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**INTERACTIVE APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN
UNDERSTANDING COMMUNITY ENVIRONMENTAL HEALTH**

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Introduction

1. Collaborative approaches to protecting the environmental health of a community have in recent years increasingly gained recognition from health professionals, urban planners, and environmentalists. Partly this trend has been driven by necessity, as public sector resources dedicated to community health have been eroded by budgetary constraints and declining public revenues.ⁱ
2. The growth of civil society, indicated by the devolution of societal responsibilities onto the private sector and concomitant increasing activity of non-governmental organisations, also creates widening opportunities for strategies of collaboration among public agencies and non-state entities. “Civil society is one of a nation’s greatest resources in formulating, implementing, and enforcing environmental laws, regulations, policies, and projects” (UNEP/INF2000/WP/3).
3. A third, cognitive factor promoting collaboration is the sheer complexity of environmental health challenges facing communities today. Complex problems may require a diverse range of solutions. In the environmental health field, local knowledge frequently needs to be employed to select and implement the right public health strategies. By working collaboratively with community members and organisations, environmental health officers can tap deep pools of local knowledge otherwise unavailable to their agencies.ⁱⁱ
4. Yet a fourth reason for increasing levels of collaboration is the need public agencies have for incorporating new technologies into public policies and programs. Such technologies, though often the product of publicly funded research and development (the Internet being one famous example), are

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frequently developed and promulgated outside of the public sector. Collaboration is a strategy for reintegrating technologies into the public sector.

5. This paper explores the interactive use of pollutant release and transfer registers (PRTRs) by community-based organisations for promoting public understanding of environmental health risks. It begins by briefly setting out the international framework for expanded chemical right to know. Through examples drawn primarily from US, UK, Czech and Hungarian case studies, it then highlights current collaborative 'best practices' in environmental health risk communication, with special attention to chemical risks. The main argument of the paper favours strongly participatory modes of collaboration, while calling for a rethinking of the terms in which public right to know, environmental information access and dissemination are commonly cast.

Pollutant Registers and Public Right to Know

6. The international commitment to public right to know is captured in Principle 10 of the Rio Declaration which called for ensuring public access to information and public participation in deliberations, as well as recourse to judiciaries to enforce such rights.

7. Agenda 21 Chapter 19, furthermore, speaks of establishment of emission inventories, or what are now commonly known as Pollutant Release and Transfer Registers (PRTRs).ⁱⁱⁱ Chapter 19 'calls on governments to implement and improve databases concerning chemicals, including emission inventories, with the co-operation of industry and the public. It further calls for industrial firms to provide data on substances they produce, particularly those needed for the assessment of potential risks to human health and the environment. As stated in Chapter 19, these data should be made available to national authorities, international bodies and other interested parties involved in hazard and risk assessment. Among the types of data referred to are those concerning emissions to air, water and soil, as well as transfers of waste off-site waste for treatment and/or disposal. A PRTR brings these data together in one system.'^{iv} PRTRs are model collaborative instruments used for assessing (or screening) environmental health risks from chemicals.

8. The origins of PRTR systems lie in the US Toxics Release Inventory (TRI). TRI was created in response to community concerns over catastrophic chemical releases in the mid-1980s occurring in Bhopal, India and West Virginia USA.^v Following these disasters, the public's right to know about potential chemical hazards and environmental risks associated with high volume chemical use and release gained widespread acceptance in the United States and Canada. In contrast to early European PRTR systems developed first in the Netherlands and later in the United Kingdom, North American PRTRs have given greater attention to the public accessibility of the data collected. The adoption of the 'Electronic Freedom of Information Act' Amendments in 1996 furthered access to US TRI data by promoting posting of major federal environmental data on the Internet in user friendly formats.

9. The 1998 United Nations Economic Commission for Europe (UN/ECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (or the "Aarhus Convention"), and the 1999 (London) Protocol on Water and Health, the first international instrument to expressly incorporate the Aarhus Convention provisions, have accelerated movement in Europe and Asia toward establishment of national PRTR systems. In September 2000, the UN/ECE Committee on Environmental Policy will take up the question of establishing a Working Group on PRTR Systems, charged with drafting a legally binding instrument on PRTR System, as was called for by the 2nd Meeting of Signatories to the Aarhus Convention, in Dubrovnik, Croatia, 3-5 July 2000.

10. In these international agreements, there is evidence of a progressive extension of public right to know provisions to cover electronic access to environment and health information. Both the Aarhus Ministerial Declaration and the London Joint Ministerial Declaration endorse the development of low-cost, user friendly electronic access to information. The 2nd Meeting of Signatories to the Aarhus Convention established a Task Force on Electronic Tools and Media, to be convened at the INFOTERRA 2000 meeting in Dublin, on 15 September 2000.

Interactive Communication, GIS and the Internet

11. In discussions of these national and international instruments, it has become customary to distinguish 'active' from 'passive' information access. Indeed, we may identify the classical formulation as one that contrasts 'passive access' with 'active dissemination'. The US Freedom of Information Act, which bestows rights to information on request from citizens, but puts no positive obligation on government to disseminate information to the public,^{vi} exemplifies 'passive access'. The production and publication of PRTR data, for example, through the Internet, exemplifies 'active dissemination'. These contrasting terms refer, then, to the level of activity of state agencies in the production of accessible information. It is noteworthy that these terms do not refer to public's relative level of effort expended in accessing information (except by implication that the converse of the state agency's level of effort is true of the public actor). Thus, in the former case (FOA), it is the public that must act proactively, first identifying then formally requesting information from the government, to ensure access to the desired information is achieved. The state officer, in this case responding to a request, is said to be the passive agent.

12. It is our contention that the distinction drawn between 'passive access' and 'active dissemination' hinders our understanding of the demand of the public for, and methods of ensuring access to, environmental information. Both cases present examples of a relatively passive role being assigned to the public. Hidden behind the false dichotomy presented by these terms are deeper modes of information access to be realised through public agency-civil society collaboration. Specifically, the present way in which we conceive of information access limits the participatory potential of emerging technologies, and therefore misses much of the democratic promise these technologies offer for the benefit of community environmental health.

13. To understand these points, we may examine the use of the Internet as a technology for accessing environmental information. The Internet as a medium of communication is unique in that it permits high volumes of information to be communicated 'interactively'. Other media, such as television (TV) and the telephone, lack this degree of interactivity. TV is primarily a broadcast medium designed to deliver produced information to wide, passive audiences. The telephone is a personal medium enabling two-way communication between (rarely more than) two persons. By contrast, the Internet permits 'narrowcasting' of both produced and individuated information to the full range of potential audiences: mass, targeted, or personal. The Internet permits communication between co-producers of information and rapid re-editing and re-presentation of received information into new communications.

14. It is best not to overstate the case for interactivity on the Internet, however. Typical applications falling under the current description of interactivity are 1) the registration of a household user for a periodic information service, such as the delivery of a sports team's daily performance statistics; and 2) on-line shopping through browsing electronic catalogues. Both qualify as exercises in interactive communication, as the parties mutually serve up information to each other, nominally guiding their future path of communication.

15. An analogue of these types of communications can be found in the serving of PRTR data to an individual user over the Internet. The user registers with a state agency for electronic notification of publication of annual reports on the pollutant releases and transfers occurring in their province or country. Acting on the notification, the user goes to a web-site containing an Internet map server and requests more detailed information relevant to their particular community. (Internet map servers allow 'point-and-click' access to information, by users floating their computer's cursor over an on-line digital map, then clicking and 'zooming' in for closer views of the geographic area of interest.)

16. An example of an Internet map server is REZZO - Czech Republic Register of Emissions and Air Pollution Sources (http://www.ecn.cz/rtk/gis/rezzo_1e/). REZZO displays common air pollutant releases in the Czech Republic, including Solid particles, NO_x - nitrogen oxides, Carbon hydrates, CO - carbon oxide, SO₂ - sulphur dioxide, NH₄ - ammonia, Anorganic compounds of chlorine, F - Fluoride, and Toluene. The REZZO map server was developed by the NGO Ecology Institute, Brno, as part of 1999 Projekt IHEAL, through a grant received by Interactive Health Ecology Access Links (IHEAL) from the European Commission DGXI and the UK Department of Environment, Transport and the Regions. Such systems

allow viewers to identify individual facilities emitting pollutants, provide details (data) of the emissions, and invite comparisons with environmental air quality standards. Alternatively, users can enter postal codes to access community level maps showing 'What's In Your Backyard'.^{vii}

17. The same effect can be accomplished with so-called 'static' map image files – a series of map graphic images showing increasing geographic detail - hyperlinked to textual information. The NGO Silicon Valley Toxics Coalition's Eco-Maps of Silicon Valley showing toxic chemical point source pollutants in Santa Clara County, California, are built out of static map image files (<http://www.svtc.org>).

18. Two of the three aforementioned Internet pollutant mapping systems were developed by non-governmental organisations working with official government data sets. All three sites, including the British Environment Agency's 'What's In Your Backyard', were inspired by the Friends of the Earth – England, Wales and Northern Ireland pioneering web project, Factory Watch (http://www.foe.co.uk/campaigns/industry_and_pollution/factorywatch/index.htm).

19. Factory Watch is credited as the first web site to exploit applications of Geographic Information Systems (GIS) digital mapping for delivery of pollutant emissions information over the Internet. U.S. EPA Envirofacts 'Maps on Demand' (<http://www.epa.gov/enviro/html/mod/index.html>), Environmental Defense 'Scorecard' (<http://www.scorecard.org>) and Silicon Valley Toxics Coalition (SVTC) 'Eco-Maps' further developed the model established by Factory Watch.

20. Notable refinements in technique illustrate the evolution of Internet pollutant mapping toward presentation of more participatory and meaningful information. SVTC's Eco-Maps series included information identifying the name and contact information of the polluting facility's environmental, health and safety officer. Community members were encouraged to contact the officer with questions about the facility's overall environmental performance and pollution prevention activities. SVTC also added schools, parks and hospitals as features on the maps to provide local geographic context. As a result, many area schools ranging from K-12 to college-level incorporated digital map inquires into their courses of study. Environmental Defense created electronic letters ('Take Action') that users of Scorecard could send to specified facilities, or to the Administrator of the U.S. Environmental Protection Agency. Scorecard also surveyed more than 6,800 chemicals for potential health effects and created links to U.S. EPA's Integrated Risk Information System (<http://www.epa.gov/iris/>) containing toxicological and epidemiological information. SVTC identified 34 Hazardous Air Pollutants commonly used by local 'High Tech' industries, categorised them by known health effects, and directed (hyperlinked) viewers to Agency for Toxic Substances and Disease Registry Public Health Statements (Toxicological Profile Information Sheet, <http://www.atsdr.cdc.gov/ToxProfiles/>).

21. Informal collaboration between these non-governmental organisations and state agencies is evidenced by the hyperlinking of U.S. EPA's Envirofacts webpages to Environmental Defense's Scorecard pages, Friends of the Earth's creation of pop-up screens drawn directly from Scorecard onto Factory Watch's chemical information pages, and Silicon Valley Toxics Coalition's hyperlinking to the Agency for Toxic Substances and Disease Registry. In this fashion, agency and NGO resources are used efficiently, creativity and specialisation (tailoring) of information to particular needs promoted, and duplication of services avoided. The Internet makes possible new forms of synergistic collaboration across public, private and non-profit sectors, as well as across international boundaries.

Toward 'Democratic Interactivity': the Role of Community-based Monitoring

22. In spite of the innovative nature of new forms of electronic communication, interactivity per se is not the distinguishing feature of participatory communication. Communication tools such as GIS mapping and map server technologies are dependent upon the quality of information they draw upon. Currently our models of information access rely on the provision or collection of data by state agencies. In the case of PRTR data, provision of information is the charge of facilities (or their corporate owners); collection of reported information is qualified then published by the government. A stronger form of participatory communication does not rely solely on information structured by state or private sector entities.

23. In contrast to 'passive access', 'active dissemination' and 'collaborative interactivity' a new concept of 'democratic interactivity' suitable for the ideal of participatory democracy is needed. By 'democratic interactivity' we mean the sharing of information produced by community members with government decision makers, experts and other communities. Individuals and civic organisations must become the co-producers of environmental information guiding public policy if the cognitive challenges to managing such information are to be met.

24. Community-based monitoring projects are effective means for involving the community in co-production of environmental data. In the Santa Clara (California) Basin Watershed environmentalists and high schools students are monitoring clams bedded to local streams to gauge the source and extent of local PCBs contamination. The Clean Streams/Clean Bay PCBs Monitoring Project is a collaboration between high schools, the City of San Jose and the NGO Silicon Valley Toxics Coalition. The information produced will be used to develop a PCBs Total Maximum Daily Load clean-up plan. The Hungarian NGO Environmental Management and Law Association (EMLA) is collecting data on hazardous waste dumping near streams in the vicinity of Budapest. Community members are invited to collect and map the data in an on-line Riparian Information System (GIS) in preparation for a community forum on restoration of the streams' watershed. In Richmond, California, the NGO Communities for a Better Environment (CBE) trained residents living in the neighbourhood of a petroleum refinery to do 'grab bag air sampling' of emissions from the facility (<http://www.igc.org/cbesf/rag11/rag11.html#Richmond>). Results of sample taken following a facility fire contributed to the adoption of new safety measures by County authorities. CBE has extended their community monitoring work to South African refinery and mining communities in collaboration with the South African Exchange Program on Environmental Justice (<http://www.igc.org/saepej/>). Real-time, community-based monitoring project in 86 U.S. cities have been supported through the U.S. EPA Environmental Monitoring for Public Access and Community Tracking (EMPACT) grants program (<http://www.epa.gov/empact/>).

25. To promote 'best practices' in electronic access, community-based monitoring, and GIS Internet mapping, non-governmental organisations working in co-operation with the European ECO Forum established Interactive Health Ecology Access Links (<http://www.iheal.org>) as an international service network in 1999. IHEAL's membership is drawn from individual members of a dozen North American and European environmental citizens organisations,^{viii} who work closely with GIS professionals, and national and international agencies. The capacity of communities to monitor and interpret risks to environmental public health will depend on such collaborations in future.

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ⁱ National Association of County and City Health Officials (NACCHO), Community Revitalization and Public Health: Issues, Roles and Relationships for Local Public Health Agencies (Washington DC: June 2000), p 12.

ⁱⁱ "Community-Health Agency Dialogues: The Brownfields Forums," in NACCHO (June 2000), pp. 97-113.

ⁱⁱⁱ Or, alternatively, as 'registries'.

^{iv} Quoted from 'PRTR Implementation: Member Country Progress', Organisation for Economic Co-operation and Development (ENV/EPOC(2000)8), p. 8.

^v As part of the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. 11001 et seq. (1986).

^{vi} At least prior to adoption of the 1996 'Electronic FOA' Amendments.

^{vii} Environment Agency of England and Wales, 'What's In Your Backyard?'

(<http://146.101.4.38/wiyby/html/introduction.htm>).

^{viii} In the U.S., U.K., Belgium, Czech Republic and Hungary.