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Participatory GIS – a people's GIS?

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Abstract: Recent years have witnessed a burgeoning of applications of GIS which grant legitimacy to indigenous geographical knowledge as well as to 'official' spatial data. By incorporating various forms of community participation these newer framings of Geographical Information Systems as 'Participatory GIS' (PGIS) offer a response to the critiques of GIS which were prevalent in the 1990s. This paper reviews PGIS in the context of the 'democratization of GIS'. It explores aspects of the control and ownership of geographical information, representations of local and indigenous knowledge, scale and scaling up, web-based approaches and some potential future technical and academic directions.

Key words: GIS, participatory GIS, public participation.

I Introduction

As the social, political, ethical and institutional dimensions of Geographical Information Systems (GIS) have come increasingly into question, dialogues around 'critical GIS' and 'GIS and society' (Sheppard, 1995; Harris and Weiner, 1996) have become firmly established both in the literature and through fora such as listservers and dedicated conference sessions. Debates around the theoretical assumptions and social implications of GIS as a technology and Geographical Information Science (GIScience) as a conceptual framework or discipline are thus well rehearsed and have been the subject of a number of recent summary works (Pickles, 1995; 1999; Schuurman, 2000). One tangible shift in the light of such critiques has been the growth of a more socially aware type of GIS which gives greater privilege and legitimacy to local or indigenous spatial knowledge. Variously labelled as, *inter alia*, Participatory GIS (PGIS), Public Participation GIS (PPGIS), and Community-integrated GIS,[1] these newer approaches are context- and issue-driven rather than technology-led and seek to emphasize community involvement in the production and/or use of geographical information. A Participatory GIS celebrates the multiplicity of geographical realities rather than the disembodied, objective and technical 'solutions' which have tended to characterize many conventional GIS applications. Of relevance here are the many and varied interpretations of what constitutes a GIS although a concise definition becomes more difficult to articulate as the boundaries between spatial technologies become increasingly blurred. Goodchild (2000: 6) defines GIS as 'a computing application

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capable of creating, storing, manipulating, visualizing, and analyzing geographic information'. Although some definitions of GIS recognize the importance of social and institutional dimensions (Chrisman, 1999) most, as Couclelis (2003) notes, focus on software functionality (particularly spatial data analysis and visualization) and this forms an important component in proprietary GIS software marketing by companies such as Environmental Systems Research Institute (ESRI) a major high-end and technically led commercial vendor which leads the market in supplying GIS products (Merrick, 2003; Sieber, 2004; Longley *et al*., 2005). With calls for a more democratic GIS, other defining capacities have come to the fore such as an 'empowerment functionality' in which indigenous technical and spatial knowledge is regarded as equally legitimate as that of 'experts' (McCall and Minang, 2005). In this sense, non-profit GIS developers such as Clark Labs[2] with a focus on applications for the developing world offer a contrasting ethos.

PGIS, as both concept and tool, has burgeoned in recent years with dedicated books (Craig *et al*., 2002b), special journal editions (*Cartography and Geographic Information Systems* 1998; *Cartographica* 2001; *Environment and Planning B* 2001; *Journal of the Urban and Regional Information Systems Association [URISA]* 2003), conferences (eg, URISA's Annual Public Participation GIS Conference) and listserver discussion groups. It has been applied in a wide range of contexts including urban planning and revitalization with neighbourhood groups (Craig and Elwood, 1998; Ghose, 2001; Casey and Pederson, 2002; Elwood, 2002a; 2002b); managing conflict over access to land and other natural resources (Weiner *et al*., 1995; Harris and Weiner, 1998; 2002; Kyem, 2002; 2004; Weiner and Harris, 2003); resource management and service access in 'First Nations' or indigenous peoples (Bond, 2002; Laituri, 2002); land-use and natural resource planning (Ventura *et al*., 2002; Walker *et al*., 2002); and conservation and environmental management (Meredith *et al*., 2002; Sieber, 2002; Tulloch, 2002). Despite this rapid progress it could be argued, however, that use of a more socially aware GIS is of limited interest (Abbot *et al*., 1998; Williams and Dunn, 2003). Indeed Kwan (2002a) proposes that, despite significant progress in helping us move away from the largely antagonistic critical discourses around GIS during the 1990s, insights from Public Participation GIS 'have yet to bear significantly upon GIS practices in geographic research at large and on the relationship between GIS and critical geographies in particular' (p. 645). Weiner *et al*. (2002: 5) add that while 'the critique of GIS has helped to launch a flood of alternative community-based GIS applications' the development of PPGIS should not serve to diminish the theoretical and philosophical debates around GIS. This seems unlikely given the conceptual relationship between alternative forms of GIS and critical discourses around use of the technology. Indeed the continued discussion of this relationship seems essential if participatory forms of GIS are to retain credibility in the wider disciplinary settings of human geography and beyond.

Ten years after the term PPGIS was first used (Schroeder, 1996), it seems timely to evaluate what a Participatory GIS has to offer for democratic spatial decision-making. This review seeks to reflect on some of the developments and frustrations embedded in attempts to mould conventional GIS into a technology with a social conscience. In so doing the paper considers four main strands in the context of PGIS development: control and ownership of geographical information; representing local and indigenous spatial knowledge; the democratization of GIS; and sustainability. The paper does not attempt to repeat the detailed history of the debates and critiques around the theory and practice behind GIS: these have been covered elsewhere (Pickles, 1999; Schuurman, 2000). Nor does it seek to provide an exhaustive review of the practical applications of PGIS (for which see, for example, Craig *et al*., 2002b). Rather

the intention is to explore the potentially fragile and transitory nature of Participatory GIS in a world where conventional GIS still has the stronger foothold and where recent developments in related ICTs bring geographical information into the public mainstream. The emphasis here is on how PGIS addresses some of the criticisms of conventional GIS, and how users engage with distributed geographical information. The paper begins with a brief contextual positioning of Participatory GIS before outlining its diverse meanings. It then considers some of the simultaneous conflicts and opportunities which are embedded in PGIS and the information it contains before discussing issues of local and indigenous knowledge in the context of spatial 'accuracy' and visual representation. The importance of scale, questions raised by web-based PGIS, and issues of evaluation and sustainability are then considered before posing some future prospects.

II Starting points: historical and spatial contexts

In chronological terms, efforts to devise a more socially inclusive GIS have not occurred solely as a direct reaction to the critiques of GIS. In the mid-1990s pioneering attempts to devise alternative approaches, notably through work by Daniel Weiner and Trevor Harris (Weiner *et al.*, 1995) operated alongside criticisms of GIS as a tool of control and a technology of surveillance (Pickles, 1995). Indeed, the mid- to late 1990s witnessed positive collaborative ventures between GIS researchers and its critics: see, for instance, work by Harris and colleagues in Pickles' seminal text *Ground truth* (Harris *et al.*, 1995) and input from John Pickles and Michael Curry in the National Center for Geographic Information and Analysis (NCGIA) specialist meeting in 1996 (Harris and Weiner, 1996). Similarly there have been fruitful collaborations between GIS practitioners and development studies scholars for applications in lower-income countries (Dunn *et al.*, 1997; Abbot *et al.*, 1998; Rambaldi *et al.*, 2006). The scene for deeper and more critical reflections had been set earlier than this, though, a fundamental determining point being the debates between Stan Openshaw and Peter Taylor in the early 1990s (Taylor, 1990; Taylor and Overton, 1991; Openshaw, 1991; 1992). Although perhaps not necessarily recognized as such at the time, these earlier exchanges paved the way for 'alternative' approaches to GIS.

But what of the genesis of these alternatives and, if they are to be more context-driven, how do their origins prepare them to achieve this? Obermeyer (1998) explains the characteristics of early conventional GIS in terms of the organizational, technical and theoretical conditions of the time in which they were developed – 'largely white males employed in academic and governmental institutions in North America and Europe' (Obermeyer, 1998: 65). One implication here is that the further away from these conditions a GIS is implemented, the less successful and appropriate it is likely to be. Of course participatory approaches to GIS come with their own values and assumptions and, like most GIS, emerged largely from a North American base. Given this starting point, then, as Sieber (2003: 54) comments, even 'PPGIS culture might prove difficult to translate to other places and organizations'. As Kwan (2002a) argues, however, although the nature of conventional GIS is historically and spatially contingent, this should not exclude possibilities for reimagining alternative visions of GIS. Indeed she suggests that 'one of the crucial tasks for feminist GIS users/researchers is to break the positivist/masculinist connection that was historically constituted' (p. 648).

III PGIS and participation: meanings and representations

Just as there is no single interpretation of the term 'GIS', a simple and concise definition of Participatory GIS is equally, if not more, elusive, although it is clear that recognition of PPGIS as more than a technology is essential (Tulloch, 2003). Indeed, Aberley and Sieber (2002) have devised 14 guiding principles

for PPGIS including, *inter alia*: aspects of community development, capacity building and public access to official data; inclusion of marginalized groups; organizational application through partnerships and practical implementation through a range of formats and data types; and links to social theory and qualitative research tools. This complexity and diversity is not only an indication of the many diverse approaches which PGIS encompasses but is also reflected in the variety of labels given to these, and related, alternative forms of GIS, each with its own history and meaning: Participatory GIS, Public Participation GIS, Community-integrated GIS (Harris and Weiner, 1998), GIS-2 (Harris and Weiner, 1996; Schroeder, 1996; Pickles, 1999), GIS for participation (GIS-P; Cinderby, 1999), Participatory 3-Dimensional Modelling (P3DM; Rambaldi and Callosa-Tarr, 2000; 2002), Bottom-Up GIS (BUGIS; Talen, 2000), and collaborative GIS/geocollaboration (MacEachren and Brewer, 2004; Schafer *et al.*, 2005; Balram and Dragićević, 2006; Jankowski *et al.*, 2006). As Schlossberg and Shuford (2005: 15) comment, 'the more one looks to find a common thread or meaning about what PPGIS exactly means, one quickly realizes that guiding definitions are not to be found and that utilizating [sic] the term 'PPGIS' is inconsistent across applications and uses'. That said, it is useful to identify those dimensions of Participatory GIS which differentiate it from conventional Geographical Information Systems. PGIS arises from a recognition that traditional GIS represent an overly simple world-view in terms of two interrelated aspects: the type of information that is fed in and on which spatial decision-making is based, and the limited source(s) of that information. In terms of information types, one understanding of PGIS is as a means of integrating local and indigenous knowledge with 'expert' data. The inclusion of social information has helped to expose the narrowness of conventional GIS and has opened up a platform for 'alternative' visualizations of space, place and reality. In terms of information sources, a PGIS entails widening the notion of participants or 'users' to include 'the public' and, particularly, marginalized groups. Thus the term 'public participation GIS' was derived from the common use among planners of the notion of involving an element of citizen participation (Obermeyer, 1998). PGIS involves local communities in the creation of information to be fed into the GIS and subsequently used in spatial decision-making which affects them. Critical to this widening participation, however, is the need for PGIS scholars and practitioners to be more explicit about who 'the public' is and what 'participation' means if appropriate goals are to be achieved (Schlossberg and Shuford, 2005). Levels, or 'intensities', of participation (and hence control) in PGIS vary from 'manipulative and passive' participation through to locally initiated or self-mobilized action (McCall and Minang, 2005). Since conventional GIS technology remains a core component of PGIS, it may play 'a strained role in enabling democratic participation' (Sieber, 2003: 54). Currently the differing notions of spatial accuracy which are implicit among the diverse types of geographical information involved tend, though, to result in applications which employ only basic technical operations through spatial analysis. Future designs may, however, incorporate more sophisticated spatial understanding capabilities and issue management technology (Nyerges *et al.*, 2002).

A Participatory GIS then is characterized by its inclusion of some of the 'messiness' and fuzziness of much geographical information and of human-environment relations. In terms of implementation of these complexities, a number of different approaches have been proposed and there is no single PGIS tool. Thus P3DM integrates spatial information and indigenous geographical knowledge in the form of three-dimensional, large-scale physical relief models subsequently captured in digital form through the use of high-resolution digital cameras and on-screen digitizing at a scale to meet the purpose of the exercise

(Rambaldi and Callosa-Tarr, 2000; 2002). In this approach, participants use low-cost materials (wool, cardboard, coloured map pins) to construct, over a period of several days, a large model (up to 5 m long) with sufficient vertical exaggeration to allow meaningful interpretation and discussion. This tangible enactment of map-making has clear parallels with 'mapping as performance' in which a process-based approach to cartography takes on renewed importance (Perkins, 2003). Other approaches combine digital spatial information tools such as remote sensing and spatial analysis with participatory research methods such as participatory mapping and diagramming, and use of photographs, video clips and oral histories through sound. This may involve public participation through spatial multimedia and virtual environments such as video conferencing (Shiffer, 2002). Others, such as that adopted by Hassan (2005) for a case study of safe drinking water planning in Bangladesh, use GIS technology to overlay participatory mental maps derived from group discussions with official administrative and resource maps. Thus, in the same way that levels of public participation in PGIS vary, so too do the levels of direct public involvement in utilizing GIS technology and manipulating digital spatial data.

IV Politics and power relations: whose PGIS?

Of fundamental importance to Participatory GIS implementations are questions of access, control and ownership of geographical information and outputs. The ways in which these issues are played out, however, depend on cultural, institutional and locational framings, the intended objectives and user characteristics, and the broader questions of political embeddedness. Harris and Weiner (1998) advocate aiming for a 'community-integrated' GIS in recognition of the fact that, although communities may increasingly participate in GIS-related projects, they lack the political, financial and technical control. A community-integrated GIS acknowledges the 'expert' nature of GIS as a technology but enhances citizen access and participation and, hence, the democratic potential. Sieber (2001) calls for a formalized approach to addressing questions about ownership, access, expertise and accountability whereby PPGIS the concept as well as PPGIS the tool is recognized: a more inclusive 'PPGIScience'. Distinctions between tools and concepts, though, may be blurred as tools are incorporated within the context of use.

The political dimensions of geographical information have been brought into particularly sharp focus by the potential uses of GIS in surveillance and control. The very act of introducing GIS, whether participatory or not, in specific settings adds new technological and political dimensions which, in themselves, can serve to alter existing power relations (Weiner *et al.*, 2002; Robbins, 2003). As Aitken and Michel (1995: 17) point out, 'participation in the creation of GIS knowledge does not necessarily give any power to those involved in, and affected by, the decision-making'. This may open up a Pandora's box of conflict within or between different stakeholder groups: indeed Harris and Weiner (1998: 74) note that 'a conflictual GIS would be an expectation'. Similarly, Robbins (2003: 249) argues for techniques which 'elicit competing localities and ground truths, and so enunciate and draw conflict to the center of attention'. Transforming vaguely demarcated boundaries on the ground into clearly defined lines on a map is potentially damaging in that conflict over land, for example, may be created where it otherwise did not exist. By drawing attention to contrasting knowledges and power imbalances, a Participatory GIS carries a greater onus in terms of justifying its composition and approach and should be implemented with a health warning since, as Weiner *et al.* (2002) point out, PPGIS projects can still be exploitative. In the same way that these authors warned us a decade ago that 'in the mode of "top-down" data creation and "expert" policy-making, GIS empowers the powerful and disenfranchises the weak'

(Weiner *et al.*, 1995: 32), in commenting on a set of 18 PPGIS case studies they noted recently that 'in all regions … there is evidence of the simultaneous empowerment and marginalization of people and communities' (Weiner *et al.*, 2002: 11).

Cinderby (1999) argues, however, that the ability to integrate multiple perspectives in a visual spatial medium offers a powerful representation which should enable local groups to engage in spatial decision-making with 'official' agencies on a more equal basis, or at least serve to raise public awareness. For a case study eliciting citizens' views of air pollution in UK cities, Cinderby and Forrester (2005) describe how participants found that simply having access to, and looking at, large-scale Ordnance Survey maps was interesting in itself. Other examples have shown that 'official' or digital representation of a local area can lead to community participants viewing their environs in new ways. Thus Weiner *et al.* (1995: 34) reported that during mapping exercises in village workshops in South Africa participants were 'excited about having access to the 1:50,000 topographic maps, which they felt helped to 'officially' confirm their personal social histories'. In a study of parish mapping with village community groups in Scotland, Wood (2005) showed how participants considered paper maps to be 'flat' whereas transferring mapped information to a PC and linking it to attribute data enhanced the sense of interactivity.

Participatory GIS, then, has the potential to be both more enabling to those whom it seeks to serve and to be misused in the 'wrong' hands as outside control and surveillance are enhanced (Abbot *et al.*, 1998; Stonich, 2002). 'Getting on the map' could mean public acknowledgement for marginalized groups (McCall and Minang, 2005) or increased control from outside (Abbot *et al.*, 1998) or aspects of both. In seeking to reduce power imbalances and external interventions (which arise either directly through GIS 'professionals' taking excessive control or indirectly through data being extracted by state or private agencies) the inputs and outputs should be processed participatorily, in situ and as a deliberative means of empowering local people (McCall, 2003). An optimistic view sees empowerment at grassroots level enhancing opportunities for political power when dimensions of good governance are addressed.

To be avoided, then, is a replication of the situation with traditional Geographical Information Systems where users 'do GIS' in a sociopolitical vacuum. McCall (2003) warns of the dangers of indigenous spatial knowledge following the marketization route of conventional geographical data. Good governance through improved transparency between people and state, and people and private sector, should help the legitimacy of local interests to be recognized (McCall and Minang, 2005). It is incumbent on those working on Participatory GIS then to adopt a code of good practice, particularly so given the ease with which digital information can be garnered by others. In this sense MacEachren (2000) suggests a four-stage process involving assessment, problem definition, decision-making, and follow-up while Rambaldi *et al.* (2006) go further and set out a series of 'Who?' type questions around empowerment/disempowerment in the context of an ethical PGIS. In this scheme informants are consulted about disclosing spatial data, and steps are implemented to ensure that the outputs are understood by all. In addition, it is incumbent upon researchers to give due consideration to the political implications of the information they extract and disseminate and this may involve, for example, avoiding questions to participants about natural resources where those questions would lead to forced displacement (Rambaldi *et al.*, 2006).

V Indigenous knowledge and spatial 'accuracy'

In the process of representing different geographical understandings and in attempting to 'reveal contradictions and similarities in spatial thinking and activity' (Williams and Dunn, 2003: 394–95), PGIS seeks not to

privilege any one type of information but to grant equal validity to all. In this way indigenous technical knowledge can grant poorer groups an equivalent standing to outsiders (McCall, 2003) and in participatory spatial planning such knowledge 'may be the only resource that the poorest groups control while their land, property, resources, or labour are rapidly appropriated' (McCall, 2003: 559). But use of this knowledge may also need to be protected, for example, through a contractual agreement between providers and users (Rambaldi *et al.*, 2006). 'Indigenous knowledge' is, however, an inherently intractable concept and Sillitoe (1998) notes how the distinctions between indigenous knowledge, local knowledge, popular knowledge and folk knowledge are blurred. Warren (1991: 1) equates indigenous and local knowledge – 'knowledge that is unique to a given culture or society' – and contrasts it with 'the international knowledge system generated by universities, research institutions, and private firms' (Warren, 1991: 1). McCall (2003: 559) highlights how indigenous technical knowledge is 'embodied knowledge to be seen as a local resource that belongs to rural and urban people both as individuals and communities. It should not be denigrated only as primitive, unassimilated, and outside of the market'. Of critical relevance in the present context is the extent to which this local and indigenous knowledge can be portrayed in a spatial way and through the use of GIS. Passed down through generations, indigenous knowledge is expressed through, *inter alia*, stories, songs, folklore, proverbs, cultural values and agricultural practices, and is communicated orally (Grenier, 1998). While not exclusively geographical, much indigenous technical knowledge has both an embedded geographical context in which the natural environment is central, and specific spatial associations – for example, knowledge related to location of resources, environmental hazards, ecosystems and spatial correlations between groups and resources (McCall, 2003). The thematic data layering properties of GIS facilitate representation of multiple perspectives and offer potential for portrayal of a holistic worldview of indigenous peoples (McCall, 2003). Some local and indigenous knowledge, then, can be mapped and, indeed, in some instances, this can be highly spatially resolved, to the level of one side of a road junction, for example (Cinderby and Forrester, 2005). In eliciting indigenous knowledge through interviews, Grenier (1998) notes how the physical presence of a map can be useful as a prompt to encourage discussion of a particular geographical area, and she defines indigenous knowledge with reference to 'the unique, traditional, local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area' (Grenier, 1998: 1).

In contrasting indigenous knowledge and scientific knowledge, McCall and Minang (2005) comment that 'indigenous technical knowledge is normally more reliable, and maybe also more accurate, because it embodies generations of practical essential knowledge, and it operates in interactive, holistic systems' (p. 343). In integrating participatory geographical information with 'official' spatially referenced data from technical landmine surveys, Williams and Dunn (2003) note how the conventional maps portrayed boundaries only for known minefields while participatory maps provided complete spatial coverage and included areas which had been de-mined by returning refugees. From the perspective of local communities, then, 'official' data were regarded as 'inaccurate' since their experiences were of widespread and indiscriminate mining. Different notions of precision and 'accuracy' of information are particularly important when the intention is to integrate spatial data for relatively small geographical scales with indigenous knowledge from participatory maps drawn at larger scales. As Craig *et al.* (2002a: 368) assert, 'PPGIS … redefines the meaning of "accuracy"'. While 'precision should not be a requirement for entry into the GIS world' (Goodchild, 2002: xxii), indistinct boundaries

derived from participatory mapping exercises, for example, should not be used in the same way as spatially accurate and precise lines from technical surveys (Cinderby, 1999). Recent developments in visualization techniques and mapping software are relevant here, since opportunities are now available to better represent indigenous spatial knowledge by avoiding representations through the use of fixed points and borders, and by using instead fuzzy boundaries, soft zoning, multi-user transparent overlays and animation (McCall, 2003).

Central to representations of indigenous knowledge in PGIS, though, are questions around participatory research itself as appropriate and relevant as a means of bringing about desirable change. Some have argued, particularly in a 'development' context, that this is far from the case. Thus Kothari (2001) argues that participatory development techniques serve to present 'cleaned up' versions of participants' knowledge through formalized graphics: charts, calendars and diagrams. That which does not fit is necessarily excluded and the framework of visual representation remains at the same time unquestioned (Henkel and Stirrat, 2001). Cooke and Kothari (2001) call for a deeper, more sophisticated and rigorous reflexivity, particularly in terms of the complexities of power and power relations, while Sanderson and Kindon (2004) recommend an approach whereby participatory methods are negotiated 'to challenge and open-up the constitution of possible knowledge' (p. 125). Drawing on work with New Zealand and Indian NGOs they conclude that, rather than eliciting local knowledge, participatory development processes 'produce knowledge *specific to their process and participants*' (Sanderson and Kindon, 2004: 125, original emphasis).

The PGIS community has, for the most part, focused on certain key aspects of the concept of knowledge(s) – for example, expert/local, spatiality, capture and representation. Given the wide body of social scientific literature on the nature of knowledge, a deeper engagement by the PGIS community is warranted. Ideas which are based around knowledge reflecting the context from which it comes, and as being 'relative' to other dimensions such as gender, ethnicity and class (Curry, 2005) provide one potentially important foundation for such an engagement. Uncertainty as an inherent property of knowledge and knowledge production has been emphasized by Couclelis (2003), while Elwood (2006) explores how participation in knowledge production is negotiated in everyday PPGIS practices. In arguing for a move away from notions of indigenous knowledge in GIS which regard local/traditional environmental knowledge either as conflicting with, or supplemental to, official/scientific information, Robbins (2003) suggests instead a focus on the partialities of all knowledge, the use of GIS to explore the nature of knowledge production itself and emphasis on local/indigenous and scientific knowledge as not being mutually exclusive. Similarly, Elwood (2006) notes how research which juxtaposes local knowledge against official knowledge can serve to conceal their interrelationships in participatory research practice. The similarities between indigenous and scientific knowledge have been noted both in terms of cognitive structures, such as in resource conservation, and functional connections such as in the restricted use of sacred or protected land (McCall and Minang, 2005). This spatial and problem-orientated technical indigenous or local knowledge, which may be gendered, 'sets people in their environmental context by describing activity spaces and responsibility spaces, and uses an understood natural language' (McCall and Minang, 2005: 343).

It is also important, though, to distinguish those dimensions of indigenous knowledge which fundamentally differ from scientific knowledge: this is not technical knowledge but rather 'deep knowledge' which places cultural values on land and place, which is manifested in fuzzy, emotional and holistic terms (McCall and Minang, 2005) and which may not fit neatly into the spatially precise demands of a GIS. But even here there are

ambiguities and a spatial element may be relevant to the more elusive symbolic, indigenous knowledge. In this context, Harmsworth (1998) uses GIS to store layers of information on Maori environmental values – eg, tribal landmarks, sacred and ancestral sites, and medicinal plants. In a promising approach to avoiding information reaching those for whom it was not intended, each layer has attached to it a level of confidentiality and access. Highly sensitive information is given a label or flag to indicate restricted access and in these cases the information is linked via a directory to an alternative source such as an individual person (eg, a Maori elder) with traditional knowledge. McCall (2003) adds illegal and 'anti-social' urban activities such as raves, prostitution and street gangs to these 'sensitive' indigenous cultural actions although he cautions against adopting an overly protective approach which may serve to safeguard existing elite privileges in situations where secret or sacred knowledge is directly linked to access to natural resources such as land.

Part of the reflexivity of, and about, Participatory GIS should also be about the types of information and knowledge which cannot be objectified (let alone represented spatially) as well as those which can. Rundstrom (1995) is fundamentally sceptical about reasons for wanting to incorporate indigenous knowledge into a system such as GIS and argues that 'the epistemological system within which GIS is grounded is largely incompatible with the corresponding systems of indigenous peoples' (p. 55). He argues instead for 'the crucial value of not telling, not writing, not encoding – the value of not inscribing' (p. 53), but he also recognizes the possibility that 'GIS may be best understood as only another link in a long, tangled chain of dialogue between Western and indigenous peoples about each other and the nature of the earth' (p. 55). Similarly, McCall and Minang (2005: 343) argue that participatory spatial planning in PGIS can 'build geo-information into the local knowledge process'. Despite improved representations of local spatial knowledge in PGIS, however, it remains the case that much indigenous knowledge is 'tacit' (Polanyi, 1944). This is the knowledge that is accumulated but not systematized (Polanyi, 1944). It is knowledge which is indirect, intuitive, understood and implied. Although there are degrees of tacitness (Howells, 1996), this type of knowledge cannot be represented by an information technology which relies on a spatial framework.

VI Scaling up and democratizing GIS: Global Participatory GIS through the web?

If Participatory GIS research is to be policy relevant, concerns are raised over the difficulties of extending the findings both spatially and in political and organizational terms since many projects are locally based. 'Scaling up' involves not only linking information from different geographical scales to elicit regional, national or global patterns but also, more importantly, being able to elicit understandings of human-environment relationships (Stonich, 2002). Under decentralization, for example, Participatory GIS could allow local priorities to feed into regional policy and planning if such priorities become more widely communicated. Stonich (1998; 2002) extends this idea by exploring the potential to link community-level PPGIS into a global PPGIS in an applied research project on a global NGO coalition set up to resist industrial shrimp farming in Asia, Latin America and Africa. Scaling up in this context presents particular challenges of achieving consensus among members of a coalition with diverse perspectives. The potential of PPGIS to inform activism at the multinational level is also considered in work by Sieber (2003) on transborder PPGIS for conservation associations. She advocates using PPGIS to help build organizational capacity and coalitions as a means of matching political power and organizational scale to the scale of the environmental issue, for example by: widening the 'reach' in terms of increased numbers of

people participating; expanding organizational diversification by using GIS across a range of applications; using GIS as a means to attract funding; and combining efforts through coalitions of users for improved political action and in order to wield greater influence through data sharing and listservers.

Scaling up may not always be desirable if, as Sieber (2003) asserts, the focus of GIS is on increasingly large data sets where 'GIS may play a role in generalizing out people and places, even as it assists larger organizations and coalitions. In PPGIS, 'bigger' is neither necessarily better nor more appropriate' (p. 58). The struggle for balanced and just outcomes is reflected as 'PPGIS attempts to leverage larger – perhaps global – connections while retaining local context' (Sieber, 2003: 58). Aitken (2002) explores the potential of PPGIS to enable local issues to 'jump scale'. Thus in work on pollution-generating facilities and urban poverty, community decision-making was empowered at the local level while the concept of 'environmental racism' was put on a larger political agenda.

At one level, web-based GIS is the definitive form of participatory and democratic GIS since it has the potential, theoretically, to reach a limitless number of people and to elicit views rapidly and efficiently. Enablement of wide dissemination and interactivity in decision-making led Kingston *et al.* (2000: 110) to go so far as to suggest that 'the previous criticisms of GIS being an elitist technology (Pickles, 1995) may no longer be valid in the same context'. Sieber (2003: 54) suggests that 'PPGIS, by definition, succeeds when as many community members as possible can utilize spatial information in the public decision-making process'. Scaling up in terms of access to Participatory GIS through the internet releases the potential for online public participation and discussion, contribution to decision-making processes through online decision support systems, citizen feedback for system improvement and enhanced communication and political action (Stonich, 2002; Tang and Waters, 2005). In settings which are relatively well resourced, where users are familiar with ICTs and western spatial representations, and where project organizational structures are formalized, this approach potentially has a lot to offer, as shown, for example, in work using internet map servers for neighbourhood environmental inventories (Leitner *et al.*, 2000) and in work by Kingston *et al*. (2000) as part of a university-local government collaboration using a participatory online planning system for environmental decision-making with residents in northern England. More intuitive and, perhaps, pared-down versions of the technology are increasingly required, though, and in this context Haklay and Tobon (2003) call for greater emphasis on Human-Computer Interaction (HCI) in PPGIS research. As well as their educational benefits, web-based GIS learning materials can also prove cheaper than using traditional printed resources where web access is good, as Bishop *et al*. (2002) demonstrate for South Africa. Drawing on examples from local government applications in Norway, Berntzen *et al.* (2005) demonstrate how web-accessible GIS can be combined with e-participation in which citizens collect and add data, and value, to a municipal GIS. Ultimately their intention is to embed the front end of such systems into other outlets such as weblogs and GPS (Global Positioning System). Clearly there are issues of quality control and data currency, and visually based information technology, whether participatory or not, can easily be used to give undue credit to 'bad' data (Dunn *et al.*, 1997). In this way web-based GIS raise questions about the need for gatekeepers, and system administrators can play crucial roles for example in controlling discussion groups through permissions and passwords (Tang and Waters, 2005).

Although there is enormous potential to widen participation in terms of sheer numbers of users, important questions remain, notably 'what kind of users and where?' and 'what kind of participation?' In the same way that Blakemore (2005) draws attention to the uneven spatial and demographic citizen uptake

of e-Government strategies, open-access web-based GIS are subject to concerns about the nature of the user community. The notion of political weblogs as effective tools for increasing participation and creating new forms of online mobilization and democratic literacies (rather than as targets for political address and marketing) is open to question (Griffiths, 2004). Of particular relevance here is the notion of access: while blogs can benefit from the lack of need for traditional media gatekeepers (Griffiths, 2004), they also assume internet availability. Although there are notable similarities between debates which take place through political weblogs and participation through GIS, an important distinction is the emphasis which the latter places on constantly reflecting on who is participating, controlling, owning, understanding, analyzing and benefiting from the process (Abbot *et al.*, 1998; Rambaldi *et al.*, 2006). Griffiths (2004) expresses concerns that 'while there's no doubting the scale of participation in the blogosphere or its democratic potential, the personalizing features of the blog seem to give support to the idea that new media is individuating citizens or causing small like-minded groups to form' (p. 156). As Warf (2001) argues, not only is it a 'fantasy' that the internet is, or could be, available to all, but internet access is also subject to 'the institutional and cultural forces that entice and encourage people to remain digitally connected' (p. 16). For analytic-deliberative decision-making and public participation the web does not yet provide 'anywhere and anytime' work (Nyerges, 2005). In addition, although web-based GIS allow non-experts to visualize and manage geographical data interactively there are still technical demands of the user in terms of basic GIS skills (Tang and Waters, 2005). For Merrick (2003), in a criticism of internet mapping interfaces, 'participation requires at least a cursory understanding of the importance of spatial concepts, spatial implications, and spatial data' (p. 35). Without such understanding, she argues, users could become *less* empowered. Working with community-based organizations and schools she notes how users found Internet Map Servers (IMS) 'manipulative and frustrating' after being exposed to a fully fledged and 'controllable' GIS such as ESRI's ArcView.

In 'traditional' Participatory GIS applications, the project researchers, being 'on the ground', have a greater (if not complete) sense of who is included and who is excluded. In web-based approaches, there are fewer opportunities to draw in those without technological access or skills. In addition, since web-based applications are likely to include 'occasional' and/or anonymous users, new sets of challenges are presented for PPGIS providers in terms of their role in developing community relationships, training, processing data and interpreting findings (Wong and Chua, 2001). In a university-community partnership project on development in deprived neighbourhoods in West Philadelphia, Wong and Chua (2001) found the demands of community outreach to be difficult to maintain in terms of project staff time and resources. Without these relationships they argue that 'a web-based PPGIS may run the risk of providing services that the public does not want' (p. 74). Some of the characteristics of the user base can, however, prove advantageous and, for a village-based case study in northern England, Kingston *et al.* (2000) and Kingston (2002) note how anonymity enables 'non-threatening' interaction compared to the personal identification and confrontation of public meetings. In this way, a web-based system can enable those voices which are less often heard in traditional forms of public participation.

Issues of data copyright are paramount, not least in terms of cost (Kingston *et al.*, 2000) while issues of confidentiality are also critical. Building researcher-participant relationships around commitment and clarifying expectations is crucial, yet it is unlikely that notions of trust can be developed in the non-personal environment of the web (Wong and Chua, 2001). This relationship is interdependent and some user responses may not be verifiable.

That said, Carver (2003) argues that in a broader context openness and enhanced accountability in decision-making may serve instead to enhance a sense of trust. Questions also remain around the ease (or otherwise) of reaching consensus in a web-based decision support environment. An online system could serve to optimize the potential for agreement, given the opportunities to experiment with different scenarios. Alternatively, an excessive amount of digital information and spatial representations may confuse or mislead (Shiffer, 2002) and much depends on how decisions are formulated (Kingston, 2002).

In the same way that Participatory GIS is not a replacement for more traditional public participation processes and participatory research (Abbot *et al.*, 1998; Carver, 2003), it could be argued that web-based PPGIS enhances and diversifies, rather than replaces, the role of more established forms of PPGIS (Wong and Chua, 2001). ICTs and spatial information systems are evolving rapidly, however, and users are increasingly demanding 3D visualizations and process simulation (Gold, 2006). With increasing focus on understanding the needs of the user in a web-based environment, technical opportunities are presented through animation, hypermaps, digital libraries, dynamic sketching (MacEachren, 1998) and navigable virtual environments (Dykes, 2000). At the same time, development of the internet has also enabled GIS concepts to become 'more open, accessible, and mobile to everyone thereby facilitating notions such as democratization of spatial data, open accessibility, and effective dissemination' (Dragićević, 2004: 79). This may call for a reworking of the ways in which GIS and PGIS have been defined and conceptualized, particularly as interaction with digital spatial information increasingly becomes part of everyday experience for many non-expert users, notably through products such as Google Maps, Google Earth and NASA's World Wind (Butler, 2006). Such 'virtual globe' tools are incorporating increasing levels of interactivity and data manipulation, increasing the potential for improved democratization of GIS and active participation. As Longley (2000) warns in the context of the explosion of digital data, however, we should be cautious that such newly created visions of the world have meaning and are not 'triumphs of gloss over substance' (p. 41). Negroponte (1995) argues optimistically for a digital age whose 'decentralizing, globalizing, harmonizing and empowering' elements will result in its 'ultimate triumph' (p. 229). But even he acknowledges that 'as we move toward such a digital world, an entire sector of the population will be or feel disenfranchised' (p. 228). The ability of the non-expert to integrate information from diverse sources and create visual and tabular output may represent 'democratization of the knowledge production process' (Couclelis, 2003: 167) but it also lacks assurance regarding the quality of the knowledge products themselves (Couclelis, 2003).

One vision then is of a ubiquitous GIS, available to millions of people via web connections from desktop PCs. As Goodchild (2000) comments 'on [sic] the order of 10^7 people make regular use of GIS-*like* services offered over the WWW' (Goodchild, 2000: 6, my emphasis). In this way individuals can access information systems which have a spatial element such as finding the shortest travel route from their home to a specific destination, using a GPS on a hiking trip, or 'flying' above a three-dimensional virtual globe. But is this really GIS at its most empowering? Rather this has the makings of a populist GIS (Goodchild, 2000), one which is often an individual and largely visual process, creating something of an illusion of geographical knowledge dissemination. This may represent one version of technology democratization through its (near) ubiquity, but what of political engagement and collective decision-making? Rather than the 'democratization of GIS' through this route, it would seem that technologizing of deliberative democracy through Participatory GIS currently offers a more effective path towards

individual and community empowerment – an analytical as opposed to largely visual process; an interventionist approach which actively rather than passively seeks citizen involvement; and a community-based as opposed to individualist ethos. The aim then is to democratize the process of engaging with GIS, and with each other to promote desirable change through collective control and action. These are issues with which GIScience needs to be more closely engaged. In this respect, recent developments in geocollaborative tools which integrate geospatial technology with tools such as shared whiteboards, large-screen displays and discussion boards offer promising ways forward for more sophisticated human-computer dialogue and human-human collaboration (MacEachren *et al.*, 2005; Schafer *et al.*, 2005).

VII Sustainability and skills

It seems self-evident that the success (or otherwise) of Participatory GIS applications should be properly evaluated and their longer-term impact assessed through follow-up studies. Indeed, Jordan (2002: 243) goes as far as saying that 'without detailed systematic evaluation, PPGIS could easily fall into the trap of combining sloppy GIS practices with sloppy social science'. Such an evaluation may be far from straightforward and, because much relies on 'measuring' change, may be why it has largely been avoided. Perhaps, as Aitken (2002) asserts, an effective PPGIS is one which politicizes issues of local concern. Thus, if we view PPGIS as a process (of empowerment, motivation, local capacity building) as much as, or more than, a product it becomes difficult to 'measure' (Jordan, 2002; Meredith *et al.*, 2002). In building local capacity for sustainable development in a case study south of Mexico City, Meredith *et al.* (2002) demonstrate how, through community map-making by mural painting, the anticipated goals of a PPGIS project may be achieved before the GIS system is even set up. Much depends on understanding the politics and power relations in which PPGIS is set (Weiner *et al.*, 2002) and, as Kyem (2001) highlights, the evaluation of a PGIS approach is implicitly encumbered by difficulties in defining and evaluating empowerment. It remains clear, though, that political integration into local infrastructures is a prerequisite for empowerment (Weiner *et al.*, 2002). Of key relevance to evaluation are dimensions of participation, access and data (Jordan, 2002; Laituri, 2002; Tulloch and Shapiro, 2003) and in this way a taxonomy of successful and unsuccessful case studies can be devised in which cases are classified according to participatory activities and who participates (Tulloch, 2003; Tulloch and Shapiro, 2003). Barndt (2002) outlines three major evaluation guidelines for PPGIS projects: understanding the value of the results in terms of providing appropriate and timely information upon which organizations can usefully act; managing projects to be sustainable and properly integrated into the activities of relevant organizations; and consensus to support a local working system with appropriate community capacity building in the context of wider, and tangible, development strategy plans. Specific means of evaluation include social cost-benefit analyses (Jordan, 2002), systematic social-behavioural research (Nyerges *et al.*, 2002) and meeting criteria for good governance (McCall and Minang, 2005) while, in evaluating the efficiency, effectiveness and equity (empowerment) associated with community multipurpose land information systems (MPLIS), Tulloch and Epstein (2002) adopt a traditional economic analytical approach.

Given that PPGIS as a methodology involves much more than GIS, and the level of spatial analysis tends, in any case, to be relatively simple, some authors (Craig *et al.*, 2002a) have begun to question the future role of GIS *per se* in PPGIS. The different notions of 'accuracy' which Participatory GIS calls for maintain that many of the sophisticated spatial operations which are embedded in a conventional GIS toolbox are inappropriate and, indeed, unnecessary. Thus, where many of the spatial analytical capabilities of GIS remain unused

in Participatory GIS, GIS can become an expensive and potentially divisive means of representing local knowledge (King, 2002). It is crucial to question whether Participatory GIS provides an appropriate means of achieving desirable change when this may be achieved by techniques such as participatory mapping alone (Abbot *et al.*, 1998). A 'checklist' of questions to be addressed before embarking on a PGIS approach is essential, the critical issue being: who gains and who loses (Abbot *et al.*, 1998)? A Participatory GIS approach may offer a potential compromise in that policy- and decision-makers may find the output more credible and convincing than, say, the detailed depth of material from participatory research methods alone or the apparent crudeness of sketch maps drawn as part of a local Participatory Rural Appraisal (PRA) exercise.

As Barndt (1998) reminds us, successful public participation is not simply about technical issues such as hardware and software: 'GIS is not the center of the public participation universe' (Barndt, 1998: 105). Since even a Participatory GIS may not necessarily be a contextually appropriate GIS, there is an argument for other starting points and different types of organizations shaping their own GIS. This calls for a 'closer coupling' of users and software design. Sieber (2000) argues for greater transferral of power in the design and development of GIS by advocating that grassroots organizations actively shape GIS to meet their needs. In so doing, GIS becomes intrinsic to the social practice of such organizations and engenders a sense of ownership. The likelihood of success of such a strategy depends to a large extent on the local context, however, and, as Sieber (2000) acknowledges, a degree of technical knowledge is implied. Many early critiques of GIS characteristically ignored the critical agency (gender, race, cultural identity) of those who use GIS and, hence, the possibilities for transforming dominant GIS practices (Kwan, 2002b). As Kwan (2002c: 262) states, 'change will not occur through trenchant critiques alone, but through everyday struggle with the technology in GIS labs or "sites" of all kinds'. Capacity (skills) building and blurring of role boundaries are likely to be beneficial in developing a more inclusive GIS and should help to foster an institutional culture in which the technocratic solution is not always seen as the first and only way. Thus environmental activists may also operate as GIS software developers while GIS researchers could usefully work in NGOs (Sieber, 2004) or multinational organizations (Williams and Dunn, 2003). In addition, national information policies can be shaped to bring about change for the better by educational processes which teach students to recognize the limitations of GIS and geographical information (Dunn *et al.*, 1999). The NCGIA Santa Barbara Varenius Workshop called attention to the need to educate users and potential users as a 'mandate for PPGIS' (Craig *et al.*, 1999) and important challenges are raised, given that users may need both technical GIS skills and familiarity with participatory methods. In this sense, Tulloch and Epstein (2002) point to the need for leadership from academics and practitioners versed in both technology and social science. Merrick (2003) has adopted an approach to training grassroots organizations with a focus on citizen empowerment, critical thinking and questioning the data, analysis and outputs.

Weiner and Harris (2003: 70) comment that they are 'less than optimistic' that their work on community-integrated GIS in post-apartheid South Africa will have a long-term continuity in the local context. Transitions in government have meant changes in policy and personnel at national and regional levels which subsequently impact on sustainability of a locally based GIS. Similarly, difficulties of retaining staff with GIS skills in public sector or non-profit-making organizations can have particular impacts (Sieber, 2003) and even the presence of 'a strong local organization', as advocated by McCall (2003: 566) as a preventative countermeasure, is not a guarantee against staff losses. In a project using

GIS in community organizations in the City of Philadelphia, Casey and Pederson (2002) found that the rapid turnover of Community Development Corporation (CDC) staff with GIS skills meant that GIS use was 'insignificant' at the CDC level. Such changes are likely to matter less in the commercial GIS world where staff are relatively easy to replace, where local context, politics and organizations are given less emphasis, and where less rests on championing ideas about participation.

VIII New approaches and future prospects: cooperation and feminist GIS

Many early exchanges around the social implications of GIS and its place in geography as a discipline (Taylor, 1990; Openshaw, 1991; 1992; Taylor and Overton, 1991; Smith, 1992; Lake, 1993) were characteristically unhelpful and often unnecessarily polemic, dividing opinion into two camps and consequently squeezing out alternative positions (Rundstrom, 1995). More recent debates have been characterized by less of a dichotomy and a more mature and constructive integration of different ways of understanding and applying geographical information and GIS. Two interrelated points emerge from this more optimistic position. First, it can be argued that debates around a more inclusive and democratic type of GIS have played a key role in actively bringing about this more accommodating perspective. Second, the more cooperative approach may have the potential to help Participatory GIS practitioners avoid some of the critiques around participatory methods more generally. Indeed, since alternative forms of GIS form a focus for inquiry based on both process and practice, prospects may be good for a more theoretically informed 'GIS-2'. Participatory GIS practitioners, unlike some of their counterparts in conventional GIS arenas, are acutely aware of social theorists' critiques and the contradictory nature of the approach so that, as MacEachren (2000: 448) notes, 'researchers who are developing PPGIS or studying its use are as likely to be GIScience "outsiders" as "insiders"'.

There is a further recent and important development with respect to alternative visions of GIS which has a number of resonances in the context of the present discussion and demonstrates clear opportunities for PGIS to make a stronger impression within human geography. This development supports the notion articulated by Pavlovskaya (2002: 287) that 'GIS ... can be employed within non-positivist epistemologies' and comes from what at first sight may appear a surprising corner of the discipline. Recent work has begun to explore the potential links between GIS and feminist geography, arguing that feminist-driven involvement in developing GIS can bring about critical practices which accord with feminist epistemologies (Kwan, 2002a; 2002c). This work has a number of parallels with the concepts which frame Participatory GIS, notably the recognition that both quantitative and qualitative methods and information can exist in the same organizational system; that there is room for a grounded, contextualized and reflexive GIS; and that such a GIS seeks to uncover local knowledges and power imbalances. A feminist critique of GIS is proposed as one which is constructive and caring, and, crucially, one which is engaged in the practices of the technology (Schuurman and Pratt, 2002). The increasing use of ethnographic materials in digital form, not only in feminist geography, but in social and cultural geography more broadly, is not only an indication of the potential for blurring of Participatory GIS and feminist GIS but may also help pave the way for engagement between two geographies which currently remain in separate worlds (Kwan, 2002a): GIS and critical geographies. The narrow dualist thinking which lies behind those who envision GIS as a place only for quantitative analysis has served to demonstrate GIS as inherently problematic (Schuurman and Pratt, 2002) and, in doing so, has suppressed ideas around GIS as part of a critical analysis (Kwan, 2002b).

While in commercial environments there are fewer incentives or opportunities to engage with notions of a 'social' GIS, large software developers retain a powerful position in setting agendas for the ways in which geographical information can be displayed and analyzed. There is an argument, therefore, to ensure that software developments reflect more strongly ideas around geographical information as fuzzy, ambiguous and incomplete. In this context Sieber (2004) advocates a 'rewiring' of current GIS technology in which the software code is rewritten with a less rigid geometry and more opportunities for participation and representation of complexity and disagreement. Early attempts to move towards a 'GIS/2' in this way include Kwan's (1998; 1999) study of women's mobility and access in the city of Columbus, Ohio, for which she developed algorithms specific to the research questions posed on space-time access. Not available in standard GIS software, these algorithms exposed gender differences which conventional measures of space-time access obscured. More recent approaches to developing GIS/2 include Sieber's (2004) 'rebuilding' of GIS through a systems-design approach which draws on current developments in computer science. This seeks to model different ways of knowing by using markup languages which enable retention of narrative richness and allow text or objects to be given tags relating to, for example, class, cultural status, power relations or gender.

With proprietary GIS and related systems ever more affordable and available in more accessible forms (eg, mobile GIS using handheld devices, in-vehicle navigation, web-based GIS, GPS for transect walks), and with the near future likely to bring merging of technologies such as GIS, the internet, virtual reality and mobile communications systems (MacEachren, 2000), we are poised at an interesting time for potential future directions of GIS and participation. There are opportunities for conventional GIS technology to be replicated 'as is' to a large public, and/or for more innovative and socially aware approaches to capitalize on this wider distribution. The latter include an enhanced citizen input to the design and application of GIS as it becomes increasingly available through more accessible routes such as cell-phone technology (Rugg, 2003). Carver (2003) and Kingston (2002) recommend exploration of opportunities for Participatory GIS to be used in media such as digital television and wireless communications. Internet-type television channels obviate the need to have access to a computer and may also provide public information and online voting services (Kingston, 2002). This type of participatory democracy was used by Ventura *et al.* (2002) in a land-use decision-making project for Wisconsin, USA, whereby citizens used the web to take part in an electronic town hall meeting. Responses from elected officials were broadcast simultaneously on local cable television and radio, as well as the website. Innovative approaches to these newer and more mobile forms of ICT do not necessarily demand a highly IT-literate user-base. Thus, in an innovative use of palm-top computers to collect information for conservation work in South Africa, Liebenberg *et al.* (1999) describe how non-literate national park rangers and trackers collect georeferenced information on wildlife sightings in the field, prior to transferring the data to a base-station PC. The introduction of computer technology has given kudos to the trackers and generated recognition of their expertise. A similar project with traditional hunters and trackers in Botswana has, however, created a degree of community resentment and conflict around resource access (Louis Liebenberg, personal communication).

In devising prospects for an alternative framework for the next wave of Participatory GIS there is also an ongoing need to consider the optimal degree of coupling, both in terms of people and practice. These are, of course, interrelated, but the research reviewed here suggests two potential directions. First, that there is a need for closer coupling between users and GIS design. Blurring of roles and

envisaging different types of user to those engaged with conventional GIS are likely to shape more publicly orientated packages. Second, participatory methods and GIS technology itself should be kept fairly loosely coupled. There are, of course, *degrees* of coupling and, in the loosest sense, this may simply involve using participatory research methods to qualify GIS analysis and outputs (see, for example, Pain *et al*., 2006). Thus, just as Kwan (2002a) argues that while still recognizing the limitations of GIS data models 'feminist geographers can *appropriate* GIS methods' (p. 653, original emphasis), the current paper suggests that a GIS which is vested in the interests of the people (as defined by them) through an approach based on 'GIS in participatory research' may be more successful and achievable than a truly 'Participatory GIS'.

Finally, exploration of the social perspectives around GIS can be regarded as a hallmark of a maturing technology; an enhanced GIS as an effective medium for communication (Schuurman, 2003). There remains, though, a question over the extent to which the mainstream GIS and GIScience literature is both driving and reflecting recent developments in the social aspects of GIS. With system development of proprietary GIS falling mainly in the realm of computer scientists rather than geographers, Longley (2000) warns of the dangers for the health of the discipline of Geography. Schuurman and Kwan (2004) comment on an increasing prominence in the last 5–10 years given to scientific and technical GIS research at the expense of papers on the social and political dimensions of GIScience. They relate this to a reduction in published research on critiques of GIS and call for a new 'socially engaged GIScience' (p. 2). Given its democratizing potential, Participatory GIS should be well placed to fill some of this gap, and an optimistic view is one in which PGIS research moves towards centre stage in the mainstream GIS publication outlets. A darker vision is one where more democratic forms of GIS act as fuel for another academic battleground. In this context, it is worth returning to the cautions of the early pioneers in Participatory GIS who, while remaining optimistic for its future, warn that 'efforts to hear the voices of "ordinary" people and "capture local knowledge" are well intentioned, but in many instances these are forms of *participation for publication*, in which academics undertake research to produce books and journal articles while leaving the subject communities with little (if any) tangible benefits' (Harris and Weiner, 2002: 248, original emphasis). This scenario seems depressingly likely given the current climate, at least in the UK, of pressure to publish research in outlets which practitioners are unlikely to access. In this context, it is worth highlighting the basic tenet that 'participatory approaches did not originate as a methodology for research, but as a process by which communities can work towards change' (Pain and Francis, 2003: 46).

Notes

1. Wherever possible in this paper, in referring to the literature, the specific terminology of individual authors is retained. Elsewhere, for convenience, the general term 'Participatory GIS' is used.
2. Clark Labs, Clark University, Worcester, Massachusetts, USA, developers of IDRISI GIS and Image Processing software.

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