Jan 2014. Vol. 1, No.3 ISSN 2311-2484
International Journal of Research In Earth & Environmental Sciences

http://www.ijsk.org/ijrees.html

PUBLIC PERCEPTION IN MONITORING ENVIRONMENTAL CONDITIONS USING GIS METHODS

Sigrid Hade[a] and Alvar Soesoo[b]

Tallinn University of Technology, Estonia
[a] E-mail: sigrid.hade@gmail.com
[b] E-mail: alvar.soesoo@gmail.com

ABSTRACT

Relationships between people and their environment have been examined in several scientific disciplines as in modern societies sustainable development and clean environmental usage is a key issue to support growing wealth and population numbers. A successful tool which allows matching qualitative and quantitative data with numerically immeasurable opinion of local people is called Public Participation Geographical Information System. We use this tool in Pakri peninsula, Estonia, to show how this method can be used in assessment of landscape changes, environmental pollution and recreational qualities of the area. The Pakri Peninsula was chosen for a pilot study because of its sensitive environment and very complex and ambiguous natural, cultural, military and social history, including major impacts on local landscapes during the two last centuries.

KEYWORDS: ***GIS methods, environmental protection, public participation, Pakri Peninsula, Estonia***

INTRODUCTION

Environmental issues remain in focus of relationship between society and environment at present and in the future. Moreover, in modern societies sustainable development and clean environmental usage is a key issue to support growing wealth and population numbers. This in turn requires much better planning in landscape, natural resource and environment usage and better human population accommodation. The new approach should be able to grasp the relationship between a number of variables as a whole, taking into account the natural, historic, cultural, economic, and social factors, in conjunction with common human needs and environmental policies. A tool which allows matching qualitative and quantitative data with numerically immeasurable opinion of local people is called Public Participation Geographical Information System, or PPGIS (Sieber, 2006).

Relationships between people and their environment have been examined in several scientific disciplines in recent years in which the concept of land use and better planning has become central. New aspects and research methods are constantly introduced, and an integrated approach which includes examining the interchange between natural, physical, culture-historical and social factors and considers the social implications in environmental planning, has gained popularity (Cosgrove & Daniels, 1988; Jones, 1991; Bender, 1993; Duncan & Ley, 1994; Hirsh & O'Hanlon, 1995; Olwig, 1996; Cinderby, 1999; Granö, 2001; Peil, 2005; Hade et al, 2005; Brown, 2006; Couper & Miller, 2008; Brown & Weber, 2011; Brown, 2012).

The initial idea behind PPGIS was empowerment and inclusion of marginalized populations, who have little voice in the public arena, through geographic technology education and participation. PPGIS uses and produces digital maps, satellite imagery, sketch maps, and many other spatial and visual tools to change geographic involvement and awareness on a local level. With worldwide development of Internet, the Internet-based PPGIS becomes an affordable and accessible GIS tool for public engagement in many key issues

of environmental planning. Here we present a case study about Pakri peninsula, Estonia, to show how PPGIS methods can be used in assessment of landscape changes, environmental pollution and recreational qualities of the area.

PUBLIC PARTICIPATION GEOGRAPHIC INFORMATION SYSTEM METHOD

The term Public Participation Geographical 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 (Sieber, 2006). 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 or local society (see Dunn, 2007; Brown, 2005; Sawicki & Peterman, 2002 for a review of PPGIS applications and methods). However, the formal definition of PPGIS remains still nebulous (Tulloch, 2007) with use of the term PPGIS emerging in the United States, Australia 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 (see Rambaldi et al, 2006). PGIS is often 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/local peoples and the current distribution of wealth and political power. In contrast, PPGIS 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.

The public participation is a vital part of environmental planning. It is not only dealing with deliberate hearings, but also seeking and facilitating public involvement in planning topics and the decision-making process (Goodspeed, 2008). Effective participation is a two-way process that includes sending information out to the publics and getting back their ideas, concerns and thoughts. The resulting "map of public positions, attitudes and wishes" is a good base for democratic and scientifically settled planning activities.

How the method works? Mapping of landscape and environment values, pollution and other spatial attributes can be achieved using a number of different data collection methods: paper maps through mail surveys, electronic maps through the Internet, and structured interviews or facilitated group processes such as workshops. Each approach has its inherent strengths and weaknesses. Even though the paper GIS method is the simplest method for collecting landscape value information from the general public, it may be not the cheapest and fastest. Following the instructions provided with a paper map, participants place sticker dots (or use other markers) on a study area. The respondent's data on the maps are then digitized into a GIS. Structured interviews or facilitated group meetings can be done with either paper or electronic maps, but considerable human effort is required to set up the interviews or meetings. Electronic mapping via the Internet can have the shortest turnaround time but has the disadvantage of requiring prospective participants to have access to both a computer and the Internet. However, the internet questionnaire provides the participants an additional freedom of not disclosing his/her personality. The internet-based study can be implemented and completed using some digital map-based interface and data storing software. The Internet-based PPGIS method provides for rapid development and implementation of the studies at significantly reduced cost compared with a mail or workshop-based approach.

Once the spatial data are collected, the data can be analyzed using a variety of methods. The most useful starting point for analysis is to generate descriptive maps of topics under the questions (landscape values, special place locations, pollution etc.). The maps can be generated for each question/problem with different layers, if needed. The resulting maps can be analyzed by researchers and/or open for discussions by participants and other local society members for future elaborations and adequate decision-making. This is a good way to map the society's response to particular problems before the decisions are made.

The explosion in Internet mapping applications (including Google Maps and Google Earth) and virtual earth models has created an environment that should be favorable to the expansion of PPGIS methods in everyday life. However, the slow adoption of PPGIS methods by government agencies for regional and environmental planning does not appear technological but may reflect a lack of government commitment to public participation and two-directional consultation in general. The general 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 PAKRI PENINSULA CASE STUDY

Pakri Peninsula was chosen for a pilot study because of its sensitive environment and very complex and ambiguous natural, cultural and social history, including major impacts on local landscapes during the two last centuries. Several projects have been launched on the Pakri peninsula in recent years, but there is still lack of reliable and unified understanding how the recent changes affect local perception (Hade et al, 2005).

Pakri peninsula is situated in the northwestern part of the Estonian mainland, Harjumaa County, between the Lahepere and Paldiski Bays of the Baltic Sea. The length of the peninsula is about 12 km, the width is 5 km, and the area in total is ca 35 km^2. Geologically, Pakri peninsula is a plateau which is bordered by the Ordovician and Cambrian limestone and sandstone outcrops. The highest part of the limestone cliff on the Cape Pakri is about 25 m above the sea level. The relief of the peninsula is flat, with some ice-edge formations, like ridges and moraines. The Quaternary cover is mainly gravel with thickness ranging from some centimeters to some meters. The Pakri peninsula is a colorful example of the northern coast of the North-Estonian Klint with its peculiar landscapes. The peninsula is edged by a klint escarpment, thus being one of the most remarkable klint sections of the entire Baltic Klint (Soesoo & Miidel, 2006). The northwestward rising limestone plateau of the klint peninsula is nearly 25 m high at the northern tip of the peninsula (Cape Pakri) and as high is the bordering escarpment. From west of Paldiski, up to Kersalu in the east (for 18 km in total), the klint peninsula is bordered by a 2–24-m-high escarpment. Five separate coastal cliffs are differentiated here: Paldiski, Uuga, Pakerort, Leetse and Lahepere.

Historically, the deep and wind-sheltered Paldiski Bay has attracted seafarers already since the times of the Vikings. In the 17th century, the Swedes established a sea fortress. Peter the 1st planned to build a giant military port of Rogerwiek here. Construction of the port started in 1716. Despite the efforts of thousands of convicts, the planned 2-km-long giant facility was not completed and later the completed part was quite soon destroyed by autumn storms. In 1762, Catherine II renamed the sea fortress of Rogerwiek to Baltiiski Port. The precipices and hills preserved from the fortress at the northern edge of the town are popularly known as the Peter's Fortress or Muula Hills. After the town came into the possession of Estonians, it was renamed as Paldiski in 1920. In May 1940, civilians were deported from both the Pakri peninsula and Pakri Islands were to build Soviet military facilities here. In 1941, the area was occupied by the Germans, who burned down the town and the port at their withdrawal in 1944.

In the post-war period, the Pakri peninsula and Paldiski town were the military sites of the Soviet Army. In 1962, Paldiski became a Soviet Navy nuclear submarine training center. Two PWR type nuclear reactors, 70 and 90 MW in output power, were used for training in safe operations of the nuclear Delta and Echo class submarine propulsion systems. With two land-based nuclear reactors, and employing some 16,000 people, it was the largest such facility in the Soviet Union. Because of its military importance, the whole town was closed off with barbed wire until the last Russian warship left in August 1994. Apart from two submarine hull sections, several other pollution-related facilities existed on the site, including liquid waste storage and treatment facilities.

The initial study was carried out in 2003 and followed by second study in 2010. The geographical map based questionnaire was used in both as printed and web-based forms. People living in Paldiski town and on the Pakri peninsula were eligible to fill out the forms. Majority of local population preferred the web-based questionnaire.

After defining anonymously person's sex, education and age, the participant moved to a set of maps where by using the paintbrush tool (in web-based version) or color pencils (in paper version) he or she could give answers to the questions which included the following topics:
Where are located the most polluted areas in the peninsula? Where has the landscape changed most during the last decade in the peninsula? Which places do you prefer in the peninsula for recreational activities/free time?

Separate maps were painted according to person's knowledge and preferences. Then the printed maps were digitised. In the Adobe Flash Web-based interface the coordinates of painted sections were recorded and saved in MySQL backend database in the server with *php* scripts. By digitally summarizing all (answered) maps sheets, the resulting maps showed in colour grades the topical perception of local people (see Fig. 1).

Figure 1 exemplifies the local perception of the question/problem – "Where has the landscape changed most during the last decade in the peninsula?" As seen, the drastic changes happened before year 2000 and in early 2000, while 2010 results show already diminishing impact on the landscape (Fig. 1). This is also true for other environmental changes, including pollution. These results show that the major landscape change and environmental impact was related to the period when Soviet troops abandoned the area. However, the extent of environmental impact during the location of the Soviet military camp on the Pakri peninsula is unknown because the area was closed and no such studies were conducted. Likely, the period of 10 to 15 years is minimum time to get first results on land and environment rehabilitation and, thus, change the perception of local people.

CONCLUSIONS

Environmental issues remain in focus of relationship between society and environment. A new approach is needed to assess all social, ecological, economic and natural variables in community decision-making process. A tool which allows matching qualitative and quantitative data with numerically immeasurable opinion of local people is called Public Participation Geographical Information System, or PPGIS. Pakri peninsula was chosen for a pilot study because of its sensitive environment and very complex and ambiguous natural, cultural and social history, including major impacts on local landscapes during the two last centuries. The initial study was carried out in 2003 and followed by a second stage in 2010. The geographical map based questionnaire was used in both printed and web-based forms. The results were summarized as colour-graded maps showing perception of local people in environmental pollution, landscape change and recreational domains. This is a suitable way to map the society's response to particular problems before making the local and regional decisions.

ACKNOWLEDGEMENTS

This study was supported by the Estonian Ministry of Education and Research target research project no. SF0140016s09.

REFERENCES

1. **Bender B.** 1993 (Ed.). Landscape: politics and perspectives. - Oxford: Berg Publishers.
2. **Brown, G.** 2012. An empirical evaluation of the spatial accuracy of public participation GIS (PPGIS) data. - Applied Geography 34, 289-294. DOI:10.1016/j.apgeog.2011.12.004
3. **Brown, G., Weber, D.** 2011. Public Participation GIS: A New Method for Use in National Park Planning. - Landscape and Urban Planning, 102(1), 1-15.
4. **Brown, G. 2006.** Mapping Landscape Values and Development Preferences: A Method for Tourism and Residential Development Planning. - International Journal of Tourism Research, 8(2), 101-113.
5. **Brown, G.** 2005. Mapping Spatial Attributes in Survey Research for Natural Resource Management: Methods and Applications. - Society & Natural Resources, 18(1), 1-23.
6. **Cinderby S.** 1999. Geographic Information Systems for Participation: the future
7. of environmental GIS? - International Journal of Environment and Pollution 11(3), 304-31.

8. **Cosgrove D., Daniels S.** 1988 (Eds.). The iconography of landscape: essays on the symbolic representation, design and use of past environments. - Cambridge: Cambridge University Press.
9. **Couper M.P., Miller, P.V.** 2008. Web survey medhods introduction. – Public Opinion Quarterly, 72(5), 831-835.
10. **Duncan J.S., Ley D.** 1993 (Eds.). Place/Culture/Representation. – London, New York: Routledge, 341 p.
11. **Dunn, C.E.** 2007. Participatory GIS – A People's GIS? - Progress in Human Geography, 31(5), 616–637.
12. **Goodspeed, R. C.** 2008. Citizen participation and Internet in urban planning (Master's thesis). - Retrieved from http://goodspeedupdate.com/wp-content/uploads/2008/11/goodspeedinternetparticipation.pdf
13. **Granö O.** 2001. The archipelago coast as a transitional zone between land and open sea – the origins and development of a research tradition grounded in the natural environment. - Publicationes Instituti Geographici Universitatis Turkuensis, 164, 11- 25 (in Finnish).
14. **Hade, S., Peil, T., Soesoo, A.** 2005. Maastikunägemus geoinfosüsteemi osana /Landscape as a part of geoinformation system/. - Estonian Social Science Online 3: Special Issue of the Estonian Social Science V Annual Conference. http://www.sotsioloogia.ee/esso3/15/sigrid_hade_tiina_peil.htm (in Estonian).
15. **Hirsh E., O'Hanlon M.** 1995 (Eds.). The anthropology of landscape: perspectives on place and space. - Oxford: Clarendon Press.
16. **Jones M.** 1991. The elusive reality of landscapes. Concepts and approaches in landscape research. - Norsk Geografisk Tidsskrift, 45, 229-44.
17. **Olwig K.R.** 1996. Recovering the substantive nature of landscape. - Annals of
18. the Association of American Geographers, 86(4), 630-53.
19. **Peil, T.** 2005. Estonian heritage connection: people, past and place: The Pakri Peninsula. - International Journal of Heritage Studies, 11, 57-69.
20. **Rambaldi G., Kwaku Kyem, A.P., Mbile, P., McCall, M., Weiner, D.** 2006. Participatory Spatial Information Management and Communication in Developing Countries, EJISDC, 25, 1, 1-9.
21. **Sawicki, D.S., Peterman, D. R.** 2002. Surveying the Extent of PPGIS Practice in the United States. – In: W.J. Craig, T.M. Harris, and D.M. Weiner (Eds.), Community Participation and Geographic Information Systems, London: Taylor & Francis, 17-36.
22. **Sieber, R.** 2006. Public Participation and Geographic Information Systems: A Literature Review and Framework. - Annals of the American Association of Geographers, 96/3, 491-507.
23. **Soesoo, A., Miidel, A.** 2006. North Estonian klint. - Tallinn: Geoguide Baltoscandia, 32 p.
24. **Tulloch, D.** 2007. Public Participation GIS (PPGIS). - In Encyclopedia of Geographic Information Science, SAGE Publications. http://www.sage-ereference.com/geoinfoscience/Article_n165.html

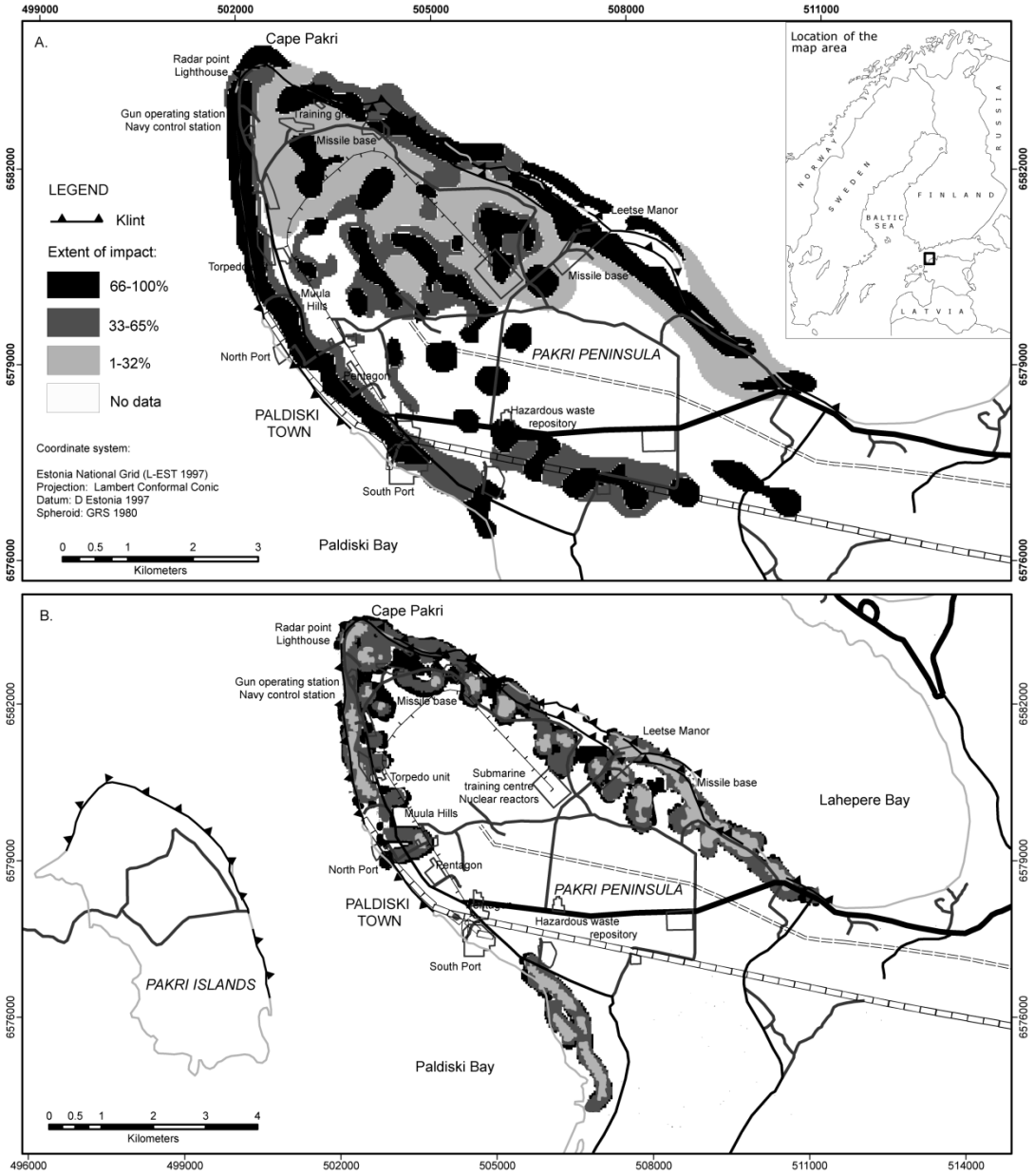

Figure 1. Resulting sketch-map of the public geographical map-based questionnaire showing local people perception to the question "Where has the landscape most changed during the last decade in the peninsula?" The study was conducted in 2003 (A) and repeated in 2010 (B). Previous Soviet military sites are shown (presently not operational).