitating and enhancing the various stages of the process.

The SEA Directive (CEC, 2001) and the related Directive 2003/35/EC (CEC, 2003) make mandatory provisions for public participation in the assessment of potential effects of certain plans and programmes on the environment. SEA processes and the integration of environmental concerns into planning can be positively influenced by public participation (Risse *et al.* 2003; Al-Kodmany, 2002). It is considered that involving the affected public and interest groups enhances the level of legitimacy, transparency, and confidence in the decision-making process (Risse *et al.* 2003; Von Seht, 1999). Methods such as submission of written comments, public hearings, workshops, interviews, etc. as well as more modern forms of consultation such as internet-based fora are possible forms of participation (CEC, 2003). Selection of appropriate public participation techniques is necessary to ensure that citizens are

given enough time and scope to participate in an effective manner while avoiding undesirable time delays in the decision-making process (Von Seht, 1999).

GIS packages tend to require skilled knowledge of the system to operate them, as applications normally have a technology focus rather than usability (Jordan, 1998; Sieber, 1998). However, recent developments in GIS are leading to more user-friendly software interfaces. Usability barriers are being reduced and a number of case studies indicate that GIS can be successfully used as a tool in participatory processes to facilitate spatial comprehension, enhance transparency and stimulate debate (Al-Kodmany, 2002; Bojórquez-Tapia *et al.*, 2001; Wood, 2005). In light of this, a GIS-based website has been developed for public participation in SEA.

## **2. Methodology**

The research seeks to test the applicability and effectiveness of GIS in SEA. To address this objective, a GIS methodology has been developed and is currently being applied to SEA case studies of Development Plans in Ireland. These case studies will allow for the assessment of its usefulness from an environmental planning perspective.

As part of the GIS for SEA methodology (GISEA hereafter), a participatory web-based GIS tool has been developed. The aim is to both promote and expand the use of GIS to enhance public participation and promote the incorporation of spatially specific information in SEA. The availability of a web-based participatory tool can facilitate public consultation processes by providing an alternative way of informing the public and allowing them to remotely submit views and comments.

Consideration was given to open source versus commercial web GIS packages. The ArcGIS family of products was chosen as the platform for developing the GISEA method. It is considered that it provides the versatility and the tools needed to achieve the research objectives. The ArcIMS interface (i.e. the server GIS used for developing the public participation website) was edited to develop a user-friendly and easy to understand system that would not require specific GIS skills and could be manipulated with basic web-browser knowledge. Therefore, the viewframe and tools available in ArcIMS were adapted to the requirements of the research: including an enhanced browser, improved user interaction, incorporation of a database and display of tools and questionnaires specific to case studies. This was achieved by programming and editing the scripts on the ArcIMS files in several computer languages, including: php, java, html, sql and visual basics. The website has been designed to follow a number of steps guiding the user through the consultation process (Figure 1).

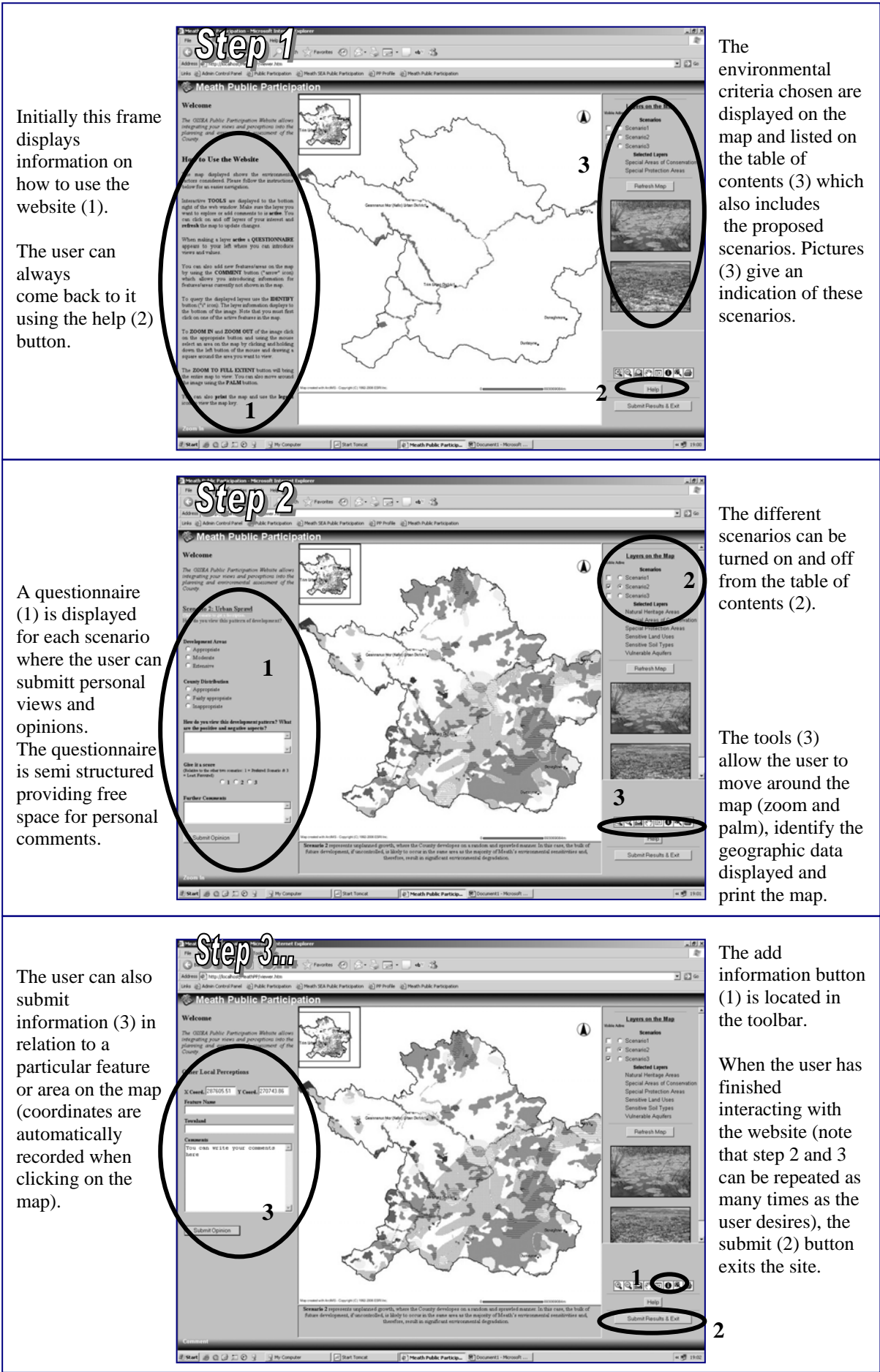


Figure 1. Details of the GISEA ArcIMS webpage.

### **3. Results**

Pilot studies on the understandability and user-friendliness of the GISEA public participation tool revealed that the majority of users (58%) found the website easy to use and navigate. The graphics were perceived as a good way of presenting the information. However, a number of users (30%) indicated that the absence of a more readily available legend (i.e. an alternative to having to select the legend menu) was a major drawback when understanding the map.

The website has been launched as part of the SEA of two County Development Plans in Ireland. The site is not intended to replace any public participation methods but to complement existing practices and techniques, ensuring that stakeholders have access to information and are provided with a mechanism to have a say outside conventional participatory processes. It is anticipated that this tool will contribute to a more transparent and better informed decision-making process. The objective is to gather spatially specific information and consequently integrate the weighted public participation results into the environmental assessment through GIS. This will provide an overall view (both scientific and social) on the environmental significance/vulnerability of the different areas and the preferred scenario/alternative for development.

### **4. Analysis**

GIS is recognised as a very useful tool for assisting decision-making. Case studies anticipate that GIS has the potential for improving the information available to the public and the spatial analysis of combined quantitative and qualitative data. However, it is still considered as an expensive solution that requires a high level of spatial understanding and technological skill to use (Kingston, *per. com.*, 2006). While open source GIS could solve the associated costs, proprietary software is most commonly used in the planning context to which the research applies, thus enhancing its usability. Concerns also derive from the apparent division between computer-skilled and 'traditional' citizens (Furlong, 2005; Scott and Oelofse, 2005) and varying degrees of access to technology. This is anticipated to affect the use of and the responses derived from the tool. Moreover, Kingston *et al.* (1999) suggest that the levels of participation are directly related to the geographical scale; the greater participation occurring at the larger or more localised scale.

This paper will discuss the key aspects of a user-friendly tool to complement traditional public participation methods and will evaluate its applicability, by addressing transparency, accessibility, understandability, accountability and usability issues. It will simultaneously provide an overview on the limitations, barriers and opportunities encountered when applying the internet-based GISEA public participation tool during the preparation of County Development Plans in Ireland.

## References

- Al-Kodmany, K., 2002, GIS and the Artist: Shaping the Image of a Neighbourhood in Participatory Environmental Design. In: Weiner, D.; Harris, T. M. and Craig W. J. (eds.) *Community Participation and Geographic Information Systems* (London, Taylor and Francis).
- Bojórquez-Tapia, L.; Diaz-Mondragón, S. and Ezcurra E., 2001 GIS-based Approach for Participatory Decision Making and Land Suitability Assessment. *International Journal of Geographical Information Science*, 15, 2, pp. 129-151.
- CEC, 2001, Directive 2001/42/EC on the Assessment of the Effects of Certain Plans and Programmes on the Environment; Luxembourg, 27 June 2001. *Official Journal of the European Union*, L 197/30, 21.7.2001.
- CEC, 2003, Directive 2003/35/EC - Providing for Public Participation in Respect of the Drawing Up of Certain Plans and Programmes Relating to the Environment and Amending with Regard to Public Participation and Access to Justice Council Directives 85/337/EEC and 96/61/EC. *Official Journal of the European Union*, L 156, 25.6.2003.
- Chan, Y. and Easa, S., 2000, Looking Ahead. In S. Easa and Y. Chan (eds.) *Urban Planning and Development Applications of GIS* (Reston, Virginia: American Society of Civil Engineers).
- Furlong, S.R., 2005, Interest Group Participation in Rule Making: A Decade of Change. *Journal of Public Administration Research and Theory*, 15, 3, pp. 353-370.
- Jordan, G., 1998, A Public Participation GIS for Community Forestry User Groups in Nepal: Putting People Before the Technology. Department of Agriculture & Forestry Newton Rigg College, University of Central Lancashire Penrith, Carlisle, UK (Available at: [http://www.geog.ntu.edu.tw/course/gisluc/GIS\\_Paper%5Cforestry.pdf](http://www.geog.ntu.edu.tw/course/gisluc/GIS_Paper%5Cforestry.pdf) - Las accessed: December 2006)
- Kingston, R., Carver, S., Evans, A.J. and Turton, I., 1999, Virtual Decision Making in Spatial Planning: Web-based Geographical Information Systems for Public Participation in Environmental Decision Making. Unpublished Paper presented at the International Conference on Public Participation and Information Technology (Lisbon, Portugal).
- Risse, N.; Crowley, M.; Vincke, P. and Waaub, J.P., 2003, Implementing the European SEA Directive: the Member States' margin of discretion. *Environmental Impact Assessment Review*, 23, pp. 453-470.
- Scott, D. and Oelofse, C., 2005, Social and Environmental Justice in South African Cities: Including Invisible Stakeholders' in Environmental Assessment Procedures. *Journal of Environmental Planning and Management*, 48, 3, pp. 445-467.
- Sieber, R.E., 1998, Geographic Information Systems in the Environmental Movement. Department of Geography and Planning, Earth Sciences 218, State University of New York, Albany, NY, USA. (Available at: <http://www.ncgia.ucsb.edu/varenius/ppgis/papers/sieber.pdf> - Las accessed: August 2006).
- Von Seht, H., 1999, Requirements of a Comprehensive Strategic Environmental Assessment System. *Landscape and Urban Planning*, 45, pp. 1-14.
- Wood, J., 2005, 'How Green is My Valley?' Desktop Geographic Information Systems as a Community-Based Participatory Mapping Tool. *Area*, 37, 2, pp. 159-170.

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**Biography of Principal Author:** Ainhoa González, BSc.(Ag.) and MSc.ERM, is an environmental analyst with key interest on the application of GIS to environmental assessment. She is at the end of the second year on her PhD, which focuses on the identification and evaluation of limitations, barriers and opportunities derived from applying GIS to SEA.