PERSPECTIVE FROM THE FIELD

Innovative Geographic Visualization for Improved Understanding and Effective Public Participation in Environmental Policy Making and Implementation

Arun Kumar. A, Sujata Upgupta, Tanvi Gaur, S. Sathyakumar, K. Ramesh

Public participation can not only contribute to improvement of decisions, but can also help in enhancing the capability of communities to solve problems and pursue common concerns. Arguably, a strong public participation in environmental governance could increase the commitment among stakeholders, which strengthens the compliance and enforcement of policies. Nevertheless, despite the critical importance of public participation in policy making, such involvements are not as effective as may be desired for logical conclusion and efficient implementation of policies. The near nonexistence of visualization tools at the disposal of the general public to aid in visual understanding of the problem is the major cause factor for the non-involvement and negligible influence of the populace in policy making. One such facility is being established at Wildlife Institute of India for visualizing the impacts of climate change on biodiversity of Indian Himalayan Region (IHR).

Public participation refers to involvement in knowledge production and/or decision-making of those involved in, affected by, knowledgeable of, or having relevant expertise or experience on the issue at stake (Van Asselt and Rijkens Klomp, 2002). Public participation involves an element of control over decisions, through the decision making process. It is sometimes assumed that conflicts over public policies and science are caused by citizen ignorance—a gap between citizen and expert knowledge, also known as a "knowledge deficit" (Stoutenborough and Vedlitz, 2014). Providing more detailed information to citizens about science and policy should increase citizen knowledge, which in turn will make citizens to think in line with natural scientists, economists, and policy experts (Rhodes, Axsen, and Jaccard, 2014). The major challenges faced in building awareness and bringing in local participation to the policy making process are the following:

1. The predominantly global nature of the issue and the information is not relevant for local users or communities.
2. The available scientific data is too complex for a common man to understand.
3. The available information is of a biophysical nature, little of which is converging on socioeconomic and other livelihood scenarios.
4. The very few effective structured processes for public participation in the policy making.
5. Nonexistence of infrastructure and capacity to visualize the scientific data into more understandable 2D and 3D output.

With the alarming threats from climate change and other extreme events, the major portion of the Asia-Pacific region is facing a challenge of escalating exposure and vulnerability to changing climate and other related hazards (UNISDR, 2012). Developing countries, particularly, are chronically vulnerable and at risk to climatic hazards due to the high agglomeration of population, non-conducive economic activities and improper development encroaching onto hazard-prone areas (Mendelsohn and Dinar, 1999; Adger et al., 2003). Although the policymakers understand the immense importance of public participation, it is not always practiced and if practiced, it has minimum public influence over the policies made. Policies that ignore the input of those affected will often have ineffective outcomes, poor implementation, and can even result in the violation of

Affiliation of authors: Arun Kumar. A, Sujata Upgupta, Tanvi Gaur, S. Sathyakumar, and K. Ramesh, Wildlife Institute of India, Chandrabani, Dehradun 248 001, Uttarakhand, India.

Address correspondence to: Arun Kumar. A, Wildlife Institute of India, Chandrabani, Dehradun 248 001, Uttarakhand, India; (e-mail) arunkumar.gis@gmail.com.

human rights. Participation also increases the level of awareness around an issue, stimulates public debate, and enhances knowledge.

Engagement of non-academic stakeholders does not simply mean transferring information, but needs to occur through an interactive, participatory process to create ownership, accountability, and a willingness to act. Progress toward public participation in policy making seems to be more likely if information is localized, visualized, and co-constructed, which can be achieved by geovisualization.

Geovisualization Tools

The ability of visual images to communicate messages quickly and powerfully has long been recognized and used as an instrument for data exploration and analysis. Among the various forms of visualization, geovisualization has some unique characteristics that could bring a consensus of the public in decision making. Landscape visualization (geovisualization) attempts to represent actual places and on-the-ground conditions in three-dimensional (3D) perspective views, with varying degrees of realism (Sheppard and Salter, 2004). There are many emerging technologies that need to be evaluated as to their suitability in assisting decision support and participation where geographical information is vital.

There exists exciting possibilities for using the new visualization techniques to facilitate community participation through (a) informing (creating interactive web sites to educate the public), (b) consulting (generating feedback mechanisms at crucial stages in the design and development process in the policy making), (c) involving (exploring alternative scenarios and comparing the outcomes of different scenarios), and (d) empowering (influencing final policies through 'citizen juries' and online ballots through visualization outcomes) (Pettit, Cartwright, and Berry, 2006).

In the context of public participation in the decision making process, the potential benefits of geovisualization include:

1. The future predictive capabilities of GIS with realistic representation in the 2D and 3D form can provide 'windows into the future' for the public.
2. The ability to depict recognizable and familiar sites will help in localizing the information for better understanding of the future changes.
3. As per the audience's visualization needs, the data can be highlighted or simplified to provide different levels of realism.

4. The alternative solution can be tested alongside with the proposed solution.
5. Attractiveness due to novelty, dynamism, and interactivity of the medium.

An appreciable amount of research has been carried out to evaluate the impact of visualization in public participation and there is already considerable evidence for effectiveness of communications and usability of visualization in planning and decision support, including the ability to engage common people (Appleton and Lovett, 2003; Sheppard and Meitner, 2005; MacEachren, 2001; Lewis and Sheppard, 2006). Realistic, immersive, and/or interactive systems have demonstrated high levels of engagement with users (HITL Report, 1997).

Sheppard et al. have described the importance and effectiveness of visualization in achieving community engagement in the framework for climate change policy making (Sheppard et al., 2011). The Local Climate Change Visioning Project (LCCVP) was conducted by British Columbia University to understand the outcomes of localizing climate change scenarios, in the context of community participation in planning and decision-making. The aim of the project was to integrate the available global, regional, and local scale climate data with geographic information science and existing local climate change studies to visualize potential climate change impacts to the communities and stakeholders. The products of this visioning project were tested with the stakeholders, and the results show the effectiveness of geovisualization technology to increase engagement, build awareness of complex environmental issues related to local climate change, and foster participants' support for climate change policy. Despite the complexities, including high technical capacities, high set up cost, and addressing multiple considerations, the visualization tools can bridge the gap between complex scientific modelling outputs and local level realities on the ground to engage the community in decision making process.

The Future of Geovisualization in Public Participation

The influence of visual media of global problems, including climate change, natural disaster, terrorism, poverty, and others, affects the respondents emotionally in local scale rather than global scale. Based on many instances of observational research on audience response during visualization workshops, it was clear that the extensive use of realistic visualizations maintained a high level of engagement among the public participants.

There is a better prospect for mobilizing stakeholders and include common people's interest and concern, if the impact of the effect of the policies can be demonstrated 'on the ground,' in familiar locations and upon landmarks and businesses. Linking global science to locally significant places with visualization serves as a powerful tool for decision-making (CSPR Report, 2009). Visualization tools are potentially too powerful and can bring the impacts of policies to home, to people in their back yard, making it personal through realistic views of their familiar landscape under possible future scenarios (Sheppard, 2006). This would ensure effective and well-informed stakeholder participation in the development of new policies and decisions.

The importance of 2D and 3D visualization is well recognized by the government of India for mainstreaming public participation in the decision making process. As a result, the National Mission for Sustaining the Himalayan Ecosystem (NMSHE), a program is being coordinated by the Department of Science and Technology (DST) wherein six Task Forces have been identified and are being implemented by six national research institutes. The task force on "Micro Flora and Fauna, Wildlife and Animal Population" is being implemented at the Wildlife Institute of India under the project entitled "Assessment and Monitoring of Climate Change Effects on Wildlife Species and Ecosystems for Developing Adaptation and Mitigation Strategies in the Indian Himalayan Region." One of the objectives of this project is to set up a visualization lab to simulate various climate change scenarios and to visualize potential effects on fauna and their habitats in the Indian Himalayan Region. The aim of this center will be to educate the stakeholders and to communicate to the public through 2D and 3D visualization outputs to influence the policy and decision making. This will have a huge implication on natural resources management policy making by bringing in the participation of multiple stakeholders and effective implementation of conservation actions in the current and future context.

References

Adger, W.N., S. Huq, K. Brown, D. Conway, and M. Hulme 2003. Adaptation to climate change in the developing world. *Progress in Development Studies* 3(3):179–195.

Appleton, K., and A. Lovett 2003. GIS-based Visualization of Rural Landscapes: Defining 'Sufficient' Realism for Environmental Decision-Making. *Landscape and Urban Planning* 65:117–131.

CSPR. 2009. Centre for Climate Science and Policy Research *State of Climate Visualization*, Report 09:04. Norrköping, Sweden, 79 pp.

HITL. 1997. *The Impact of Three Dimensional Immersive Virtual Environments on Modern Pedagogy*. Human Interface Technology Laboratory Technical Report R-97-15, Seattle, Washington, 34 pp.

Lewis, J.L., and S.R.J. Sheppard 2006. Culture and Communication: Can Landscape Visualisation Improve Forest Management Consultation with Indigenous Communities? *Landscape and Urban Planning* 77: 291–313.

MacEachren, A.M. 2001. Cartography and GIS: Extending Collaborative Tools to Support Virtual Teams. *Progress in Human Geography* 25(3): 431–444.

Mendelsohn, R., and A. Dinar 1999. Climate Change, Agriculture, and Developing Countries: Does Adaptation Matter? *The World Bank Research Observer* 14(2):277–293.

Pettit, C., W. Cartwright, and M. Berry 2006. Geographical visualization: A participatory planning supporting tool for imagining landscape futures. *Applied Geographical Information System (GIS)* 2(3):22.1–22.17.

Rhodes, E., J. Axsen, and M. Jaccard 2014. Does Effective Climate Policy Require Well-informed Citizen Support? *Global Environmental Change* 29:92–104.

Sheppard, S.R.J. 2006. Bridging the sustainability gap with landscape visualisation in community visioning hubs. *Integrated Assessment* 6(4): 79–108.

Sheppard, S.R.J., and M.J. Meitner 2005. Using Multi-criteria Analysis and Visualisation for Sustainable Forest Management Planning with Stakeholder Groups. *Forest Ecology and Management* 207(1–2): 171–187.

Sheppard, S.R.J., and J. Salter 2004. The role of visualisation in forest planning. In. *Encyclopedia of Forest Sciences*, J. Julian Evans and J. Burley, eds. Academic Press, Oxford, United Kingdom, 486–498.

Sheppard, S.R.J., A. Shaw, D. Flanders, S. Burch, A. Wiek, J. Carmichael, J. Robinson, and S. Cohen 2011. Future Visioning of Local Climate Change: A Framework for Community Engagement and Planning with Scenarios and Visualisation. *Futures* 43:400–412.

Stoutenborough, J.W., and A. Vedlitz 2014. The Effect of Perceived and Assessed Knowledge of Climate Change on Public Policy Concerns: An Empirical Comparison. *Environmental Science & Policy* 37:23–33.

UNISDR. 2012. *Reducing Vulnerability and Exposure to Disasters*. The Asia-Pacific Disaster Report 2012, Bangkok, 134 pp.

Van Asselt, M., and N. Rijkens-Klomp 2002. A Look in the Mirror: Reflection on Participation in Integrated Assessment from a Methodological Perspective. *Global Environmental Change* 12(3):167–184.