Introduction to Public Participation Geographic Information Systems Special Issue

Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research

Innovative Public Participatory GIS Methodologies Adopted to Deal with the Social Impact Assessment Process Challenges: A Sri Lankan Experience

Analyzing Perceptions of Inequalities in Rural Areas of England Using a Mixed-methods Approach

Participatory Asset Mapping in the Lake Victoria Basin of Kenya

Increasing Access to and Use of Geospatial Data by Municipal Government and Citizens: The Process of “Geomatization” in Rural Québec

Active Transportation, Citizen Engagement and Livability: Coupling Citizens and Smartphones to Make the Change

Web-based PPGIS for Wilhelmsburg, Germany: An Integration of Interactive GIS-based Maps with an Online Questionnaire
Join us in Providence, Rhode Island for
GIS-Pro 2013:
URISA’s 51st Annual Conference for GIS Professionals

September 16-19, 2013
Submit an abstract, share your research and ideas!
Contents

5  Introduction to Public Participation Geographic Information Systems Special Issue
   Special Guest Editors: Michelle M. Thompson and Kelly D. Owens

7  Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research
   Greg Brown

19  Innovative Public Participatory GIS Methodologies Adopted to Deal with the Social Impact Assessment Process Challenges: A Sri Lankan Experience
    Ram Alagan and Seela Aladuwaka

33  Analyzing Perceptions of Inequalities in Rural Areas of England Using a Mixed-methods Approach
    Steve Cinderby, Annemarieke de Bruin, Piran White, and Meg Huby

45  Participatory Asset Mapping in the Lake Victoria Basin of Kenya
    Michael Martin, Brianne Peters, and Jon Corbett

57  Increasing Access to and Use of Geospatial Data by Municipal Government and Citizens: The Process of “Geomatization” in Rural Québec
    Peter A. Johnson and Renee E. Sieber

65  Active Transportation, Citizen Engagement and Livability: Coupling Citizens and Smartphones to Make the Change
    Marc Schlossberg, Cody Evers, Ken Kato, and Christo Brehm

75  Web-based PPGIS for Wilhelmsburg, Germany: An Integration of Interactive GIS-based Maps with an Online Questionnaire
    Alenka Poplin
URISA Journal

Publisher: Urban and Regional Information Systems Association

Editor-in-Chief: Dr. Piyushimita (Vonu) Thakuriah

Special Issue Editors: Michelle M. Thompson
Kelly D. Owens

Journal Coordinator: Wendy Nelson

Electronic Journal: http://www.urisa.org/urisajournal

EDITORIAL OFFICE: Urban and Regional Information Systems Association, 701 Lee Street, Suite 680, Des Plaines, Illinois 60016; Voice (847) 824-6300; Fax (847) 824-6363; E-mail info@urisa.org.

SUBMISSIONS: This publication accepts from authors an exclusive right of first publication to their article plus an accompanying grant of non-exclusive full rights. The publisher requires that full credit for first publication in the URISA Journal is provided in any subsequent electronic or print publications. For more information, the “Manuscript Submission Guidelines for Refereed Articles” is available on our website, www.urisa.org, or by calling (847) 824-6300.

SUBSCRIPTION AND ADVERTISING: All correspondence about advertising, subscriptions, and URISA memberships should be directed to: Urban and Regional Information Systems Association, 701 Lee Street, Suite 680, Des Plaines, Illinois 60016; Voice (847) 824-6300; Fax (847) 824-6363; E-mail info@urisa.org.

URISA Journal is published two times a year by the Urban and Regional Information Systems Association.

© 2012 by the Urban and Regional Information Systems Association. Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by permission of the Urban and Regional Information Systems Association.

Educational programs planned and presented by URISA provide attendees with relevant and rewarding continuing education experience. However, neither the content (whether written or oral) of any course, seminar, or other presentation, nor the use of a specific product in conjunction therewith, nor the exhibition of any materials by any party coincident with the educational event, should be construed as indicating endorsement or approval of the views presented, the products used, or the materials exhibited by URISA, or by its committees, Special Interest Groups, Chapters, or other commissions.

SUBSCRIPTION RATE: One year: $295 business, libraries, government agencies, and public institutions. Individuals interested in subscriptions should contact URISA for membership information.

US ISSN 1045-8077
Editorial Board

URISA Journal Editor

Editor-in-Chief
Dr. Piyushimita (Vonu) Thakuriah, Department of Urban Planning and Policy, University of Illinois at Chicago

Thematic Editors:

Sustainability Analysis and Decision Support Systems:
Timothy Nyerges, University of Washington

Participatory GIS and Related Applications:
Laxmi Ramasubramanian, Hunter College

Social, Economic, Governance and Political Sciences:
Francis Harvey, University of Minnesota

GIScience:
Harvey Miller, University of Utah

Urban and Regional Systems and Modeling:
Itzhak Benenson, Tel Aviv University

Editorial Board

Jochen Albrecht, Hunter College

Peggy Agouris, Center for Earth Observing and Space Research, George Mason University, Virginia

David Arctur, Open Geospatial Consortium

Michael Batty, Centre for Advanced Spatial Analysis, University College London (United Kingdom)

Kate Beard, Department of Spatial Information Science and Engineering, University of Maine

Yvan Bédard, Centre for Research in Geomatics, Laval University (Canada)

Itzhak Benenson, Department of Geography, Tel Aviv University (Israel)

Al Butler, GISP, Milepost Zero

Barbara P. Buttenfield, Department of Geography, University of Colorado

Keith C. Clarke, Department of Geography, University of California-Santa Barbara

David Coleman, Department of Geodesy and Geomatics Engineering, University of New Brunswick (Canada)

Paul Cote, Graduate School of Design, Harvard University

David J. Cowen, Department of Geography, University of South Carolina

William J. Craig, GISP, Center for Urban and Regional Affairs, University of Minnesota

Robert G. Cromley, Department of Geography, University of Connecticut

Michael Gould, Environmental Systems Research Institute

Klaus Greve, Department of Geography, University of Bonn (Germany)

Daniel A. Griffith, Geographic Information Sciences, University of Texas at Dallas

Francis J. Harvey, Department of Geography, University of Minnesota

Bin Jiang, University of Gävle, Sweden

Richard Klosterman, Department of Geography and Planning, University of Akron

Jeremy Mennis, Department of Geography and Urban Studies, Temple University

Nancy von Meyer, GISP, Fairview Industries

Harvey J. Miller, Department of Geography, University of Utah

Zorica Nedovic-Budic, School of Geography, Planning and Environmental Policy, University College, Dublin (Ireland)

Timothy Nyerges, University of Washington, Department of Geography, Seattle

Harlan Onsrud, Spatial Information Science and Engineering, University of Maine

Zhong-Ren Peng, Department of Urban and Regional Planning, University of Florida

Laxmi Ramasubramanian, Hunter College, Department of Urban Affairs and Planning, New York City

Carl Reed, Open Geospatial Consortium

Claus Rinner, Department of Geography, Ryerson University (Canada)

Monika Sester, Institute of Cartography and Geoinformatics, Leibniz Universität Hannover, Germany

David Tulloch, Department of Landscape Architecture, Rutgers University

Stephen J. Ventura, Department of Environmental Studies and Soil Science, University of Wisconsin-Madison

Barry Wellar, Department of Geography, University of Ottawa (Canada)

Lyna Wiggins, Department of Planning, Rutgers University

F. Benjamin Zhan, Department of Geography, Texas State University-San Marcos
Introduction to Public Participation Geographic Information Systems Special Issue

Less than 25 years ago, the collective wisdom of university entrepreneurs recognized a more robust and sustainable means to advance knowledge by combining resources of community organizations, municipal departments, and academia. As a result, Public Participation Geographic Information Systems (PPGIS) has significantly increased the capacity to identify community desires, convey municipal plans, and leverage university resources. Within the last five years, technology has departed from a mostly exclusive process that shielded public information through proprietary software to open data and spatial formats not previously accessible at the neighborhood or regional scale. Municipal budgets are now earmarking more technology dollars and increasing the capacity for locales to bolster infrastructure and drive programs. With the availability of spatially-enabled websites from the federal, state and local levels, costs are further reduced and access is significantly increased. These factors have dramatically shifted us in the direction of providing a better picture of neighborhood demographics and to evaluate quality of life issues.

With the progression of PPGIS, variations in the technology’s adaptability and application have brought forth critiques related to access, technology, and time. Geographic Information Systems (GIS) permeates a global market and technology appears to drive social, economic and civic progress with varying outcomes. Residents, advocates, and community organizations are utilizing democratized data in ways that early PPGIS investors could not have imagined. However, while many applaud the ability to create a trinity with data serving as a neutral partner, some wonder if any advancement has been made. A major critique of PPGIS is the inability to have a sustained, longitudinal impact that applies a ‘middle through’ approach of GIS theory to practice or praxis (Ferreira 1998; Thompson 2011). Also, the potential for mismanaging or intentionally mis-representing information has increased significantly with the use of spatial data (Monmonier 1996). Adding to the PPGIS conundrum is Volunteered Geographic Information (VGI) accompanied by increased concerns about data integrity, accuracy and reliability (Thompson 2011). With the inclusion of public data, the ability to shape public policy has improved but not equally in rural and urban environments.

URISA’s Special Issue on PPGIS addresses many of these critiques. Our authors report on innovative utilization of PPGIS that allows for increased community participation in the development of spatial tools and VGI data. The reliance on an intermediary, such as a university, for creation of base maps, GIS programming, data development or analysis is desired but not required. A number of ‘plug and play’ internet mapping services have decreased or eliminated the issues of access and cost that hampered successful development of earlier PPGIS projects. Data reliability has increased with the integration of community and municipal data within the same platform. Essentially, these developments have helped to create a new era, if not a new PPGIS.

Interestingly, the advances in these technologies and integration with planning are associated more with developed countries, and in particular North America, although it was in Africa that the idea of evaluating space, time and resources was “invented” through trade (Lacroix 1998). The Roman Empire is recognized as defining much of modern mapping language before it was documented in Western Europe. As such, our collection of articles provides a broad survey of PPGIS application across the globe. This special issue of the URISA journal presents local to regional and national to international applications that inform the new PPGIS.

Our survey begins with a comprehensive evaluation of PPGIS as a utility for environmental planning. Greg Brown questions whether the public is equitably represented and what constitutes participation in PPGIS. He discovers top-down ideology as the barrier to the capacity of PPGIS to move from a simply smart information technology to a decision-making information system. Full integration of PPGIS has been prohibited due to inherent social and institutional practices. An apparent imbalance in power is due to a lack of credible, reliable, accessible and contemporary data that communities could use to validate their concerns. In Brown’s cases, participation is relegated to cursory surveys with low response rates thus dismantling the potential magnitude of PPGIS. The full incorporation of community voices is described by Michael Martin, Brianne Peters, and Jon Corbett who use a bottom-up Asset-Based Community Development (ABCD) PPGIS approach in the Lake Victoria Basin of Western Kenya. An emphasis on simplicity positions ABCD as an optimal tool for collecting multi-dimensional local knowledge which complements GIS interpretation that requires intervention by experts whose biases may dilute community goals. Amidst ethical considerations and concerns about community data ownership and reliability, Martin et al. present a case for how to evaluate a process that can be successful and replicable. Alenka Poplin’s assessment of VGI also promotes replication. Map-enabled, web-based surveys were used as part of project SWITCH in Wilhemsburg, Germany. Poplin provides insight about the evaluation of PPGIS by describing how open source technology was utilized to assess the effectiveness of citizen participation when using form-based online questionnaires to collect data. Results of the pilot project provide instructive commentary on the topics of online survey design, citizen engagement, and GIS usability and bring VGI to the forefront as a favorable, inclusionary tool.

The issue of access is examined in Ram Alagan and Seela Aladuwaka’s investigation of grassroots approaches to conducting non-traditional assessments of anticipated social impacts associated with redevelopment. In their Sri Lankan case study, the community’s task was to minimize impact as 600 families were being displaced by a reservoir project. The project changed the definition of community
engagement by allowing stakeholders to employ a blended model of PPGIS with social impact assessment (SIA) from conception to completion. By creating a base level of data and maps that met the needs of the municipal government and could be understood by residents (with potentially low levels of comprehension), the SIA-PPGIS model was found to be effective. Steve Cinderby, Annemarieke de Bruin, Meg Huby, and Piran White report on the integration of Rapid Appraisal Participatory GIS (RAP-GIS), mapping, and vignettes used in rural England for a project that sought to grasp individual perceptions and spatial manifestations of social and environmental inequities. Utilizing a mixed-methods approach allowed for rich interpretation of conditions supported by quantified results and the incorporation of RAP-GIS effectively increased access by serving as a mechanism to include community members confronted with participation constraints such as time, disability, confidentiality, suspicion, or work and family commitments. Among the notable best practices surrounding emerging technologies presented in this issue, Peter Johnson and Renée Sieber’s case study on Quebec’s GéoActon presents a readily-accessible cloud-based data tool that serves as a cost-effective method for other municipalities to adopt. Key features of the GeoWeb platform include a participatory, bidirectional option and practical applications for rural areas. The Fix This Tool, developed and piloted by Mark Schlossberg, Cody Evers, Ken Kato, and Christo Brehm, literally places PPGIS technology in the palms of community members’ hands. As circulation impediments are discovered, access to a smartphone and the Fix This Tool widget allows citizens to contribute towards infrastructure needs assessment processes that directly impact plans to improve walking and cycling paths. The Fix This Tool represents innovative PPGIS technology that has the potential to create more livable cities, an imperative of President Obama’s Administration. While considered mainly a theoretical objective, there is now a long history of applying PPGIS models in practice. Our compilation of articles suggests that this model offers more than just a ‘mash up’ of community engagement and technology. Community participation, public policy and new technologies can better assist government with developing better, more sustainable policies by using citizen input and a ‘middle through’ approach to decision-making. We hope that this special issue which combines an historical overview of limitations, current ethical considerations, and a glimpse of emerging technologies within a global context will fuel ideas about how to achieve an equitable balance between community needs and municipal planning.

Special URISA Journal Guest Editors,
Michelle M. Thompson
Kelly D. Owens

References:


About the Special Guest Editors:

Michelle M. Thompson, Ph.D. is an Assistant Professor in the Department of Planning & Urban Studies and Geography at the University of New Orleans. Michelle teaches courses in applied geographic information systems, community development finance, urban public finance, housing, urban studies and land use planning. Michelle is a graduate of the Cornell University Department of City and Regional Planning where she focused on community development and spatial analysis using geographic information systems (GIS). Michelle has also worked in both public and private companies related to the finance of residential and commercial real estate and serves as the principal of Thompson RE Consultants, a real estate research and education firm. In her role as assistant director of Cross World Africa, she provides cultural, education and micro-finance resources in Sub-Saharan Africa. This work is representative of her commitment over the past 20+ years to provide technical support, market research and evaluation services to community-based organizations.

Michelle’s research focuses on the application of public participation geographic information systems (PPGIS) in community development and reinvestment. Michelle is the project manager of the web-based community information mapping service, WhoData.org, which combines parcel level neighborhood condition information with public data to monitor socio-economic and demographic changes. For descriptions of current projects, visit www.WhoData.net.

Kelly D. Owens, Ph.D. teaches a survey of urban studies, urban planning, and public policy courses at Dillard University in New Orleans, LA. Her research interests include housing, sustainable neighborhoods, social inequalities, and community engagement. Her expertise in program development combined with previous education-related administrative posts with the U.S. House of Representatives and Congressional Black Caucus Foundation provide her with a unique lens through which to analyze processes and outcomes. Serving as a volunteer during the citizen engagement components of the New Orleans 2030 Master Plan process piqued her interest in PPGIS. Kelly, a former student of co-editor Michelle Thompson, credits Michelle for her introduction to GIS.
Public Participation GIS (PPGIS) for Regional and Environmental Planning: Reflections on a Decade of Empirical Research

Greg Brown

Abstract: The term public participation geographic information system (PPGIS) was conceived to describe how GIS technology could support public participation with the goal of including local or marginalized populations in planning and decision processes. Based on experience with more than 15 PPGIS studies, the central thesis of this paper is that PPGIS has not substantively increased the level of public impact in decision making because of multiple social and institutional constraints. Following a review of a decade of empirical PPGIS research, this paper explores why government and nongovernment organization (NGO) adoption of PPGIS for environmental planning decision support has lagged. Despite methodological advances in PPGIS, agency barriers to effective public participation have not been fundamentally altered by PPGIS. For PPGIS to have a sustained impact on regional and environmental planning, agencies must meaningfully encourage and involve the public in planning processes irrespective of the GIS component.

INTRODUCTION

This paper reflects on more than a decade of public participation geographic information systems (PPGISs) research in a range of regional and environmental applications in developed countries involving the general public as the key participant group. The central thesis is that while PPGIS aspires to improve the quality of decision making and increase the level of public impact beyond traditional stakeholder and interest groups, the fullest potential of PPGIS has yet to be realized because of a number of social and institutional constraints.

The term public participation geographic information system (PPGIS) was conceived in 1996 at the meeting of the National Center for Geographic Information and Analysis (NCGIA) in the United States to describe how GIS technology could support public participation for a variety of applications with the goal of inclusion and empowerment of marginalized populations. Since the 1990s, the range of PPGIS applications has been extensive, ranging from community and neighborhood planning to environmental and natural resource management to mapping traditional ecological knowledge of indigenous people (see Dunn 2007, Sieber 2006, Brown 2005, and Sawicki and Peterman 2002 for a review of PPGIS applications and methods).

The formal definition of the PPGIS remains nebulous (Tulloch 2007) with use of the term PPGIS emerging in the United States and developed-country contexts while the term participatory GIS or PGIS emerged from participatory planning approaches in rural areas of developing countries, the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with geographic information technologies (Rambaldi et al. 2006). PGIS often is used to promote the goals of nongovernmental organizations, grassroots groups, and community-based organizations that may oppose official government policy, especially as pertaining to the rights of indigenous peoples and the current distribution of wealth and political power. In contrast, PPGISs may be sanctioned by government agencies, especially in Western democratic countries, as more effective means to engage in public participation and community consultation in land-use planning and decision making.

A concept related to PPGIS and PGIS, volunteered geographic information (VGI), is the harnessing of tools to create, assemble, and disseminate geographic data provided voluntarily by individuals (Goodchild 2007). The review of PPGIS studies in this paper are distinguished from volunteered geographic information in that the spatial data-collection process is purposive and agency-driven rather than citizen-initiated and voluntary. Furthermore, the PPGIS methods described here contain probability sampling of the general public in combination with purposive and convenience sampling of stakeholders and interested observers. Although participatory GIS activity may involve community mapping and database development outside of formal government processes, the focus of this paper is on the genre of PPGIS research that seeks to expand and enhance public participation and community consultation in governmental processes for regional and environmental planning applications.

Regional and environmental planning processes in developed countries have historically been dominated by stakeholder and interest groups that are vested in planning outcomes. These planning processes can be highly technical in nature (e.g., public lands planning, town and regional planning, environmental planning) and may rely on technical assessments of land capacity and forecasts of probabilistic events. A persistent and important question for PPGIS is what can individuals possessing lay knowledge and understanding of place substantively contribute to the planning process? One possible answer is that PPGISs can provide unde-
standing of place from the lived experience—a type of knowledge that is earned rather than learned. Local knowledge can provide a check and balance on expert and self-interest–driven assumptions about planning outcomes.

The integration of lay knowledge from PPGIS in planning outcomes is a normative aspiration for deeper public participation and impact in the planning process. In terms of public participation impact identified by the International Association of Public Participation (http://www.iap2.org), collaboration or even empowerment, rather than involvement or consultation, would be the preferred public participation impact. An often unstated assumption is that the use of PPGIS will result in more socially equitable planning decisions. In developed countries, the social reform tenets of PPGIS are muted but not absent. The tenor of PPGIS in developed countries, as compared to PGIS is developing countries, is more aligned with reform and innovation of public participation processes rather than revolution in governance and land-tenure structure.

Following a review of PPGIS applications, this paper argues that despite methodological advances, PPGIS has yet to have a significant impact on regional and environmental planning outcomes. For PPGIS to have greater impact, agencies must be more committed to involving the public in planning processes irrespective of GIS.

**PPGIS APPLICATIONS OVER THE PAST DECADE**

The reflections in this paper derive from 17 PPGIS studies completed in the United States, Australia, and New Zealand between 1998 and 2011 (see Table 1). PPGIS studies were implemented for various regional and environmental planning applications, including national forest and national park planning, regional conservation planning, marine and coastal area conservation, urban park and open-space planning, tourism development, and scenic byway planning. All the PPGIS studies contained a random sample of the general public to identify the perceived location of spatial attributes such as landscape values, activities and experiences, development preferences, and special places. The type and number of spatial attributes collected were tailored to the planning purpose and geographic context of each PPGIS study. For example, planning for multiple-use lands such as national forests differs from planning for national parks or urban parks because of different legislative mandates. Table 2 provides a composite of spatial attribute definitions for landscape values, experiences, and development preferences that were used in multiple PPGIS studies.

**Spatial Attributes**


In the earliest PPGIS application for public lands, Brown and Reed (2000) asked randomly selected households in Alaska to identify the spatial location of landscape values such as aesthetic, recreation, economic, and ecological values, in addition to more indirect and symbolic landscape values such as spiritual and intrinsic values, as part of the Chugach National Forest (Alaska, USA) planning process. The guiding principle behind landscape-value mapping for public lands is that these lands should be managed for values that are consistent with values the public has for these lands. Although the quantity and mix of landscape values varies across landscapes, cultures, and countries, there is a core set of landscape values that apply to most public lands. What differs is the relative weighting and importance of values that the public holds for these lands. To illustrate, Figure 1 shows the collective distribution of landscape values, depicted as areas of high density in Prince William Sound (Alaska), from two different PPGIS studies completed in 1998 and 2000. The image displays the importance of the sampling approach in PPGIS as the spatial results vary significantly by community. Until the advent of PPGIS, there were few methods for agencies to spatially identify community values to assess the consistency of plan alternatives with regional and community values.

![Figure 1. Spatial distribution of landscape values (“hotspots”) by sampled community in the Chugach National Forest/Prince William Sound region in Alaska: (a) Cordova, (b) Valdez, (c) Whittier, (d) Anchorage, (e) all values in all communities, and (f) special places. “Hotspots” are higher densities or concentrations of point data within the PPGIS study region.](image-url)
<table>
<thead>
<tr>
<th>Year</th>
<th>Implementation Mode</th>
<th>Location</th>
<th>Planning Purpose</th>
<th>Published References</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Internet (Google Maps)</td>
<td>Otago Region (New Zealand)</td>
<td>Regional conservation</td>
<td>Brown, G. In process. Website: <a href="http://www.landscapemap2.org/otago">http://www.landscapemap2.org/otago</a></td>
</tr>
<tr>
<td>2010</td>
<td>Internet (Google Maps)</td>
<td>Kangaroo Island (South Australia)</td>
<td>Tourism and conservation</td>
<td>Brown, G., and D. Weber. In process. Website: <a href="http://www.landscapemap2.org/kangaroo">http://www.landscapemap2.org/kangaroo</a></td>
</tr>
<tr>
<td>2009</td>
<td>Internet (Flash)</td>
<td>Alpine Region (Victoria, Australia)</td>
<td>National park planning</td>
<td>Brown, G., and D. Weber. 2011.</td>
</tr>
</tbody>
</table>
Table 2. A composite of selected spatial attribute definitions used in different PPGIS studies. The number and type of spatial attributes varied depending on the purpose and location of the PPGIS process. Other PPGIS spatial attributes not shown here include activities, highway qualities, urban park values, and ecosystem services.

<table>
<thead>
<tr>
<th>Landscape values</th>
<th>Development Preferences</th>
<th>Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic/scenic—these areas are valuable because they contain attractive scenery including sights, smells, and sounds.</td>
<td>Tourism accommodation—this area is acceptable for building tourism accommodation such as hotels, motels, or lodges.</td>
<td>Aesthetic/scenic—I experienced pleasing sights, sounds, and/or smells.</td>
</tr>
<tr>
<td>Economic—these areas are valuable because they provide timber, fisheries, minerals, or tourism opportunities such as outfitting and guiding.</td>
<td>Tourism services—this area is acceptable for building tourism services such as restaurants, gas stations, or retail establishments.</td>
<td>Crowding/congestion—I experienced crowding with other visitors (e.g., the car park was full, I didn't find the right spot).</td>
</tr>
<tr>
<td>Recreation—these areas are valuable because they provide a place for my favorite outdoor recreation activities.</td>
<td>Urban development—this area is acceptable for new urban development (residential and commercial).</td>
<td>Solitude/escape—I experienced solitude, tranquility, and escape from social pressures.</td>
</tr>
<tr>
<td>Life sustaining—these areas are valuable because they help produce, preserve, clean, and renew air, soil, and water.</td>
<td>Rural residential development—this area is acceptable for rural residences with acreage.</td>
<td>Social interaction—I experienced positive social interaction with family, friends, or other visitors.</td>
</tr>
<tr>
<td>Learning/scientific—these areas are valuable because they provide places where we can learn about the environment through observation or study.</td>
<td>Industrial development—this area is acceptable for industrial development, including manufacturing, processing, or mining (e.g., gravel).</td>
<td>Trail-based activity—I experienced trail-based, physical, and/or adventure activity (e.g., bushwalking, mountain biking, cycling, jogging/running, cross-country skiing).</td>
</tr>
<tr>
<td>Biological—these areas are valuable because they provide a variety of fish, wildlife, plants, or other living organisms.</td>
<td>Wind-energy development—this area is acceptable for installing commercial wind turbines.</td>
<td>Other physical activity/adventure—I experienced other physical and/or adventure activity (e.g., canoeing, caving, swimming, exercising/fitness, fishing).</td>
</tr>
<tr>
<td>Spiritual—these areas are valuable because they are sacred, religious, or spiritually special places or because I feel reverence and respect for nature here.</td>
<td>Natural resource development—this area is acceptable for natural resource development such as gravel extraction, grazing, or forestry.</td>
<td>Overnight stay/camping—I experienced an overnight stay or camping.</td>
</tr>
<tr>
<td>Intrinsic—these areas are valuable in their own right, no matter what I or others think about them.</td>
<td>Energy development—this area is acceptable for energy development such as hydroelectric dams or wind turbines.</td>
<td>Learning/discovery—I experienced learning about nature, culture, or heritage.</td>
</tr>
<tr>
<td>Historic—these areas are valuable because they represent natural and human history that matters to me, others, or the nation.</td>
<td>Tourism development—this area is acceptable for building tourism accommodation and services.</td>
<td>Positive wildlife/vegetation experience—I had a positive experience with wildlife or vegetation.</td>
</tr>
<tr>
<td>Future—these areas are valuable because they allow future generations to know and experience the area as it is now.</td>
<td>Other development—this area is suitable for future development. Please click on the marker and write the type of development.</td>
<td>Noise—I experienced excessive noise (e.g., other people, aircraft, boats) here.</td>
</tr>
<tr>
<td>Subsistence—these areas are valuable because they provide necessary food and supplies to sustain my life.</td>
<td>No development—this area is perfect as is and should not have any new development of any kind.</td>
<td></td>
</tr>
<tr>
<td>Therapeutic—these places are valuable because they make me feel better, physically and/or mentally.</td>
<td>Cultural—these places are valuable because they allow me or others to continue and pass down the wisdom and knowledge, traditions, and way of life of ancestors.</td>
<td></td>
</tr>
<tr>
<td>Wilderness—these places are valuable because they are wild, uninhabited, or relatively untouched by human activity.</td>
<td>Marine—these places are valuable because they support marine life.</td>
<td></td>
</tr>
<tr>
<td>Social—these areas are valuable because they provide opportunities for social interaction.</td>
<td>Special places—these places are special or valuable because...indicate your reason.</td>
<td></td>
</tr>
</tbody>
</table>
Development preferences appear relatively easy for PPGIS participants to identify and, arguably, have the closest nexus to potential land-use decisions. Development preferences can assess the general consistency of zoning classifications (Brown 2006) or more specific development proposals such as wind energy (Pocewicz et al. 2010). And yet, the identification of development preferences sponsored by local governments using PPGIS has been limited because public development preferences have strong implications for local land use including zoning and land-use controls. Figure 2 shows longitudinal tourism development preferences of Kangaroo Island (South Australia) residents generated from two PPGIS studies completed in 2004 and 2010. Kangaroo Island is an international tourism destination subject to tourism development pressure in ecologically sensitive areas. The image displays general consistency in resident preferences for the location of tourism development over time with residents preferring protection of the coastal areas and supporting tourism development in existing townships. In the 2004 PPGIS study, the South Australian Tourism Commission, a quasi-governmental tourism promotion agency, initially agreed to partner with the University of South Australia to provide financial support for the baseline PPGIS study of KI resident values. When the agency learned that the PPGIS process also would ask residents where tourism development was appropriate on the island, the agency withdrew support. PPGIS preference data appears threatening because of the potential to legitimate public opposition to development applications in a review process that has historically favored tourism development pressure (see Figure 3). The relative positioning of the PPGIS attributes in the figure is based on this author’s experience in implementing different PPGISs over the past decade. As illustrated in the figure, the mapping of ecosystem services in PPGIS represents the highest expert knowledge threshold and the greatest cognitive challenge thus far attempted in PPGIS. This is especially true for the spatial identification of “regulating” and “supporting” ecological services that require a minimum base-level knowledge about the functioning of natural systems in addition to familiarity with the regional landscape (Brown, Montag, and Lyon 2012). In contrast, participant identification of place-based activities, experiences, and development preferences represent low cognitive challenge and do not require a high level of technical expertise. These attributes are identified based on a participant’s life experience living in or visiting the study region. The mapping of landscape values and perceived environmental impacts occupy the midrange of cognitive challenge and technical expertise. The identification of landscape values requires that the participant relate personal preferences to landscape features while the identification of perceived environmental impacts requires some understanding of changes to natural systems. The level of participation in PPGIS (i.e., response rate) can be influenced by the cognitive challenge and perceived level of expertise required, but most PPGIS studies include a mix of more and less challenging spatial attributes to map. The influence of cognitively challenging PPGIS attributes on response rates is most observable on a per-item basis and not generally reflected in overall participation rates that are subject to other larger, contextual variables that contribute to nonparticipation such as available time, Internet access, familiarity with the study region, and level of personal interest in the study content.

### Mapping Methods

PPGIS data collection from the general public has been implemented using multiple spatial methods and technologies. For example, simple technology such as paper maps and markers (e.g., pencil, pen, stickers) were used in early PPGIS studies while digital mapping with markers using Internet PPGIS applications were implemented in more recent studies. Common to all types of PPGIS data capture is the need to symbolically represent the spatial attributes of interest on a map. Figure 4 shows four different...
lative areas, or recreation sites. Boundary metrics include PPGIS boundaries such as watersheds, political boundaries, administrative areas, or recreation sites. Boundary metrics include PPGIS attribute frequency, dominance, density, and diversity, as well as indices that measure conflict potential. Social landscape metrics may be useful in the planning and management of public lands such as national forests, parks, and resource-management areas because statutory requirements often dictate that these lands be managed for a range of public values and uses. Social landscape metrics identify and quantify the location of these values for comparative analysis and management.

PPGIS can be used to visually display the compatibility of proposed planning alternatives with the collective values held by different individuals and groups in society. Reed and Brown (2003) developed a quantitative modeling approach for PPGIS mapped-landscape values to determine whether forest plan activities and alternatives were generally consistent and, more important, place consistent with publicly held forest values. This decision support method was called “values-suitability analysis” because of its conceptual similarity to traditional physical lands suitability analysis. In a specific example of decision support, the place-specific compatibility of all-terrain vehicle use on a national forest in the United States was assessed based on PPGIS landscape values collected from a regional sample of random households (Brown and Reed, 2012).

For national park management, PPGIS has been used to generate indicators of social and ecological conditions such as crowding or trail conditions that provide thresholds for management action (Brown and Weber 2011). PPGIS also can be used to assess the consistency of visitor experiences and perceived environmental impacts within park management zones at the regional, national park unit, or subunit level.

The decision support potential of PPGIS for regional and environmental planning has been described in academic literature, and PPGIS has been presented to national forest and park planning personnel in particular, but there is little evidence of formal agency adoption beyond initial PPGIS trials. For PPGIS to play a significant role in agency decision support, it will need to become standardized into agency planning procedures.

THE NAGGING QUESTIONS

Who Is the “Public” in PPGIS?

Schlossberg and Shuford (2005) argue that the meaning of public and participation are essential to understanding the public participation component of PPGIS. In their typology, the term public may include decision makers, implementers, affected individuals, interested observers, or the random public. The latter classification—random public—appears most consistent with the more common dictionary definitions of public that include “all the people” or “people in general” (Merriam-Webster). And yet, PPGIS processes that systematically sample the general public are not common. Which “public” is represented in the PPGIS process? Is PPGIS just GIS with convenience sampling? Arguably, it is the public sampling and participation, not the GIS, that is the heart of PPGIS innovation.

The logic of collection action (Olsen 1971) ensures that vested interests in a planning process (i.e., the “affected individu-
Whose Interests Count More in PPGIS?

Critics of PPGIS may argue that decisions about public good often are national in scope while most implemented PPGIS systems have information collected from a regional population. Stakeholders in national, public lands should normatively include all citizens of the country. Local and regional populations, it is argued, are more vulnerable to “capture” by local economic development interests or may not fully appreciate the national importance of local landscapes. While this argument appears prima facie valid, there are practical resource limits for implementing national random-sampling methods using PPGIS. The PPGIS studies cited here used regional sampling of residents under the assumption that these people will be more familiar with the lands in questions and, arguably, have a greater direct stake in the outcome of the planning process. Consent of the regional population for planning outcomes appears a necessary (but insufficient) condition if future plan direction is not to be undermined. And yet, it is important to provide opportunities for nonregional participants and individuals not randomly selected to participate in the process.

All the PPGIS studies in Table 1 allowed participation regardless of geographic origin and regardless of whether an individual was randomly selected for participation. Responses from PPGIS “volunteers” are tracked and analyzed separately to compare with randomly sampled individuals. An ideal PPGIS process is one where random-sampling methods are used to generate the most objective spatial information possible, but where participation is encouraged from all segments of society. Empirically, participation in PPGIS processes from outside the planning area or from individuals not specifically invited to participate has been minimal because of, in part, a lack of awareness. Fears about local and regional populations not reflecting national interests in public land-planning outcomes appear overstated in practice, but the important question remains: Whose interests count most on the map and how does one aggregate spatial values and preferences equitably in PPGIS?

Participation: What If the Public Opt Out?

One of the strongest arguments in favor of PPGIS is that it expands the participatory process to individuals and groups who would not otherwise participate in the process. But what if these individuals are provided the opportunity but fail to participate? Internet-based PPGIS participation rates have averaged 13 percent across five studies (Beverly et al. 2008, Brown and Reed 2009, Brown et al. 2012), while paper-based PPGIS response rates have ranged from 15 percent to 47 percent, with an average of 30 percent across 11 surveys (Brown et al. 2004, Brown 2005, Alesa et al. 2008, Zhu et al. 2010, Clement and Cheng 2011, Nielsen-Pincus 2011, Raymond and Brown 2010). All modes of
survey data collection show declining response rates (Couper and Miller 2008) and Internet-based surveys show 11 percent lower response rates (on average) than other survey modes (Manfreda et al. 2008).

Do low participation rates limit the usefulness of PPGIS methods? Yes and no. Participation rates that fall significantly below those reported for general survey results clearly threaten the external validity of the PPGIS results. Claims of representing the “public” are dubious with participation rates less than 20 percent. However, a typical regional PPGIS process will generate more than 200 responses, depending on the sampling effort, which far exceeds the number of individuals that would have participated in the planning process. Some participation bias will exist in respondent characteristics, but empirical evidence suggests this bias is not because of the content of the information being collected but rather is broadly attributable to other social factors that result in nonparticipation.

PPGIS methods compete with the many life demands placed on citizens of the world. And PPGIS methods are coming of age at a time when interest in nature and conservation, at least among the youth, is waning. Lack of participation should not necessarily be interpreted as lack of interest and apathy, but this may be a contributing factor. PPGIS may be a positive means to reconnect individuals to the places around them through maps and visualization, but the actual educational benefit of PPGIS participation is yet to be systematically assessed.

Virtually every PPGIS study has been challenged on the scope of participation and/or the participation rate and, consequently, the inferences about public support that can be legitimately claimed. Until PPGIS practitioners find ways to reverse declining social research participation trends, detractors of the method will be difficult to rebut based on the argument of social representation.

**THE DEVIL YOU KNOW OR PPGIS?**

While the potential of PPGIS to measure and integrate public values in regional and environmental planning outcomes appears promising, these aspirations have yet to materialize. Beierle (1999) suggests five social goals to evaluate the quality of public participation in environmental decision making. Does the process educate and inform the public? Incorporate public values into decision making? Improve the substantive quality of decisions? Increase trust in institutions? Reduce conflict? These are worthy goals but difficult to empirically assess without study beyond the PPGIS process itself.

The primary evaluation criterion guiding this paper is whether public values measured using PPGIS have been incorporated into regional or environmental decision making. This author has yet to observe any tangible evidence that PPGIS data has been used in agency decision making, let alone influence and improve the substantive quality of decisions in planning outcomes. The example of PPGIS for the Coconino National Forest in Arizona provides evidence for this conclusion. In 2006–2007, this author developed and implemented a PPGIS process for the Coconino National Forest to evaluate the effectiveness of Internet-based PPGIS. The resulting PPGIS dataset contained more than 8,000 observations of forest values and special places provided by Arizona residents. Following PPGIS data collection, the author traveled to Arizona to brief the forest’s planning and management teams on the PPGIS results and to present the forest with the actual PPGIS data. After several years of delay in the forest plan revision process, the author reminded the forest planning staff about the PPGIS data that was collected for the forest planning process. The forest management team had either lost or forgotten (or both) the PPGIS dataset. As of the writing of this manuscript, the PPGIS data have yet to be even acknowledged as part of the public record for the Coconino planning process.

To date, PPGIS has been promoted more by academics than it has by government agencies or NGOs. There are a variety of explanations and many are related to the reasons why government agencies are reluctant to engage in broader, more inclusive public participation in general.

**Lack of Specific Directives/Incentives to Engage the Public**

Bureaucrats do not get rewarded for innovation or taking risks with new participatory methods. Just the opposite. There are career risks for engaging new methods, especially ones that are untested, and few tangible rewards if the new methods prove effective. The use of PPGIS for environmental planning requires inside bureaucratic champions (early adopters) who are institutionally rare. Nonetheless, some progressive individuals were identified to sponsor the PPGIS studies shown in Table 1 and include the U.S. Forest Service, Parks Victoria (Australia), and the New Zealand Department of Conservation. But the identification and recruitment of bureaucratic innovators remain significant barriers to more widespread agency adoption.

**Fear of the General Public**

Does engaging the general public through PPGIS tap into the “wisdom of the crowds” or the “tyranny of the masses”? For some, the people, the masses, are unpredictable, unstable, and can be mobilized into revolutionary action. Political leaders can lose their figurative heads in the ensuing planning debate. Both political and bureaucratic leaders will naturally seek to avoid any situation in which the masses are presented with an opportunity to express doubt about their leadership.

**Lack of Experience**

Never attribute to malice what can otherwise be attributed to incompetence or inexperience. The Coconino National Forest’s handling of the PPGIS data, described previously, illustrates this principle. Government agencies lack experience in innovative and nonlegalistic public participation techniques. Many simply do not know how to effectively engage and manage the public in planning processes. Public participation often is contracted out to consultants who have the experience, but this has the effect
of placing an intermediary between the people and the agency, which increases distrust in the planning authority.

**Expert-Lay Divide**

Agencies house experts in particular disciplines associated with environmental planning and management. Many of these individuals believe that they did not spend significant time and effort to obtain their technical expertise and qualifications only to abdicate responsibility to those less formally educated in the discipline. Agencies believe they have the necessary expertise to make sound technical decisions and they do not believe public consultation will substantially improve the knowledge base for decisions.

**Regulatory Barriers to Public Participation**

For agencies in the United States, legislation prohibits federal government information collection without review and approval by the Office of Management and Budget (OMB). This regulatory requirement, which can take well over a year to obtain approval (if at all), effectively hinders agencies from engaging in broad participatory processes that involve PPGIS data collection even if an agency is predisposed to the concept of PPGIS. For example, the U.S. Forest Service has formally requested to use PPGIS to assist national forest planning but has been denied by the OMB for more than three years (P. Reed, personal communication).

These reasons provide strong disincentives for government agencies to engage in participatory processes that would include PPGIS. Even if agencies recognize the deficiencies and limitations of prevailing public participation methods, it is more comfortable to work with a known system.

Government agencies are not the only ones reluctant to engage PPGIS methods and distrust of the public is not limited to government agencies. Resistance to use of PPGIS has come from unexpected sources. There was an expectation that environmental stakeholders and NGOs would embrace the use of PPGIS in public land-planning processes because the identification of place-based conservation values is a likely, but not guaranteed, outcome of a PPGIS process. But in practice, the opposite has occurred. Generally speaking, environmental stakeholders do not trust PPGIS. Why? Environmental stakeholders and NGOs trust in their ability to influence the public land-planning process from the inside through pressure politics and their own technical expertise. Although not always successful, they have learned how to exert political pressure at the appropriate time to ensure conservation outcomes. For them, PPGIS is a wild card for which they have little control over the outcome. They fear the PPGIS process can be “gamed” in ways in which they are unfamiliar and unprepared. NGOs have become quite adept at influencing public planning processes, and even though the outcomes are not always ones they would prefer, they would rather live with the political devil they know than with PPGIS.

Industry stakeholders share a similar level of distrust as do environmental NGOs. PPGIS is too new for them to feel comfortable with the method. They would prefer to keep the number of actors in a planning process small and manageable. Like their environmental adversaries, they do not trust a process that could result in outcomes unfavorable to their interests. Both environmental and industry stakeholders have the ability to orchestrate “public” support for particular planning outcomes. They would prefer a process where they can manage “public opinion” rather than having an agency measure public preferences through PPGIS.

In summary, there is not strong support from within government to expand public participation through PPGIS, and there is active resistance from some traditional stakeholder and interest groups. And yet, the use of PPGIS is likely to increase given the irresistible pull of new technology and the Internet.

**Mapping the Future of PPGIS**

The slow adoption of PPGIS methods by agencies for regional and environmental planning does not appear technological but may reflect a lack of government commitment to public participation and consultation in general. The lack of familiarity with PPGIS as a new consultation methodology and concerns with the accuracy and validity of lay knowledge in environmental decision processes serve to reinforce a propensity toward agency inertia. The lack of standardized methods and models for both collecting and integrating PPGIS data into decision processes—the knowledge integration problem—add additional resistance to PPGIS adoption. And yet, mapping technology is a compelling and powerful force that is not easily dismissed.

The explosion in Internet mapping applications and virtual earth models has created an environment that should be favorable to the expansion of PPGIS. But GIS technological innovation has outpaced understanding of human factors resulting in suboptimal implementation of mapping technology for PPGIS. For example, in a recent Web-based PPGIS application for Parks Victoria (Australia), we provided an integrated Google Maps and Google Earth application interface that allowed participants the opportunity to examine and map any attribute in the study area. The application contained the zoom features of Google Maps and the three-dimensional visualization of Google Earth and provided the participant with the ability to seamlessly switch between map modes. But few PPGIS participants actually used these advanced navigational and visualization features; the majority of participants choose to identify the spatial attributes at the default map scale that provided insufficient map resolution for placing the spatial attributes within the requested national park boundaries. When the application was modified to enforce a minimum map scale for marker placement, participants responded by placing fewer markers. Thus, the most effective means for increasing PPGIS participation while maintaining spatial data quality remains a work in progress.

Using incentives such as prize drawings or “lotteries” to increase general public participation has had limited effect with the PPGIS studies described here. This result is consistent with the extensive survey research literature on lottery incentives in-
indicating little or no impact on survey response (see, e.g., Singer, van Hoewyk, and Maher 2000; Warriner et al. 1996). Prevailing upon planning stakeholder groups to encourage their constituents to participate can increase the rate of volunteer participation, but this does not increase the participation rate of the general public that provides important baseline, comparative data. A PPGIS implemented for Parks Victoria evaluated the use of an opt-in Internet panel maintained by a leading survey research organization in Australia as a potential pathway to increase public participation; participants were rewarded for PPGIS completion and the number of completions increased, but the overall quality of the PPGIS data based on mapping effort was poor (Brown et al. in process).

Thus, we are left with the current paradox of PPGIS applications: Despite the proliferation of Internet mapping technology, there has not been a commensurate increase in PPGIS participation rates. In fact, the opposite may be true. With greater saturation of Internet mapping applications, the novelty and potential attractiveness of participating in an Internet-based PPGIS may decline. There is no magic formula for increasing PPGIS participation that also maintains data quality. Agency appeals through advertising such as that used by the New Zealand Department of Conservation (see Figure 5) offer potential to increase participation, but the actual effectiveness of mass media advertising for PPGIS currently is unknown.

The initial reluctance of conservation NGOs to engage in PPGIS may be waning. The recent PPGIS study by the Nature Conservancy in Wyoming (Pocewicz et al. 2010) suggests the method may be gaining some favor as a means to indirectly promote the mission of the NGO and to increase public awareness about important land-use issues. In the United States, because federal agencies are constrained in their ability to conduct PPGIS because of OMB regulatory review, NGOs may play an important partnering role with agencies in collecting PPGIS data.

Although PPGIS methods for regional and environmental planning now are more than a decade old, the planning and decision impact, thus far, has been limited. PPGIS will not fix fundamentally flawed participatory processes that are superficial, obligatory, or token. For PPGIS to have a sustained impact on regional and environmental planning, agencies must meaningfully encourage and engage the public in planning processes irrespective of the GIS component.

About the Author

Greg Brown is an associate professor of environmental planning at the School of Geography, Planning and Management, University of Queensland, Brisbane, Australia, and a research associate at Central Washington University, Ellensburg, Washington, and Green Mountain College, Poultney, Vermont.

Corresponding Address:
School of Geography, Planning and Management
University of Queensland
Brisbane, QLD 4072, Australia
Greg.brown@uq.edu.au

References


Sherrouse, B.C., J.M. Clement, and D.J. Semmens, 2011, A GIS application for assessing, mapping, and quantifying the social values of ecosystem services, Applied Geography, 31(2), 748-760.


Warriner, K., J. Goyder, H. Gjertsen, P. Hohner, and K. McSpurren, 1996, Charities, no; Lotteries, no; Cash, yes: Main effects and Interactions in a Canadian Incentives Experiment, Public Opinion Quarterly, 60, 542–562.

Innovative Public Participatory GIS Methodologies Adopted to Deal with the Social Impact Assessment Process Challenges: A Sri Lankan Experience

Ram Alagan and Seela Aladuwaka

Abstract: Public participatory geographic information system (PPGIS) is a growing concept in many disciplines and is increasingly practiced in participatory approaches to national planning and development proposals. Social Impact Assessment (SIA) is a vital element in Environmental Impact Assessment (EIA), which helps minimize impacts on local communities because of development projects and proposed mitigation measures. Both concepts require professional involvement with bottom-up approaches and innovative methods to identify societal concerns in relation to proposed development. Currently, use of a PPGIS application within an SIA is limited, yet use of these innovative approaches is vital to explore the strengths and weaknesses of assessment methodology and community impact. This paper presents challenges encountered in the process of conducting SIA in the Kalu Ganga reservoir project in the Matale District of Sri Lanka.

The proposed Kalu Ganga reservoir development will force 613 families to relocate. The business district will be totally inundated. The project site is environmentally and culturally sensitive, for it still maintains its pristine surroundings and the long-term impact on the area is unknown. As a result, the assessment team faced severe challenges from the local communities, including: (1) obstacles to carrying out the SIA because of strong resistance against construction of the reservoir; (2) difficulties of recording sensitive cultural and social aspects of the community; and (3) limited opportunities for integrating local and expert knowledge for effective decision making.

In this paper, we will discuss the innovative, bottom-up PPGIS methodologies adopted to deal with the SIA process challenges. PPGIS integrates a variety of geospatial technologies and various traditional participatory research methods to represent people’s concerns over development proposals and advocacy. In this reservoir project, PPGIS methodologies have helped developers, policy planners, and stakeholders to appreciate the project issues and incorporate them in the decision making. By bridging the strengths of PPGIS within SIA, we suggest that PPGIS techniques and procedures have great potential to enhance public policy and community engagement in development proposals.

INTRODUCTION

The Kalu Ganga (Black River) reservoir development is a national irrigation development project in Sri Lanka. The development will impact communities and local environments for the project site is located in a very sensitive area in terms of its culture and physical environment. Because of the lack of communication and the effect of the top-down decision process on local communities, the project has been halted. Traditionally, GIS technology captures one official version, promoting an agency and “expert” data-driven representation (Harris et al. 1996). However, the recent development of critical approaches to GIS and social issues has raised a number of important concerns among scholars (Mark 1993, Harvey and Chrisman 1998, Harris and Weiner 1996, 1998), and exploring the potential role of PPGIS applications in social and environmental research is an important component of this research. PPGIS is a familiar initiative in many disciplines for participatory decision making with regard to national planning and development proposals. Social Impact Assessment (SIA) is a vital element in Environmental Impact Assessment (EIA), which helps minimize impacts on local communities caused by development projects and proposed mitigation measures. Since the official recognition in the National Environmental Protection Act of 1969 of the potential negative impacts of large-scale project developments on the environment, a formal EIA process has been developed and adopted in most countries. Both concepts require professional involvement with participatory approaches and innovative methods to identify societal concerns over development proposals. Currently, PPGIS application in SIA is not fully integrated, and developing these innovative approaches is vital in incorporating the voice of the local community inhabitants who will be greatly impacted by changes to their environment and lifestyles. This paper presents challenges encountered in the
process of conducting SIA in the Kalu Ganga reservoir project\(^1\) in the Matale District in Sri Lanka.

Development projects and programs in Sri Lanka have adopted SIA as part of the decision-making procedure in recent years. Although this assessment tool is widely applied in large-scale development proposals, Sri Lankan SIA studies have historically been based on expert opinions and technical applications and have been limited with regards to public participation. In the past, Sri Lanka’s use of SIA has excluded intuitive and participatory analysis, relying solely on experts’ application to mitigate impacts. According to IIAA (2003), "public participation is defined as the involvement of individuals and groups that are positively or negatively affected by, or that are interested in, a proposed project, program and policy that is subject to a decision-making process.” As Burdge (2002) stated, SIA brings more public participation, and helps communities, government and private-sector organizations to comprehend and anticipate the possible social consequences on human populations and communities of proposed development projects. Accordingly, if performed properly, SIA has great potential to help all stakeholders plan for social change resulting from a proposed action (IIAA 2003). Although public opinions are collected using a variety of field research methods (such as questionnaire surveys, key-informants interviews, focus-groups interviews, etc.), it has been revealed that, for the most part, in the Sri Lankan experience local voices have been undermined. This exclusionary practice is especially true in the final decision-making process. Top-down technical solutions that protect government and agency interests without factoring in local concerns have been imposed on impacted communities. Despite criticism by the scientific community and liberal media, hierarchical and expert-driven planning dominates the decision-making process with little more than a nod to community participation. With increased global communication and information networks, challenges from local communities, media, scientists, environmental-activist groups, and opposition parties have raised concerns against national development proposals and helped to create a more bottom-up approach to land planning. Throughout the history of Sri Lankan politics, however, ruling governments generally have defeated all democratic opposition and implemented their economically motivated policies. These top-down decision-making processes raise serious ethical questions in regard to the development practice in Sri Lanka. To explore the complexity of the decision-making process, this paper examines the Kalu Ganga reservoir development in Sri Lanka. This project provides a great opportunity to explore the power struggle between local communities and government and aims to address the potential to initiate a PPGIS approach in an SIA study to develop democratic decision making within the planning process.

The past two decades have witnessed PPGIS applications in numerous research activities, including forest-management, land-use, transportation, resource-management, governance, and indigenous studies (Weiner et al. 1995; Weiner and Harris 1999, 2003; Kwaku Kyem 1996; Walker et al. 1998; McCall and Minang 2005; Alagan 2007; Rambaldi 2010). However, as described, PPGIS approaches in SIA are not fully integrated, and bridging such attempts has the potential to increase people-centered decisions in development programs. Using the Kalu Ganga reservoir development, this paper explores the potential that the PPGIS offers to the SIA as an intuitive approach. While the first section outlines the introduction of the research, the next section discusses the importance of PPGIS in the SIA process. The following section describes the study site and stakeholders in the Kalu Ganga development. Next, we elaborate on the PPGIS methodologies in the Kalu Ganga development, and then we explain how PPGIS and SIA integration enhanced the reconciliation and collaboration of the affected communities. The following section raises challenges in the PPGIS-SIA approach, and the last section concludes with final remarks.

### PUBLIC PARTICIPATORY GIS AND SOCIAL IMPACT ASSESSMENT

PPGIS is a concept that employs GIS technology used by members of the public, both by individuals and grassroots community organizations, for participation in the public decision-making processes affecting their lives; these processes include data collection, local knowledge integration, data access, multiple representation, collaborating mapping, analysis, and/or decision making. In recent years, the rapid growth of GIS is transforming how places and environments are visualized, represented, and understood (Rambaldi 2010). On the other hand, the top-down politics of landscape and the social production of nature frequently are ignored, and valuable local knowledge often is marginalized (Weiner and Harris 1999). Yet, during the past two decades, there has been a strong interest toward linking GIS as a bottom-up application and people-centered approach (Weiner et al. 1995, Abbot et al. 1998, Weiner and Harris 2003, Rambaldi 2010). By doing so, GIS would place impact groups in positions to generate and analyze spatial data and integrate local knowledge for greater understanding. Despite progress made along these lines, challenges still need to be addressed to overcome the undemocratic process of decision making. This case study underlines some of the community challenges in PPGIS and SIA application.


\(^1\) The Kalu Ganga reservoir is a 67-meter-high rock-filled dam (across the Kalu Ganga River in Pallekama) with an impervious core and two saddle dams (47-meter rock fill and 8-meter earth fill) with a reservoir full supply level (FSL) of 210 meters above sea level and a 13.1-kilometer transfer canal/tunnel of discharge capacity 15 m3/s to the Moragahakanda reservoir, together with the development of 975 hectares of new land for irrigation in the Kalu Ganga basin. (Source: Natural Resources Management Services (Pvt.) Ltd., Sri Lanka, 2008)
practices. Walker et al. (1998) researched GIS applications in sustainable resource use and participatory methods in Australia. According to Walker (Varènuis 1998 research papers: http://www.ncgia.ucsb.edu), an effective community participation in resource planning depends on three fundamental requirements: (1) There should be effective access to information pertinent to resource-use planning; (2) the public should be provided analytical tools to make effective use of that information; and (3) a legislative and institutional environment should be developed to foster effective participation and greater community empowerment. McCall and Minang (2005) stated the importance of participatory mapping in community-based natural-resource management. McCall et al. also emphasize that participatory mapping at the local level is effective, simultaneously meeting the content needs and satisfying the underlying interests of stakeholders, thus revealing it as a tool for better governance. The Internet has created promising opportunities for PPGIS by serving as an avenue for better communication for those involved in GIS and decision-support research (Carver 1998, Kingston et al. 1999). Kingston et al. (1999) further examined the potential of the Internet as a means of increasing public participation in environmental decision making. They also provide evidence of the potential and actual benefits of online spatial decision-making systems in the United Kingdom through three real environmental decision-making problems at the local, regional, and national scales.

SIA is an integral part of environmental assessment because it evaluates the impact of a development project on the people and their culture. It is a challenging process and requires vigilant planning, methodologies, and techniques that clearly identify the impact of the proposed development on individuals, families, communities, their livelihood, culture, and way of life. SIA supports a systematic approach to identify impacts of the proposed project on affected communities. Consultation with affected societies in this process is critical to the success of the project. Use of a participatory approach in SIA is highly beneficial because it directly involves communities in the process of decision making that impacts their lives and incorporates local knowledge, which may prevent errors in the planning process. In addition, this allows for greater communication of impacts from a local perspective, reflecting a unique understanding of an individual’s community (Becker et al. 2003). Therefore, participatory approaches place an emphasis on the identification and prediction of impacts through the use of local knowledge within communities and among those most likely to be affected by change (Fenton 2005). Although SIA was intended to be undertaken in the community interest, the process is not always democratic and has engaged the community only in initial fact finding rather than in the final decision making. This was one problem that we aim to address in this research to identify the community struggles with top-down decisions on local landscape using a PPGIS approach to SIA. Nevertheless, in recent years, the lack of community involvement in SIA has been recognized, and community-based participatory approaches have been increasingly accepted. Restricting SIA to technical and quantifiable questions misses the point and serves only to consider some values over others (Lockie 2001).

Fonseca and Gouveia (1994) integrated EIA with multimedia GIS for analyzing environmental data with spatial dimension. This research underlines that the use of multimedia technology capabilities within GIS can enhance the development of decision support systems closer to reality. Alagan (2007) employed the participatory GIS approach in EIA through geovisualization techniques in a transportation project in West Virginia. Alagan emphasizes that three-dimensional GIS and Internet GIS are useful techniques to describe complex spatial data, which helps nonexpert communities seeking to understand diverse transportation information.

Although PPGIS has been employed in diverse perspectives, integrating PPGIS in SIA has been limited. From a practical standpoint, SIA helps development programs to become more sustainable. SIA studies include the processes of analyzing, monitoring, and managing unintended social consequences of planned interventions (Branch et al. 1984, Burdge 2002, IAIA 2006, Sadler et al. 2000, Becker et al. 2003, Vancly 2003, 2005). Conducting SIA is a complicated process, however, because it aims to evaluate the impact on the day-to-day lives of people, cultural values, religious beliefs, and their properties. According to Becker (2003), many models exist regarding the measurement of social impacts. Yet, the ability to predict environment or social impacts has been limited. This is the greatest challenge in GIS or SIA in development proposals, and one of the most vital reasons for the use of these new technologies. Chambers (1997) and Stolp et al. (2002) argued that, as a result, research techniques that consider how proposed developments affect local environmental qualities from the perspective of people who live there, or otherwise use the affected area, are gaining relevance. Having said that, the momentum of PPGIS and the recent development of GIS techniques and methodologies have greatly influenced research communities’ public participation, allowing people to voice their opinions and create people-centered decisions in development programs. Thus, participatory spatial decision-making applications (such as PPGIS) for socially sensitive development must be accompanied by SIA (PPGIS-SIA)², which addresses public concerns over the likely impacts on the cultural landscape.

STUDY SITE AND STAKEHOLDERS

Sri Lanka—Brief Country Profile

Sri Lanka is a small country, about the size of the state of West Virginia. It is located in the Indian Ocean off the southern tip of India. The island’s geographic location is considered an imperative geostrategic location in the Indian Ocean and a crucial link between the East and West countries’ maritime relations. As far as the history, Sri Lanka’s cultural heritage highlights more than 2,000 years. Because it is a tropical island, Sri Lanka is rich in natural resources and is among the top biodiversity places in the world. Sri Lanka has 21 million inhabitants. The largest ethnic group is the Sinhalese,

² PPGIS-SIA = participatory spatial decision-making applications (PPGIS) for socially sensitive development must be accompanied by SIA, which addresses public concerns over the likely impacts on the cultural landscape.
officially comprising 74 percent of the population. The next largest minority population is known as the Tamils, which is approximately 17 percent of the population. The Tamil population is divided into two major groups, the Sri Lankan Tamil (12 percent) and the Indian Tamil (five percent), because of their history of settlement in the island. The second largest minority is the Muslims, who make up approximately seven percent of the population. The rest consist of Christians, Burgers, and native communities. Geographically, the Sinhalese population resides in the western, southern, central, and north central provinces. The majority of Sri Lankan Tamils live in the northern and eastern part of the country, while Indian Tamils reside in the central part of the island. Both Sinhalese and Sri Lankan Tamils have a very strong history in the region as proud ethnic groups of the island.

History highlights that both major ethnic groups have fought several times over control of traditional land in Sri Lanka. Because of the implementation of Sinhala as the national language in 1956 and in conjunction with rising unequal opportunities (e.g., education, employment, regional redevelopment, and political representation), Sri Lankan Tamils fought for separation from the rest of Sri Lanka to form an independent state (which combines the northern and eastern provinces). To resolve the ethnic conflict, several peace talks and political negotiation were held between the Sri Lankan government(s) and Tamil political parties, including the Liberation Tiger of Tamil Ealam (LTTE). Unfortunately, because of the lack of leadership and vision from all ethnic group leaderships (e.g., Sinhalese, Tamils, Muslims), there were no agreeable and constructive solutions to power decentralization, and all peace talks failed, resulting in extremism among the Sri Lankan Tamils to seek freedom through use of weapons. In July of 1983, ethnic rioting became the turning point of Sri Lankan history by intensifying the ethnic tension because of the LTTE bombing of 13 Sinhalese soldiers in the north, which created anger and frustration among the majority of the Sinhalese community and resulted in the loss of several thousand Tamil lives in many parts of the island. Since then, the country has faced enormous political challenges to seek solutions to this ethnic unrest, which is estimated to have claimed more than 100,000 lives from every ethnic group and dismantled the country in terms of politics, economics, environment, international relations, education, peace, and social harmony. This conflict has disturbed generations of development activities and social harmony and, most important, pushed the country far behind from the rest of the world development.

As a nation, Sri Lanka struggled to bring economic development, but all development activities, regardless of location, have been delayed or canceled during the past 30 years because of the ethnic unrest. Among many disturbances, several large-scale reservoirs (located in the central region) also were threatened to be destroyed by the northern fighting groups. If one of the reservoirs were targeted and destroyed, the devastation and damages to the land and people would be massive. The Kalu Ganga reservoir was only in the initial stage of planning and, therefore, not at risk. The war now is technically over (although the final phase of the war once again has claimed more than several thousand lives), and economic development is taking place in all parts of the country. If the present and future majority governments and political leaders perform with a proactive mindset, the water resources of Kalu Ganga would be one of the grand peace builders and bring social harmony between northern and southern Sri Lank. But the current plan for the Kalu Ganga water resources does not allow for water to be distributed to the northern district communities for agricultural and drinking purposes. Instead, the project ends in the north-central districts (e.g., Polonnaruwa and Anuradhapura, shown in Figure 1) where the majority is Sinhalese. Although distributing central province water resources to the northern districts (the majority is Tamils) was one of the main goals of the greater Mahaweli River development program and it has been agreed to do so in the initial stage (during 1960s and 1970s) of the North Central Canal Development Program, the project stopped short of this goal. If as agreed the central province water resources had been channeled to the northern districts, the agreement could have minimized the ethnic tension and increased the social harmony between north and south while providing economic and agricultural livelihood development opportunities to the northern communities. However, the Kalu Ganga project still can be an excellent opportunity to bring development to all “Sri Lankans,” which includes every ethnic group regardless of language, race, ethnics, religion, color, and gender, because development is not just about infrastructure development for certain communities’ happiness. Rather, it is about...
building cultural, religious, and social integrity; establishing peace among all societies; maintaining social harmony among all people; and preserving traditional values.

**KALU GANGA—THE STUDY SITE**

The study site, Laggala-Pallegama, is a rural community that lies in the Matale District, which is in the central part of Sri Lanka (see Figure 1). Laggala-Pallegama is predominantly a Sinhala community and home to pristine environments, historic landscape, and river-based mineral resources. Agricultural production is the economic backbone of this rural community, which strongly depends on the Kalu Ganga3 both in the wet and dry seasons. Severe poverty, poor infrastructure, physical and administrative isolation, and human-elephant4 conflicts compound the development challenges in Laggala-Pallegama. According to the 2001 census, Laggala-Pallegama has a total population of 12,399, consisting of 6,494 males and 5,905 females (Kalu Ganga Feasibility Study 2004). Because of its remote geographic location, the region has been identified by its traditional lifestyle. The day-to-day living in Laggala-Pallegama is difficult and many struggle with poor economic conditions.

The Kalu Ganga reservoir development site has been proposed in the central part of the Laggala-Pallegama community. The reservoir project will impact the entire business district and 613 households in six local government administrative boundaries. The Laggala-Pallegama township and 613 families are to be relocated during implementation of the project. The local population depends heavily on agriculture, home gardens, shifting cultivation, home-based small industries, and gem mining. Because of a lack of economic opportunities, poverty is very high compared to the other parts of Sri Lanka. For example, the recipients of the government’s subsidiary and poverty alleviation program in Laggala-Pallegama in 2005 are illustrated in Table 1. Less than five percent of the members of the community who have connections with members of political parties have control over natural resources, land, agriculture, business, and gem mining. Women and children are greatly marginalized in economic development.

3 Kalu Ganga is one of the vital rivers, which begins in the Knuckles Forest and runs through Laggala-Pallegama. Kalu Ganga not only supports rich biodiversity in the whole watershed but also supports socio-economic development in the central and north central districts of the country.

4 Laggala-Pallegama is located close to two national wildlife parks, Wasgomuwa and Minneriya. Both parks are inhabited with wild elephants and they are connected via elephant corridors. The recent human illegal land encroachments in the national park areas (e.g., settlement, agricultural practices, and other development practices) have disturbed the movements of the elephants within the national park areas and corridors. In turn, elephant movements have increased in the human settlement areas and created severe threats between human versus elephant safety. There were a few occasions when villagers were killed by wild elephants and, in turn, when villagers killed elephants.

...
1 In 1994, the government of Sri Lanka initiated the Samurdhi Program as a strategy for poverty reduction by ensuring participation of the poor in the production process. The main goal of the strategy is to enhance the health and nutritional status of the poor.

The stated main objectives of the program are as follows: (1) Broadening opportunities for income enhancement and employment; (2) organizing youth, women, and other disadvantaged sections of the population into small groups and encouraging them to participate in decision-making activities and developmental processes at the grassroots level; (3) assisting persons to develop their latent talents and strengthening their asset bases through productive employment; and (4) establishing and maintaining productive assets to create additional wage employment opportunities at the rural level. (Source: www.fao.org, 2003)

Table 1. Number of families receiving Samurdhi

<table>
<thead>
<tr>
<th>Government Subsidiary and Poverty Alleviation Program</th>
<th>Local Government Division</th>
<th>Total Families</th>
<th>Families Receiving Samurdhi</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Karadamulla</td>
<td>146</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Gonawala</td>
<td>67</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Miniranketiya</td>
<td>115</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Halminiya</td>
<td>130</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Laggala-Pallegama</td>
<td>130</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Gangahenwala</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>613</td>
<td>337</td>
</tr>
</tbody>
</table>


Expert-driven approach changed into participatory process. To capture the full strength of GIS, the SIA team adopted a participatory approach to reconcile disagreements in a volatile situation. With long days and months of consultation, communication, collaboration, and in-depth questionnaire research with local communities, the PPGIS-SIA approach to the Kalu Ganga reservoir proved very constructive and permitted stakeholders to rethink sustainable development for the Laggala-Pallegama community.

The Kalu Ganga development SIA includes social, cultural, and environmental issues in the project site and it requires in-depth collaboration and reconciliation to be successful. A lack of collaboration and reconciliation by stakeholders has delayed the development project as planned. Vanclay (2000) argued that the impacts of reservoir development could have special consequences because such initiatives involve relocation of communities. Thus, it is important to understand that relocating traditional communities is not a single social effect but causes multiple implications such as anxiety and stress, uncertainty, disruption to daily living, and, most important, potential change to family structure. As a result, reservoir development needs profoundly detailed studies to understand the process as a holistic approach toward sustainability. Social and cultural values are subjective and present indistinguishable assessments, as was the case with the Kalu Ganga reservoir development. The PPGIS-SIA team realized that for all parties to be satisfied, the SIA process requires vigilant planning with participatory methodologies and suitable alternatives. By doing so, the SIA process impacts on communities to the center of inquiries, which helps them express their values, feelings, perceptions, and suggestions.

**METODOLOGY**

Our research applies PPGIS methodology to SIA to integrate local and expert knowledge and to support collaborative decision making. The PPGIS methodology used in the SIA study includes a variety of spatial methods (e.g., two-dimensional GIS, three-dimensional GIS, community mapping, global position systems, and remote sensing) to address issues of environmental, social, biophysical, and resettlement site selection. Using the PPGIS approach, we have developed a series of GIS models, including topography (digital elevation models and hydrographic), land use (agroecology and natural resource information), and infrastructure (route selections, resettlement sites, and sociocultural information). The PPGIS approach seeks to adopt diverse traditional research methods and combine them with nontraditional methods as a way of allowing project proponents and impact communities to understand, participate in, have access to, and integrate their voices into decision making. Accordingly, PPGIS helps to facilitate all stakeholders to participate and become involved in the decision-making process.

The following section illustrates how PPGIS methodologies have been adopted in the Kalu Ganga reservoir development. In this context, the PPGIS-SIA aimed to establish a conclusive and collaborative process in development programs.

**PPGIS-SIA APPROACH IN KALU GANGA RESERVOIR**

Very few research activities have been employed using the PPGIS approach in the Sri Lankan context (Alagan 2008, Alagan and Aladuwaka 2011, Kumara 2008, Widyasekara et al. 2010). The PPGIS approach used in our SIA study attempted to address the following issues that are considered vital for the reconciliation approach: (1) Establish a PPGIS administrative center for reconciliation; (2) conduct social and infrastructural mapping for compensation because of relocation; (3) formulate project alternatives and resettlement strategies; (4) identify resettlement site selection; (5) launch recommendations for elephant and eco-tourism corridors; and (6) propose relocation sites for impacted business and administration.

**PPGIS Administrative Center for Reconciliation**

The PPGIS approach has been designed to achieve a greater collaboration among stakeholders (Harris and Weiner 1998, Carver 1998, Kingston et al. 1999). Because of a lack of transparency and a top-down decision-making approach, the proposed Kalu Ganga reservoir project had been rejected by the local communities in the initial stage, making it very difficult for PPGIS-SIA to create...
opportunities for local communities to be effectively involved in the development process. In addition, the study site is incredibly sensitive to any development activities; local communities demonstrated their strong resistance to the proposed project. Not only did local officials inform the SIA team about the dissatisfaction of the local community, but the team also witnessed a variety of antidevelopment posters and demonstrations such as burning tires (in front of government institutions), public resentment, and, most important, reluctance to welcome outside experts to the community. After several weeks of brainstorming, the SIA team gradually approached the local leaders for an initial conciliation. Following a number of consultation meetings and discussions with government officials and community representatives, the SIA experts realized that innovative and collaborative methods were required to overcome the community resistance.

Setting up a local administrative center for the PPGIS approach in the impact area in Laggala-Pallegama was the first step. The main goal of setting up the PPGIS-SIA administrative center was to provide local citizens with wider access to project information (such as providing opportunities for meetings with SIA consultants and offering a place for collaboration to discuss the reservoir project and its implications). Setting up a local administrative center was an effective step in reaching the community. The administrative center was being used as a temporary residence for both researchers and consultants. The purpose of establishing the administrative center was to give community members access to resources and expert knowledge and to have their voices heard. Open access to the administrative center brought collaboration, enthusiasm, and trust from the community. GIS maps, visual aids, project-related statistics, comments, a suggestions board, and other environmentally related demonstrations were made available in the office for community members to comment and inquire about the project details. This approach proved to be very positive in involving locals with the project development.

Social and Infrastructural Mapping for Compensation

Because of relocation, the project will make significant changes on nearly all the self-sufficient livelihood systems enjoyed by local communities. Some of these changes will be unavoidable even through any form of mitigation methods. For example, households that depend entirely on forests or home gardens for fuel wood or that collect medicinal products from the surrounding environment will not receive similar privileges in the new location. However, the existing settlements have to relocate at any financial cost. To explore the social, cultural, and property values, an infrastructural mapping technique has been developed with the use of a GPS survey in the area to be inundated. Sri Lanka Survey Department 1:10,000 and 1:50,000 base maps and GPS field survey spatial maps were used to develop and identify direct and indirect impacts. The GPS survey provided data on the existing location of infrastructure (homes, land use, resettlement locations, roads, public and private buildings), natural resources (stream networks, archeological sites, tank systems, mineral resources, canal outlets, soil-sampling sites, and water-sampling sites), topography (contours and spot elevations), and political boundaries (local government administrative boundaries).

Six hundred and thirteen households and properties were identified and will be inundated because of reservoir development (see Figure 2). The SIA team revealed that one of the critical disagreements centered around determining a reasonable compensation package for property damage. Because of a lack of communication, there was substantial disagreement between the impacted communities and the project proponent. As revealed in the SIA survey and the focus-group discussions, the social and economic structure of the affected communities will be disturbed with the resettlement process. This fear pushed local communities to stand for strong compensation to rebuild their future livelihoods. Figure 2 illustrates the proposed reservoir inundated area and the GPS locations of all 613 households in Laggala-Pallegama.

The GPS location of all 613 households and social economic data, as well as qualitative representations of the homes, were integrated in GIS to develop a participatory multimedia GIS database (shown in Figure 3). The database helped the parties involved make a fair judgment of the compensation package. Also, the database provided opportunities for community members to voice their sentiments regarding land, cultural values, and livelihood standards. Moreover, the multimedia GIS provided a realistic perspective to discuss the compensation package because this database is designed to capture qualitative and quantitative information (e.g., text, data, maps, pictures, videos, and narratives). Furthermore, this database can be easily updated in GIS with good database management systems. Figure 3 illustrates the detailed socioeconomic information of a house, which could be affected in the inundated area. As agreed in the stakeholders’ and consultation meetings, the compensation package will be circulated to impacted community members during the Right Bank (RB) resettlement. Currently, the initial stage of the project in progress and resettlement plans and compensations are under way.

![Figure 2. Multimedia GIS application for mapping impact household in the direct impact area. Source: Center for Environmental Studies and Kalu Ganga Field Survey (2007)](image-url)
Resettlement Policy (NIRP) should be performed in accordance with the National Involuntary to the existing government regulations, new resettlement practices in the case of the Kalu Ganga reservoir development, according to the government of Sri Lanka (2001), NIRP ensures that people affected by development projects are treated in a fair and equitable manner, and that they are not impoverished in the process. As highlighted from the SIA field survey (2007), local communities suggested basic requirements for establishing agroindustries in the RB have to be provided. Based on their concerns, the PPGIS-based land-use model was developed to support the impacted community’s requests on agricultural land-use planning, and also, most important, develop a low-cost community-mapping technique to integrate local knowledge. The community-mapping technique assisted locals to improve comfort and control with mapping technologies. Additionally, stakeholders confidently took part in reviewing expert data and adding new information about the RB agricultural land use, water resources, road networks, settlements, and canal systems.

Traditional knowledge evolved over centuries in agricultural systems and is a mixture of ideas derived from religious and spiritual origins and natural phenomena. To build a feasible relocation program, the proposed RB resettlement model considered traditional knowledge in irrigation and tank systems, irrigable land-use practices, commercial lands, forestlands, and road networks (see Figure 4). To involve local communities in the land-use model, the PPGIS-SIA team presented the model in several community consultant meetings at public schools, religious places, and government offices (Figure 5). The colorful multimedia maps were presented and displaced for public review and comment. The displays helped locals easily access, review, and understand the resettlement plan. A multimedia map presentation followed for feedback. To make the consultation meetings more communicative, the PPGIS-SIA team members facilitated interaction in every possible situation. With a great deal of communication and reconciliation, the RB resettlement model was approved at the community level. The community-approved resettlement model was shared with the project proponent for its consent.

The community-approved resettlement model initiated a great deal of demands with the project proponent. Although there were some concerns over land allocation for agricultural practices, overall, the RB resettlement model was agreed on and approved. It was another great achievement for a PPGIS-SIA application because all stakeholders had opportunities to participate in the reconciliation process.

**PPGIS-BASED LAND-USE MODEL FOR RESETTLEMENT**

The recent development in PPGIS applications have underlined that linking PPGIS in development proposals has great potential to integrate local and expert knowledge for democratic decision making (McCall and Minang 2005, Weiner and Harris 1999, Kwaku Kyem and Saku 2009). With regard to reservoir development, families living in potentially inundated areas have to sacrifice their traditional lands, cultural values, and perhaps their employment and income sources. In most cases, when impacted communities are compelled to leave, they have different preferences. For example, in many situations, traditional communities prefer to live in clusters and cultivate their lands jointly with relatives. The family relationship helps them continue and further develop social connections, promote mutual support, and collectively meet challenges of establishing a neighborhood in the new environment. Subsequently, project proponents should provide various infrastructural services, including the establishment of agroindustries and substantial nonfarm employment avenues. This means that the new settlements should become catalysts and generate development momentum among them.

To develop this concept, a great deal of local knowledge and planning are required. Impacts to the local communities should be mitigated before any other activities take place, for they directly affect the progress of the project in achieving the desired objectives. In the case of the Kalu Ganga reservoir development, according to the existing government regulations, new resettlement practices should be performed in accordance with the National Involuntary Resettlement Policy (NIRP) of the government of Sri Lanka. As highlighted from the SIA field survey (2007), local communities suggested basic requirements for establishing agroindustries in the

---

5 According to the government of Sri Lanka (2001), NIRP ensures that people affected by development projects are treated in a fair and equitable manner, and that they are not impoverished in the process. NIRP also helps to avoid, minimize, and mitigate the negative impacts of involuntary resettlement by facilitating the reestablishment of the affected people on a productive and self-sustaining basis. The policy further facilitates the development of the project-affected people and the project.

---

**RESETTLEMENT SITE SELECTION**

PPGIS methods have potential to integrate public concerns, experiences, and local groups’ interests in land-management practices (Kwaku Kyem 1996, Alagan and Aladuwaka 2011). To develop sustainable land-use practices in the resettlement area in the Kalu Ganga reservoir development, the SIA team consulted stakeholders. In the process of selecting resettlement areas, local communities have demanded the exploration of abandoned lands in the RB. The PPGIS-SIA team joined with local community leaders to explore the abandoned agricultural and forested areas in the RB. During the visit in the RB, the PPGIS-SIA team witnessed the existence of abandoned agricultural lands and small tank systems, which were used for irrigation (shown in Figures 6 and 7). The field survey revealed that the current conditions of the lands were unsafe for human settlement, and especially local leaders pointed out that elephant movement was very common in these sites. Local
leaders worked to identify the land-use systems in the RB (such as abandoned agricultural lands, irrigation tanks, potential canal development, and prospective future resettlement areas). A GPS survey was used to locate this information. Using 1:50,000 Sri Lanka Survey Department base maps, water bodies, land contours, and forest patches were identified. Adding local and expert knowledge, the RB resettlement plan was developed for further reconciliation. The comprehensive resettlement plan included information such as water resources, forest cover, contour lines, abandoned agricultural lands, and irrigation tanks. Once again, the colorful images and maps were presented at several consultant meetings for public opinion. Community input was recorded and integrated as local knowledge in the final resettlement report.

PLANNING CANAL SYSTEM AND INFRASTRUCTURE LAYOUTS FOR ELEPHANT CORRIDOR

The proposed resettlement site in the RB is situated in the Laggala-Pallegama Divisional Secretariat Division (DSD) in which four local governmental divisions—Galgedewala, Guruwela, Rawanagama, and Akarahadiya—directly come under the project site. This area has been uninhabited for a long time because of human-elephant conflict. As described earlier, the study site is rather well known owing to its history and rich culture and because it lies next to two national parks—Wasgamuwa and Minneriya-Giritale. The existence of wild elephants and the elephant corridor in the national parks is widely known and in several occasions local inhabitants have been attacked or killed by wild elephants. First, the flora and fauna in the study site depend on the water of the downstream river. During the dry season, when there is no water flow along the river downstream, humans and animals have to undergo severe difficulties. Second, some of the village agricultural fields are located in close proximity to the national parks. Third, human-elephant conflict has escalated because of the increasing clearance of forestland for human settlement. As a result, the wild elephants encroach on villages and threaten the lives and property of the villagers. It was evident that villagers’ vegetable gardens and other crops were damaged and shattered by elephants several times. In retaliation, angry villagers have shot or killed wild elephants. This was one of the major reasons that RB lands were neglected, as described earlier. When the RB resettlement model was proposed, many locals raised concerns over the human-elephant conflict and requested a high priority of human safety and gardening security.

With the support of experts, an elephant corridor construction was proposed along the RB. Building a secure elephant corridor is vital to demonstrate the safety and sustainability of the RB resettlement, as well as in protecting the natural habitat. Several alternatives were considered to develop elephant corridors and protect the inhabitants from elephant conflict: placing an electric fence along the main RB canal, constructing concrete walls for both sides of the RB canal, and building a concrete wall on one side while leaving the other side of the canal as an open water area. All three alternatives were discussed among PPGIS-SIA team members, and elephant experts were particularly helpful in describing the vital role of elephant behavior and movements in this part of the forestland. With a great deal of communication and discussion, the latter option was agreed, for it provides more realistic alternatives to develop economic opportunities, namely “ecotourism” for the local community. If the wall is designed as a tall single banking lined with concrete, animals cannot cross to the irrigable side of the canal and disturb human life. Thus, it would work not only as a barrier for elephants but for other animals as well. Elephants and other animals can only approach the water of the single bank canal from the forest area but cannot cross the canal bank.

The main RB canal would automatically become an attractive route for ecotourists, which could bring more economy to the
locals through new job opportunities and various other income
generators. Taking all these matters into consideration (local and
expert knowledge), we developed the elephant corridor maps
that were presented at local consultants’ meetings for review and
comment by the communities. Many locals enthusiastically par-
ticipated, reviewed, and supported the new multifaceted idea of
protecting lives, supporting economic development, and creating
job opportunities via ecotourism. The use of PPGIS methods to
share experts’ recommendations about the RB elephant corridor
was highly effective, for people easily understood the proposal
through the demonstration of the GIS maps. Figure 8 illustrates
the Kalu Ganga RB settlement model, irrigation canal, and el-
ephant corridor sites.

RELOCATION OF BUSINESS AND
ADMINISTRATIVE TOWNS
Another important outcome of the PPGIS-SIA approach was
establishing small business towns for the RB resettlement. The
current Laggala-Pallegama business district will be inundated
completely and 613 families will face challenges without admin-
istrative offices and a business district. In the original resettlement
plan, the project proponent (MASL) proposed to shift the existing
Laggala-Pallegama business district to Hattota Amuna on the Left
Bank of the Kalu Ganga. The Laggala-Pallegama business com-

munity had strongly rejected this proposal to shift the existing
town to Hattota Amuna (which is about 15 miles north of the
Laggala-Pallegama business district) and requested relocating the
district toward the RB. In particular, the business community
pointed out that shifting the Laggala-Pallegama business district
to the north will adversely impact the business life of the local
community because of conflicting social statuses and cultural
beliefs between Hattota Amuna and Laggala-Pallegama.

Laggala-Pallegama is a medium-size business district with a
variety of small-scale shopping centers that include agrobusinesses,
clothing, home appliances, brick making, and animal husbandry.
Except for paddy cultivation, all the other income-generating
activities and businesses will be affected negatively if the busi-
ness district moves toward the north without the cooperation
of the people. Also establishing new businesses in Hattota Amuna
for newly settled people will take time and effort. Furthermore,
because of conflicting societal backgrounds, it is not easy to set up
new businesses in a well-established place such as Hattota Amuna.

After a series of negotiations between the project proponent
and local communities, three new small business towns in the RB
were proposed to support local businesses, while Hattota Amuna
will operate as the main administrative town on the Left Bank
for both communities (see Figure 9). Although access to the new
Hattota Amuna administrative town is approximately 15 miles
from the RB resettlement, present transportation challenges make
this a great distance; therefore, establishing a series of new small
towns will enhance local businesses. The PPGIS-SIA team made
every effort to incorporate the desires of the Laggala-Pallegama
community and their willingness to reconcile with the project
proponent. The team has presented the administrative and busi-
ness district models both in quantitative and qualitative forms,
and has articulated that the sustainability of the Kalu Ganga
development depends on “community collaboration.” Just as
PPGIS provided local groups the opportunities to participate,
access, voice, and review the reservoir development, local groups
contributed a great deal of ownership and good judgment to
PPGIS applications in development activities.

Sustainable SIA depends on incorporating traditional
knowledge and healthy community collaboration. Vanclay
(2003) explained that SIA builds on local knowledge and utilizes
participatory processes to explore the concerns of impacted com-
unities. The Kalu Ganga SIA clearly articulated the importance
of incorporating public collaboration in the assessment of social
impacts and of finding effective alternatives. Valcany (2005) also
asserted that “if SIA is to be a guiding process of steering develop-
ment, and then the ‘quality’ of SIA should be judged not by its products, but by the effectiveness of its process. It also becomes a process that is implicit in communities as well as in the companies (and government agencies) that initiate planned interventions.” One of the most important lessons learned from this SIA study was that integrative and participatory processes, in fact, created an opportunity for communities and project proponents to plan collaboratively for common goals.

The final EIA report has been completed and distributed to the project proponent and all other interested parties for review. With a great deal of communication, collaboration, and consultation, the final report has been approved for project implementation. International governments (e.g., Kuwait, Saudi Arabia, and Japan) as well as the OPEC organization have come forward to provide necessary financial assistance for the reservoir and agroproject (which includes the Moragahakanda project), estimated to cost $557 million (Mahaweli Authority 2009). The first stage of the Kalu Ganga multipurpose irrigation development project already has been started and the resettlement program and compensation are in progress. The MASL (2008) states that the project aims to provide irrigation facilities to 81,422 hectares in the dry zone of Sri Lanka, benefiting more than 100,000 families. According to many locals (who will be resettled in the RB), the reservoir project will bring encouraging economic opportunities such as infrastructure (e.g., road development, water supply, new irrigation lands, market facilities, power supply, communication, schools, religious places, hospital, and local governmental offices); and more business opportunities (e.g., farmers and small-scale business opportunities to women). Also local communities believe that the reservoir development would support connection with other parts of the country through better communication facilities. Eventually, it will support the local communities in eradicating poverty, providing empowerment prospects to women, and developing a more prosperous economy.

**CHALLENGES**

The primary challenge that the PPGIS-SIA team faced was how to implement the PPGIS methodology in a centrally controlled and governmental top-down development program in a rural community. Although social research is well rooted in participatory methods, PPGIS application is a new concept to Sri Lankan development activities. Integrating traditional knowledge in GIS and changing the decision making to a bottom-up process is rarely practiced in Sri Lanka. As explained earlier, it is because of a lack of experts, an unfamiliarity with PPGIS, a reluctance to accept a bottom-up approach, and, most important, a lack of knowledge on the potential side of the PPGIS approach in development programs. In addition, traditionally GIS practice in Sri Lanka is a top-down and expert data–driven culture. Thus, bridging public participatory GIS with SIA was a major issue, for it brought new challenges to decision makers who are accustomed to top-down approaches.

Another challenge conducting participatory GIS in SIA is that it is a costly and time-consuming process. Coordinating between stakeholders and arranging community consultant meetings were not easy tasks because of the remoteness of the area. The PPGIS team handled these challenges by maintaining regular local contact with community leaders, coordinators, and local government officials. Yet the amount of resources (e.g., finances, human resources, and transportation) needed for this type of research method was very high.

Third, the PPGIS approach in SIA has great potential for incorporating local knowledge in decision making by using advanced communication methods, such as Internet facilities, computers, and spatial software. Using these technologies, project data could be accessed by affected communities from homes, schools, offices, business places; therefore, impacted communities could effectively participate in decision making. However, because of the remoteness of the local area, the poor economy, and the lack of infrastructure development, access to Internet, computers, and software is inadequate. It could be more effective if technology were more available in the project site.

Finally, difficulties were noticed because of conflicting interests between government line ministries. Although the Kalu Ganga reservoir development is directly associated with the MASL and local communities, there are other important players, such as GOSL ministries and several departments (e.g., forest,
wildlife, irrigation, archaeology, development, agriculture, and environment). Because all these institutions function on their own mandates and guidelines, it was not easy for the PPGIS-SIA team to coordinate among them. Instead, the team faced challenges negotiating between institutions on land, forest, archeology, wildlife, and irrigation-related base information, which are vital to this study. This was chaotic, for overlapping responsibilities between governmental institutions delayed the SIA studies.

CONCLUSION
As highlighted by Weiner and Harris (2003) and Rambaldi (2010), the growth of geospatial technologies is rapidly transforming how place and environment are visualized, represented, and understood. In the meantime, GIS has a tendency to marginalize the valuable local knowledge in the decision making (Weiner and Harris 2003). This research illustrates the use of PPGIS to accommodate affected communities’ concerns and suggestions in a national irrigation development project (Kalu Ganga) in Sri Lanka. As described earlier, reservoir development certainly will have significant consequences on local people and culture because such large-scale initiatives involve relocation of communities (Vanclay 2000). Thus, it is important to understand that relocating traditional communities is not a single social effect but causes multiple implications. The proposed Kalu Ganga reservoir development project will impact communities and local environments for the project site is located in a very sensitive area in terms of its culture and physical environment. Because of the lack of communication and the top-down decision process in local communities, the development program had been halted. Participatory approaches, such as PPGIS, were adopted in an SIA study and created collaborative decisions. Although PPGIS has been employed in diverse research activities, including in EIA, it is lacking in SIA in Sri Lanka. This study highlights the importance of using PPGIS in SIA, particularly in a large-scale project such as the Kalu Ganga reservoir development.

This study also illustrates that PPGIS has great potential to enhance public participation and negotiation in development projects. The interactive nature of such an approach provides opportunities to bridge local knowledge with expert knowledge instead of top-down decision making that often undermines the very people who are affected by the proposed development activities. Although there are limitations building a hands-on PPGIS for SIA, it was the first step toward demonstrating that SIA should involve a people-centered approach, and that participatory spatial decision making is vital. PPGIS-SIA has cast the very people impacted by the project into decision-making roles and has provided the opportunity for them to voice their opinions. As Becker (2003) pointed out, a keystone of collaborative approach is that the people who will be directly affected by development actions should be given an opportunity to assess those impacts. Thus, the PPGIS-based collaborative approach used in the Kalu Ganga SIA clearly supported development-planning solutions based on negotiations among stakeholders. Finally, the PPGIS approach illustrated the effectiveness of participatory and innovative approaches to SIA that could bring collaboration among all parties involved, which is the core of sustainable development.

Acknowledgments
Many individuals and institutions helped us in this EIA/SIA research project. The SIA team members through the Center for Environmental Studies (CES), University of Peradeniya, Sri Lanka, rendered this Kalu Ganga EIA/SIA study. The GIS team from the CES also offered enormous support to produce spatial maps for this research project. Natural Resources Management Services (Pvt.) Ltd., Polgolla and Mahaweli Authority, Sri Lanka, provided financial and logistic supports to conduct the research. Although it is impossible to thank everyone, we would like to extend our sincere thanks to the Laggala-Pallegama local public, village community members, community leaders, and religious leaders for their insight and support in this project.
About the Authors

Ram Alagan is an Assistant Professor of Geography, Department of Humanities at Alabama State University, Montgomery, Alabama. From 1991 to 2008 he worked as Senior Lecturer at the Department of Geography, University of Peradeniya, Sri Lanka. From 2008 to 2010 he taught as visiting scholar to Global Gender Studies and Asian Studies Departments at University at Buffalo, New York. His research interests include Participatory GIS, Geo-visualization, Environmental Impact Assessment, and Disaster Management Studies. He has done research on Tsunami disaster in Sri Lanka, focusing on coastal erosion, disaster rehabilitation and reconstruction, and livelihood development.

Seela Aladuwaka is an Assistant Professor of Geography at the Department of Humanities at Alabama State University, Montgomery, Alabama. She was a Senior Lecturer at the Department of Geography, University of Peradeniya, Sri Lanka from 1991 to 2008. From 2008 to 2010 she taught as visiting scholar to Global Gender Studies and Asian Studies Departments at University at Buffalo, New York. She was recipient of the Fulbright scholarship for her MA degree in 1993 at American University, Washington DC. Seela’s research interests include poverty, gender and development, social impact assessment, and disaster management. She has done research on Tsunami in Sri Lanka, focusing on coastal erosion, disaster rehabilitation and reconstruction, and livelihood development.

References


ANALYZING PERCEPTIONS OF INEQUALITIES IN RURAL AREAS OF ENGLAND USING A MIXED-METHODS APPROACH

STEVE CINDERBY, ANNEMARIEKE DE BRUIN, PIRAN WHITE, AND MEG HUBY

ABSTRACT: This paper describes the findings of the Social and Environmental Inequalities in Rural Areas (SEIRA) project which investigated both dataset and methodology development to investigate this issue from an interdisciplinary viewpoint. The research utilised mixed methodologies to examine how rural residents experienced and perceived conditions in the 21st century English countryside. These included a rapid appraisal participatory mapping to generate a baseline of local concerns and recruit participants for in-depth discussion groups. The group meetings then combined vignette techniques from social qualitative research to investigate local knowledge of inequalities and adapted them to include participatory mapping to capture participant understandings in a spatial framework. The stakeholder supplied information was then analysed in a participatory geographic information system and qualitative software to investigate whether place plays a role in perceptions of unfairness or injustice and how residents are differentially affected by rural conditions. These novel mixed participatory methods are described and linked to highlights of the findings of the participatory geographic information system analysis of local stakeholder’s perceptions of inequalities in rural England.

INTRODUCTION

Tickamyer (2000) conceptualises space in three ways: As place—a specific locale comprising a hybrid of biography and topography (Hall, Lashua, & Coffey, 2006); as relational units developed to organize our ideas of place including comparing between them; and as scale—the size of these relational units used to make comparisons. By comparing places using different relational unit’s inequalities between locations operating at a variety of scales can be identified. The term ‘inequality’ in this case (as used in this paper) refers simply to the spatial dispersion of a distribution, following precedents set by Litchfield (1999) and Kokko et al. (1999).

Why do we give precedence to inequality resulting from gender, race or class but fail to give equal consideration to spatial categories (Tickamyer, 2000; Dorling, 2011)? The achievement of sustainable rural development implicitly depends on the spatial distribution of social, economic, and environmental goods and services that are needed to maintain, reinforce, or improve the vitality of rural areas. The need to understand inequalities in the distribution of environmental conditions across different social groups is highlighted in the UK Government Sustainable Development Strategy (HM Government, 2005) and plays a key role in the work of the Environment Agency and other government bodies (Warburton, 2006; Coleman and Duarte-Davidson, 2007; Defra 2008). There is a growing recognition that to achieve real improvements in rural conditions it is not sufficient simply to consider levels of poverty and environmental quality. The gaps between rich and poor, and between good and bad are at least as important (Boyce, 2007; Hills et al., 2009; Wilkinson and Pickett, 2009). However, there is little research to date that investigates specifically rural inequalities from the necessary interdisciplinary perspective.

A society can be considered well-ordered when designed to advance the good of its residents and effectively regulated by a shared public conception of what is considered just. The challenge in identifying concepts of justice is whether they are based on the actual distributions of resources or instead derived from normative principles of what should or could be (Jasso & PH. Rossi, 1977). That is to identify whether the unequal distribution of a resource only identifies a difference in location or rather implies unfairness or injustice (Le Grand, 1991). The use of participatory geographic information system (PGIS) methods offers the potential to investigate, in a spatial framework, how actual distributions of resources interact with resident’s normative principles of a fair or just allocation of goods and services (Dorling, 2010; Soja, 2010).

This paper reports on the findings from a project that attempted to look at concepts of place across relational units at different scales to identify both quantitatively and qualitatively the distribution, magnitude and effect of spatial inequalities on rural residents of England in the 21st Century. This research is used to illustrate the development of novel mixed method approaches incorporating the use of PGIS techniques to help identify perceptions of injustice that may be applicable in a wider range of contexts, places and communities.

A QUANTITATIVE ANALYSIS OF INEQUALITIES

The Social and Environmental Inequalities in Rural Areas (SEIRA) project (www.sei.se/relu/seira) was organised in interlinked phases. Initially, spatial datasets of social, economic and environmental conditions in rural England were derived from
existing national datasets and then this information was used to identify and measure inequalities quantitatively.

Rural England was identified according to the official UK government rural-urban definition (Bibby and Shepherd (2004)) which was based on population density and linked to settlement morphology. The definition was generated for spatial units called Lower Layer Super Output Areas (LSOA) that were used to analyse the outputs of the 2001 national census. LSOAs are consistent in terms of population size (with a mean of 1596 residents) but vary dramatically in spatial extent in rural England with an average area of 18.3km$^2$ but a maximum size of 683.7km$^2$ (National Statistics Online, 2007). In total there are 6027 rural LSOAs in England representing approximately 3.9 million households. LSOAs are ideal for analysing social and economic information which is made available for these spatial units, but represent methodological challenges when incorporating environmental data collected on a different geography (Huby, et al, 2009).

The SEIRA project compiled a large number of social, environmental and economic datasets and then selected a subset of thirty-two individual variables for further analysis. Statistical techniques were then applied to this subset to extract underlying factors representing conditions of rural England. Four factors were identified (as seen in table 1): ‘Disadvantage’ incorporated income deprivation together with poor education and employment opportunities, mental well-being issues, fuel poverty and problems related to access to housing, such as affordability; ‘Remoteness’ was an indicator of areas further away from schools and leisure activities and where farming was often subsidised; ‘Richness’ indicated areas that had a high diversity in vegetation and wildlife and where house prices and business activity tended to be high; and, ‘Pollution’ was an indicator of where air quality was poor and crime problems existed. Inequalities in these factors between LSOAs in different administrative geographies, for example English counties, were then quantified (Huby, et al, 2009b).

RESIDENTS PERCEPTIONS OF INEQUALITY

However the spatial data and quantified measures of inequality only revealed differences between locations. Were the distributions of goods and services identified from the quantitative data distinguishable from personal experience? More importantly, did people living in rural England perceive an unfair or unjust distribution of social, economic and environmental resources? In short, could there be an inequitable distribution of resources (Walker, 2010) in rural areas? In order to answer these questions it was necessary to better understand the experience, knowledge and perceptions of rural residents.

To facilitate this discussion groups were organised in four counties distributed across England namely: Northumberland, South Yorkshire, Buckinghamshire and Devon (see Figure 1). The first three of these exhibited the highest levels of relative inequality among their LSOAs in terms of both environmental-ecological and socio-economic conditions. In order to include the perceptions of residents from southern England, Devon was also identified on the grounds that this county was the most unequal relative to the other counties in the South West. Within these counties specific locations where the LSOA factor data indicated relatively poor social and economic conditions but high variation in terms of the physical environment were identified as target communities for the qualitative fieldwork.

RECRUITING PARTICIPANTS: TRYING TO AVOID THE USUAL SUSPECTS!

The project wanted to encourage participation from a wide range of residents and avoid only speaking to the so called ‘usual-suspects’ (who are active in their local areas and typically come forward to represent their communities’ viewpoint). The researchers felt engaging with a potentially wider mix of views would increase the understanding of the various ways participants

| Table 1. SEIRA quantitative factors and underlying variables |
|---|---|---|---|
| Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| Disadvantage | Remoteness | Richness | Pollution |
| 1a. Educational disadvantage | 2a. Further from primary school | 3a. High probability of badgers | 4a. High PM10 pollution |
| 1b. Income deprivation | 2b. Environmentally sensitive agriculture | 3b. High house prices | 4b. High NO2 pollution |
| 1c. Low mean incomes | 2c. Lot of farmland | 3c. High bat species richness | 4c. High crime rates |
| 1d. Poor mental well-being | 2d. Further from secondary school | 3d. High business activity | |
| 1e. Low employment | 2e. Few sports and leisure activities | 3e. High land-cover diversity | |
| 1f. Fuel poverty | 2f. Good quality rivers | | |
| 1g. Barriers to housing | 2g. Little local work | | |
understood and thought of the issues of unfairness in relation to rural inequality.

In order to identify participants for in-depth discussions a variety of approaches were tried, including contacting existing community groups (such as the Women’s Institute, the community church organisations and local sports teams); putting up posters in the villages inviting people to contact the research team; and direct contact with people via recommendations from existing participants.

The project team also utilised a version of the Rapid Appraisal Participatory-Geographic Information System (RAP-GIS) methodology (Cinderby, 2010). This method was designed to engage with people who would not typically attend an organised meeting through barriers such as time, work or family commitments, disability, confidence and suspicion. The RAP-GIS approach involved taking the mapping to the community – rather than expecting them to come to a meeting. In this case the technique was taken to the street at local markets in the fieldwork villages.

In each market the research team set up a stall with a colour A0 sized map of the local area mounted on thick foam. Passers-by were encouraged to come across for five minutes and share what they thought of the local area. The project was introduced by the researchers and participants were each given two numbered coloured flags (yellow and blue – to avoid issues of colour blindness) and asked to identify one location they would recommend or thought was good in the local area and another (using the alternate coloured flag) they felt had a problem or something they would like to see changed or improved. Participant’s comments (numbered to match the flags) were recorded on clipboards alongside their demographic and contact details. This ‘off-map’ recording of comments meant that future participants could not be overly influenced by previously supplied information, although obviously the colour of existing flags indicated thematic clusters of ‘goods’ and ‘bads’. RAP-GIS in progress on one of the markets can be seen in Figure 2 above.

The technique proved useful for getting a wide demographic balance and large number of participants illustrated with data from two three-hour long events held in Buckinghamshire (see Figure 3). The project specifically did not attempt to engage with under-18 year olds due to the relative sensitivity of the inequality issue. This rapid data collection and engagement methodology provided an opportunity for the team to invite the passers-by to more in-depth meetings at later dates. Their contact details were collected and followed-up later with telephone calls confirming the dates and availability of people for discussion groups or in some cases individual interviews.

**IN-DEPTH DISCUSSIONS OF UNFAIRNESS**

From the outset, the aim of the fieldwork was to get a wide range of participants involved, but not a statistically representative
sample. The intention was not to generate a survey of how the population of rural England thinks about inequity and injustice. Instead, rather it was to understand how the participants in this fieldwork expressed their ways of thinking and concepts around issues related to unfairness in the distribution of social, economic and environmental goods and services.

In total fifty-four people attended the discussion groups. Their gender and age breakdown can be seen in Figure 4. For most participants of the fieldwork the concepts of inequality and inequity were relatively alien to their everyday thinking and discourse. In order to guide people through the two-hour discussion groups, a three-step process, illustrated in Figure 5, was developed starting with an orientation exercise and leading to in-depth debates on the concepts of unfairness.

The orientation exercise simply asked participants to mark on a map where they lived, worked, shopped and went for leisure. It was designed to get them used to looking at, and comfortable with, marking locations on the supplied A0 British Ordnance Survey 1:50K topographic map centred on the village in question.

Let Us Tell You A Story...

Once participants had located themselves on the map the discussions moved onto identifying their knowledge and experiences of rural living through the use of vignettes linked to a participatory mapping activity.

Vignettes were originally conceived as a short description containing a controlled amount of information upon which interviewees responded (Nosanchuk, 1972; Wilks, 2004) but allowing them to build their own interpretation and meaning into those response (Finch, 1987). The narratives often took the form of moral dilemmas (Barter & Renold, 2000; Finch, 1987; Gould, 1996; Graves & Frederiksen, 1991; Hughes, 1998; Hughes & Huby, 2002; Jenkins, Bloor, Fischer, Berney, & Neale, 2010; Sim, Milner, & Love, 1998; Taylor, 2005; Wilks, 2004) with the vignette keeping the framing of these issues consistent and allowing some control and direction to be introduced by the researcher (Alexander & Becker, 1978). They have been used in a wide variety of contexts including large surveys where they are used to generate consistent data that can be analysed quantitatively (Nosanchuk 1972; Rossi et al. 1974). In qualitative research they are designed to allow normative issues to be discussed in a way that is equivalent to the complexity of everyday life (Finch, 1987).

The vignettes used in the SEIRA project were constructed to gain comments on the options available to different rural residents housing and lifestyle needs. One involved a family moving from an urban area that had childcare and transport requirements. The other was constructed around the story of a young woman on a low income hoping to move out from their family home but wanting to stay in a rural location. The vignettes were built to incorporate aspects of the quantitative factors (described in table 1) that were important for determining patterns of inequalities.

These vignettes (seen in full below in table 2) were employed in order to allow people to discuss conditions in their locality in relation to the needs of hypothetical characters rather than having to describe their own personal situations. This has the advantage of making the questions less personal and broke away from the limitations of participant’s personal experience and circumstances. The variety of different content in the two vignettes was designed to discourage participants from replying purely on their own experience but necessitate them to consider conditions from an alternative using their local knowledge of environmental, social and economic conditions.

The vignettes were read out loud by the research team to avoid any issues of literacy amongst the participants. There were also paper copies available for people to refer to during the mapping component of the vignette responses.

Can you mark that with a sticker?

Vignettes have previously been used in face-to-face interviews, focus groups, postal and self-administered questionnaires; and presented via video-tape, audio recordings, newspaper reports, rap music and through photographs (Hughes, 1998). Lieberman (1987) turned the approach on its head by getting participants to compose narratives she termed vignettes rather than respond to existing text. The novelty of the application of vignettes in this research was their combination with participatory mapping and GIS. Participants were requested independently (and without conferring) to identify and mark with a sticker places that might be suitable locations to meet the requirements of the hypothetical characters. They were then asked to explain in turn why they had marked the specific locations.

Is this a fair distribution?

The final stage of the discussions centred on whether the patterns of opportunities and problems identified through the vignette mapping were just for the actual people currently living in those localities—was there any inequity for rural residents. These discussions proved very fruitful for understanding the normative framework of the participants in relation not just to their own circumstances, but thanks to the vignette, those for other people with differing needs and choices.
Table 2. Vignette narratives used with participatory mapping (the numbers relate to the variable descriptions in Table 1). Elements marked *** were customized to each location with relevant and appropriate detail.

<table>
<thead>
<tr>
<th>Vignette One—Health and Safety</th>
<th>Vignette Two—Leaving the Nest</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Mr. Adam Regis (32 years old) and his wife Mrs. Janet Regis (30) are moving to the local area so that Adam can take up a new job with the local council in *** as a transportation planner. He will be paid approximately $***K for this new role [3b, 3d]. They have two children, George, six, and Chloe, two. Janet cannot drive so ideally they would like a house somewhere with facilities or public transportation links [2a, 2d, 2e]. The family is moving from Manchester and would like somewhere safer [4c] and healthier [4a, 4b] to bring up their children. They enjoy being outside (walking and cycling) [2c, 2f, 3a, 3c, 3e] and would ideally like somewhere with facilities for the children [2e].”</td>
<td>“Sarah is 23 and still living at home with her parents in ***. She has always lived at home [1g] as she has struggled to find work locally [2g, 1e] and could not afford to move out [1g]. Sarah has recently started a more secure job in *** with an income of $17K per annum [1b] and now feels she would like to move into a place of her own. She realizes she cannot afford to buy locally [3b], but would like to rent. She would like to stay near her family, but doesn’t know if this is possible or affordable. Sarah drives to work but would like to save money by taking public transportation.”</td>
</tr>
</tbody>
</table>

ANALYSIS AND RESULTS

The discussion groups were recorded and transcribed for further analysis in a qualitative software package. They were then coded using a structure, collaboratively defined by the research team, which evolved as the process developed using a grounded theory approach (Bryman, 2008; Ritchie and Lewis, 2007). The findings from the vignette responses, participatory mapping information and the in-depth discussions of unfairness can be grouped into themes related back to the quantitative factors seen in table 1. The ‘richness’ of living in a rural environment was described in relation to the beauty of the countryside, low pollution levels, but also linked to risks associated with these qualities such as river flooding. The increasing ‘remoteness’ of rural settlements was highlighted in relation to the availability (or more often lack) of services such as schools, doctors, shops, banks, libraries and post-offices. This was a major concern and linked to the increasing inaccessibility of key services for many residents by any means other than private transport. The high levels of perceived safety and relatively low crime were considered important benefits of rural living and were related to a strong community spirit and cohesion felt to exist in these locations. This could be considered the inverse of the quantitative ‘pollution’ factor. The lack of affordable housing was a concern across the country, particularly in relation to the options available to young people’s ability to live in villages. This was seen to be connected to the rise of tourism and rural second homes leading to less people living fulltime in villages. This depopulation was seen to be leading to a reduction in employment opportunities and an increase in seasonal or tourist related work that was low paid. These issues equate to the ‘disadvantage’ factor. These findings gave increased confidence that the identified quantitative factors had resonance with everyday life in rural England and were consistent with the experiences of people residing in the countryside.

Analysing these views more deeply identified the normative framework that participants were using to generate their perceptions of inequity. This framework included: the nature of the inequalities (typically in services); for whom these inequalities had an impact (mainly children, the elderly and those on low income); and the impact these inequalities had on peoples quality of life (such as increased isolation and lack of available facilities).

VIGNETTES LINKED TO PARTICIPATORY MAPPING

The spatial component of the vignette responses linked to participatory mapping makes it possible to compare participants’ perceptions of rural conditions with the four factors generated in the first part of the project. By classifying the characteristics of places that led to locations being identified as suitable or not suitable for the vignette characters into four themes similar to the quantitative factors the qualitative information can be compared to the quantitative findings. This comparison should be considered a pilot of this methodological approach as the original data collection had not been explicitly designed to undertake such an assessment. Nevertheless it did reveal some interesting, although tentative, findings and is included here to demonstrate the potential of the technique.

Considering the ‘remoteness’ quantitative factor, this was first grouped nationally into quintile classes. The locations identified...
from the vignette responses in Northumberland were then coded as remote based on whether people had described a settlement as lacking all services including shops, schools and leisure facilities (these issues corresponding to some of the components of the ‘remoteness’ factor); or possibly remote if there were only problems in relation to a subset of these facilities, for example, far from primary and secondary schools.

Figure 6 correlating participant’s perceptions with the factor class indicates that the locations identified quantitatively as remote and lacking facilities resonated with the personal experiences and local knowledge of the Northumberland participants.

Undertaking a similar correlation between the ‘disadvantage’ factor and Northumberland experiential information there is far less agreement as seen in Figure 7. The quantitative classes include issues such as educational disadvantage, low incomes and levels of employment, barriers to housing, poor mental health and fuel poverty. The participants did not describe locations in these precise terms but instead referred to a lack of affordable housing but also villages that were suffering from what was often described as deprivation. The spatial variations in these perceived problems of deprivation were high, meaning neighbouring villages could be quite different in terms of their relative affluence. This fine grained differentiation was not picked up with the quantitative data based on a standard population base unit of analysis, the LSOA.

This indicates that whilst census based social and economic data can usefully differentiate between areas it will also (perhaps obviously) mask variations operating on a finer geographic scale. In relation to the issues of inequality, inequity and possible policy responses, this leads to some considerations discussed in more detail below.

**BENEFITS OF A MIXED METHOD APPROACH**

The mixed method approach to assessing inequality and inequity in rural England described above generated a variety of advantages to our understanding of these issues and possible interventions to ameliorate them.

The RAP-GIS method proved useful for attracting a relatively large and varied sample of participants. The concepts of inequality and inequity were specifically not raised in the RAP-GIS questions as it was felt that it was an inappropriate method, due to the very benefit of its short, speedy nature, to discuss this potentially contentious and sensitive issue. However using the approach proved beneficial to the project for a number of reasons.

It allowed the team to make contact with a wider cross-section of the local population than might otherwise have been the case through the other engagement techniques employed to recruit participants for the in-depth meetings. The actual up-take of attendance at the meetings from RAP-GIS participants was quite disappointingly low. Of the fifty-four participants less than ten were recruited through this approach. This low uptake may have been a result of the time delays of a few weeks between the on-market events and the subsequent discussion groups. It may also reflect the strength of the method in engaging with people who are not enthusiastic for attending meetings, what UK local councils often call the ‘hard-to-reach’ (Cinderby, 2010). However as the intention of using the approach was to recruit people unlikely to respond to more conventional methods in some ways even this low uptake could be viewed as a success.

Despite this relatively disappointing number of recruits, the RAP-GIS generated useful information and provided a spatial snapshot of wide cross sections of residents’ viewpoints on the positive and negative aspects of their local surroundings. For the fieldworkers this was particularly useful as it allowed them to quickly tap into current issues and concerns in localities they were unfamiliar with. This scoping proved beneficial for the facilitators during the discussion groups as it gave them some initial understanding of the local environment and politics.

PGIS linked to vignettes proved particularly beneficial in helping to generate the projects qualitative findings. The vignettes
forced participants to consider current conditions from differing viewpoints other than their own. This included an existing young resident on a low income but also an incomer moving from a large urban conurbation. The technique proved popular with the participants with one woman asking humorously when the Regis family were moving in as they would fit in nicely to the local village.

The first step in utilising vignettes (as with any research method) is to be clear on their purpose. Qualitative vignettes do not provide an accurate forecast of the individual participants’ behaviour but rather give insight into their interpretative framework and perceptions (Jenkins et al., 2010). Responding to the SEIRA vignettes encouraged people to discuss conditions of income, employment, transport and housing without first person reference to their own situations. One participant responded afterwards by saying she had never thought about the local area in this way before. However, whilst the participants described conditions in relation to the needs of vignette characters, their viewpoints and framing of the problems indicated their specific experiences and local knowledge (Taylor, 2005).

The response to the Sarah vignette also proved interesting as it contained less detail of her personality and lifestyle making it more ambiguous (Finch, 1987). This led participants to infill this information based on their ideas of what a 23 year old woman would be interested in and want to live. Details of Sarah’s social life were deliberately not included in the narrative but were imagined by many participants. As Barter and Renold’s (2000) state, this ‘fuzziness’ can be a strength of the vignette approach. Participants assume that the protagonist is exposed to the same group norms as themselves and so explicate those norms in their responses to the narratives. However, disjunctions between participants’ experiences and vignette descriptions can lead to the methodology breaking down if the differences are too great (Hughes & Huby, 2002). This may have been an issue for younger participants when dealing with the 30-something Regis family or for older people trying to empathise with Sarah’s housing predicament.

The advantage of the vignette method in relation to inequality and inequity research is that by projecting situations onto hypothetical characters and asking the interviewees to consider the options open to the protagonist’s, sensitive data can be obtained in an indirect, non-confrontational manner (Barter & Renold, 2000). This is especially the case when also combined to participatory mapping (Cinderby & Forrester 2005; Cinderby & Potts 2007) which has been shown to deflect direct confrontation with participants focussed on interacting with the map as much as with each other.

Gould (1996) recommends that attempts are made to establish the internal validity of vignettes. Researcher bias in creation of vignettes is reduced by basing factors incorporated into the narrative on a systematic review of the research (Taylor, 2005). We attempted to generate this validity in two ways. Firstly, the factors (see table 1 and 2) affecting the vignette characters were identified as being significant issues for socio-environmental justice in the English countryside by the quantitative spatial data analysis and literature (for example State of the Countryside (Countryside Agency, 2004)). Secondly, the specific vignette narratives were trialled at a project workshop with UK Environment Agency staff in Bristol and through a preliminary focus group held in a rural village local to the research team. To make the details in vignette pertinent to local conditions they were also modified to make them more realistic for participants. For example, Adam Regis’s salary was modified to make it feasible (with an additional lump sum deposit) to buy a rural property, but not made so large that this would not prove challenging in the local property market. This meant considerably different salaries for South Yorkshire as opposed to more affluent Buckinghamshire.

Jenkins (2010) speculates that participant’s responses to vignettes may be more considered and elaborate interpretation of a moral dilemma than would occur in every-day life. In the SEIRA vignettes we would argue the inverse happened with people taking the task less seriously than they would if they were really being asked by someone (particularly a friend or family member) to recommend places to live. This is not to say that people did not consider their responses carefully, more that there were obviously no real world consequences resulting from their recommendations. However, the focus groups setting did entail participants explaining the reasoning behind their selected locations to the wider audience. This meant they had to justify their local knowledge (Cinderby & Forrester, 2005), particularly when identifying failings in locations that made them unsuitable for the vignette characters as places to live.

The consistency of the vignette content also meant that some of the stimulants behind discussions were kept constant between groups and locations. This makes the technique similar to a survey and led to the results from the different meetings being easier to compare and generalise (Finch, 1987; Hughes & Huby, 2002). A weakness of the approach has been identified as being that participant’s give lowest common denominator of morality responses (Barter & Renold, 2000). That is, the least offensive response to the implications of the vignette. The link to participatory mapping may overcome this drawback to some extent as the necessity to explain why the location was suitable or unsuitable necessitated making and explaining differences between places. These differences could be considered disparaging for communities and participants did remark that they didn’t mean to criticise particular villages and their inhabitants, just the conditions would not suit the Regis’s or Sarah.

The issues of inequality and their possible inequity include concepts of change both in the places and people who inhabit them, what Hall, Lashua and Coffey (2006) term animate geography. The use of the vignettes and mapping allowed us to tap into this living geography with people’s perceptions of current fairness relating to the way conditions and the distribution of services had changed. If shops had closed and bus services reduced over time this downward trend added to the feelings that these changes were unfair for remaining residents – particularly for the young and elderly – who still lived in now isolated places. The vignettes helped participants consider conditions for people living lives
different than their own. Linking this to participatory mapping helped people concentrate on the current and past distribution of social, economic and environmental resources and how these actual, rather than abstract, changes related to injustice, the animate geography of rural England.

The use of RAP-GIS, PGIS and vignettes in the context of inequality and inequity research presented a number of ethical concerns. The research deliberately excluded young people from the discussions, even though they were a focus for much of the perceived injustice, as it was felt too sensitive an issue for this age group and ethically challenging for the researchers. Posters and invitations to the discussion groups did not mention inequality or inequity as they were considered loaded terms and off putting for a lay audience. To compensate for this ambiguity, participants were all given a briefing and consent form at the start of the group meetings with the option to withdraw. Nobody indicated to the researchers that they had been invited under false prentences.

The nature of the material generated from the vignette when linked to mapping of actual places poses particular ethical concerns. It may not be beneficial to communities that may already have significant social or economic problems to be labelled as deprived or isolated. In the project this was overcome by only presenting anonymised results back to the participants. However, this approach significantly weakens the value of the data to future research or policy making. These ethical concerns should be a consideration in any form of PGIS engagement but may need particular attention in relation to vignettes and mapping (Gutmann and Stern, 2006). Whilst the use of vignettes may have stimulated negative feelings about particular places for participants feedback from the group meetings indicated that most people had valued the opportunity to talk about the issue of inequality and fairness. The very fact that participants were all living in rural England indicated that they had chosen to live and stay in these communities despite any difficulties.

CONCLUSIONS
The use of a mixed methods approach incorporating a rapid scoping of local conditions and PGIS combined with vignette techniques proved insightful for understanding how inequalities were perceived by rural English residents. The high participation levels of the RAP-GIS mapping demonstrated its potential as a scoping method for engaging with a wide cross-section of a community. The possible limitations of the approach for recruitment were highlighted by the low uptake of participation in the group meetings.

The methodological development of linking vignettes from qualitative research to participatory mapping and GIS holds great potential. Vignettes are a useful tool for stimulating discussions on sensitive or contentious topics allowing researchers to gain insight into participants understanding and normative framing around difficult issues. Linking this to PGIS adds the spatial dimension which relates responses to the actual rather than the abstract. For topics such as inequalities, inequity, unfairness and justice this spatial framing allows both participants and facilitators to generate significant insight into the current distribution of resources and consequent effects on the choices and options available to real residents and communities. Particular ethical care needs to be given to applying spatial vignettes to ensure that the participants and also the places identified are not stigmatised by the findings, particularly in relation to contentious issues such as inequality. The information generated from this hybrid method can be analysed spatially in comparison to other data, including official viewpoints on the same topic, one of the longstanding benefits of a PGIS approach. The use of mapping also seems to help participants understand and focus their responses to the fictional descriptions grounding them in the real world and leading to qualitative spatial insights that may not be generated from vignettes alone.

The tentative findings of the comparison between qualitative understandings of inequalities and their distribution with that generated on higher geographies indicates that policy makers need to consider their responses to such issues carefully. Understandings generated from official data may be operating on different a scale to the underlying inequalities. This may mask the actual distribution of effects and consequent problems. The use of participatory methods such as those described here can highlight these fine-grained differences and concerns at the geography experienced by real residents. This could be used to generate useful finding to guide policy interventions and changes on the ground.

Using a mixture of methods stimulated participation and interest in this important and challenging topic. By employing a combination of approaches to investigate the distribution of resources, social, environmental and economic in rural England and examine the consequences of these differences a more insightful, rounded and useful understanding was generated for the research team, policy makers and rural participants.

Acknowledgements
The project ‘Social and environmental inequalities in rural areas’ was part of the Rural Economy and Land Use programme, funded by the ESRC, NERC, BBSRC, with additional funding from SEERAD and Defra. We would like to acknowledge the advice and support provided to the project by Nicola Lloyd and Justin Martin of the Commission for Rural Communities and Kieron Stanley of the Environment Agency. We would also like to thank all the participants of the research across rural England who made this paper possible.

About The Authors
Steve Cinderby is Deputy Director of Stockholm Environment Institutes (SEI) Centre in the Environment Department of the University of York, UK. He has been using PGIS techniques since the mid-1990s in both developing and developed countries. Steve was a co-investigator on SEIRA and with the project team developed the use of vignettes linked to participatory GIS techniques.
Contact: Stockholm Environment Institute, University of York, YO10 5DD, UK. Tel. (+44 1904 322994), Fax (+44 1904 322897), Email: (steve.cinderby@york.ac.uk), web (www.sei.se/relu)

Annemarieke de Bruin is a Research Associate at SEIs York Centre and worked in the project team of SEIRA. With her background in GIS and Tropical Land Use she was responsible for the projects data gathering and spatial analysis. She was heavily involved in the development, execution and analysis of the PGIS activities.

Piran White is Deputy Director of the Environment Department at the University of York, and was a co-investigator on the SEIRA project. His research interests span wildlife ecology, biodiversity and ecosystem function, ecosystem health and social and environmental inequalities.

Meg Huby is a Senior Research Fellow at the University of York. She was the principal investigator on the SEIRA project. Her research experience reflects longstanding interests in the linkages between social and environmental problems and policies.

References


Get involved with URISA’s GISCORPS, a URISA program that coordinates short term, volunteer based GIS services to underprivileged communities across the globe.

Volunteer, contribute financially... get involved!

www.giscorps.org
Participatory Asset Mapping in the Lake Victoria Basin of Kenya

Michael Martin, Brianne Peters, and Jon Corbett

Abstract: In this paper we describe how a public participatory GIS process has been combined with a bottom-up development approach called Asset-based Community Development (ABCD). This methodology, called participatory asset mapping, has been designed specifically to tackle common pitfalls in public participatory GIS when it is used for rural communities in technologically scarce areas. It has been tested successfully in the Lake Victoria Basin of Western Kenya and has resulted in a set of maps designed and driven by community members that show not only the assets within the community but also the relationships citizens have to their assets, pushing past a simple understanding of points, lines, and polygons. This research project further engaged local development institutions to ensure the sustainability of the program through capacity training on geographic information technologies. The paper concludes with a discussion on the practical ethics involved with using participatory asset mapping.

INTRODUCTION

This paper explores how public participatory GIS (PPGIS) can be applied to an Asset-based Community Development (ABCD) approach to support rural development in Kenya. PPGIS is a collection of methodologies that seek to produce mapped data using geographic information technologies with varying levels of rigor to strengthen a geographic community of participants (Elwood 2004). These methodologies are designed to put as much of the map-making process as possible in the hands of the participants and thus to increase ownership and decrease the reliance on outside experts. ABCD is an approach that recognizes the strengths, gifts, talents, and resources of individuals and communities, and helps communities to mobilize and build on these for sustainable development. At its core are the various assets (human, social, financial, natural, and physical) that already exist in the community, especially the formal and informal associations that mobilize assets and strengthen the social relationships that are important for bridging local initiatives to external opportunities (Coady International Institute 2009).

In many countries, discovering (or rediscovering) this variety of assets at the community level has taken the form of storytelling of instances where communities have achieved something they are proud of in the absence of external assistance (Ashford and Patkar 2001). Complementary to the ABCD approach are simple mapping exercises that use sketch maps or ephemeral mapping on the ground to identify natural resources, physical infrastructure, financial assets, individual skills, associations, and institutions (IFAD 2009, Chambers 1997). Mapping in this environment is not intended to be an exercise in data gathering for outside actors, rather it is used to stimulate local pride in existing capacity as well as discussions about resources that communities can control and how they can be organized to identify and meet community-defined opportunity. Mapping, therefore, in and of itself, is not the end goal.

Combining PPGIS and an ABCD approach is a fresh perspective to mapping community assets because it enables community members to better communicate their landscapes in multiple dimensions and their relationships to the land. Maps made using GIS also can be perceived to be more rigorous and convincing when presented to other community members and outside actors, conveying a variety of assets on one map. These maps also can be easily linked to other forms of technology, such as audio, video, and digital images, providing a platform for more dynamic use.

As a relatively technical and sophisticated technology, GIS also introduces a number of challenges that can run counter to community-driven principles if deliberate measures are not taken. These specifically include accessibility, affordability, accuracy, and exclusivity, as well as reliance on external expertise. This

Figure 1. Example map from the participatory asset-mapping exercise in Western Kenya
paper will discuss the advantages, innovations, and limitations of introducing PPGIS using a case study from Western Kenya where more accessible and user-friendly geospatial technologies such as Google Earth were introduced. While the effectiveness of this case continues to be evaluated and it is too soon to determine whether it has led to community-driven activity, preliminary results show that the asset maps produced have increased cross-community dialogue, which, in turn, has directly influenced resource-sharing leading to ethnic tension mitigation. Before looking at the results, it is useful to review the concepts of and challenges related to PPGIS as well as the situation in Western Kenya leading toward the use of ABCD and eventually PPGIS.

**PUBLIC PARTICIPATORY GIS**

Participatory mapping projects are prevalent throughout the world. Many different types of communities have undertaken mapping projects, ranging from relatively prosperous groups in areas of Northern Europe and America (King 1993, Elwood 2002, Rinner and Bird 2009) to local communities and indigenous groups throughout the tropics (Di Gessa 2009, IFAD 2009, Poole 1995).

Although participatory maps provide useful and powerful tools for communicating and discussing local assets and knowledge, they are limited in describing the complexity and extent of what is known about the land (Brown and Reed 2011, Ghose and Huxhold 2001, Jordan 2002, Kyem 2002). For this reason, community maps often are supplemented with the written word. Generally, this is an imperfect medium to represent local knowledge, especially for people who may be nonliterate and accustomed to communicating orally. Johnson (1992) noted that much local knowledge about the land is transmitted in the form of stories and legends that use metaphors and sophisticated terminology that might be lost if the information is transcribed. There is a need for a tool that can combine the usefulness of participatory maps with the ability to present multiple perspectives, as well as capture local knowledge using other digital media that are better at documenting the oral and visual aspects and the complexities of local knowledge.

Some practitioners argue that geographic information technologies, particularly GIS, can help demonstrate the close relationship between people and their land and assets by illustrating the multiple dimensions of human-land relations; as a result, they are well suited to preserve, revitalize, and disseminate local knowledge (Brodnig and Mayer-Schönberger 2000, Pfeffer 2010). These technologies maintain the benefits of the Cartesian map to organize and reference spatial information and combine this with the capability of linking to attribute databases and other information in the form of discrete map layers, digital images, audio and video.

The 1990s saw an increase in academic interest in the use of GIS by local communities and organizations working with local communities. Research literature covering the theory and potential of social and community GIS application is now well established (Barndt 1998, Craig et al. 2002, Dunn 2007, Pickles 1995, Stonich 1998). This evolving research area, methodological development, and project application is referred to as public participation GIS (PPGIS).

This PPGIS discussion is linked to the broader political discussion related to enhancing local community participation in decision making and development (Brodnig and Mayer-Schönberger 2000, Dunn 2007, Pfeffer et al. 2010). However, Abbot et al. (1998) note that participation is the least understood component of PPGIS. Dunn et al. (1997: 155) argues that participatory ideals and mechanisms traditionally “reject techniques or technologies which are complex, expensive or time-consuming.” This argument is further reiterated by Abbott et al. (1998: 12) who state that “the more complex and centralized the technology, the more likely that others will control the process and use of the product.” These statements imply that many information communication technologies (ICTs), including GIS, are in essence inaccessible and, therefore, of limited value to local communities.

Despite criticisms, Dunn et al. (1997) and Abbott et al. (1998) go on to say these technologies are potentially a valuable complement to participatory mechanisms. This is taken up by Harris and Weiner (1998) who assert from their research in South Africa that community-integrated GIS (CIGIS) is a more realistic objective. Through CIGIS, they propose to increase the number of people participating in the use of the system. Although recognizing that GIS is an “expert system” and is “likely to be agency driven” (74), they argue that it still can be used to serve the communities interest so they are less peripheral to spatial decision-making processes and politics. This is similar to the “chauffeur-driven” Coastal Spatial Decision Support System recommended by Canessa (1997) to assist in multiple stakeholder decision-making processes. Central to the success of all PPGIS projects, as stressed within PPGIS literature, is the mechanism and form of participation and not the hardware/software configuration (Jordan 2002, Weiner et al. 2002).

PPGIS literature recognizes that despite the potential benefits of GIS to suit the needs of documenting and representing community assets and local knowledge, the full promise of this technology has yet to be realized. In a development context, four constraints that prevent the full adoption of GIS to satisfy communities’ needs include technological inaccessibility (i.e., complexity of the use); cost of training, software, and hardware; accessing accurate and meaningful base-layer data; and representational exclusivity (i.e., being constrained by the point, line, polygon model intrinsic to GIS).

Although the developments in geospatial Web tools such as Google Earth are helping overcome some of the constraints that have hindered GIS from becoming a broadly popular tool, in the face of these challenges, GIS could be perceived as the antithesis of ABCD. An ABCD approach purposely uses simple popular education tools that can be replicated and translated easily at all levels as opposed to those that rely heavily on outside technical expertise. Furthermore, the sketch maps traditionally used in an ABCD approach usually are sufficient to generate discussions about how people can organize around their existing assets, which
is the goal of the process—not the generation of a sophisticated map. Indeed, practitioners caution against paying too much attention to "tools and technical skills without paying attention to values, attitudes and behavior necessary to deliver these well" (Pretty and Chambers et al. 1993). Although beneficial, GIS-aided tools often are inaccessible and unfortunately can result in a one-off extractive exercise, where the mapping process supersedes the organizing principles behind the intention of the ABCD process, reinforcing dependence on external agencies to move forward.

**ASSET-BASED COMMUNITY DEVELOPMENT (ABCD)**

The ABCD approach was originally coined by Jody Kretzmann and John McKnight (1993) of the ABCD Institute at Northwestern University in Chicago as an alternative to needs-based models of development. Its principles and practices have since been taken up by many local and international organizations in the global North and South. Although well intentioned, Kretzmann and McKnight argue that over time, emphasizing only needs and problems results in community members internalizing this view of themselves and their communities. This leads to a sense of apathy and hopelessness and a perverse dependence on external institutions to fill the gaps. This overreliance on institutions often undermines or replaces the informal social networks and the kinds of mutual assistance that have helped communities meet opportunities or overcome challenges. Furthermore, the needs that are projected by community members often are categorized into the silos that are consistent with sector-specific institutions. These silos ignore the integrated and multifaceted ways that livelihoods and well-being are composed. Projects and programs, therefore, often are unsustainable, inappropriate, and unresponsive to local realities and priorities. These unintended consequences of needs-based or problem-focused approaches have been well documented in the literature, including Kretzmann and McKnight 1993; McKnight 2005; Mathie and Cunningham 2003, 2005, 2008; Bergdall 2003; Wilkinson-Maposa, Fowler, Oliver-Evans, and Mulenga 2005; Wilkinson-Maposa 2009; Russell 2009; O’Leary 2007; Cameron and Gibson 2001; Burkett 2011.

These practitioners and academics argue for a new approach to engaging with communities. By using existing capacities of communities (social, natural, financial, physical, or individual) as the starting point, the approach is appreciative of the contributions that have traditionally gone overlooked or undervalued by development actors (Ashford and Patkar 2001; Elliott 1999). In this way, the approach also draws on positive psychology by not only focusing on problems and how they can be fixed, but by also identifying what works and how to build on it (Seligman 2002). The role of the outsider is thus one of a facilitator and responsive supporter or investor in community-led activity as opposed to the instigator or the driver (Bergdall 2003).

By highlighting the importance of integrating a variety of assets or “capitals” to overcome vulnerability and shocks, the ABCD process (discussed on the following page) operationalizes the Sustainable Livelihoods Framework, originally articulated by Conway and Chambers (1992) and adopted by organizations such as the International Institute for Sustainable Development, Oxfam, the United Nations Development Program, the United Kingdom’s Department for International Development, and CARE. Of all the capitals articulated in this framework (human, social, financial, natural, and physical), perhaps the most important is social capital for it is the relationships, networks, and associations between people that provide access to all the other types of assets (Woolcock and Narayan 2000, Bebbington 1999, Krishna 2002, Putnam 1993, 2000). These assets do not only improve material well-being, but they are intrinsic to a person’s identity and provide the capability, control, motivation, and power to meaningfully act, engage, and contribute, as well as to challenge the structural causes of poverty (Sen 1989, 1993; Bebbington 1999).

It was an ambitious task to blend PPGIS with ABCD. In many ways, the approaches are complementary and, in others, they are at great odds. This case study has specifically tailored the lessons learned in previous PPGIS efforts for use within an ABCD approach to development, calling this methodology participatory asset mapping. As applying geospatial technologies to asset mapping is new to the Nyando Valley, it is still too early to understand the ultimate impact of this exercise on the three water catchments of Western Kenya where this study was undertaken. However, deliberate measures were taken to ensure community participation, ownership of data, and sustainable uptake of the technologies to keep the process as community-driven as possible.

**CASE STUDY**

The Introduction of ABCD to Farmers

In 2008, local Kenyan staff from World Neighbors, an international nongovernment organization (INGO) based in Oklahoma, introduced an ABCD approach to three microcatchments. These microcatchments are located in the upstream (Kapsorok), midstream (Katuk-Kapsiti), and downstream (Onyongo) areas of the Nyando and Kericho Districts, 50 kilometers from the city of Kisumu in Western Kenya (see Figure 2).

The three catchments are composed of between 20,000 to 22,000 people each and household landholdings are small, rang-
The ABCD Process

While there is no blueprint for an ABCD approach, the process introduced by World Neighbors was influenced by a course offered by the Coady International Institute in 2008 and 2009. The process began with appreciative interviewing. This technique involves the application of a set of structured questions that inquire about positive changes that have occurred in the past in the absence of external assistance. This exercise serves a number of purposes. First, it allows participants to contemplate, verbalize, and celebrate their successes; this can help build confidence and give people an opportunity to highlight their skills and talents. This can be particularly important for marginalized populations whose skills often have been overlooked or undervalued. Second, it sets the tone for the rest of the training: assets and opportunities as opposed to problems and needs. Third, it presents the facilitator as a genuine inquirer and respectful listener, who is not there to prescribe solutions or answers. Fourth, it helps participants to identify the common trends emerging from these stories and to isolate the factors that contribute to successful initiatives in this context.

Following the interviews, participants were asked to identify and sketch-map a defined set of assets that included: physical assets (infrastructure), individual skills and strengths, natural resources, institutions, and associations. This activity drew attention to the range of resources that people have within their own communities. As previously mentioned, it was important that these maps were used as conversation starters about how people can organize and mobilize their resources together; it was not just an exercise in data gathering. The group then listed its financial inflows and outflows using a simple tool called the “Leaky Bucket” (Cunningham 2010); this helped identify economic opportunities that could increase incomes or reduce expenditures.

Finally, and perhaps most important, was the translation of these assets into action. Based on the discussions of existing assets, opportunities, and possibilities, the group envisioned mutually beneficial opportunities such as potable water, improved land, and shallow wells, water pans, and piped water. Environmental degradation has contributed to advanced cases of gully erosion, low crop production and failure, and high incidences of human diseases (personal communication with World Neighbors 2011).

Named after the Nyando River, which flows into Lake Victoria, the area faces two acute issues: soil erosion and ethnic conflict, which are directly interrelated. These communities are scattered at different altitudes along the same slope and as a result of ethnic division between the Luo and Kipsigi tribes, there is little cooperation between the two groups. This is problematic because the activities of those located upstream have serious implications on the livelihoods of those downstream and vice versa. For example, overgrazing of livestock and clearcutting of trees for charcoal cause siltation and erosion for midstream and downstream catchments; maize production midstream soaks up much of the rainwater for downstream; and sand harvesting exacerbates the issue at the base of the catchments. Farmers indicate that they are well aware of the issues and more than 40 groups exist across the three catchments to address them through digging dams and planting tree seedlings, bamboo, and grass to slow water runoff, and by diversifying income sources to include those with fewer environmental impacts such as poultry production, zero-grazing goats, horticulture, and fish ponds (personal communication 2010).

The driving intent behind introducing an ABCD approach into this region was to bring farmers from the three catchments together to identify and share mutually beneficial strengths and activities to improve relationships between the catchments, thus leading to more collaborative and fair stewardship of the environment. To this end, 13 farmers from the three microcatchments were trained in Kisumu for three days on ABCD principles and processes that can be used to identify the strengths and assets of each respective community to identify opportunities for collaboration.

Figure 3. Sketch-mapping three communities in Kisumu
PARTICIPATORY ASSET-MAPPING METHODOLOGY

A number of NGOs are working in the Nyando Valley using different approaches and focusing on different issues. As a way of enhancing collaboration and harmonizing approaches, World Neighbors organized a seminar to introduce the principles and processes of an ABCD approach to seven organizations while piloting the integration of PPGIS tools as well. This was the first time that many of these organizations had used PPGIS tools. During the training, the process of sketch-mapping assets within the community was used (see Figure 3). Following the generation of these sketch maps, the assets were located onto Google Earth, using the knowledge of a community elder and then presented to the larger audience of the seminar participants. Participants were excited by the ease of use of the technology and the all-encompassing way that they were able to see the assets that spanned across all three microcatchments. They expressed interest in introducing the process at the community level. The advantages of this approach were apparent: These maps showed all the assets and their relationships from the three catchments, which was an easier way to explain the ABCD process to others who were not involved; they showed how interrelated the environmental issues were, which added a sense of urgency to finding a way to collaborate despite ethnic tensions; and the maps were perceived to be more legitimate and accurate representations of communities, which is helpful when appealing to outside agencies for support. This enthusiasm prompted a request to take the initial demonstration of PPGIS to the community level.

The initial goal for the PPGIS activity in Kisumu was to produce a visualization of community assets in the water catchments using community input for their identification and location. This activity was to be complementary to the sketch-mapping exercises previously undertaken because it would allow participants to see the connection between the way that they used the land and the impact it was having on others, which often can be a difficult gap when rolling out an ABCD approach to the community at large. It was hoped that the activity itself would be able to ignite this connection and result in a useful map of community resources and therefore lead to the identification of mutually beneficial opportunities. To this end, a participatory asset-mapping methodology was developed, which at its core was to show not only the assets in the community but also the relationship that social capital can play as well.

The methodology used in this case study is adapted from processes common to both ABCD and PPGIS. In particular, it makes use of appreciative interviewing and asset inventories from the ABCD process as well as “chauffeur-driven” (Canessa 1997) marker placement on Google Earth. In other words, an experienced computer operator added this information under direction from community participants. Before the PPGIS activities started, consent was obtained to share the data with the community at large and for World Neighbors to act as a digital data holder so long as the information was available on request. Facilitators also asked participants who in the community should have the final copy of the map and if the PPGIS facilitator could use the lessons learned and data gathered during the study. The methodology used in this participatory asset mapping included five major steps and was completed over the course of one week, spending one full day with each community in the upstream, midstream, and downstream water catchment areas in the Nyando Valley of Western Kenya. These steps are discussed in more detail below.

Step One: Asset Inventory

An inventory of assets was undertaken to identify natural resources, physical infrastructure, associations, and institutions. This inventory was created through brainstorming and the results were recorded using simple lists. Community participants then were asked to categorize individual assets into broad categories (e.g., local government buildings, schools, water sources, etc.), which served two purposes. First, these categories made it easier for participants to recall all the assets within a particular category. Second, it made for easy processing of the data when it came time to placing assets onto the map in feature classes (step four).

Figure 4. Steps involved in participatory asset mapping

Figure 5. Community members in Western Kenya write down community assets in categories

2 From 20 to 25 community members participated in each of the three sessions, which lasted approximately from 10 a.m. to 3 p.m.
Step Two: From Asset Inventory to Google Earth

After creating the inventory of assets, participants appeared energized by the process. Some decided to excuse themselves to tackle other business and a few community elders with intimate knowledge of their land volunteered to stay to work with a PPGIS chauffeur who led the elders positioning each asset on Google Earth similar to Canessa’s (1997) approach to facilitator-led PPGIS. The PPGIS process was aided by using a tablet computer so that participants could navigate the map directly using a pen input device, working alongside the PPGIS chauffeur at the keyboard.

This activity was completed in two phases: The first was to educate volunteers on how to use the Google Earth software while orienting themselves to the map data. The second phase was to place each of the assets onto the Google Earth map, category by category. Learning how to use the software and becoming familiar with the map data took approximately 20 minutes and the creation of a digitally geolocated asset inventory took approximately 45 minutes.

Step Three: Mapping Relationships and Asset Utility

Using an appreciative line of questioning, the final phase of the mapping process was to connect the assets on the map with the people using them. This activity was helpful in identifying relationships and social networks as well as ways that assets can be combined and used to support community-driven activities. Elders selected three people from the community with the instruction that there must be at least one male, one female, and one youth. The rationale for this selection criterion was to highlight the varying ways that different segments of the population understand and interact with their assets.

---

3 The data was a mixture of precached Google-owned satellite data and country-level vector files acquired from ‘World Neighbors’ partners databases.

Once selected, interviewees were asked to identify the assets from the inventory listed in step one that they use as well as the degree to which they use them. The purpose of this exercise was to gauge their perceived utility. Participants were given the choice of high, medium, low, and no utility based on their control, access to, and benefit of the asset. This interview process lasted approximately one hour per participant.

Step Four: Organizing and Verifying the Data

After the three days of community meetings and participatory mapping activities, the resultant data lacked clarity because of the sheer number of items connections represented. As a result, a day was spent at the World Neighbors regional office organizing the data into structured data files and preparing clear cartographic representations of the data in both two-dimensional and three-dimensional representations.

Step Five: Creating Capacity for Using Maps and Data

The data generated from the mapping exercises would be of limited use if no one understood the Google Earth software used to view it digitally or how to read the printed maps. To bridge this skills gap, a one-day training session was organized by the PPGIS chauffeur demonstrating Google Earth for members of World Neighbors field staff. Second, on the last day in the region, the three catchments were invited to attend a session to share the printed maps and data collected. This included both interactive and static maps of social relationships that tied these assets together. This acted as a verification meeting for participants to discuss their maps and assets and to make suggestions for changes. The session provided an opportunity for all three groups to discuss with one another the different ways that each of the catchments specialized (the upstream catchment specialized in grain production, the downstream in fishing, and the midstream...
community included a central market for trading), which were mutually beneficial, creating dialogue through the map interface.

**PARTICIPATORY ASSET-MAPPING RESULTS**

The participatory asset-mapping process in this study yielded a number of deliverables for both the implementing organization (World Neighbors) and the participants from the three catchments in the Nyando Valley. These results included textual and visual inventories of assets in both top-down and three-dimensional perspectives, spatially referenced asset data, and trained local staff members.

**Textual Results**

During the first step of the methodology used, participants created an exhaustive list of the assets in their communities: natural, physical, institutional, and the social networks that tied them together. These lists were recorded digitally (via a digital camera) for later cartographic and planning use. The physical documents, however, remained with local community-based organizations so they could use them for their own planning purposes and share with the broader community.

**Cartographic Results**

The cartographic results of the participatory asset-mapping process yielded a series of maps for the communities surveyed. Because the assets were captured and prepared in Google Earth, which does not have advanced layout capabilities, the cartographic elements such as legend, title, information, etc., were added using graphics manipulation software. Each layout was comprised of a large-scale perspective map, with several inset maps for small-scale details, three-dimensional perspectives, and a country-scale reference map. A total of four maps were prepared, one containing all three catchments displayed, and three others, which centered on each catchment individually. One of these maps has been presented to give the reader an appreciation of the landscape, the data collected, and the social connections. However, the place names and the legend have been blurred to protect locally specific information and community ownership of the data (see Figure 1).

**Spatially Referenced Asset Data**

Another result of the participatory asset-mapping exercise was the spatially referenced asset data. The data was kept in KML format, which is easily accessible in free and open-source software, such as Google Earth (free) and Quantum GIS (open source). At the request of the community, the data was kept on the computers at the World Neighbors office in Kisumu.

**Training Results**

In an effort to make the data accessible to the communities, World Neighbors staff were trained to use Google Earth (methodology step five). This was accomplished through a one-day crash course at the World Neighbors office in Kisumu, and was open to all field staff involved with the project. The result of this training was four staff members acquired the capability to visualize, edit, and maintain the KML datasets, as well as the requisite skills to work directly with communities using these tools in the future.

**Discussion**

In the past, the principal constraints that prevented communities from effectively using GIS included technological inaccessibility, cost, accessing accurate and meaningful base-layer data, and representational exclusivity (i.e., being constrained by the point, line, polygon model intrinsic to GIS). The participatory asset-mapping methodology and accompanying results in this study were designed to address these challenges noted earlier—and also to be cognizant of the ethical considerations involved in collecting and proliferating community data while increasing community discussion. These are discussed in more detail below.

**Technological Accessibility and Cost**

Technological accessibility has been a difficult issue to surmount when introducing GIS to community development. The principal reasons for this are related to access to both the software and the highly qualified personnel who are able to operate it.

Using free and open-source software and including training for local facilitators, participatory asset mapping directly address these issues. Recent releases of free and open-source software have changed the way that geographic information technologies are made available and ultimately used. While geographic software has been limited by licensing in the past, this software is free for anyone to use, and, in the case of Google Earth, it connects novice users to a wealth of data in the form of satellite images entirely free of charge. In a community-development context, this means that organizations can make use of these new technologies and methodologies with little financial risk.

The provision of free and open-source software is only part of using geographic information technologies, however. The persons using these technologies must know how to use the software effectively to be able to extract useful information and make informed decisions. By training local NGO staff (who often are embedded within local communities), the methodology used in this project ensured that the process and data are not owned and maintained by foreigners, but by members of the community themselves. This is helped by the nature of the software used, Google Earth, which is designed to be usable for novices of geographic information technologies. Using a combination of free and open-source technologies

---

4 For a free and open-source approach, GIMP could have been used instead of Photoshop.

5 Google Earth provides access to a global patchwork of satellite imagery as well as various ancillary data layers such as borders, place names, and geolocated images.
and training in the methodological approach then ensures that the PPGIS technique used is accessible to and appropriate for its intended audience. However, the free and open-source model and training aspects do not address the accuracy and representational challenges of PPGIS.

**Accuracy and Representational Limitations**

To fulfill the desired goal of producing asset maps that contain valuable geographic information, the participatory asset mapping must contain data that is both accurate and able to push past simple understanding of points, lines, and polygons.

Although it has been argued that PPGIS approaches lack the positional accuracy and rigor of more traditional methods of geographical survey (Dunn 2007), by using technologies that include a mixture of base-layer data, satellite imagery, and three-dimensional visualizations, it is possible to be very precise when locating assets in a PPGIS setting. In this case study, community members geolocating assets were able to orient themselves very closely with the land. Base data allowed for a connection between the place names that they knew and locations in the satellite data. The satellite data presented furthered this understanding by showing the objects in the built and natural environment such as rivers and forests as well as villages and buildings in a way that the base data was unable to do. Finally, the ability to change the perspective of the map with terrain information from a top-down to a three-dimensional perspective was particularly important.

Community participants found that while it could be difficult to locate items from the top-down view, having the ability to see the land forms such as mountains and gullies made the map data far easier to navigate.

Using base data, imagery, and three-dimensional navigation for data collection (step two) allowed participants to feel more confident about the location accuracy of assets placed on the map. When validating the data during the community meeting at the conclusion of the case study, the quality and accuracy of the data was validated by the commentary of members from the community.

Accuracy of data, however, is not an effective measure for identifying the connection between people and their interactions with community assets. If PPGIS only locates simple points lines and polygons, the effect of the exercises can be limited, and has since been dubbed “red dot fever” (Livni 2010). However, the process used included the social relationships between people and their assets. By linking community members to assets and indicating the level at which they were involved with each asset, this methodology pushes beyond just the location of assets as represented as points, lines, and polygons: It transforms them into meaningful visualizations of social capital and interconnectedness within the community itself and with others. In this way, the participatory asset-mapping methodology transcends the basic understanding of point, line, and polygon and instead pushes to a deeper level of understanding about the social relationships that exist within communities and physical assets.

In fact, it is important to note that mapping social relationships and the connection between people and resources proved to be one of the most meaningful elements of this process — not only between residents but between entire communities. As mentioned, the livelihood strategies of those living upstream have sometimes had negative consequences on those of people living downstream and vice versa. Bringing people together from all catchments to visibly see the related nature of their activities spurred discussion between two tribes that traditionally work separately because of conflict. This would not have been as effective using sketch maps.

**Ethical Considerations**

Previous PPGIS attempts have shown that while there often are clear benefits to using PPGIS, there can be a number of unintended consequences (Corbett et al. 2006, Rambaldi et al. 2006). These considerations often can be difficult to understand from the outset of the project, however. While a number of ethical issues have been brought forward (Rambaldi et al. 2006), no set of standard guidelines can be used universally. In the case of the mapping of the Lower Nyando Valley, a meeting was held before the start of the data-collection sessions in the field to try to identify the ethical issues that might arise and how they might be dealt with. While the issue of sharing community data was not an issue for the community members (accepting the presentation of data within this paper), data ownership and accessibility was immediately identified.

Using a technologically rich approach in a community that is relatively technologically poor, data ownership is particularly difficult to ensure. However, it is important given the community-driven and owned principles behind the work carried out to date by World Neighbors and the water catchments. If the community is recording its assets digitally and then giving them away without any ownership, the top-down expert approach is reinforced, instead of challenged. Furthermore, the intent of the maps (i.e., community-driven activity) is undermined.5

This challenge of community data ownership was discussed in a meeting prior to beginning the mapping process with World Neighbors staff. It was decided that participants would be consulted at all stages of data collection as to how they felt about sharing their information, as well as where they would like to have the maps displayed and how the data could be shared with the broader community. This meant having a discussion at the beginning of the mapping process so that the community was informed of the considerations related to data ownership. This issue of ownership was brought forward at each stage of asset listing, community linkage interviews, and at the final results sharing meeting to ensure that participants were in control of their own data.

Ultimately, participants decided that they would like to have one overview map as well as a community scale map printed (a total

---

5 Some community-based organizations in the Nyando Valley have plans to create a technology center for teaching and Internet usage; however, at the current time there are a very limited number of computers located in these communities.
of six printed maps—two for each catchment), have the data saved to a USB data key and kept with the local community leaders, and have the data saved to and loaded in Google Earth at the World Neighbors regional office. Lastly, the community gave access to the data to the PPGIS chauffeur to use for research purposes.

Community Discussions
PPGIS has an innate ability to foster discussion between participants both during and at the conclusion of the mapping process. While listing and placing assets on the map canvas (steps one and two), each community found itself drawing on different perspectives of community members and remembering community assets that had previously been forgotten. Furthermore, discussions on the relative importance of assets were raised, creating much debate. After the mapping was complete, it was clear that upstream communities were the principal producers of grain and the downstream communities specialized in fishing. The midstream community was placed along the regional road and made effective use of markets where all the communities came together to trade goods.

During the final presentation of the mapping exercises (step five), all three community groups were brought together to see the results of their invested efforts. Each community was able to examine the assets and abilities of their neighbors. This conversation created an engaged debate related to the differences between the communities, as well as the ways in which those resources are used both internally within the community and externally with other communities. Through the interface of the map, the communities were able to examine and then discuss intercommunity connections with regards to trade and resource-based conflicts as well as the different approaches to internal development.

CONCLUSIONS
Using a case study from Western Kenya, this paper introduced an adapted asset-based and community-driven development approach (ABCD). World Neighbors, an organization that traditionally uses sketch maps to facilitate the identification and mobilization of community assets, integrated public participatory GIS tools into this process and a methodology was developed to address the challenges of using technology that often has been thought to be inaccessible and unaffordable for communities. The participatory asset mapping resulted in the creation of a series of maps and data, which were left physically and digitally within the communities, ensuring data ownership rights were the focus at all times.

These maps added value to traditional sketch maps because participants could see how their actions were impacting the land in a more scientific and visual way as well as the way their activities impacted other communities located upstream and downstream. By mapping not only physical and natural resources but also the social networks that connect people and their resources, the process facilitated discussions between two tribes that have had little interaction as a result of long-standing conflict. Whether this translates into more peaceful and environmentally sound practices has yet to be determined.

This work has shown that when facilitators ensure ethical issues are considered at every step, there are strong and meaningful results from blending public participatory mapping with the bottom-up approach of asset-based community development. Indeed, the participatory asset mapping presented in this case has been used as a test case to inform the introduction and successful uptake of PPGIS in other parts of Africa and will continue to be improved as further projects are undertaken.

FUTURE WORK
The participatory asset-mapping work that has been illustrated in this article is one example of the ways that PPGIS can be used to add value to asset mapping and to community development efforts more generally. Since this case study, Mapping Across Borders, a Canadian nonprofit organization, has taken the lessons learned in Western Kenya and applied them in South Africa and Ethiopia. The work in South Africa challenged the speed at which participatory asset mapping can be done (seven community groups in six hours, but without community participant linkages) and work in Ethiopia adopted the work to produce a mixture of PPGIS and paper-based surveys to use the best of both approaches for surveying a wider population of community members in four hours.

In Kisumu, follow-up meetings with community members are planned. These meetings will provide updated information about the long-term uptake and use of the ABCD maps as well as information on how the participatory asset-mapping methodology can be refined and provide an opportunity to put the lessons learned into practice.

Acknowledgments

The authors of this paper would like to recognize and thank the World Neighbors for its help in facilitating this case study and thank the communities of the Lower Nyando Valley for volunteering their time and efforts.

About the Authors

Michael Martin is a master’s candidate at the University of British Columbia Okanagan and is currently researching the role that Web technologies can play in international development. He previously worked as an intern for the Coady International Institute in Ethiopia and Kenya and is now Director of Mapping Across Borders, a Canadian nonprofit organization.

Corresponding Address:  
University of British Columbia Okanagan  
124 Lawrence Crescent  
Toronto, Ontario M4N 1N6  
Canada  
michael.martin@ube.ca
Brianne Peters works for the Coady International Institute based at St. Francis Xavier University, Antigonish, Nova Scotia, Canada. She coordinates the Coady Institute’s East Africa program in asset-based and citizen-led development. Peters also works to support the Institute’s asset-based and citizen-led development work in a number of other countries and in the Institute’s overseas and Canada-based educational offerings.

Corresponding Address: bpeters@stfx.ca

Jon Corbett is an assistant professor in the Community, Culture, and Global Studies Unit at UBC Okanagan. His community-based research investigates participatory mapping processes and tools that are used by communities to help express their relationship to, and knowledge of, their territories and resources.

Corresponding Address: jon.corbett@ubc.ca

References


Kretzmann, J., and J. McKnight. 1993. Building communities from the inside out: A path toward finding and mobilizing a community’s assets. Chicago: ACTA Publications.


INTRODUCTION

There is a strong history of the application of geographic information systems (GIS) at the local level within government (Budic 1994, Goelman 2005, Harris 1965) and community organizations (Carver, Evans, Kingston, and Turton 2000; Drummond and French 2008; Ghose 2001; Sieber 2000). Many of the tasks of municipal planning, such as land-use management, zoning, location analysis, and impact assessment, can be supported through the use of GIS and geospatial data more broadly. Despite the potential value of GIS and geospatial data, the adoption of this technology at the municipal and community levels can face many challenges, including organizational, fit-to-task, technical, and user-interface constraints (Budic 1999; Onsrud and Pinto 1991; Vonk, Geertman, and Schot 2005).

Recent developments in online mapping software have produced a range of alternate approaches that can be used to provide the GIS-like communication and visualization of geospatial data that may be more suited to local government and community organizations compared to conventional desktop GIS (Dragicevic and Balram 2004; Goelman 2005; Johnson and Sieber 2011a; Rouse, Bergeron, and Harris 2007). The Geospatial Web 2.0 (Geoweb) is an online collection of frameworks and services that can be used to gather, display, analyze, and share geospatial data (Scharl and Tochterman 2007). Compared to traditional desktop GIS, the Geoweb provides an approach that is claimed to be more democratized, user-friendly, and accessible to a broader range of users, particularly nonexperts (Hudson-Smith, Crooks, Gibin, Milton, and Batty 2009; Rinner, Keßler, and Andrulis 2008). This is partly because of the use of a familiar Web browser to access Geoweb sites and the general simplicity of the Geoweb compared to full-featured desktop GIS (Gorman 2007).

The Geoweb is typically considered to have a bidirectional, or participatory, aspect to it, with users contributing content that is then shared with other users (Haklay, Singleton, and Parker 2008; Johnson and Sieber 2011a; Rouse et al. 2007). Geoweb frameworks or application programming interfaces (APIs) such as the Google Maps API or OpenLayers API provide a repository of source codes and tools that allow anyone with sufficient programming skills to develop and customize their own Geoweb platform. Key characteristics of the Geoweb include openness of data and tools, a focus on ease of use and lightweight delivery that is enforced by Web access, and the ability for users to contribute (Haklay et al. 2008). Johnson and Sieber (2011a) define two broad types of the Geoweb; informational and participatory. Informational Geoweb sites serve as lightweight accessible platforms through which data and information are delivered online in a map form. These informational Geoweb sites are in many cases provided by governments as access portals for developers, groups, and individual citizens to access data. Notable examples of these informational sites include the U.S. government data.gov, the Canadian government data.gc.ca, and municipal government sites, such as San Francisco’s dataSF.org. Compared to the informational Geoweb, the participatory Geoweb looks to develop a two-way conversation based on map data displayed within the tool. This two-way conversation can be between Geoweb tool developer and tool user, or between users. There are several prominent examples of participatory Geoweb tools, including ArgooMap (Rinner and Bird 2009, Sidlar and Rinner...
This paper describes the development of a municipal government–centric Geoweb platform used to integrate federal and provincial geospatial data with existing municipal data. The goals of this development are to bring together these three sources of data within a user-friendly interface that is tailored to the needs of users within a rural municipal government, including elected officials, as well as citizens and community organizations. By making data available, visualizing it on a map, it is anticipated that this will provide support to decision making and the communication of information between all levels of government and between government and citizens. In addition, this project aims to make as much data as possible available to the public, allowing them to view, print, and contribute annotations and comments to select datasets. Because of the enforcement in Canada of restrictive crown copyright for most federal and provincial geospatial data, it is prohibited to share this data with the public. Thus, making this type of provincial-level geospatial data available to the public is relatively rare in both Canada and Québec.

The rural municipality of Acton, Québec, serves as a case study for the implementation of this municipality-centric Geoweb platform. Currently in Acton, poor connections to municipal and federal sources of high-quality spatial data have led to a situation where GIS has been unevenly adopted by municipal government and where geospatial information could be better incorporated into decision-making processes. Additionally, provincial-level initiatives designed to increase the use of geospatial data for decision-making support at the municipal level face significant adoption roadblocks. In response to these issues, this paper presents research on the development of an informational Geoweb platform called GéoActon that is designed to facilitate access to geospatial data for municipal government and community organization user communities. In many ways, the development of GéoActon is intended to serve as an extension of provincial and federal spatial data infrastructures (SDI), providing the technological conduit to link citizens and municipalities to these existing SDIs. For our purposes, we consider an SDI to be a set of policies, agreements, and technology for cataloging, displaying, sharing, and maintaining geospatial data (Budhathoki, Bruce, and Nedovic-Budic 2008; Goodchild 2007; Zhao and Coleman 2006).

We describe the development path of GéoActon, including the underlying need, establishment of partnerships between various levels of government to access data, and the unique role of a local geospatial consulting co-operative in providing technical development, support expertise, and in sustaining GéoActon. We then discuss the advantages and constraints of this approach, identifying barriers to adoption. A central goal of the GéoActon project is to provide a portable solution that can be transferred to other jurisdictions. To further this goal, we conclude with a discussion of lessons learned in the development of GéoActon to assist others to overcome these same challenges. We intend this paper to contribute to current academic discourse on the development and adoption of Web-based geospatial technology in government (Ganapati 2011, Johnson and Sieber 2011a) and to be of value to both municipalities and government agencies as an example of the Geoweb, providing background on technical and adoption factors.

THE USE OF GIS AND GEOSPATIAL DATA IN THE RURAL MUNICIPALITY OF ACTON, QUEBEC

This research is set in the municipality of Acton, Québec, located a one-hour drive east of the major Canadian city of Montréal (see Figure 1). Acton is a largely rural municipality, with a population of approximately 16,000 and an economic base dominated by agriculture and light manufacturing. Acton is facing issues that are typical of many other rural areas in Canada and the United States. These include rural depopulation as young people migrate to urban centers, ongoing consolidation of family farms into large-scale farms, transfer of manufacturing jobs to other countries, the negative impact of global economic trends on commodity prices, and the requirement to remediate natural resources affected by a long history of environmental degradation. As a result, Acton represents a region with a number of interlinked planning challenges, based around land use, land-use change, and economic development to which geospatial information can provide valuable insights.

To support addressing these planning challenges, the local regional government or Municipalité Régionale de Comté d’Acton (MRC Acton) uses conventional desktop GIS for a number of tasks, including land-use rezoning, locating erosion-management projects, municipal property-parcel management, economic-development tasks, such as commercial and industrial building

Figure 1. Map of Acton in relation to Montréal
inventories, and managing building and property-inspection records. A significant component of these uses of GIS involve communicating information to citizens, using a map as a high-impact visual medium. This current level of GIS use in Acton is sporadic and is focused on particular tasks for which MRC Acton is responsible for data collection, such as the generation of property boundary files. A limitation to further use of GIS to prepare materials for communication with citizens, and for internal reporting to decision makers, as identified by MRC Acton staff, is the lack of easy access to pertinent datasets from provincial and federal agencies. This type of data is required as a critical support for decision making by MRC staff and elected officials at the local level, affecting economic and environmental planning and the way that these issues are communicated to citizens. A significant existing factor that impedes the further use of GIS in MRC Acton is difficulty in accessing both existing federal and provincial SDIs.

The needs and concerns of municipalities usually are omitted from the development of SDIs. This generally has been the case in Québec, where, until recently, the SDI, from a municipal point of view, has operated in an ad hoc manner. Historically, geospatial datasets have been provided on an as-needed basis, requiring a request from MRC staff to contacts at regional branches of specific ministries, who would then either deliver datasets or forward requests to the central ministry offices. These datasets then are restricted to use only by municipal staff. Recently, the government of Québec has decided to redesign its method of geospatial data delivery, creating a centralized cloud-based geospatial data-sharing service. The objectives of this redesign are to provide increased access to geospatial data for municipalities and to better share geospatial data between provincial ministries. This sharing service has been developed by the geospatial division of the Ministère de la Sécurité publique (Ministry of Public Security or MSP). The MSP set up a series of geospatial Web servers to deliver geospatial data to other municipalities and government departments using Web Mapping Service (WMS) feeds. WMS feeds are cloud-based—the data is hosted on a Web server that is accessible from a variety of types of software, whether desktop GIS or Web browser–based front ends. The data is accessed through a link that queries the central database for a set of attributes and assigns a symbology. One significant benefit to distributing data via WMS is that any update or change to the source data hosted on the server is immediately reflected in the WMS link, making it possible for users to always be using the most up-to-date version of the data. This is a feature typical of cloud-based data-storage systems, where the version of a file on a Web server is the most current version, which then is propagated to all users automatically. WMS technology is seen as a way to use modern Web technologies to increase government-to-government (G2G) and potentially government-to-citizen (G2C) sharing of geospatial data. These WMS feeds provide more than 400 geospatial data layers, with varying levels of user access for each layer. For example, there are certain layers that are available to all users, but certain restricted layers that are considered confidential. A similar WMS feed initiative exists within the Canadian federal government, providing basic topographic and thematic data for public and government use.

The distribution of government data via WMS feeds makes the sharing of up-to-date spatial data with municipalities easier; however, this still ignores the fact that few municipalities have full-fledged GIS divisions with the technical expertise to tap into this type of SDI. In addition, the delivery of data in this manner ignores the lack of full-time or dedicated GIS expertise available at the MRC level. A novel solution to this issue is the development of a lightweight, easy-to-use, municipality-specific Geoweb platform, GéoActon, tailored to the needs of the municipality and supported by a third-party geospatial consulting co-operative. This development has the goals of moving both data and many of the data visualization and communication tasks from a stand-alone workstation, accessible by only those with a specific set of software skills, to a Web-based cloud solution, accessible by anyone with a Web browser. This approach attempts to make the federal and provincial SDI more accessible, applicable, and sustainable in a resource-constrained municipal context.

THE GÉOACTION PLATFORM
GéoActon (http://geomont.qc.ca/geoacton/) is a geospatial data access and sharing solution that is based at the municipal level, intended to be used by municipal staff, elected officials, community groups, and citizens. The development of GéoActon itself was made possible by technological developments at the federal and provincial
levels, the application of Geoweb technology at the municipal level, and the presence of key supporting organizations within the region.

From a technical perspective, GéoActon can be described as a Web-based cartographic framework that displays geospatial data from both WMS feed sources (federal and provincial) and data hosted on a map-specific Web server (municipal). GéoActon uses MapFish (http://www.mapfish.org/), an open-source framework that allows for the development of customized online mapping portals. MapFish is used as the foundation for federal, provincial, and municipal data to be integrated, providing common mapping functionality in a familiar layout. The MapFish framework provides such functionality as zooming, panning, length and area measurement, map printing, a list of data layers, and commenting tools (see Figure 2).

Geospatial data can be added to MapFish in two major ways: First, it can be served from a geospatially enabled Web server (such as MapServer: http://mapserver.org/) or through the integration of WMS feeds. GéoActon is a MapFish implementation that uses both of these approaches. As the primary user of GéoActon, MRC Acton has contributed many of its existing geospatial datasets to be included. These datasets are served using MapServer, as MRC Acton has full rights to distribute this data publicly. MapFish also allows for the integration of WMS feeds, displayed as data layers. From the user perspective, these two separate data sources are loaded the same way: through toggling the layer visibility in the legend. The development of the open-source geospatial data WMS feed system has meant that a large variety of up-to-date federal and provincial-level data could be delivered in a cloud-based system directly to GéoActon, while being stored and maintained on government servers. This eliminates the need for MRC Acton to purchase, store, update, or otherwise handle raw GIS files. Rather, every time a user loads a specific data layer in GéoActon, the most recent version is obtained from a central server operated by provincial and federal governments. This method of accessing data obviously reduces the cost, both in purchasing and in staff time, required to gain access to geospatial data.

From a development cost perspective, the use of open-source technology has several benefits (Hall, Chipeniuk, Feick, Leahy, and Deparday 2010; Steiniger and Bocher 2009). The MapFish framework is provided free of cost, with no annual license for use. As an open-source project, MapFish is being constantly improved and extended by a volunteer community of users who contribute to the project, as part of the Open Source Geospatial Foundation (http://www.osgeo.org/), a nonprofit foundation formed to develop and support open-source geospatial software (Steiniger and Bocher 2009). For municipal governments, particularly those without a GIS division or few resources to support technology, the use of open-source software can be a significant cost savings. Though MapFish does not replace the advanced features found in a commercial desktop GIS, it can be applied to a narrower range of tasks, with a focus on accessing and displaying WMS feeds, making geospatial data visualization available to nonexperts.

Applications of GéoActon

GéoActon brings together data from the federal and provincial governments, provided as WMS feeds, supplemented with data from the municipal government, stored locally on map servers. GéoActon represents an informational application of the Geoweb, as users (whether municipal staff, municipal officials, citizens, or citizen groups) use the Web application to access and view a variety of geospatial data, without the need for specialized local software or extensive training in desktop GIS usage. Users can retrieve this data by printing custom maps, though no conventional form of data export is available because of data-use restrictions imposed by government copyrights—a practice that is still common in Canada. There are several ways in which GéoActon is used to communicate information to decision makers and citizens through the visualization of geospatial data. For decision makers, GéoActon brings a variety of datasets together in one interface, accessible via the familiar interface of a Web browser. For many decision makers, particularly elected officials, they do not frequently have easy access to the specialist data that is available in GéoActon, including (but not limited to): zoning plans, sensitive ecological areas, drainage plans, flood plans, and soil types. In reality, even a frequently updated dataset, such as the municipal property limits and assessment values, is not provided in a digital format to decision makers or citizens. By placing this data online, and allowing nonexperts to access, view, and print it, this provides an important support to decision making, data sharing, and government transparency. That this is done in a way that any one with a Web browser can access this information represents for MRC Acton, and many smaller, resource constrained municipalities, an important step toward reducing the distance between citizen and government, and in support of open governance principles (Ganapati 2011).

GéoActon also contains a participatory aspect, where users are able to add comments in the form of points. Doing so creates a new data layer. This feature was added to provide a conduit for citizens to comment or query on aspects of the data, for example, to point out inaccuracies or to submit a request for changes. There are other potential uses for this feature that may be explored by MRC Acton in the future, including hosting an online public consultation where citizens mark up a section of a map with comments. To support this type of online consultation, specific GIS layers can be preloaded onto GéoActon, as a base map for commentary. Users also can be restricted from accessing certain parts of GéoActon by means of a user log-in. Thus, the bulk of GéoActon may remain public to all visitors, but to access participatory functions, a user log-in can be used to ensure accountability and filter users. This creates the potential for a two-way conversation to flow between citizen and government, supporting a type of e-government using geospatial data as a starting point not simply for communication of plans but for discussion in the creation or refinement of plans and decisions (Dovey and Eggers 2008, Ganapati 2011, Talen 2000). This type of approach to public consultation can be seen in several urban
areas, where citizens are engaged using map-based discussion of planning options (Rinner and Bird 2009, Rinner et al. 2008), or in facilitating communications between citizens, and between citizens and government during crisis situations (Goodchild and Glennon 2010, Liu and Palen 2010).

**CHALLENGES IN THE DEVELOPMENT AND IMPLEMENTATION OF GÉOACTON**

Any technology that is implemented within an organizational context must overcome a range of adoption constraints. The process of negotiating adoption constraints attempts to reconcile the differences between the abilities of the technology, the goals and restrictions of the developer, and existing and future organizational and user constraints (Couclelis 2005, Geertman 2002, Johnson and Sieber 2011b). Despite several potential beneficial uses of GéoActon, there are a number of significant constraints to this approach and development process. These constraints concern the Geoweb technology itself, sustainability of the tool, and constraints inherent in the organization and user contexts.

**Lack of Spatial Analysis Tools**

As a simplified viewer of geospatial data, there are significant limitations of the Geoweb technology as implemented in GéoActon. Most notable among these is the lack of spatial analysis tools within GéoActon. Though GéoActon is not intended to be a replacement or alternative to desktop GIS, the way that traditional forms of WebGIS have been proposed (Al-Kodmany 2000, Dragicevic and Balram 2004, Goelman 2005), this lack of analysis tools should be considered as a constraint on the use of GéoActon for more advanced purposes, beyond its current role as a distributor and viewer of data. There are currently several Geoweb options, most notably Geocommons.com, that provide users with basic analysis functions, such as merging, buffer, intersection, clipping, and prediction, in addition to greater control over symbology, style, sharing, and data export in a variety of formats. These types of advanced features and services require the use of public data compared to the limited WMS feed provided for use in GéoActon. This WMS data is akin to viewing a digital map of the data: Data properties may be symbolized, but there is no attribute table or analysis options available to the user. Despite the lack of analysis functions built into GéoActon (which would also increase the complexity and cost of the tool), it is still possible to disseminate the results of GIS analysis using GéoActon. For example, MRC Acton staff can produce a GIS layer showing the results of a GIS analysis and allow this layer to be loaded into GéoActon, ready to be layered with other data and explored by citizens or decision makers in a dynamic fashion.

The lack of analysis tools in GéoActon can be seen as a limitation on the functionality of the tool, but this is also a result of the built-in limitations of using data from WMS feeds. As data providers, the provincial and federal governments require the protection of the raw data files, including data attributes, through the enforcement of crown copyright on the data. This is a significant reason why WMS feeds are used to share data, for WMS feeds can be used to effectively seal off the attribute table that underlies geospatial data, only showing preset values or symbology. This is a choice that limits the reuse of data for a variety of purposes, but in the context of a crown copyright data-usage agreement, this type of protection is mandatory for the release of the data. Without assurances that raw data files and attributes would be protected, the Quebec provincial government and the federal Canadian government would not be releasing any of this data at all. GéoActon may be considered as one small step toward opening up government data in Canada, but the use of WMS feeds ultimately restricts the use of this data to visual interpretation only or printing. The ability to download data, or to create a “mashup” (Sui 2008) or value-added product is not possible.

**Sustainability of GéoActon**

As with many types of technology development and implementation, there are a host of organizational and sustainability constraints to be negotiated. Figure 3 provides an overview of all agencies implicated in the use of GéoActon, outlining their roles as either data producer, data user/producer, or as support staff. The two main organizations involved with the conceptual development of GéoActon (McGill University and MRC Acton) were each subject to serious sustainability constraints. McGill University was limited by a research project mandate of a limited length, fluctuating resources, and a need to stay at arm’s length from government geospatial data provision to municipalities. MRC Acton, on the other hand, had a limited budget and Geoweb/GIS expertise and could not afford to purchase proprietary software or invest in learning the open-source technology required to develop and support GéoActon.

To help ensure the sustainability of GéoActon within the MRC, we built on the local presence of l’Agence géomatique montréalienne (GéoMont), a regional geomatics consulting co-operative. GéoMont has a mandate to provide cost-recovery...
geomatics consulting services to municipal, provincial, and community organizations operating within the Montérégie region of Québec, of which Acton is a part. GéoMont operates as a co-operative, with a budget supported by contributions from all Montérégian municipal governments, several local agricultural and environmental organizations, and funded on a project-by-project basis by provincial government contracts. GéoMont provides the full-time staff, expertise, and long-term presence in the region required to help support the sustainability of any tool developed. As part of the long-term plan with the development of GéoActon, it was proposed that GéoMont export the GéoActon approach to other MRCs interested in developing a geospatial data portal on a cost-recovery basis.

Organizational and User Context
As a geospatial data aggregator, visualization, and two-way communication platform, GéoActon is intended for use by a number of different groups, including MRC Acton staff, elected officials, community groups, and citizens. A number of constraints to the use of GéoActon may affect the levels of use for each of these user communities. More generally, a number of constraints are generated by the rural location of Acton and are endemic to rural areas across North America. For example, citizen and community group use may be constrained by the speed of Internet access available. As a rural area, there is still not widespread access to high-speed Internet, which is the preferred way to access GéoActon. For users connecting to GéoActon with dial-up, there is a noticeable delay in refreshing map layers, particularly for those data layers with high bandwidth requirements, such as digital orthophotos. These technical issues will be less so for MRC staff and elected officials who choose to access GéoActon through their workplace Internet connections. Other constraints that may affect many users include the level of digital skill required to use GéoActon. Despite developing GéoActon with a focus on simplicity and ease of use, for a novice user, particularly one with little prior exposure to maps and online mapping applications, there may be a learning curve. We have attempted to address this constraint with the development of a comprehensive set of instructions, but it is still likely that some users may experience difficulty. For MRC staff and elected officials, we are hosting a series of training sessions to introduce and familiarize users with GéoActon. We anticipate that feedback from these sessions will be used to further refine the tool and improve documentation.

Conclusions: The Geoweb as a Link to Spatial Data Infrastructure for Municipal Government
We propose that GéoActon and, more generally, the Geoweb can serve as a tool to extend existing federal and provincial SDIs. GéoActon provides a key benefit to MRC Acton and citizens: wider access to geospatial data. This wider access is facilitated by two factors: a Web-based platform that supports aggregation and viewing of cloud-based geospatial data and a user interface targeted toward GIS nonexperts. Considering that much of the intended user community of municipal staff, elected officials, community groups, and citizens do not have any prior exposure to or experience with using desktop GIS, this simple delivery of data in a viewable form is a significant benefit of the approach. We consider this data provision as a step toward the “geomatization” of the MRC, to more tightly integrate the use of geospatial data into regular activities. The term geomatization is a French term used by MRC staff to describe both the process and the outcome of the development of GéoActon. We suggest that this term be considered as a descriptor of a geospatial variant of the process of diffusion of information technology within an organization (Onsrud and Pinto 1991, Rogers 2003). Geomatization was used to define a general increase in both the availability and use of geospatial data and tools within an organization. MRC staff saw the geomatization of their operations through the development of GéoActon, as a way to modernize their organization, keeping it on the leading edge of both technology, through Web-based delivery of geospatial data, and a more open form of government in facilitating communication with citizens. With the inclusion of a unique organization such as GéoMont to support the technical development and maintenance of the Geoweb, there is greater potential for long-term sustainability and eventual adaptation to user needs and new SDIs as the technology continues to change and evolve. This involvement of a local “on the ground” set of geospatial experts can make a significant contribution toward managing many of the organizational and implementation constraints that often hamper technology adoption (Rogers 2003, Stoecker 2005).

The next steps in this research are to generalize the GéoActon software as an open-source template that can be exported to other municipalities throughout Québec and other locations where there may be a need for a data aggregator and visualization platform. Developing this export process relies on a continued partnership with GéoMont in delivering software customization and support services to other Quebec MRCs. For MRCs with an existing GIS or information technology division, we plan to make the code base of GéoActon available as an open-source product, for their own reuse and customization. Similarly, for other organizations interested in serving their own data and combining it with WMS feeds from government organizations, the GéoActon framework can provide a possible solution. In this way, GéoActon, as an approach, creates a type of extended SDI at the municipal level.

GéoActon is a small-scale solution that begins to address a larger problem—the lack of a provincial or federal SDI that can provide data to all levels of government, community groups, and citizens. Though it remains quite far from achieving a fully functional SDI, GéoActon as both a software and as a process represents several notable advances. Most significant is integrating three sources of data (municipal, provincial, and federal) into one interface that is accessible by all municipal workers and also
citizens. This type of multiple-source data sharing is a rarity in Canada, especially in Québec. The second advance is the organizational support provided by GéoMont. The organizational challenges involved with launching GI technology in government are well known (Budic 1994; Carver, Evans, Kingston, and Turton 2001; Onsrud and Pinto 1991), making the integration of a group of GI experts on an as-needed basis a way of effectively adding a GIS division to a municipal government that could not afford its own full-time GIS support staff. This is a resource that is unique to the Montérégie area of Québec, and we propose it as a model for other areas, particularly rural or otherwise resource-constrained areas.

In conclusion, the combination geospatial data provided in the cloud by provincial and federal governments and new Web-based forms of accessing, displaying, and using this data can allow for the creation of small-scale SDIs that are tuned to local needs and resources. These small-scale SDIs have the opportunity to support a wider range of users, such as those from organizations that would not typically have access. This has been our experience with GéoActon, that a rural, resource-strapped municipality without a dedicated GIS division can use a lightweight technical solution to access multiple existing SDIs, plus to make its own data available. This allows geospatial data to be made available to a broader range of users, including municipal staff, elected officials, and also to citizens. This can allow the use and distribution of new forms of data to support decision making and to facilitate communication between key stakeholders.

About the Authors

Dr Peter A. Johnson is an Assistant professor in the Department of Geography and Environmental Management at the University of Waterloo, Ontario, Canada. Previous to this appointment, he was a postdoctoral researcher in the Department of Geography, McGill University, Montreal, Canada. He graduated with a PhD from the same institution.

Corresponding Address:
University of Waterloo
Department of Geography and Environmental Management
Waterloo, Ontario
Canada
peter.johnson@uwaterloo.ca

Dr. Renee E. Sieber is an Associate Professor in the Department of Geography and School of the Environment, McGill University.

Corresponding Address:
Department of Geography
McGill University
Montreal, Canada

Acknowledgements

This research has been funded by the Quebec Ministère des services gouvernementaux program “Appui au passage à la société de l’information” and the Canadian GEOIDE Network of Centres of Excellence in Geomatics. We would also like to acknowledge the constructive comments of the anonymous reviewers.

References


Active Transportation, Citizen Engagement and Livability: Coupling Citizens and Smartphones to Make the Change

Marc Schlossberg, Cody Evers, Ken Kato, and Christo Brehm

Abstract: Supporting livable cities is a key priority of the Obama Administration, fully embraced by the U.S. Secretary of Transportation, and necessitates increased active transportation (walking and cycling) in communities across the country. Transportation data that support active transportation planning are lacking for most communities. With the increasing pervasiveness of smartphones that are graphically rich, spatially accurate, and simple to use, it is now possible to approach transportation and livability data collection in a new way by engaging citizens directly in the process.

This paper describes the development and testing of an iPhone-based transportation livability audit tool called the Fix This Tool, a tool specifically designed to engage and empower citizens across the country to easily collect active transportation data to help local communities and transportation agencies meet the needs of the livability era. The tool requires no special training, is spatially specific, and addresses subjective perception of place as well as key objective variables that underlie that perception.

Through initial development and testing, we found the tool to be intuitive for people to use and the data robust, and that the combination of features available on a smartphone-based tool provides a rich set of opportunities for both the citizen and the public agency to be engaged in improving their active transportation system. That said, it is clear that active transportation data can be complex and "messy" and will require new approaches toward use compared to traditional, objective measured regional scale measures used for transportation modeling.

INTRODUCTION

Supporting livable cities is a key priority of the Obama Administration, fully embraced by the U.S. Secretary of Transportation. Because the concept of livability implicitly focuses on land use and community design first, and transportation systems optimized to fit those land-use patterns second, the move toward a livability agenda is a radical shift in how transportation planning is carried out by local and state agencies.

In the context of livability, transportation not only becomes subservient to land-use decision making, but nonautomobile modes receive an increasing share of attention for walking, biking, and transit often are the most efficient means of helping people access destinations. Yet given the slower and more human-scaled pace and experience of these active modes, planning for pedestrian and bicycle transportation requires a detailed and more nuanced set of tools and indicators than does traditional car-based modeling. And while traditional transportation models are beginning to address walking and biking, a different type of data and planning may be needed to properly plan for increased shares of active transportation.

Unlike with the car, the decision to walk or bike and the route to take often is based on a more complex set of inputs, in addition to the importance of directness and speed. Some of those built-environment qualities may include sidewalk presence and condition, buffer between sidewalk and moving cars, type of bike facilities, lighting, street trees, architectural design, and scores of other potential variables (Pikora, Bull et al. 2002; Vernez Moudon and Lee 2003; Clifton, Smith et al. 2007). For all these objective indicators, however, they may never fully explain an individual's quick intuitive assessment of the built environment (McGinn, Evenson et al. 2007). For active transportation planning, it is likely that initial perceptions, especially the perception of safety, are critical in deciding whether individuals will even consider biking or walking as an option in the future (Ogilvie, Egan et al. 2004). This more subjective and perception-based relationship between active transportation users (or potential users) and the built environment presents a new and more complex challenge to transportation planners.

A key question then becomes, how do we create a set of national data, useful for active transportation planning, and based on individual experience of the local walking or biking environment? This paper explores a potential approach to bridging the new data needs of transportation agencies by catalyzing a general citizenry, equipped with their own smartphones, mobilized to act as both data gatherers and system users to assist local public officials in prioritizing and improving local active transportation...
systems. Specifically, the paper will explain the technical details and broader rationale and use of the Fix This Tool, a customized iPhone application that allows users anywhere in the country to instantly and spatially document subjective and objective conditions of their local active transportation environment.

CONTEXT
Within its recently released strategic plan, the U.S. Department of Transportation presented the visionary new goal of transportation-supported livability. Transportation Secretary Ray LaHood described a livable community as one “where if people don’t want an automobile, they don’t have to have one. A community where you can walk to work, your doctor’s appointment, pharmacy or grocery store. Or you could take light rail, a bus or ride a bike” (Findlay 2009).

While the predominant transportation focus of the past 70 years has been to increase the mobility of automobiles, a livability orientation toward the nation’s transportation systems focuses on access. The difference could not be more fundamental; the status quo seeks to move vehicles quickly (mobility) and the new goal seeks to get people to where they want to go more easily (accessibility). Placing transportation planning under the umbrella of livability represents a critical policy statement that suggests that people do not consume transportation for its own sake but rather use transportation to get to where they want. Focusing on destinations rather than on just moving vehicles allows regional planners to be more effective in rebalancing the transportation system so that different modes of travel are appropriately used for the types of trips for which they are best suited.

Of course, translating broad national policy goals for systemic change into local action can be difficult. There are many fundamental barriers, including: (1) generations of transportation planning and engineering staff have little or no experience approaching walking or biking as equally appropriate modes of transportation; (2) almost no data are available at the local level to support active transportation decision making; and (3) communities across the country are diverse in land use and culture.

The U.S. Department of Transportation (2010) recognizes the need for appropriate treatment of place and context while addressing these substantive barriers related to scale, authority, and capacity, suggesting that one of the key federal roles, in addition to direct funding, is to “give communities the tools and technical assistance they need so that they can develop the capacity to assess their transportation systems, plan for needed improvements, and integrate transportation and other community needs” (49). The Fix This Tool, a class of planning support tools that combines detailed built-environment assessments, spatial accuracy, and public involvement, was designed to meet this key gap.

Tools for Addressing the Data Needs of Local Communities
A variety of planning support and data-gathering tools have been developed over the past decade to assist with active transportation planning (although most focus on pedestrian rather than bicycle infrastructure) (Pikora, Bull et al. 2002; Vernez Moudon and Lee 2003; Schlossberg 2006). These tools range from paper and pen checklists to mobile GIS-based systems for gathering appropriate built-environment data directly in the field. Some of these tools are targeted toward community groups interested in auditing their local neighborhoods (Schlossberg and Brehm 2009), while others attempt to collect highly rigorous, comprehensive city-wide data to advance transportation planning and modeling for active transportation (Clifton, Smith et al. 2007).

Transportation decisions are invariably limited by the availability of spatial street data. Data currently used in transportation decisions largely consists of a comprehensive street network, augmented by local lane and speed data. Pedestrian network data (i.e., sidewalks) are inconsistent and rarely complete (even when adjacent to the streets) and often lack pedestrian paths that do not follow roadways. Pedestrian volume data are largely nonexistent. Bicycle infrastructure data also are limited, partly because most cities in the United States lack bicycle infrastructure, and partly because there are few agencies that care or have the capacity to do anything with bicycle-related data. Local governments often are reluctant to rectify these gaps because most transportation planning revolves around the work trip and the share of both bicycling and walking commuters is generally quite low.

What seems clear is that bicycle and pedestrian transportation system planning is in its infancy in the United States, especially relative to the comprehensive and dominant emphasis of the automobile-based transportation planning of the past 70 years. And given that active transportation users are impacted more by small variations in the streetscape than are car drivers, it seems appropriate that the experiences of these cyclists and pedestrians should play a role in the transition toward livability. This process will not only produce data useful for improving local conditions, but the participation in the process itself may lead to social learning (Bull, Petts et al. 2008). Research suggests that the process may be just as important as the data that is collected (Schlossberg and Brehm 2009); as more people reimagine their local environment in terms of biking or walking, the easier it may become to achieve a greater use of such modes.

It also is important to understand that active transportation (walking and biking) are not fringe modes of travel relegated to the elderly, young, or poor—or those who simply cannot own and operate a car. The full potential modal split of walking and biking for all kinds of trips—work and nonwork—is unknown because the transportation infrastructure in most American cities makes choosing these modes undesirable, unsafe, and irrational. There is a disconnect between what current active transportation rates are and what their potential might be, and identifying the barriers from the user perspective is an important component in catalyzing cities to improve their active transportation infrastructure.

There is a lot of potential. Almost half of all daily American trips are under three miles and 28 percent of all trips are under one mile (Bureau of Transportation Statistics 2001), meaning there are a significant number of potential active transportation trips.
Bicycling rates are about the same across income levels, although motivation for use differs across income group (Pucher, Buehler et al. 2011). For children walking to school—an issue of importance to families of every income and racial demographic—there has been a dramatic decline in rates of walking and biking to school (Kindergarten to 8th grade) from 48 percent in 1969 to 13 percent in 2009 (National Center for Safe Routes to School 2011). According to a national poll, “Americans would like to walk more than they are currently, but they are held back by poorly designed communities that encourage speeding and dangerous intersections” and “More than half (55 percent) say they would like to walk rather than drive more throughout the day either for exercise or to get to specific places” (Belden Russonello and Stewart 2003).

There is a desire to walk and bike more, and new federal initiatives are helping to support cities in meeting this desire. Yet, the ability to make decisions at a very local scale—the scale of most importance to active transportation users—is limited because data does not exist at such a fine grain and collecting that data is time consuming, difficult, and seemingly endless. Engaging community residents in that data gathering, however, may be an approach to bridge citizen desire, federal policy, and municipal paralysis. Moreover, engaging a broader public in this data-collection process actually may yield decisions that are smarter, spatially targeted where they will be most effective, and this data-collection process actually may yield decisions that are more sustainable in that the beneficiaries of improved active transportation infrastructure could be the ones most responsible for identifying the priority areas of need.

**Citizen Involvement in Spatial Data Collection and Analysis**

Using geographic information systems (GIS) for local government decision making is not a new concept (O’Looney 2000) and, perhaps surprisingly to some, neither is connecting ordinary citizens to GIS for local community decision making. Participatory GIS, for example, has been used in a variety of ways to connect fairly sophisticated information technology with lay-citizen engagement (Harris 1998; Obermeyer 1998; Talen 2000; Craig, Harris et al. 2002; English and Feaster 2003). Even in the area of engaging citizens in active transportation, there have been some preliminary efforts of experimentation. The Complete Streets Assessment Tool (CSAT) and the School Environment Assessment Tool (SEAT) connect concerned citizens with mobile GIS data-collection tools so that citizens themselves collect objective built-environment data and subjectively evaluate the same (Schlossberg and Brehm 2009).

A key potential benefit to transportation agencies utilizing a general citizenry in data collection is both the distributed approach to actually gathering the data (no need to hire a new staff) and to connect system users to system improvement (public involvement). Empowering citizens to collect and rate their local active transportation environment can help direct limited agency resources to areas in the community most in need. In a larger context, this “soft” benefit of cultivating an engaged and empowered citizenry can have longer-term benefits such as the establishment of trust and the experience of success often needed to push community change forward (Arnstein 1969).

Yet collecting data in a decentralized, community-managed, and mobile GIS environment is difficult to scale beyond select individual communities. GIS requires a fair amount of technical expertise, even if handled by a technician independent of citizen data gatherers, and collecting field data using GIS (e.g., Arcpad) requires training the user. Facilitator-led training for data collection, as has been the case for most past community-based or researcher-based active transportation assessments, is expensive, time consuming, and severely limited in geographic coverage. These technical and process-based limitations are especially relevant in the context of a national push toward planning for livability, which requires data that are national in coverage but engagement that is locally scaled. Smartphones may provide advantages where previous spatial data collection tools could not.

**Capitalizing on the Emergence of Spatially Aware Mobile Technology**

Current mobile devices (i.e., smartphones) differ markedly from previous generations of mobile phones in three significant ways: (1) they have active GPS capability; (2) they have near unlimited Internet access; and (3) graphical resolution and interactivity allows users to push data out from the phone rather than just receive calls and simple static information. This two-way information exchange, in conjunction with GPS location capability, creates a spatially aware mobile technology increasingly ubiquitous in the hands of people across the country and even across the globe.

More than 80 percent of all U.S. adults own a cell phone, and, of those, 42 percent use smartphones, meaning that almost one third of all adults currently own and use smartphones (Smith 2011). Smartphone sales are growing at more than ten times the rate of other mobile-device sales (Gartner Research 2010) with the industry-leading Apple iPhone nearly doubling past sales from 2009 to 2010 with the sale of 25 million units within a single year (International Data Corporation (IDC) 2010). Urban and suburban residents are twice as likely to own a smartphone as those in rural areas and minorities are more likely to own them compared to whites (Smith 2011). The least likely to own smartphones are those over age 65 (11 percent) and those earning less than $30,000 (22 percent) (Smith 2011), but with new options for lower cost data plans and the continued increase in smartphone choices, price no longer will be a significant barrier to owning a smartphone. In fact, owning a smartphone actually “provides teens from lower income households without a computer an opportunity to use the Internet, hence helping to bridge the digital divide” (Amanda Lenhart, Ling et al. 2010). The main barrier to smartphone adoption, then, seems to be technological unfamiliarity, explaining a lower adoption rate by older Americans. That said, even 62 percent of those older than 75 live in a household with a cell phone (Kathryn Zickuhr 2011).
Spatial technology also has matured to the extent that online map and GPS use (i.e., satellite navigation systems or online tools such as MapQuest) are widely used, inexpensive (one dollar for a GPS chip), and can quickly combine user location and fairly detailed maps almost anywhere across the country. Not surprisingly, analysts predict greater public demand for, and industry capacity for providing, these location-aware information services (Tarmo 2009).

The spread of smartphones, access to customizable applications, and growing familiarity with mapping and location-based applications presents new opportunities for transportation agencies to interact with their citizenry. There may be real opportunities for citizens to help transportation agencies better target their resources and for agencies to be more responsible to citizen concerns. Not surprisingly, there are already examples of local governments and private developers releasing spatial tools designed around general public input (Sutter 2009) although most act as simple reporting tools such as telling the public works department the location of potholes.

The data relevant to active transportation planning are of a grain much finer than that traditionally collected for automobile travel based around mobility and level of service. These micro characteristics of the streetscape can all act to encourage or exclude individuals walking or biking.

Collecting the Data That Matters

The decision to walk or bike and the choice of route is based, in part, on minimizing personal risk. This individual risk calculation can be thought of in two distinct ways. Risk that is perceived as feeling informs a person's instinctual aversion to danger (i.e., hazard). Risk as analysis adds the faculties of reason and logic. Local governments normally seek to minimize risk analytically, while individuals tend to seek to minimize risk intuitively. When a person crosses the street, the decision is made in the moment, intuitively, and often with incomplete information. This heuristic form of decision making is based primarily on affective qualities—that is, good or bad—of the environment. The mother who drives her child to school on a daily basis does not know which safety interventions are lacking that make her feel it would be unsafe to let her child walk to school; rather, she just feels concern about her child's safety, so she drives.

Furthermore, research has shown that these two forms of decision making interact. If a person believes something is “good,” they also are more likely to perceive a higher benefit in the action and a lower degree of risk, irrespective of any logical conclusion to the contrary. Likewise, a “bad” decision accentuates possible risks and attenuates perceived benefits (Alhakami and Slovic 1994). As a result, the benefits of any safety interventions will likely be moot if the individual continues to perceive his or her environment as hostile or dangerous. Examples are abundant: While many cities now provide dedicated bike lanes on arterial roadways, only the least risk-adverse individuals (i.e., younger male riders) actually use those facilities (Baker 2009).

In planning for active transportation, it is important to include both components while retrofitting cities toward livability. Inventories of physical infrastructure needs that could support increased walking and cycling are clearly needed, as it is impossible to plan for the future within an accounting of what exists today. For active transportation in particular, it may be equally important to understand how individuals perceive their environments. Combining these two sets of data, along with deliberately including citizens in the direct process of evaluating their active transportation environment, is what led to the development of the Fix This Tool.

THE FIX THIS TOOL: DECENTRALIZED, AFFECT-BASED, CITIZEN-LED DATA COLLECTION IN SUPPORT OF ACTIVE TRANSPORTATION

The Fix This Tool is an initial attempt to utilize the latest smartphone technology via Apple's iPhone to create a location-based, quick, and easy way for citizens across the country to rate the bicycle and pedestrian environments within their communities and to apply these data toward local change in livability. The development of the Fix This Tool can easily be adapted to other smartphones, although we were drawn to the iPhone because of its ease of use and superior graphical quality.

Our use of iPhones differs markedly from other public engagement tools because there is no technical limit to the number of devices (thus participants) that can be simultaneously involved in the data-collection process. This is a “decentralized” process for it follows a model of data collection using survey devices not centrally owned or controlled. Instead, survey tools are privately owned and any person is free to become a contributor to the data collection. Devices and software do not require any centralized setup by a trained technician; the application can be downloaded to the device by anyone and anyone can collect data immediately. There is no need for any user training for the interface and controls utilize common standards.

Guiding Principles and Assumptions

When developing the Fix This Tool, we assumed that the following assertions are true:

*People are influenced by their surroundings and they are more sensitive to their surroundings when walking or biking than when in a car.*

Within a hierarchy of transportation modes, cyclists and pedestrians are the most vulnerable. Not only is safety from cars a constant concern, but cyclists and pedestrians also are influenced by small and unique things, such as leaves left in a bike lane, a house with an aggressive dog in the yard, or a simple lack of path continuity. Do nice walking environments attract more pedestrians or do bad environments repulse them? This is an
open question, and as a result, the tool was designed for users to record good, bad, objective, and subjective data as they choose.

The Fix This Tool treats all street elements as “observations,” whether it is something built (e.g., streets, signage, etc.) or something felt (e.g., danger, poor lighting, etc.).

A person can identify places where he or she does not feel comfortable and safe, even if he or she may not be able to identify every contributing factor. Each person perceives benefits and risks differently. Yet how people perceive risk depends on many factors, including how beneficial walking or biking is seen in the first place. People choose routes and modes of transportation that minimize risk and maximize speed/directness, yet individual navigation decisions never are based on a complete inventory of one's surroundings. The Fix This Tool asks individuals to first rate an environment based on their initial subjective feeling, then asks more detailed questions seeking to objectively identify what the issues may be.

Interface
The Fix This Tool is made up of two principle elements: (1) the map interface and (2) the survey interface. These two interface elements allow the user to easily switch between navigating the local built environment and entering information about his or her street-level observations.

The application uses the built-in GPS and “always-on” Internet access to zoom in to the user’s exact location using Google maps as a backdrop. Users then just tap on the screen to begin entering data.

Figure 1. Visual interface of the Fix This Tool

Aerial Navigation Map
The map interface allows the user to virtually navigate to a given location, which is aided by the iPhone’s built-in GPS. The map is controlled using simple “gestures,” such as swiping the finger across the screen or using the index and thumb to either “pinch” or “pull” the map to zoom in or out. In comparison to other mobile devices, we have found this system extremely intuitive, often requiring no previous explanation.

An observation is registered by either double tapping at the appropriate location on the map or by having the device automatically place the point at the current GPS location (see Figure 1). As a result, a person can either register a point that he or she noticed earlier or in the case he or she actually is at the location of observation can simply rely on the built-in GPS.

Transportation Observation Survey
The survey interface is composed of a hierarchy of interconnected tables that allow the user to select one or multiple responses depending on the question. The wording and question responses are stored in independent tables, making the tool not only highly flexible but also customizable by other potential developers.

Survey questions are asked in three groupings. The initial survey question asks the user to note the affective quality of the observation. We are interested in this subjective feeling of the environment and it is important to capture that feeling before a
user pays too much attention to the details of his or her environment from an analytical perspective.

After the initial subjective evaluation, the user describes the location using keywords, pictures (using the iPhone’s built-in camera or potentially a preloaded set of imagery), or custom text (see Figure 2). A final set of optional questions ask about the related impact of the observation being noted, including the area that it affects (i.e., specific point or corridor), the time of day that the issue is most pronounced, the modes of transportation most affected, and the types of users who the issue might impact (i.e., children, people with disabilities, etc.).

RESULTS
The types of data collected by the Fix This Tool were chosen based on the assumption that people are sensitive to their environment, that transportation decisions are made intuitively based on momentary and incomplete information, and that that information is assembled and used primarily based on its affective qualities. But what does affective street-level data collected in an unstructured and decentralized format look like?

Tool Testers
During our testing of the tool and citizen-based approach, we followed a hybrid centralized/decentralized approach. We purchased ten iPhones with prepaid data plans and cycled the phones through a self-selecting group of volunteers. The Fix This Tool was preloaded on each iPhone and each user was assigned a unique ID for research purposes. The volunteers kept the iPhone for a weeklong period and were instructed to make note of “those things they felt important to share on those routes that they regularly bike and walk within a given week.”

Our Fix This Tool testers consisted of 25 self-selected volunteers. The participants were primarily university students (91 percent), male (64 percent), and under the age of 25 (64 percent). Most volunteers used active transportation regularly, reporting on average 12 hours spent weekly either biking or walking. Very few hours were reported spent in a car. Each volunteer was given an explanation of the project, a quick tutorial on the application’s use, and then issued an iPhone for a weeklong data-collection period. On returning the iPhones, the volunteers were given a quick post-survey to collect basic demographics and to allow them to comment on their experience using the tool and performing the assessment.

Data-collection Behavior
Over the four-week data-collection period, 307 data points were recorded over an area of approximately five square miles, with the majority of data focused in or near the University of Oregon campus. On average, volunteers noted 18 points of interest during the weeklong period they had their iPhones, although actual numbers varied largely by the individual.

Volunteers noted that for the majority of cases, observations were recorded on location and at the time first noticed (as opposed to returning to the location at a later point or recording it remotely). Observations were noted during all times of day although they were concentrated around typical travel times of students in the morning (33 percent) or at midday (33 percent).
Nonspatial Character of Data
As described previously, the survey captured affective qualities of the built environment before recording more objective built-environment characteristics. The majority (65 percent) of observations noted were considered bad (41 percent bad and 24 percent very bad). Interestingly however, nearly one quarter of the responses noted something that was perceived as good (11 percent good and 11 percent very good). Users saw the remainder of observations (13 percent) as value-neutral.

Description of Issue
Participants were asked to describe the issue in one or more ways, categorizing the issue by keyword, by photograph, or as a custom description written by the user. While users were required to categorize the observation, both photographs and text were optional. For 63 percent of the observations, the user submitted additional text and added a photograph in 25 percent of the observations.

In the majority of observations (Figure 3), users identified the general travel path as the issue, whether it was the road (25 percent), the bike lane (28 percent), or the sidewalk (21 percent). Interestingly, crossings and intersections were noted less often. More subtle aspects of the built environment such as signage or signaling devices were noted even less often. Very few participants noted observations related to the routing, hills, or curves, which is not surprising for most data were collected in a flat, grided area of the city. Users were able to select one or more of these categories and the average number of issues selected per observation was 1.67. For some observations, however, as many as nine different problems/keywords were selected for a single location.

Description of Impact
The survey did not require users to answer all the questions. That said, all users did enter data about impacted user groups and the time of day that the issue is most relevant. For those questions without a complete response rate, 77 percent of the users recorded data about the frequency of the issue observed as well as noting the spatial extent of the impact (although postsurveys indicated some confusion by users over how to describe the spatial extent of the observation).

When asked to assess which user groups would be most affected by the issue being noted, cyclists and walkers were cited for the majority of the observations. For about a third of all observations, people with disabilities and motorists were indicated. Children and the elderly were the groups least noted to be affected by observed issues, which could be explained by bias on the part of university student volunteers. Participants could select more than one impacted user group and most did, selecting on average 2.56 impacted groups.

The majority of observations addressed permanent characteristics that would always be experienced (53 percent). Slightly less than half (42 percent) of the data points addressed conditions that would be relevant at all hours of the day, compared to conditions that would only be significant during daylight hours (53).

How to Use the Data: A Bicycle Boulevard
Example
Because the observation data are associated with geographically specific locations, the data can be isolated or aggregated with GIS as needed within a particular planning exercise. For example, the city of Eugene wishes to make significant improvements to its bicycle infrastructure, beginning with the creation of a signature bicycle boulevard along Alder Street near the University of Oregon campus (which has since received a major bicycling upgrade to a two-way cycle track). Oriented vertically in the center of Figure 4, the Alder Street corridor is color coded by an aggregated average rating of quality: darker colors (e.g., toward the top of the map) represent a poorer evaluation compared to the lighter that represent a favorable evaluation. Aggregating and mapping the data in this way is highly useful for analysis, planning, and urban design.

Because the details also are important in terms of the experiences of users along the corridors, individual comments on the right of the corridor map illustrate some of the good and bad qualities along it. This format is similar to community forums where citizens are asked to place Post-it notes on a map indicating areas of concern. However, the digital format of the Fix This Tool allows individual geographically specific observations to be extracted or aggregated for analysis. Finally, users can take advantage of the iPhone camera that is directly integrated into the tool to visually capture the nature of an observation. Photographs serve as powerful visual evidence and support effective communication with public officials and agency staff.

FINDINGS AND DISCUSSION
The primary purpose of this project was to create an intuitive, decentralized, citizen-based tool to spatially collect transportation-based livability data. Having developed this tool and tested it, and even with a small and biased set of participants, several unexpected and interesting observations can be made.
Users Principally Focus on Risks
Users were free to note good or bad aspects of their built environment, yet approximately two-thirds of the observations were described as bad or very bad. This suggests that a participant’s likelihood to walk or bike is decreased more by the presence of barriers to walking and biking than by the absence of positive pedestrian and cycling amenities.

Data Is “Messy” at the Microscale
Our initial work seems to indicate that even with a semi-homogeneous group of participants, there can be a wide variety of ideas about the quality of the active transportation environment. The more users that traveled an area, the greater the range of qualitative assessments that were made. In contrast to system-wide transportation planning at a regional scale, experiences at the microscale—that experienced by pedestrians and cyclists who directly interact with their physical environment in an immediate way—is complex with an almost unlimited number of real or perceived conditions that can influence decision making. Many built-environment research studies have tried (and failed) to isolate a minimal number of factors that actually matter for active transportation users, and we suggest that for the issue of livability, transportation professionals may need to rethink how to embrace the complexity and messiness of microenvironments and find ways to utilize data and experiences to improve conditions without unnecessarily homogenizing or summarizing complex environments.

We understand this may be difficult and require a fairly radical change in thinking. In a traditional data-driven decision paradigm, such inconsistency of evaluation across auditors would be a serious cause of concern for it would point to a lack of rigor in training and data collection. Our take on the variation, however, is that it illustrates the nature of plural knowledge. Aggregating or averaging data to have a singular result may mask the true variation of space and quality. We believe that there is a need for new ways of analysis that can take advantage of such “messy” data, and in fact celebrate the fact that vibrant, livable spaces are often “messy” (after all, that’s what often makes them enjoyable), and that different responses to similar environments merely illustrate that there is a need to plan environments that accommodate a range of types of people. Thus, in some ways, developing new ways of using “messy” data also honors the central intent of citizen engagement by retaining an ability to treat citizen input as coming from the very real heterogeneous reality of our society.

A “Complex Public” Is Complex
The fact is that in this approach to citizen empowerment, we are suggesting that a “complex public” be engaged. A complex public is one that is so large, poorly defined, and heterogeneous that engagement becomes extremely difficult (Thomas 1995). Public involvement often is difficult even with small groups, which explains why so much of public engagement is really only token in nature (Arnstein 1969). Suggesting that every citizen is equally capable of engaging in the process of data collection necessarily adds a level of complexity that will be unfamiliar to most transportation engineers and planners. We believe it is of critical importance to pursue such engagement, however, for engaging the public in data collection can be part of the cultural education and transformation that is needed to increase rates of walking and biking. That is, the social learning of engaging in this public process may be an important component toward changing actual behavior (Bull, Petts et al. 2008).

Subjective Data Is Okay
Within transportation planning, data is normally understood at a macrolevel expressed through system connectivity and transportation modeling. Such an approach requires objective and easily quantifiable data. Any behavior not accounted for by such objective measures is thought to be inherently unpredictable and, therefore, the result of error on the part of the user. However, we assert that subjective data is equally important, for the perception of risk is critical to pedestrians and cyclists and some of this risk may be difficult to ascertain simply through objective measures of the built environment.
The Tool Is Easy to Use
An important motivation in tool development via the iPhone platform was to create both a tool and a tool distribution system that did not require much technical knowledge or specialized hardware or software to use. From the user’s point of view, the technical requirements are just an iPhone (or iPod Touch) and the ability to download an application from the Apple App Store. For citizen users, there is no real technical barrier to use. Our volunteers seemed remarkably comfortable using their fingers to navigate maps and applications, much more so than previous PDA-based audit tools that required a stylus to enter data via ArcPad.

The Data-collection Paradox
Naturally, users are the most aware of issues along the corridors they frequently travel. In an unstructured data-collection format carried out by a decentralized and unsupervised public, a type of data-collection paradox thus emerges: How does data get collected in areas with low active transportation use if predominantly active transportation users are collecting the data? This is a challenge to take up once a wider scale adoption of a tool like the Fix This Tool begins in earnest.

CONCLUSION
The livability agenda is a very different paradigm toward transportation planning than the nation has seen over the modern transportation era. It implies that transportation should be about helping people access the places they want to go rather than facilitating the movement of vehicles unimpeded. Moreover, the livability context directly calls for a significant increase in the amount of active transportation—walking and biking—than current levels, especially for the 40 percent of trips that are two miles or less.

That said, there are at least two large data hurdles to effectively plan for a national retrofit of communities toward livability. First, there exists very little bicycle or pedestrian data, including physical infrastructure such as sidewalks, counts of users, or any comprehensive set of built-environment variables that promote or impede active travel. Second, pedestrians and cyclists are much more influenced by microscaled aspects of the local environment than streetscape features affect car drivers, so the complexity of data to support active transportation is more difficult to collect and use. Moreover, subjective reactions to the built environment are important for cyclists or pedestrians feel more vulnerable to their physical environment, meaning that objective-only data may not be fully adequate to understand the quality of one space over another.

The Fix This Tool has been designed to meet both of these limitations. Its ease of use and model of distribution easily lends itself to a decentralized approach to engaging citizens across the country to use their existing smartphones (an iPhone in the case of this particular study) to begin to collect microscale data within their own communities that can be easily aggregated to any other geographic scale of interest. The tool requires no special training, is spatially specific, and focuses both on the subjective perception of place as well as some of the objective variables that may be important to note.

Clearly, engaging hundreds of thousands of citizens to collect data in their own way and at their own pace represents a very different approach toward accumulating data for transportation planning. New ways of both aggregating data into meaningful forms as well as honoring the very specific and individual experiences of citizens are needed. The era of livability necessitates new types of data and new ways of gathering that data. With the increasing pervasiveness of smartphones that are graphically rich, spatially accurate, and simple to use, it is now possible to approach transportation and livability data collection in a new way by engaging citizens directly in the process. The Fix This Tool begins to demonstrate this way forward.

Acknowledgments
The authors wish to thank the Oregon Transportation Research and Education Consortium (OTREC) for their support of this project.

About the Authors

Marc Schlossberg, Ph.D., is an associate professor in the Planning, Public Policy, and Management Department at the University of Oregon, Associate Director of the Sustainable Cities Initiative (SCI), and Associate Director of the Oregon Transportation Research and Education Consortium (OTREC).

Cody Evers is a dual master’s student in Environmental Studies and Community and Regional Planning at the University of Oregon.

Ken Kato is Associate Director of the InfoGraphics Lab at the University of Oregon.

Christo Brehm is a master’s student in Landscape Architecture at the University of Oregon.

Dana Maher is a dual master’s graduate student in Environmental Studies and Community and Regional Planning at the University of Oregon.
References


International Data Corporation (IDC). 2010. Worldwide converged mobile device market grows 39.0% year over year in fourth quarter, says IDC. Press release, Framingham, MA.


Tarmo, V. 2009. Smartphone growth to continue strong in 2010. Reuters online.


Web-based PPGIS for Wilhelmsburg, Germany: An Integration of Interactive GIS-based Maps with an Online Questionnaire

Alenka Poplin

Abstract: The aim of this paper is to study the implementation of a Web-based public participation geographic information system (PPGIS) with open-source technology and its integration with an online questionnaire. Its theoretical foundations are based on previous work in PPGISs, online surveys, field research, and map-based surveys. The concept of a PPGIS that interlinks interactive GIS maps with an online questionnaire was developed. The concept was implemented with open-source technology and tested in a public participation process designed with the European project SWITCH. The study case was taken from a city district, Wilhelmsburg, in Hamburg, Germany. The combination of the GIS maps combined with the online questionnaire enabled the inhabitants of Wilhelmsburg to draw their answers directly into the online maps. The results of the participation processes were saved directly into the central database. The paper concludes with a critical discussion and directions for further research.

INTRODUCTION

The concept of a public participation geographic information system (PPGIS) has been extensively discussed since the middle of the 1990s (Pickles 1995; Rinner 1999; Kingston, Carver et al. 2000; Carver 2001; Al-Kodmany 2001). The main idea at that time was to enable and enhance communication between citizens and decision makers with the help of a geographical information system (GIS). Rinner (1999, 2005, 2006) contributed a model known as argumentation maps that modeled relations of geographically referenced objects with the opinions of citizens. One of the first implemented PPGIS applications was titled Virtual Slaithwaite and developed in 1998. It was “arguably among the first such systems available to the public which allowed a two-way flow of information” (Carver, Evans et al. 2012). Research at that time mostly focused on discussions about a variety of participatory functionalities that could possibly be integrated into a GIS (Steinmann, Krek et al. 2004).

Around 2005, the enthusiasm about PPGIS began to fade, but the research community still had several very interesting study cases and applications implemented mostly by universities. The conceptual ideas were inspiring but did not lead to user-friendly implementations in practice. Several possible issues led to such a development: (1) The complexity of the applications was criticized by several researchers (Basedow and Pundt 2001; Craig, Harris et al. 2002; Haklay and Tobón 2003; Steinmann, Krek et al. 2004); (2) the computer skills of the participants in public participation processes were not taken into consideration; and (3) the interaction with online interactive maps was rather complex and in many cases too difficult for non-GIS experts. Carver (2001: 64) pointed to the problem in the following way: “Access to GIS alone does not, however, provide the public user with a satisfactory means of active participation in the decision process. GIS is far too complex a technology to allow effective use by the nonspecialist with little or no previous training or experience in this field.”

More than a decade later, we experience emerging collaborative mapping processes in which citizens contribute their knowledge via open-source platforms such as OpenStreet Map. The researchers refer to these processes as “volunteered geographical information” (Goodchild 2007), “neogeography” (Turner 2006, Goodchild 2009), or “geography without geographers” (Sui 2008). This new development demonstrates the interest of the citizens to participate and use map-based participation tools. Perhaps now is the appropriate time for further developments of the PPGIS concept and its implementations.

The aim of this paper is to study the implementation of a PPGIS with open-source technology and its integration with an online questionnaire. This research builds on the previous work in PPGIS and research conducted by Sidman, Swett et al. (2005) and Al-Kodmany (2001). Sidman, Swett et al. (2005) focused on the development of a paper, nondigital questionnaire that was sent to the participants of the survey in the mail. Their responses were manually inserted into a GIS and later communicated to the focus group. Al-Kodmany (2001) and his research colleagues at the University of Illinois at Chicago (UIC) developed an online survey tool, but a GIS program was used “only at a later stage for analyzing the composite participants’ data and integrating it with other GIS layers” (Al-Kodmany 2001).

This novel contribution is in the integration of an online questionnaire with interactive GIS-based maps. Specifically, it is in the technical implementation that enables the users to interact with a GIS-based map. The online questionnaire is directly linked to the interactive online map and the answers to the questionnaire and those answers entered on the map are stored in a GIS database on the server. No comparable implementation that presents a
similar innovation of PPGIS has been found. The main research questions were: How can an online questionnaire be integrated with interactive GIS-based maps? How can the citizens’ responses be gathered and stored in a common database? How should the online map be designed to enable a pleasant interaction by the user with the content of the map as well as to encourage citizens to contribute their opinions? To investigate these research questions, a concept that directly links an online questionnaire with online interactive GIS maps was designed. The concept was implemented in the study case of the city district of Wilhelmsburg in Hamburg, Germany. Wilhelmsburg is the largest inhabited river island in Europe and is characterized by a number of canals. The PPGIS for Wilhelmsburg aimed to stimulate the discussion about the current use of the canals by the inhabitants and their wishes for their use in the future. The results of the participation process were used for the development of the Water Sensitive Urban Design concept within the European research project SWITCH.

This paper is structured as follows: The next section provides an overview of the previous work related to online survey research, PPGIS, and map-based surveys. Then the study case in Wilhelmsburg is introduced. In the following section, the research questions and goals are highlighted. Next the technical implementation of the PPGIS for Wilhelmsburg is described. The focus is on the design of the online questionnaire, interactive GIS maps, and the user interface. The next section describes the executed public participation process and the results of the public participation process executed with the help of PPGIS for Wilhelmsburg. Finally, the developed application and its usability are critically assessed and research perspectives are discussed. The paper concludes with further research directions.

PREVIOUS WORK

Online Survey Research

The past decade has seen a tremendous increase in Internet use and computer-mediated communication (Nie and Erbring 2000; Fox, Rainie et al. 2001; Horrigan 2001; Nie, Hillygus et al. 2002). As an increasing amount of communicative activity takes place through this relatively new medium, there also has been a significant increase in research on virtual communities, online relationships, and a variety of other aspects of computer-mediated communication (Matheson 1991; Walther 1996; Flaherty, Pearce et al. 1998; Preece 1999; Wright 1999; Wright 2000a, 2000b; Preece and Ghozati 2001; Walther 2002; Nonnecke, Preece et al. 2004). Studies of online communities have led to an increase in the use of online surveys, presenting scholars with new challenges in terms of applying traditional survey research methods to the study of online behavior and Internet use (Bachmann and Elfrink 1996; Stanton 1998; Yun and Trumbo 2000; Andrews, Nonnecke et al. 2003). Two forms of electronic surveys have emerged in the past 15 years (Andrews, Nonnecke et al. 2003): asynchronous e-mail surveys and synchronous Web-based surveys. The first asynchronous e-mail surveys date back to 1986 (Kiesler and Sproull 1986) and indicate that sending the survey to the participants and their responses to the survey occur at different times. They include responses either embedded directly within e-mail messages or attached as word documents. They must be manually transferred and entered into a digital storage. E-mail is a “push” technology that allows researchers to directly communicate with prospective respondents. The second synchronous Web-based survey, started around 1994 (Kehoe, Pitkow et al. 1997), signifies the survey available online enables the participants to respond immediately. This provides the ability to automatically verify and store survey responses using database technology and an HTML (hypertext markup language) user interface.

More than ten years of research resulted in suggestions and criteria for designing online questionnaires that collect reliable and valid data. “An accurate survey is one where the questions collect the data in a reliable and valid way. If the questions ask respondents things they do not know, then it can result in inaccurate data. Some additional things to consider about the relevancy and accuracy of survey questions are the ways in which the questions are written and their overall length” (SurveyMonkey 1999–2011). Iarossi (2006) suggests considering the following criteria:

• Address the wording style, type, and question sequence.
• Make the survey interesting and notice the survey length or how long it takes to answer the entire survey.
• When designing a survey, the author should try to put himself or herself “in the position of the typical, or rather the least educated, respondent” (Moser and Kalton 1971).

None of these efforts include maps; they are based on online questionnaires designed for the purpose of a survey. Until recently, creating and conducting online surveys was a time-consuming task requiring familiarity with Web-authoring programs, HTML code, and scripting programs. Today, survey-authoring software packages and online survey services make online survey research much easier and faster. One such example is SurveyGizmo (Survey Gizmo 2011) that offers easy and quick possibilities for designing online questionnaires. A simple version that can be used for research purposes is available online, free of charge. The advantages associated with conducting survey research online include access to individuals in distant locations, the ability to reach difficult-to-contact participants, and the convenience of having automated data collection, which reduces researcher time and effort. “Disadvantages of online survey research include uncertainty over the validity of the data and sampling issues, and concerns surrounding the design, implementation, and evaluation of an online survey” (Wright 2005).

Public Participation GIS

Public participation GIS has been extensively discussed since the mid-1990s by many pioneering researchers (Pickles 1995; Schroeder 1996; Rinner 1999; Talen 1999; Kingston, Carver et al. 2000; Al-Kodmany 2001; Basedow and Pundt 2001; Carver 2001; Jankowski and Nyerges 2001; Craig, Harris et al. 2002; Schlossberg and Shuford 2005; and Georgiadou and Stoter 2010).
It represented a novel idea in which a geographical information system (GIS) has been used as the main technology, extended by some public participatory functions. PPGIS aimed at advancing the level of citizens’ involvement into decision making in urban planning by using online, GIS-based, and interactive maps. One of the main ideas was to enhance the decision-making process and enable novel digital visualization possibilities. Craig and his coeditors (Craig, Harris et al. 2002) collected different methodologies and study cases in their book. Sieber (2006) provides a thorough overview of the contributions of a variety of researchers in this subject area, looking back at more than 15 years of research.

In PPGIS and other applications that facilitate map-based discussions, the communication between the citizens and decision makers is based on online maps. Rinner (1999, 2001, 2005, 2006) contributed an argumentation map model that models relations between geographic and opinion objects. Objects from the real world such as houses, trees, and canals are modeled as geographic objects; and the opinions of the citizens are modeled as opinion objects. The ideas presented in his conceptual model can be implemented in many different ways. In some cases, the citizens can send their annotated maps to the planning authority (Steinmann, Krek et al. 2004) or leave a comment directly on the online maps (Rinner 1999, Al-Kodmany 2001, Rinner 2005, 2006).

Some of the researchers took a very positive view on these new developments; for example, Schlossberg and Shuford (2005) state that “PPGIS represents a broad notion that the spatial visualization and analysis capacities inherent in GIS present a unique opportunity for enhanced citizen involvement in public policy and planning issues.” Thus, it can be used to augment traditional methods of participation such as public meetings (Steinmann et al. 2004: 1). The advantage of PPGIS for planners, often stressed by some of the researchers (Kingston, Carver et al. 2000), is that data collected online is georeferenced and easier to process and analyze than data that is collected from traditional public meetings. At a public forum, a note taker would have to record the comments or people would have to be surveyed using traditional telephone surveys or manual map making (Nasar 1998).

Several researchers focused on the analysis of functionalities integrated in PPGIS applications. Thompson (2000) concentrated on GIS and the possibilities it enables for data sharing. Basedow and Pundt (2001) analyzed the comments of an urban planning project and their spatial relation. Based on their results, they suggest that GIS functionalities are suitable for a map-based discussion. Haklay and Tobón (2003) looked at the usability aspects of PPGIS. Another analysis of the selected online PPGIS applications with the focus on the application’s functionalities was performed by Steinmann, Krek et al. (2004). In their research, the authors report on the complexity of the applications and the problems users might have while using them, which could possibly result in rational ignorance of the citizens, the concept suggested by Krek (2005). According to the rational ignorance condition, citizens decide to be irrational, ignoring, for example, an urban planning participation process because participating would require a high investment of time and effort to ascertain the current planning situation (Poplin 2011).

**Online Map-based Surveys**

Map-based questionnaires are a novel research area; there are only a few examples of research available. Sidman, Swett et al. (2005) developed a paper questionnaire that was sent to the participants of the survey in the mail. Their responses then were manually inserted into a GIS and later communicated to the focus group. The disadvantage of inserting the data from analogue questionnaires into a GIS is that it requires additional time and effort for this activity. Several errors are possible with this process: not intended omissions of the data drawn on the paper map, imprecise input of the data into the computer-based system, false interpretation of the data inferred from the paper map, etc.

One of the first experiments with an online map-based survey was undertaken by Al-Kodmany (2001) and his colleagues at the University of Illinois at Chicago (UIC). They developed a Web-based map survey tool that was linked to a GIS through a server. It aimed at advancing a community-planning process and was based on the theories provided by Lynch (1960) and Nasar (1998). They emphasized the importance of discovering how city design affects citizens. The main goal of the online survey was to collect local spatial knowledge about the Pilsen community in Illinois. It was based on interactive online maps displaying an aerial picture with a grid and enabled two-way communication with the citizens of this community. “The project advances the prospect of allowing citizens to comment, using Web-based maps, upon government actions and development proposals” (Al-Kodmany 2001: 332). The researchers at UIC focused on the evaluation of the appearance of their community by asking what particular places the citizens like and dislike. “Once all responses were received, two composite GIS maps were created—one showing the areas of the community that were liked and the other showing areas of the community that were disliked” (Al-Kodmany 2001). A GIS program was used in the later stages for analyzing the participants’ data and its integration with other GIS layers. In the summary of the ways to improve the tool, Al-Kodmany (2001) and his colleagues suggested improving the “optimum” map design/survey tool to further explore how different map designs could lead to different kinds of information. This would provide some kind of feedback to the respondents and expand the tool to provide a larger geographic area. They suggested exploring and possibly including some established survey standards.

A practical integration of a questionnaire and a map also can be seen in the example of the land-use planning for the city of New Orleans. The citizens are invited to respond to the question “What do you think?” Six detailed questions are described on the Website (http://www.nolamasterplan.org/whatdoyouthink.asp) and three of them are linked with a map. The displayed maps are static and do not enable any interactive communication with the participants. One of the main disadvantages of this Website is that there is no direct possibility to answer the questions on the
Website and to deliver the opinion about the issues in question. The attached maps are static and do not allow for any interaction with the map content.

**STUDY CASE AND GOALS OF PUBLIC PARTICIPATION IN WILHELMSBURG**

**Project Background**

The research presented in this article was accomplished within the research project SWITCH, founded by the European Commission. SWITCH stands for Sustainable Water Management Improves Tomorrows Cities Health (www.switchurbanwater.eu). The project focused on innovative water management for the city of the future. Its aim was to initiate a paradigm shift in urban water management from existing ad hoc solutions to a more coherent and integrated approach. One of the key features of the SWITCH methodology was an establishment of city learning alliances. These were groups of interconnected people that typically included public sector, private sector, and civil societies. The project started in 2006 and was completed in 2011. More than 33 partners from all over the world were involved in SWITCH; the HafenCity University Hamburg (HCU) and the Technical University of Hamburg-Harburg were research project partners. HCU proposed the city of Hamburg as one of the study cases in the SWITCH project. The city of Hamburg is home to more than 1.8 million people, and it is situated on the Elbe River in north Germany. The port of Hamburg is the second largest (after Rotterdam) in Europe and handles approximately 10 percent of Germany's foreign trade. The urban development of the city mainly concentrates on the south of the city, in particular on the river island of Wilhelmsburg (see Figure 1). In 2006, Wilhelmsburg was selected as the main study case in which the researchers concentrated on the analysis of the environmental quality of the water system as well as potential risks and water problems related to global environmental change. A new innovative water-management approach was needed that would be able to combine new water-management techniques and modern urban planning, as well as to support a more efficient water-management system.

**Study Area: Wilhelmsburg in Hamburg, Germany**

Wilhelmsburg is situated on the homonymous island between the northern and southern branches of the Elbe River, south of the city center of Hamburg (as shown in Figure 1). The largest inhabited river island in Europe, it is characterized by a number of expanses of water with diverse water canals. Figure 2 shows the canal scenery in Wilhelmsburg with typical architecture in the background. Many parts of Wilhelmsburg are below the water level of the Elbe River, which is the reason for drainage channels in this area. The district is located close to the harbor of Hamburg and is surrounded by docks and waterways as well as by the riverbanks of the Elbe River. Currently, it is the focus of various planning initiatives in Hamburg.

Wilhelmsburg developed from a rural community into an important industrial and residential district at the end of the 19th century. The result of this development is a patchwork of different land uses, including port areas, areas with one-family houses, agricultural land, allotments, and nature-conservation areas. After the flood in 1962, the economic and social situation of Wilhelmsburg declined because of the lack of maintenance of the buildings and structural changes in the harbor. Today, Wilhelmsburg is a socially disadvantaged neighborhood, with low income levels, a high unemployment rate, a high number of Social Security benefit recipients, a large migrant population, and a low level of education. In 2010, according to the statistical office of Hamburg and Schleswig-Holstein (Dickhaut, Hoyer et al. 2006), the city district of Wilhelmsburg had 50,250 inhabitants, of which 33,365 are Germans and 16,885 are foreign. It covers,
is 134 per 1,000 inhabitants. In total, 6,698 crimes were recorded in 2010, which in total, an area of 55.3 square kilometers (14 square miles), with a population density of 1,419/km². In 2010, there were 3,961 jobless inhabitants in this city district and 12,775 receiving Social Security. Average housing size was 67.7 m², which is 28.1 m² per inhabitant. In total, 6,698 crimes were recorded in 2010, which is 134 per 1,000 inhabitants.

Learning Alliance Organized in Wilhelmsburg

To comply with the methodology proposed within the SWITCH project, a panel called the Learning Alliance (LA) was established in Wilhelmsburg. Its main role was to work on the design of an integrated urban water-management system. Initially, in 2007, the LA consisted of a rather small “core” group of urban planners, researchers, ministers such as the Ministry for Urban Development and Environment, and nongovernmental organizations such as the Chamber of Commerce of Hamburg, the District Advisory Urban Development Committee of Wilhelmsburg, and the Union for Environmental Protection and Conservation of Hamburg. The research involved the partners HafenCity University Hamburg (HCU) and the Technical University Hamburg-Harburg. Since its initial formation, the membership has expanded to also include people interested in nature conservation in Wilhelmsburg and various citizen groups representing the needs of the inhabitants. Figures 3 (left) and 4 (right) show the members of the LA at a workshop, discussing ideas about the future development of Wilhelmsburg.

HafenCity University Hamburg was one of the members of the LA and played a key role in coordinating and managing the alliance. The research conducted by HCU was accomplished by two groups located in two different university departments. The first research group focused on the Water Sensitive Urban Design and concentrated on the combination of technical water-management problems (flood risks, stormwater management, etc.) and urban planning demands (water as an element to develop attractive locations, planning in urban transformation processes, etc.). The second group, under the leadership of the author of this article, worked on the design and implementation of an online map-based participatory process, which enabled collecting additional digital data needed for the Water Sensitive Urban Design. Both groups first focused on the analysis of the current use of the canals in Wilhelmsburg, the inhabitants’ wishes for their use in the future, and the possible conflicts between the naturally protected areas and the areas used for the inhabitants’ activities.

RESEARCH GOALS OF THE WEB-BASED PPGIS FOR WILHELMSBURG

Goals of Public Participation in Wilhelmsburg

The first goal of public participation executed in Wilhelmsburg aimed to understand possible conflicts in land use between the naturally protected areas and the needs and wishes of the inhabitants of Wilhelmsburg for recreational places. Some of the canals, especially in the southern part of Wilhelmsburg, are defined as protected nature areas. The inhabitants and visitors are not allowed to use these protected areas for recreational or social activities such as barbecues, canoeing, or swimming. The regulation that prevents recreational use of these protected areas can possibly conflict with the wishes and needs of the inhabitants and visitors. The questions of interest to the urban planners, the alliance, and the HCU Hamburg researchers were: How are the canals used in Wilhelmsburg? What kind of activities are performed along the canals? How are the recreational areas along the canals used? What particular wishes do the inhabitants have related to the canals? What is their perception of the protected areas in Wilhelmsburg? The second goal was to determine the wishes of the inhabitants about the possible future use of the canals. How would the inhabitants like to use the canals in the future and for which activities in particular? The third goal was to use the results of the public participation process executed in Wilhelmsburg for the concept of Water Sensitive Urban Design. The state-of-the-art land use, the actual use of the canals, and the wishes of the inhabitants about the future use of the canals were inserted into ArcGIS. The result was a GIS-based analysis of the study area in Wilhelmsburg.

Technical Requirements

The main idea was to design a participation platform that would enable the users to directly interact with the maps. In this way, they could directly insert their information related to the use of canals and waterways in Wilhelmsburg. The main technical requirements for the Web-based PPGIS created for Wilhelmsburg application were:

- Web-based and available online during the participation process to all inhabitants of Wilhelmsburg;
- GIS-based, to enable the researchers to store the acquired data in a common database and combine it with the data gathered from other data sources;
- Interactive, to enable the inhabitants to interact with the online maps and insert their information directly into the system;
- Usable and designed in such a way that diverse users from Wilhelmsburg, some of them not skilled in GIS, can use it; 
• Functional and operational, to be used for the execution of a real participation process and not designed solely for research purposes;
• Based on an open-source technology, because of the limitations of the budget available for the implementation of the application.

Research questions related to the technology were: Which combination of the open-source technology could enable the implementation of such applications? How should it be designed to attract various inhabitants from Wilhelmsburg to participate?

**Design of the Online Questionnaire Interlinked with GIS Maps**

One of the main research goals was to explore integration and implementation of an online questionnaire interlinked with online interactive GIS maps. In our research of the previous work of map-based online questionnaires, we were not able to find any directly comparable example. The research as presented in this paper is novel because it directly interlinks the online questionnaire with online interactive GIS-based maps. The data inserted by the inhabitants is stored directly in a GIS database on the central server. The research questions included the following:

- How should an online questionnaire be designed to collect reliable and valid data?
- Which questions can be linked with a GIS online map, and how should these questions be designed to be clear and understandable possibly to all participants in the participation process?
- How can the data be inserted in the interactive GIS map and saved in a common database?
- Which drawing functionalities can be included and how should they be designed to be clear and understandable possibly to all participants in the participation process?
- How should the user interface be designed to attract as many participants as possible?

We strived to design simple and short questions that could be easily understood by the participants. After designing the first set of questions, we tested them in an offline survey. We collected the feedback from five inhabitants who responded to the first set of questions in person. We executed a pilot study with five inhabitants interviewed in a field survey in Wilhelmsburg. In these interviews, we aimed to check if the designed questions could be understood by a variety of possible potential users of our application. After the pilot study, we revised the questions according to the feedback and came up with the final version of the questions, which was later integrated into the online survey.

**IMPLEMENTATION OF THE WEB-BASED PPGIS**

**Entrance Page**

The entrance page of the Web-based PPGIS for Wilhelmsburg is designed in a simple way. It is available at [http://digimap.hcu-hamburg.de/wilhelmsburgamwasser](http://digimap.hcu-hamburg.de/wilhelmsburgamwasser) and implemented in the German language (see Figure 5). At the top of the page, the participants can see the logo in blue and green colors, indicating the main topics of the survey: the water and canals (blue) and naturally protected areas (green). The question “Wie wollen sie die Wilhelmsburg gewässer gerne nutzen?” translated into English: “How do you want to use the waters/canals in Wilhelmsburg?” aims to invite participants to participate in the survey.

The left side of the entrance page includes three blue buttons, which help the participants navigate among the sections Home, Information, and Contact. The Home section explains the goals of the designed Web-based PPGIS for Wilhelmsburg. It provides the information about the duration of the survey, which is estimated at 20 to 30 minutes. It includes a direct link to the survey and invites the inhabitants of Wilhelmsburg to participate in the survey. The Information section provides some basic information about the SWITCH project and the link to the official SWITCH Website. It explains the main goals of public participation in Wilhelmsburg and provides three pictures of Wilhelmsburg to illustrate the case study. The Contact section provides information about the two involved research groups at the HafenCity University Hamburg and their contact information.

**Design of the Map-based Online Questionnaire**

The questionnaire includes 26 main questions displayed online on 26 Web pages. It starts with two questions related to the gender and age of the participant. Some researchers (Thielsch and Weltzin 2009) suggest to include such questions at the beginning of the online questionnaire in case of a possible high dropout rate.
This design later enables researchers to analyze who dropped out and when. In our case, the participants could select among the suggested categories:

- Gender: Male or female
- Age category: Under 25 years, 25–40 years, 41–60 years, more than 60 years old

The second page includes a question that is linked to the GIS-based interactive map (shown in Figure 6). The question is displayed on the top of the Web page and continues with the question “Do you take walks along the canals in Wilhelmsburg?” Two answers are possible and the Website explains what to do in each of the two cases:

- If yes, then draw three lines along those canals where you take a walk.
- If no, choose the button “weiter”/“continue” and continue with the online survey.

A short text gives instructions on how to draw the lines, instructing the participants to use the icon with the pencil and draw the line with it. Participants can complete drawing a line with a double-click. They can draw up to three lines, which appear in three different colors. If they click on the globe icon, they can freely explore the map. With the icon plus top right on the Website, they can change the view from a map to a satellite image and turn the layer with waters on or off.

The following three questions (3 to 5) have the same structure as the set questions and are all related to the interactive GIS-based map displayed under the question:

- Do you ride a bike along the canals in Wilhelmsburg?
- Do you walk your pet along the canals in Wilhelmsburg?
- Do you use the canals in Wilhelmsburg for boat trips?

The questions 6 to 11 require inserting points instead of lines. The points can be inserted with the three pencils visible on the left side of the Web page (see Figure 6), used in the same way as the lines. It is possible to insert up to three points on the map. The explanation of how to draw the points of interest is displayed below every question.

- Do you grill or barbecue along the canals in Wilhelmsburg?
- Do you fish in the canals in Wilhelmsburg?
- Do you swim or bathe in the canals in Wilhelmsburg?
- Do you observe the nature at the canals in Wilhelmsburg?
- Is there any activity, not mentioned yet, that you might do at the canals in Wilhelmsburg? If yes, please enter the activity and draw the sites of this activity at the canals in Wilhelmsburg.

The next question, 12, enables a participant to draw/designate one point on the map representing the favorite or most beloved place in Wilhelmsburg (see Figure 7). Two additional questions are related to the qualities of this place and the activities of the participant at this place. Question 12 consists of the following three questions (Figure 7):

- Which is your favorite place in Wilhelmsburg?
- What do you particularly like at this place?
- What do you usually do at this place?

The following set of questions is related to the future use of the canals in Wilhelmsburg. If you would like to take walks,
walk your pet, make boat trips, grill/barbecue, fish, bath or swim, observe or enjoy nature, or exercise in the future along different canals in Wilhelmsburg, please draw them on the map. These are questions 13 to 21. The last one in this set, 22, includes:

Is there any other way/activity in which you would like to use the canals in Wilhelmsburg in the future? Please describe and mark the places on the map.

The next three questions address possible issues related to the protected nature areas.

• Can you imagine that certain activities should be restricted to certain places? If yes, please explain why. If no, please explain why.

• Which natural areas in Wilhelmsburg do you consider especially worth protecting? Mark three places on the map. Please explain why you find these places particularly worth protecting.

• How clean or dirty do you find the water in the canals in Wilhelmsburg? Mark on the scale from 1 (very clean) to 5 (very polluted). Which of the canals do you find the most polluted? Please mark them on the map.

The last set of questions is related to the place of residence of the participant.

• Do you live in Wilhelmsburg?

• How long have you lived in Wilhelmsburg?

• Please mark your home district on the map.

• How did you get to know about this participatory process and our online survey?

• Here is a place for your comment. Is there anything else you would like to share with us?

The questions were designed so that the citizens could answer them or skip those that they did not want to or could not answer. Skipping a question or several questions did not prevent them from continuing the participation. With this strategy, we aimed to allow the participants to answer the questions that were of interest to them.

### Design of the Interactive Maps

The design of the interactive map includes the design of the map itself and the design of the user interface, including the basic functionalities needed for the interaction with maps. The basic maps were taken from Google Maps, which were combined with the specific data related to Wilhelmsburg and gathered within the project SWITCH (shown in Figure 8). The maps combine the following data sources: a Google map, a Google hybrid map, and a layer with the canals in Wilhelmsburg acquired within the SWITCH project.

The interactive maps were integrated into the Website (http://digimap.hcu-hamburg.de/wilhelmsburgamwasser) with the open-source technology OpenLayers (OL). OpenLayers enables the display of data sources such as Google Maps, Bing Maps, Yahoo, Open Street Maps, as well as data coming from Web Map Server (WMS) or Web Feature Server. It provides interactive maps with standard navigation functions such as zoom and pan. We developed two different modes: the navigation and the edit mode. The navigation mode enables respondents to zoom and pan to the area of interest and to switch the layers with geographic information turned off and on. The edit mode enables them to add points or lines on the displayed map. The participant can switch between the two modes selecting either the globe icon for turning on the navigation mode or the pencil icon for the edit mode.

In the online map-based questionnaire, the participant has the possibility to construct up to three geometries for each question in the corresponding map. The geometries offered, depending on the question, are points or lines. Figure 8 shows three pencil geometries: dots for points, lines for lines, and lines for areas.
icons enabling the participants to draw up to three lines. Every button uses a different color for the line or point drawn on the interactive map.

Enabling Technology and Technical Architecture
The online map-based survey was implemented in a classical client-server architecture using standard Web 2.0 technology (see Figure 9). The HCU DigiMap server was based on the virtual system VSphere provided by VMWare. This system enabled us to host a virtual server independent from the hardware. The operating system was a Linux-System Ubuntu 10.04 LTS (Lucid Lynx), and for the HTTP-Server we used Apache 2 from the Apache Software Foundation.

To be able to provide the Website with a high degree of participants’ confidence and comfort, we integrated the content management system (CMS) Typolight 2.8 providing the HTML pages. The questionnaire templates were embedded in the CMS. Typolight 2.8 is an Open Source CMS and is shipped with a support for a variety of templates; it is php-based and provides templates and architecture for the map-based survey application and related Javascript libraries. The template support of the CMS did not include any support for the integration with the interactive maps; therefore, we used the Open Source Javascript library and OpenLayers to develop the interactive maps.

The interactive maps were embedded in the forms of Typolight using the HTML-form field support of Typolight. We integrated MySql 5.0 database, which stores the Typolight system data and the user input data gathered by the questionnaire. The application does not include any direct traffic between the client and the database. All input data is sent to the HTTP server and afterwards transported to the database by Typolight. This means that the participant using the application on his or her browser does not need any permission for the access of the data in the database. All communication with the database is between Typolight and MySql on the server side. This solution enables a better security and protection of the data given by the respondents of the survey. This, therefore, is designed in a rather simple way, being able to use and integrate the input from the respondents, using a variety of different browsers such as FireFox, Internet Explorer, Chrome, Google, Safari, etc.

<table>
<thead>
<tr>
<th>Table 1. Gender and age of the participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
</tr>
<tr>
<td>Gender (Together)</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td>Age (Together)</td>
</tr>
<tr>
<td>Under 25</td>
</tr>
<tr>
<td>25–40</td>
</tr>
<tr>
<td>41–60</td>
</tr>
<tr>
<td>Above 60</td>
</tr>
<tr>
<td>No response</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Responses related to the activities of the participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
</tr>
<tr>
<td>Take a walk</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Ride a bike</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Walk a pet</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Boat trips</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Grill/barbecue</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Fishing</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Swimming, bathing</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Observing nature</td>
</tr>
<tr>
<td>No answer</td>
</tr>
<tr>
<td>Sports</td>
</tr>
<tr>
<td>No answer</td>
</tr>
</tbody>
</table>

RESULTS OF THE ONLINE PUBLIC PARTICIPATION

Execution of the Participation Process
The online PPGIS for the Wilhelmsburg application was completed in May of 2010 and available online until the end of July of 2010. The second group of researchers from the HCU needed the results in August of 2010; therefore, we had six months available for the development of the PPGIS and a relatively short period for the execution of the participation process. The Learning Alliance and the HafenCity University Hamburg (HCU) advertised the designed online PPGIS for Wilhelmsburg and the possibilities for the inhabitants of Wilhelmsburg to express their opinions about their city district. Specially designed flyers were created and sent to all households in Wilhelmsburg. Posters designed for advertising the Website were placed in the public buildings in Wilhelmsburg and at HCU. A special-interest group was created on Facebook where we advertised the implemented PPGIS for Wilhelmsburg and invited interested inhabitants to participate. After two months of advertising activities, 98 citizens visited the online PPGIS for the Wilhelmsburg platform. Following is a summary of results gathered in the online participation process.
Age and Gender of the Participants
All together, 98 inhabitants entered their opinions via online PPGIS for Wilhelmsburg. Ninety-eight inhabitants answered at least one of the questions in the survey. All answers to the questions were registered in the central database and were considered valid. The analysis was conducted separately for every question. Thirty-eight female and 49 male inhabitants started the survey and answered the first question related to the age and gender. Eleven participants decided not to answer this question. The majority of the participants were between 25 and 40 years old (46 percent), followed by participants between 41 and 60 (19.5 percent), younger than 25 years (18.5 percent), and 4 percent were older than 60.

Summary of the Responses to the Questions
The online responses related to the current activities along the canals in Wilhelmsburg are summarized in Table 2. The majority of the participants enjoy most taking walks along the canals, riding a bike, or swimming.

In the future, the participants would like to take walks along the canals (16 participants), bike (9), walk a pet (1), boat trips (6), barbecue (8), fish (1), swim (9), observe nature (8), sports (3). Only 10 participants, which represents 10 percent, agree with additional regulations for natural protection, and 11 are against (11 percent). The water in the canals was evaluated on the scale from 1 (very clean) to 6 (very polluted). The majority of the participants (13 percent) evaluated it at 4.

Responses to the GIS Maps
The responses on the interactive GIS maps were collected in a common database. Figure 10 shows all data entered by the 98 inhabitants in the online PPGIS for Wilhelmsburg. Answers to every question were combined and saved as a separate layer. This map shows all entered lines and points. The darker lines are the most preferred paths along the canals.

Further analysis of the collected material revealed that the recreational activities on the one side and the high ecological value of the canals on the other side provoke conflicts based on concurring and conflicting demands. Based on the results of the questionnaire and mapping of the canals, strategic directions were developed.
within the project SWITCH to improve the actual management of the canals, aiming toward sustainability and an improved balance of the concurring demands, needs, and restrictions.

DISCUSSION AND RESEARCH PERSPECTIVES

Design of Online Interactive Maps
The maps designed for the PPGIS for Wilhelmsburg are based on Google Maps. The layer with the canals was generated within the SWITCH project. We tried to integrate data coming from these two different sources. The layer with the canals is displayed on the top of the layers, representing streets and bridges (see Figure 11). Figure 11 shows inconsistencies in data quality and compatibility that are marked with circles. The bridges and parts of the streets are missing. The integration of additional datasets with Google Maps was relatively easy to implement, but we were not able to solve data inconsistencies in the relatively short time of the project duration of six months.

In designing the concept of PPGIS for Wilhelmsburg based on Google Maps, we assumed that many online participants are familiar with Google Maps and interact with them. In further research of Web-based PPGIS applications integrated with a questionnaire, it would be interesting to evaluate the usability of these maps and the participants’ literacy related to the use of Google Maps in general. Further research should investigate if alternative visualizations could potentially lead to better results with fewer inconsistencies in the datasets.

Navigation and Edit Mode
Drawing the elements on the maps required a switch between the navigation and the edit mode. The explanation on how to do that was given below every question in the questionnaire. Despite this explanation, the participants had problems switching between these two modes. Figure 12 shows one of the lines that makes no particular sense; it is marked with the black arrow on the image (it is a straight line in the middle of the map). Such lines demonstrate the inability of some participants to delete the lines and/or switch between the navigation and the edit mode.

On the basis of the entered data, we can assume that the need to switch from one to the other mode was not self-explanatory. The other possibility for such results could be the inability of the participants to find the delete function or to finish the drawing operation. To be able to finish the drawing of the line, the participants had to use their right button on the mouse and click it once. This function is often used by skilled GIS users, but the users of other software programs might not know it.

Dropout Rate
Online questionnaires often face a problem of a high dropout rate (Thielsch and Weltzin 2009). The dropout rate is the number of participants who exit the questionnaire without completing it. It is a specific problem of online questionnaires because online there are no interviewers that lead the interview and are able to motivate people to complete the tasks and answer all the suggested questions. In our application, the majority of users dropped out when they had to start using the online interactive GIS map. While the first question about the age and gender was responded to by 87 inhabitants, only 38 responded to the second question asking them to draw a line of the walks that they take along the canals in Wilhelmsburg. We can clearly see that this most likely represented a barrier that was set too high for many participants in our online survey. Another reason for some people dropping out might be the length of the questionnaire. Additional research is needed to understand the reasons for such behavior and to relate it to the other computer skills, age, gender, or educational background of the participants. Additional research also should investigate the techniques and strategies for lowering the dropout rate. Also a dynamic help integrated within the application and a feedback could possibly improve the dropout rate. Al-Kodmany (2001: 339) recommends: “Have the survey tool return feedback to the respondent.” A feedback given to the participants could motivate them to continue with their activity.

Suggested Improvements of the PPGIS for Wilhelmsburg
Suggested improvements of the implemented PPGIS for Wilhelmsburg and similar applications include the following:

• Drag an element to the point of interest: With this method, a point of interest could be placed on the exact location on the map. The elements that could be possibly dragged on the map could be suggested by the application. An example for a question where this function is suitable is “Where would you like to have trees planted?” The participant has a choice of the icons for different kinds of trees and is able to drag them on the map to the point desired. In this way, the participant has the chance to decide which tree he or she wishes to place where and how many.

• Mark the element on the map: An additional layer with clickable elements could be added to the map that would allow less experienced participants to point to the graphical element on the map. Participants asked to choose a canal (line) or a region could click on a line or polygon to mark it. A question for this kind of input could be “In which city district do you live?” Al-Kodmany and his colleagues (2001) used this kind of method in their “Web map-survey.”

• Marker including text comments: The participants place a marker, e.g., a small flag, somewhere on the map and add a comment to this flag. This is a popular method often used within Google Maps.

• Sketch function: A drawing tool that would allow the participant to draw on the map using different colors and line types. Asking rather “how” then “where” this tool is an option for some skilled participants. The results might not
be analyzed automatically in an easy way, but would have to be evaluated qualitatively.

• Barrier-free Web-based PPGIS: Barrier-free Web was suggested by the World Wide Web Consortium (W3C) under the Web Accessibility Initiative. The main objective of the W3C is to make the WWW accessible to as many people as possible. This refers to people with different disabilities, for example, who are not able to work with an ordinary keyboard or, instead of a screen, need a different depiction of the content. Additional research needs to be conducted in defining what a barrier-free PPGIS application is, how can it be defined, designed, and implemented. When can a PPGIS be barrier-free and how can we achieve a self-explanatory stage in which all users understand the functionalities of the application?

To make the PPGIS for the Wilhelmsburg application easier to operate, it would be helpful to make drawing possible without switching between the two modes. In the future, the buttons included should be tested also by their affordance capabilities. Gibson (1977, 1979) defines affordances as “action possibilities” latent in the environment, objectively measurable and independent of the individual’s ability to recognize them, but always in relation to the individual and, therefore, dependent on the individual’s capabilities. In more simple words, an affordance is a quality of an object or an environment that allows an individual to perform an action. For example, the chair affords to sit on it; the button in an online application affords to draw a line.

Conclusions and Further Research Directions
In the research presented in this article, we concentrate on the implementation of a PPGIS for Wilhelmsburg. We explored the possibility of combining interactive online GIS maps with an online questionnaire. After the implementation of the application and completion of the research, we conducted a usability test of the PPGIS for Wilhelmsburg. During the intense phase of the work on the project, the implementation of the PPGIS for Wilhelmsburg, and the pressure to gain the opinions from the inhabitants of Wilhelmsburg on time, there was not enough time to conduct a usability study prior to the execution of the participatory process. The usability study was conducted separately as part of the lecture on usability testing and conducted with 29 students of urban planning from HafenCity University Hamburg. Their responses indicate that “How to draw a line . . .” was “not at all clear” or “not clear” for 31 percent of the students and “To finish the line . . .” was very difficult or difficult for 39 percent of the urban-planning students. These students represent a young generation that is used to searching on the Internet and using Google Maps, etc. Despite our assumptions that the included functionalities represented standards in using online interactive maps, we seemed to overestimate the online map literacy of the participants in the online participation process in Wilhelmsburg. The students’ answers on the questions related to the difficulty in using some of the functionalities show that 31 percent to 39 percent of them had problems with some of the functionalities included in the PPGIS for Wilhelmsburg.

These results clearly demonstrate the need for additional research in the area of PPGIS and its use in public participation processes. Several research questions are worthwhile to explore further and are part of our broader research agenda. These questions include the following:

• How should the maps be designed to be better accepted by the participants?
• How to enable an easy and pleasant interaction with maps?
• How to integrate functionalities that seem easy to use to a variety of users?
• Which elements of the application can result in positive feelings while using them?
• How to design maps for mobile public participation applications?

One of the interesting research questions is “How to design the user interface to improve the affordance?” Norman (1988) discusses the design issues in his earlier book titled The Design of Everyday Things. Later, he explored the characteristics of the emotional design (Norman 2004). According to him, there are three aspects of emotional design that need to be taken into consideration: visceral, behavioral, and reflective. The main idea is that emotions enable people to understand the world and learn about it in a particular way. For example, aesthetically pleasing objects appear to the user more effective. Our future research will deal with the design of the user interface and the buttons included in the user interface. How can they be designed in a more intuitive and aesthetically pleasing way?

Online games can possibly bring new dimensions and a novel approach in space representation, offering alternatives to maps. Especially, serious games (Abt 1970, Michael and Chen 2005, Zyd 2005) can contribute with their concepts and innovative ways of including stories and playful elements in the process of learning. How can they be integrated in online public participation processes? Usability and accessibility issues should have a high priority while designing map-based applications to attract as many participants as possible. Goodchild (2010) stresses the importance of the map design in the following way: “Now, more than ever, we need a technology of design that can work in tandem with human decision-making processes, bringing what we know about how the planet works to bear on the decisions that have to be made about its future.”

Acknowledgments

A special thank you to the SWITCH project for the funding of this research, our HCU partners Prof. W. Dickhaut and Mr. B. Weber for their support, and my assistant researchers M. Fessele, S. Schröder, and B. Weninger for their contributions in the development of the platform. Thank you to Stephen Poplin for his valuable comments and language improvements of this paper.
Alenka Poplin is an assistant professor at HafenCity University Hamburg, Germany. She has a Ph.D. in geoinformation science from the Vienna University of Technology and an MBA from Clemson University, SC. Her research interests include e-participation in urban planning, digital serious games for civic engagement, design of interactive online maps, and the user’s interaction with online maps.

Corresponding Address: HafenCity University Hamburg Winterhuder Weg 29 22085 Hamburg, Germany alenka.poplin@hcu-hamburg.de

References

Fessele, M., and Al Poplin. 2010. Quality of information collected with the help of online map-based questionnaires. REAL CORP 2011, 16th International Conference on Urban Planning and Regional Development in the Information Society GeoMultimedia 2011, Essen, Germany.


GIS/CAMA Technologies Conference  
Albuquerque, New Mexico  
March 4-7, 2013

19th Annual CalGIS Conference  
Long Beach, California  
April 15-17, 2013

URISA Leadership Academy  
San Antonio, Texas  
May 13-17, 2013

URISA’s GIS in Public Health Conference  
June 17-20, 2013  
Miami, Florida

GIS-Pro 2013: URISA’s 51st Annual Conference for GIS Professionals  
Providence, Rhode Island  
September 16-19, 2013

GIS in Public Transit Conference  
Washington, DC  
October 16-18, 2013

2013 URISA/NENA Addressing Conference  
Dates & Location - coming soon
Your Decisions Affect Theirs

Government decisions affect more than 300 million Americans a year. With Esri® Technology, you can connect with your entire constituency. Esri helps you demonstrate accountability, foster collaboration, and make the effective decisions that keep your constituents happy.

Learn more at esri.com/urisanews