PERGAMON

Progress in Planning 58 (2002) 81–140

PROGRESS
IN PLANNING

www.elsevier.com/locate/pplann

Towards a methodology for mapping 'regions for sustainability' using PPGIS

Jonathan Ball

The School of Construction, Property & Surveying, The Robert Gordon University, Garthdee Road, Aberdeen, AB10 7QB, UK

Abstract

There is debate about the problems of communication between scientists, planners and stakeholder, and the scale at which environmental planning should take place. A review of the literature reveals that the concept of holistic landscape ecology is gaining ground in the scientific community. It also becomes clear that participation by stakeholders is not only important in satisfying the requirements of Agenda 21 but also of ensuring cooperation by local inhabitants in the final plan. Moreover, participation is becoming accepted as a vehicle for the planners to gain access to local knowledge, which is a vital complement to scientific knowledge. The challenge is to create a methodology that will overcome the shortfalls currently encountered and allow participants to be proactive in their definition of their landscape. This is possible by extending the experiments in public participation geographical information systems so long as care is taken to overcome problems in public unfamiliarity with the technology. The purpose of this paper is to draw together research in the fields of landscape ecology and planning to enable the formulation of a methodology for achieving greater and more proactive input in participation. The methodology proposed is currently actionable and this paper also points to the potential for a new emphasis in research.

E-mail address: dr_jon_ball@hotmail.com (J. Ball).

PII: S0305-9006(02)00020-X

CHAPTER 1

Introduction

1.1. The background and challenge

It is clear that a holistic approach and community involvement are high on the political agenda but the mechanism for the integration of both the communities and holism is less clear. However, as Holdgate (1997) points out, there is a big difference between an issue being on the agenda and a mechanism for that issue to be addressed.

A holistic approach to environmental planning embraces both the natural and the built environments, inclusive of the people, plants and animals that live in them both. Together, these environments are part of the landscape. The landscape can be an intuitively easy term to understand but a difficult one to define. Like some bizarre drawing by Escher a landscape, being a human construct based on meanings and values ascribed to a bio-physical place, belongs in the noosphere (or conceptual space of the human mind, a term coined by Vernadsky (1945)). But the noosphere, being a part of the humans inhabiting a place, is contained by the landscape. In this logic equivalent of a snake eating its own tail, it is hard to determine the beginning and the end of the ecological 'context of perception of context' loop, so we try to manage the landscape as though it was a certain fact and not a Gestalt system. This is probably responsible, in part, for making it difficult for holistic landscape ecology to emerge fully into the mainstream policy and planning process.

To compound the problem, the cognitive landscape has become divided into the biosphere and the technosphere as sub-divisions of the total human environment (Naveh, 2000). The biosphere relies on internal positive feedback loops for regulation and energy from the sun. The technosphere relies on human agencies and external sources of energy such as fossil fuels. This bifurcation is mirrored by the extremes of philosophical spectrum of O'Riordan (1981) of the ecocentric and technocentric environmental management philosophies. The more the technocentric solutions applied to the management of the biosphere, they become a larger part of the technosphere, as can be seen in the transition from traditional farming, which was largely organic, to modern agriculture. The 'Gaia hypothesis' (Margulis and Lovelock, 1974) states that the earth is a global self-regulatory, co-evolutionary system. However, that self-regulation depends on the regulatory feedback from the biosphere. As the biosphere is eroded and fragmented the strength of the regulation decreases and the Gaia system starts to break down, a situation that is suggested by global climate change (Intergovernmental Panel On Climate Change, 1995). The problems we are currently facing are not due to a failure of technological solutions to remedy ecological problems but a failure to maintain the ecological services provided by the biosphere. With humanity having such a large ecological footprint, arguably covering the entire globe, the only option left open is to manage the environment in such a way that humans are part of the biosphere and not divorced from it in a dominating technosphere, where the biosphere is effectively a ghettoised. The biosphere must be managed in a more ecocentric way to not only avoid further conversion of it into part of the technosphere but to reverse the process of conversion. Ecosystems management and landscape ecology will play an increasingly important role in this respect.

Weiss (1969: 10–11) points out that observations of synergy are too often taken in a literal, algebraic way. An organism contains no more mass or energy than the sum of its cells although it does have some transcendent properties but, according to Weiss, these properties are not additional to the sum of the parts but a consequence of it. Therefore, the phenomenon of synergy is not so much an addition to the measurable properties; rather it is the restoration of information lost during the process of reductionist analysis (Naveh, 2000). Weiss goes on to point out that natural systems are not at all like mechanical systems in which each part or sub-system is effectively external to all other parts. Parts of a natural system do affect not only each other's state but also each other's inner nature. This means that conceptually reassembling a natural system after studying it through a Descartesian process of deconstruction will not give a true picture of how the complete system functions. There is therefore a need for what Joergensen (1997) calls a new holistic science, especially in landscape ecology (Naveh, 2000). However, the authors should have gone further to say there is a need for holistic application of the understanding gained from holistic landscape ecology.

There are some key gaps in the science base needed for the implementation of ecocentric management (Linehan and Gross, 1998), which is typified by ecosystems approaches and landscape ecology. However, the barriers to the employment of an ecosystems approach and their solutions appear to be of a more social or institutional nature than scientific (Szaro *et al.*, 1998) although there are limits to the science too. Particularly, there are a number of problems that stand in the way of effective communication between scientists, planners and stakeholders. These include the nature and conduct of science itself, differences in notions and understandings of scale and the problems of participation. To address the shortfall in information, Szaro *et al.* (1998) recommend that there should be a programme of integrated research in socio-economic and landscape ecology to provide, amongst others, a broader base of public support and adoption, techniques for incorporating spatial analysis to link objectives at different scales into planning and decision making and methodologies for integrated planning and management across site, landscape and regional levels.

Planning for the management of natural resources through the paradigm of landscape ecology must move towards a proactive, integrated, multidisciplinary ecosystem-wide approach from a reactive, fragmented, site-specific approach (Szaro *et al.*, 1998). To achieve this, Szaro states that comparative ecosystems (i.e. regional, watershed) management activities that will reduce the cumulative effects of ecosystem stress must be undertaken. This is true but before any effective action can be taken, the landscape must be holistically mapped so that its specific natures can be known. To this end, there have been repeated calls from many quarters, starting with the so-called anarchist geographers from the turn of the 19th/20th century, for a reintegration of humans with their environment not only physically but also intellectually and conceptually. Recently, there have been calls for the participation of stakeholders and the acceptance of civic science into environmental planning, the most notable example of which comes from the Rio Summit (United Nations, 1993).

Luz (2000) rightly calls for the inclusion of a social layer in the superimposition of thematic maps during landscape analysis to allow the needs of different landscape users to be taken into account with equal professionalism as the mapping of soils, vegetation or land-use. The justification for the inclusion of a social layer is clear. Landscapes are not just a set of ecosystems within an appropriate scale but are a socially collective phenomenological interpretation of human activity within the biosphere (Wilson, 1992). The question remains as to what definition of social criteria, or combination of social criteria, should be used to determine the social layer in the mapping process. Within the strict meaning of the term 'holistic' all social criteria should be added. This is clearly unfeasible and some criteria are likely to have greater or lesser significance depending on the nature of the planning in hand.

Adding a social schema to the planning and mapping process is only half the challenge. The planning process must be collaborative (Healey, 1997). The process must also facilitate effective communication between participants so that all thematic layers have meaning to all participants that is relevant to the specific landscape in question, including the cultural landscape, and not just to landscapes of a given generic character. The approach of landscape ecology to environmental management requires that natural resource planners, scientists and the public generate a shared vision for the future in the formulation of which societal and economic decisions are integrated with an increasingly comprehensive understanding of the environment (Szaro *et al.*, 1998).

The challenge is a big one but can be summarised as the need for landscape planning to become more socially relevant (Linehan and Gross, 1998). Despite the magnitude of the challenge, there would seem to be one particular issue at its heart. It would appear that the most pressing need is the development of practical methodologies that can bring together different information at the scale of the landscape in such a way that the professional scientific community, the lay stakeholders, planners and policy makers can all communicate meaningfully with each other and contribute information during the process of constructing a shared vision (Ball, 2001). This paper explores the literature to draw out a potential methodology that holds promise for achieving this end and therefore enabling a more effective application of holistic landscape ecology in the planning process. The generalities of public participation in the 'information age' will be related to the specifics of public participation geographical information systems (PPGIS). With the recognition that there are very many areas of planning that could theoretically employ PPGIS, the paper will finish by concentrating on a methodology for the identification of regions for sustainability.

1.2. Civic science and stakeholder involvement

Science cannot, and does not deliver truth that is non-arguable (Cullen, 1990). As such there is no such thing as truly objective science (Cortner, 2000). Subjective value judgements are an inherent part of the scientific process that start from the definition of a problem and continue through the framing of a hypothesis, development of methodological design and assumptions to analysis and interpretation of results. Scientific facts are consequently the current consensus based on repeatability, and subject to change or re-interpretation. Furthermore, there is the overriding value of efficiency while other humanistic-values such as equity, legitimacy and especially beauty are largely excluded. This gives the lie to scientific endeavour being value-free (Heineman *et al.*, 1997: 38). If scientific veracity cannot be guaranteed, it must be a better approach to base environmental management on place-specific scientific consensus founded on the values of the people who are most affected by local policy and planning decisions. If environmental management is best performed at the scale of the landscape or region, and landscape ecology perforce includes the human residents, then consensus can only be achieved by the involvement of the human communities to represent their association with the landscape in question.

Social anthropologists and environmental historians have shown that practically all human societies have been, and are now, in negotiation with their worlds to try and guarantee their future (O'Riordan, 1995). Within this negotiation there are many alternative understandings. Concepts such as the environment and landscapes differ according to the interpretation of the observer and their relationship with the area. The introduction of the analysis of an 'expert outsider', the scientist, does not provide the community with a vision they can share, but another alternative viewpoint with which many will disagree. Contrasting the perspectives of the expert outsider and the lay stakeholder reveals that there is a difference between *the* environment and *my* environment, an observation that is supported by other commentators such as Goodwin (1999) and Luz (2000). From this there must also be the notion of *our* environment, which is the community's shared understanding of its landscape. The designation of ownership between the community and the landscape is used advisedly to reflect that 'landscape' is a human construct but culture and community are routed in and a part of the landscape. However, modern Western society seems to have reached a stage of dysfunction in this respect (McBurney, 1990) not least through the agencies of globalisation, which have reduced distinctive landscapes to the status of cultural artefacts (Linehan and Gross, 1998) or culture to that of an atavism. The extent to which the urban-centric majority lack any feeling of direct links with 'the environment' may preclude them from meaningful negotiation (Volker, 1997). To compound this problem, there is an imbalance between the technical knowledge of landscape planning and the cultural, economic and political knowledge, perceptions and practices of real people (Linehan and Gross, 1998). An effective participatory process must overcome this dysfunction, which inevitably requires dialog between scientists and lay participants but, moreover, requires acceptance of the total human ecosystems construct of Egler (1964) (Naveh and Leiberman, 1994) or some variation of the general hypothesis. Within the concept of the total human environment and the process of participation is a reliance on the notion of 'community' whether it is explicitly stated or not.

The notion of community had been in retreat from rural studies over the last couple of decades, but is re-emerging, despite the difficulties of defining the term. Liepins (2000) attributes this renewed interest to the need to address the significance of social space and arenas in conjunction with their cultural meanings and practices. The literature is once again discussing spatial communities (Bryden, 1994; Mattson, 1997; Silk, 1999). In spatial communities, spaces and structures are media through which there is a material and metaphorical embodiment of community, both in terms of a passive definition of territoriality or 'place', but also an active re-enforcing of social phenomena through the inhabitation of such an identifiable place. Most cultures can be closely related to their particular locality (Rapoport, 1994). Therefore, appreciation of the qualities of spaces, natural materials or resources relies heavily on how a culture or community has assimilated its local environment into its consciousness. For example, this variation can be readily identified through the wide variety of local languages (Ujam *et al.*, 1997), even in different regions of one country, and the relationship of individual languages to the environment in which they have evolved. Languages and linguistic nuances reflect how a local culture's interpretation of available materials and resources is effected by their landscape, as can be seen, for instance, in the meanings of the word 'forest' (Stevenson and Ball, 1998). For those not living and working in a forest it may simply mean 'many trees'. However, for those using it as a term in landscape ecology it means a 'living natural economy' inhabited by people and used to mutual benefit. It contains houses, animals, farms, woods, roads, tourism, workshops, and much more (Reforesting Scotland, 1993). This means that the notion of 're-foresting Scotland' (or any other deforested landscape) is not about just covering it in trees, it is about creating a living economy from a natural resource and all the cultural, physical and economic complexity that implies. This local knowledge can come in many forms, depending on the different values and experiential interpretations of the individuals and groups that make up the community (Healey, 1998).

The essence of a place-based community, in the modern idiom, is the importance of a bio-physical, 4D space in which people build their culture, political practices and negotiate with the non-human elements in the pursuit of primary economic activity. The local community is therefore clearly a part of the landscape and therefore stakeholders in the ecological well being of their landscape. The association of community and place is far from new and dates back to considerably earlier than even the middle of the 20th century. It can be found in the writings of the so-called anarchist geographers of the turn of the previous century such as Peter Kropotkin, Patrick Geddes and Lewis Mumford (Aberley, 1995). There are many other more recent authors on the subject of place but the most radical espousal of the unity of place and community can be found in the writings of bioregionalists (Berg, 1977; Aberley 1993; McGinnis, 1999a,b).

Local culture and a sense of 'living in place' are as important to sustainable development as is 'pure' ecological protection (Sale, 1985). Pure ecological protection is used here to mean measures taken to sustain and nurture individual species and tracts of the natural environment as opposed to issues such as recycling and energy from renewable sources, both of which are important but lie out with the scope of the term as used here.

> The phenomenon of universalisation, while being an advancement of mankind, at the same time constitutes a sort of subtle destruction, not only of traditional cultures …but also of the creative nucleus of great cultures, the nucleus on the basis of which we interpret life…

Frampton (1983) quotes from Paul Ricoeur's *Universal Civilisation and National Cultures*, History and Time (1961, original not sourced).

Possibly the most important aspect of bioregionalism that emerges from the literature is that of 're-inhabitation' (Sale, 1984; Aberley, 1993; Berg, 1977). At first sight the word 're-inhabitation' can appear a somewhat bizarre notion. In essence, it is all about reversing the divorce of humans from their local natural environment. Re-inhabitation focuses on developing and connecting with a regional ecologically based identity:

> …if the life-destructive path of technological society is to be diverted into life-sustaining directions, the land must be reinhabited. Reinhabitation means

> developing a bioregional identity. It means learning to live-in-place in an area that has been disrupted and injured through past exploitation. It involves becoming native to a place through becoming aware of the particular ecological relationships that operate within it. Simply stated it involves becoming fully alive in and with such a place. It involves applying for membership of a biotic community and ceasing to be its exploiter. Berg and Dasmann (1977)

This powerful statement describes the meaning of re-inhabitation. Importantly it refers to an ecocentric versus technocentric dichotomy. Bioregionalism is an alternative philosophy most aligned with the more extremely ecocentric end of the environmental continuum identified by O'Riordan (1981), typified by 'Deep Ecology' (Naess, 1989). Until now, the guiding principle of environmental management has been a defensive attitude of saving what remains of dwindling natural and semi-natural areas. This is the natural conclusion that is reached through a 'progressional' strategy but bioregionalism proposes a 'strategy by vision'. Bioregionalists advocate that the time has come to stop merely trying to save what is left but to expand the ideals of the nature reserves to be more inclusive; for people to 'step inside' the reserves so to speak; to reinhabit the land and no longer be separated from it (Berg, 1983). A glimpse of such bioregionalism might be seen in the buffer zones of the biosphere reserves construct. The concept of the biosphere reserves was popular with conservationists in the 1960s and 1970s and grew out of the 'Man and the Biosphere' (MAB) programme (Batisse, 1982). MAB was a product of the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The biosphere reserve lies halfway between conventional conservation and bioregionalism. Although it is still oriented towards research, UNESCO stressed the reserves' logistical role. The crucial difference between the biosphere reserves and bioregions is the occupancy and utilisation of the resources within the areas by human inhabitants in the case of the latter. Although the biosphere reserves do not preclude the presence of humans, it is stressed that there should be an undisturbed core area (Batisse, 1982). The reserves should be set up with a buffer zone in which 'traditional land-use' can take place. These traditional land-uses are, essentially, less intensive agriculture or uses of the land that have lower impact by virtue of the traditional (as opposed to modern) methods employed. In particular, land uses that preserve a certain type of habitat are encouraged, for instance the maintenance of heather moorland or woodland composed of coppice with standards. The buffer zone acts as a transition between what is effectively the ecocentric landscape and the technocentric modern industrial landscape. The stated purpose of this buffer zone is to ensure the proper integration of the reserve into the geographical region that it represents and serves (Batisse, 1982). From an ecocentric standpoint this is the wrong way round. The buffer zone should surely ameliorate the integration of the unnatural into the more natural.

For people to participate in this collaborative way is not exclusive to bioregionalism or even the biosphere reserve (Healey, 1997). It is the concept of the 'stakeholder'. The metaphorical nature of the 'stakeholder' concept must be borne in mind in any discussion of participation (Sunley, 1999). Sunley raises some justified criticisms of the use of the stakeholder concept, highlighting the potential of political cynicism to hijack the process in particular. In a similar vein, Healey (1998) notes that there is a danger of well-organised

Table 1
Major bioregional stakeholders who must be considered in the future state visioning process

Directly involved	Indirectly involved
Residents	Absentee landlords
People dependent on the region's natural resources	National authoritative bodies (e.g. water or agriculture regulatory bodies)
People who derive their livelihood from other activities dependent on the region (e.g. tourism)	National government (in as much as it has the power to officially recognise a bioregion as an operational entity)
Local government and political groups	Inhabitants 'upstream' of the region
Floral and faunal communities	
Inhabitants 'downstream' of any outputs from the region	

pressure groups taking over the process and supplanting the issues with their own agendas. Nonetheless, if the pitfalls can be avoided, the importance and benefit of stakeholder participation in the environmental planning process is well documented (Batisse, 1982; Chambers, 1983; Al-Kodmany, 1999; Luz, 2000) and has proved one of the overriding factors that determines the success of many environmental conservation ventures, such as the biosphere reserves (Batisse, 1982) and landscape planning (Luz, 2000). The examples from Al-Kodmany (1999) and Batisse (1982) reflect the difference between participation as a process through which objectives and actions emerge as opposed to a management tool for a predetermined product of external expertise, respectively. Goodwin (1999) considers the former to be more desirable, despite or perhaps because of the need for institutional change. It is the model for participation that will be followed in this paper.

Every geographic region will have its own unique set of stakeholders although there will be certain groups which might reasonably be expected to occur in most situations. These groups are shown in Table 1, which is divided into those who should be directly involved in the environmental planning process and outside bodies or groups who have an interest. It is difficult to involve all stakeholders at all levels of the planning process but it is essential that their needs are always considered, which is why floral and faunal communities are included in Table 1. It may, at first sight, seem rather bizarre that biological communities should be listed as stakeholders, but the biotic communities of a region are not only a resource for food, fuel and clothing but are providers of services that include water purification, conversion of carbon-dioxide to oxygen, and revenue from tourism. Building on the concepts of the rights of nature (Nash, 1989) and the imperatives for humankind to respect and preserve the natural environment through stewardship, particularly of environmental services, it becomes clear that the biotic communities must also be counted as stakeholders. Including such a diversity of stakeholders has a positive effect of enriching the breadth and depth of local knowledge and fostering an understanding between groups (Healey, 1998).

A second imperative for ensuring the participation of stakeholders is that action is only achievable through the motivation of interested parties (Stewart, 1993). People have a sense of ownership in a vision that they helped to create and a shared vision is a much more powerful force for change than one that has been imposed. The social criteria of a planning scheme can be considered to be determinants of whether a scheme will be both locally acceptable and realisable (Luz, 1993).

There is a third imperative of participation to ensure that all sources of knowledge are tapped and given due consideration. It is a truth that knowledge is power but equally importantly different groups within the list of stakeholders will have different perceptions and knowledge. A full picture can only be built when all sources of information have been brought together and the value of local or 'native' knowledge should never be underestimated (Chambers, 1983; Al-Kodmany, 1999).

The technological–scientific definition of ecological and environmental problems and risks is often at odds with the local community's perception through the differences in value systems. Social values are part of the landscape, contributing as they do to the boundaries of home in a place-based community. However, the standards and values of the expert community often substitute for open and democratic discussion, leading to social exclusion. Schneider and Ingram (1997: 178) drew an example from water pollution, which is scientifically defined in parts per million of certain substances. The formulation of regulations is bound to professional instrumentation, sampling procedures and more often than not are imposed at 'end of pipe', thus treating the symptom and not the cause. In a more socially inclusive context, where the domination of scientists and professionals is moderated, water pollution might be said to exist when people in a particular catchment desire use such as habitat for fish, for example, in which water quality is unsuitable. Such an approach to the definition of environmental problems would require discussion of preferences among water users.

A phenomenological approach to geography was dropped at the time when geography achieved the status of an institutionalised academic discipline (Granö, 1981). It was also around this time that the response of geographers to this contextual development within their discipline moved from the study of regionalism and environmentalism to quantification and later to social humanism (Granö, 1981). Kropotkin and Geddes can be considered representative of the regionalist, phenomenological approach. The bioregionalist prizes local phenomenological knowledge (Aberley, 1999). In the past couple of years, there has been a resurgence of interest in the value of local phenomenological knowledge in geography.

The importance of this split between scientific knowledge and local phenomenological knowledge is twofold. The first point is that global or scientific knowledge cannot always provide satisfactory answers at the local scale, usually because of the specifics of the situation. Both Goldstein (1999) and Chambers (1983) list examples of how scientific enquiry has resulted in poor decision making because the outsider scientists either did not perceive localised micro-variations or asked the wrong questions through a lack of cultural understanding. The second point is the issue of empowerment. Goldstein (1999) puts it thus:

> Reliance on scientific expertise exclusively has the tendency to concentrate power in the hands of the technically and scientifically adept, transforming a democracy into a technocracy (Fisher, 1990). Technocracy does not simply discount place-based knowledge but also fosters the illusion of objectivity that facilitates the transformation of moral and political questions into technical issues.

The way in which the environment is understood and the reliance on any particular knowledge base has implications for environmental planning, particularly in the formulation of future strategy because that strategy is developed out of the way in which the knowledge is interpreted. The ideal, which Goldstein (1999) supports, is that local knowledge and scientific knowledge should be wed. Jacobs and Mulvihill (1995) are in concordance with Goldstein on this point and they point to the success of joint institutions that incorporate both native and non-native members and knowledge bases, particularly in Canada but elsewhere too.

The foregoing can be summed up in the words of Batisse who writes, in connection with biosphere reserves, about how social inclusion and integration are necessary in a bottom-up approach to planning, which is a visionary step in itself as is clear from the following quote:

> It cannot be over-stressed that conservation measures—especially those which involve productive lands—will not succeed without the agreement, support and participation of the population directly concerned. Unless administrative habits of most countries, which tend to dictate from above what has to be done in the field of nature conservation—and indeed in other fields—are radically modified, and unless major efforts are made to explain the value of protected areas and to associate the local people with their management, all conservation measures will be bound to collapse sooner or later. Batisse (1982)

It is axiomatic of bioregionalism that the exercise of political power is most effective at the local level (Sale, 1984; Diffenderfer and Birch, 1997). This is the basis of the principal of stakeholder participation. Two of the cornerstones that underpin nearly all the social principles are empowerment and education. It is on both of these issues that a person's ability to participate in the debate and processes of environmental preservation are based. Over the centuries, but particularly this century, there has been a concentration of power in urban areas and a centralisation of government. Although some power has been retained in rural areas of Scotland by wealthy landlords the trend of urbanisation, and the consequent urban focus, cannot be denied. Even knowledge and values have become increasingly concentrated in urban areas from which they dominate (Chambers, 1983). Chambers goes on to describe the two cultures of academics and practitioners (each of C.P. Snow's two nations, arts and science, can be expected to have within it these two cultures). He describes the former as a negative culture engaged in unhurried analysis and criticism and the latter as a positive culture. Such a distinction, while possibly having some observation, is very value-laden and rather unhelpful.

Social anthropologists recognise the importance and validity of indigenous local knowledge systems (Chambers, 1983). However, gaps exists between the practitioner, the academic and the politician (Harrison, 1989). The latter two are conditioned to be suspicious of 'rural people's knowledge'; a term coined by Chambers, in preference to 'local knowledge' or other similar terms, to be more inclusive and signify that it is the knowledge within the people and not necessarily, exclusively of the place.

The gap is considerably less wide in Scotland than it might be in some so-called third world countries. There, the outside knowledge comes from aid and extension workers who are often foreigners, conditioned with a different set of values and practices that are appropriate in their own region but not to their current location. Harrison (1989) and Chambers (1983) give numerous examples from Africa. Outside knowledge is deemed modern and scientific and traditional rural people's knowledge is marginalised as, at best, quaint and, at worst, backward.

The importance of local and, particularly, indigenous cultures is that the bioregionalist sees them as repositories of local or 'place-based' knowledge (Goldstein, 1999). The bioregionalist recognises that social customs and religious practices help to cement the connection between many cultures and their surroundings (Parsons, 1985). It stems from this that cultural diversity is, almost de facto, desirable. As Parsons (1985) writes:

> [Bioregionalists] have a special sympathy for separatist, home-rule movements (Quebec, the Basques, The Lapps, the Celtic fringe of Europe, Australian Aborigines, American Indians).

The recent developments in political devolution make this all the more poignant. Regional planning has made some progress towards overcoming the disempowerment of local citizens but there are still concerns about the structure of regional planning organisations and the institutionalisation of citizen output (Diffenderfer and Birch, 1997). There is a danger of environmental planning becoming utilitarian. The regional perspective must support a healthy relationship between individuals and their natural world through their attachment to it (Diffenderfer and Birch, 1997). Viewing the world in terms of bioregions and ecosystems is potentially a major step on the road to building a co-operative sustainable relationship with our surroundings and the environment. However, bioregionalism differs from most forms of regional planning by putting its primary focus on the development of an integrated self-reliant economic, social and political system (Diffenderfer and Birch, 1997). As such it demands a detailed understanding of a region's geography, ecology and resources.

There are a number of pitfalls in the path of a route to civic science, not least the risk that the baby will be thrown out with the bath water if scientific understanding and measurement are entirely substituted by social values. Civic science should supplement the quantitative approach of traditional science with qualitative discussion and meaning (Cortner, 2000). The scientific process is often able to identify a problem or determine the cause of a problem that would be otherwise undetected if left to popular determination. Another pitfall is that the desires of the human stakeholders may be at odds with the requirements of other organisms within the landscape or reliant on the resource in question. Components of the natural environment must be considered as stakeholders (see Table 1) if the environmental planning process is to avoid becoming overly anthropocentric and utilitarian. The sustainable development debate turns on the main dialectics of technocentrism distinguished from ecocentrism and of efficiency versus equity (O'Riordan, 1995). Although, who could act on behalf of the biotic communities with impartiality remains a difficulty. A further pitfall is that civic science is in danger of becoming a process whereby the stakeholders are merely helpers in the scientific process without any reciprocity within the processes of the production of knowledge and the enlightenment of such knowledge with moral and cultural meaning (Shannon and Antypas, 1996).

CHAPTER 2

Methodology and technology in PPGIS

2.1. Public participation methodology in the information age

During the 1960s and 1970s, there was a particular interest in the methodology of public participation (Sarjakoski, 1998). Arnstein (1969), Sanoff (1978) and Burke (1979) were influential authors on the subject at that time. Burke (1979) states that planning is 'axiomatically participatory' and describes the transition from planning by a small informal elite to a formal broad base of constituents during the 1970s, with a swing back to a small elite as scientific knowledge became the paradigm during the 1980s. However, the fact that there was, and to some extent is, an elite involved in planning clearly demonstrates that it is not axiomatic that the process of planning is participatory, and that participation is something that must be strived for rather than given, whose absence is a temporary aberration.

It would appear that community participation was initially demand-lead (Sewell and Coppock, 1977: 1). That situation is no longer the case in the West, whether through apathy or through the scientific paradigm replacing local phenomenological knowledge (Cortner, 2000). To some extent, however, there has been resurgence of an interest in the methodology of public participation (Healey, 1997), not least as a result of the Earth Summit in Rio and the demands of Agenda 21 (United Nations, 1993). Anderson (1995) identifies two approaches to civic planning. The first relies upon planners to prepare a plan, which is presented to a group of citizens for their reactions. This approach is still more common, not least because of the difficulties in achieving consensus. The participants should, and can, have a much broader role than being limited to their reactions. The second approach requires earlier involvement of other participants. Between Burke (1979) and Arnstein (1969), the roles of citizen participation can be summarised as one or more of the following:

1. consultation;
2. advisory;
3. decision-making (shared and controlled);
4. review and comment.

Public participation in planning has been greatly enabled in the information age and many techniques have been developed over the years to foster the above roles. Most of these techniques, however, are as old as civilisation itself and were the mechanisms behind social change for centuries. Examples can be drawn from development of rights from the Baronial pressure group that crafted the Magna Carter through to the emancipation of slaves, women (e.g. the Suffragette movement) and ethnic minorities (Nash, 1989). The impact of the information age on these methods of participation was the ease with which knowledge could be disseminated, and so involve more people. This ability to involve more people in the process was analysed by Vindasius (1974) and Sewell and Coppock (1977), and is reproduced in Table 4.

Moore and Davis (1997) describe the modern application of participation techniques in the context of land use planning. Each technique has some capacity for spatial empowerment of stakeholders through the use of geographic information technologies (GIT). Drawing on Moore and Davis (1997) and Howard (1998), the techniques are presented in increasing order of their complexity according to staff preparation and involvement, and their application to groups or individual utilisation. However, the techniques are re-cast to be in concordance with Vindasius (1974) to relate directly to Table 4 and because Moore and Davis omitted some common techniques.

1. *Informal local contacts*—or the 'garden fence debate';
2. *Mass media campaigns*—used to educate citizens about planning, advertise planning actions and solicit involvement in planning participation activities.
3. *Surveys and questionnaires*—used to elicit information from citizens—very amenable to becoming web-based
4. *Guided tours*—used to acquaint participants with existing conditions and potential enhancements of an area, bringing together a diverse group of people to increase their awareness of a project area.
5. *Workshops and facilitated meetings*—used to try to find a solution that is mutually acceptable to representatives of local interest groups, city staff, and other stakeholders participate in an effort to. Planners increasingly use digital maps, photographs, and charts to display information at these meetings.
6. *Public hearings, meetings and formal neighbourhood groups*—used to try to achieve direct lines of communication between stakeholder groups and planners.
7. *Visioning*—visioning is an exercise that brings citizens and stakeholders together to establish a common vision for the future of their community. The goal of visioning is to derive written statements of a community's long-term goals. Visioning is a term that is often misapplied and a technique that is often poorly understood, but Stewart (1993) and Westley and Mintzberg (1987) provide good overviews, showing the technique's origins in the corporate business sector.
8. *Visual preference survey*—the visual preference survey (VPS) was first developed by A. Nelessen Associates to enable citizens to evaluate images of the natural and built environment through the expression of their preferences. VPS has become a widely used technique and has been successfully pioneered using the Internet (Wherret, 1999) since the development of World Wide Web (WWW) browsers in 1994.
9. *Special task forces and design charettes*—used as an intensive collaborative effort that brings together stakeholders and designers. Charettes enable designers to assimilate information from the public into a plan, which can be re-assessed or modified by the stakeholders. Charettes can utilise digital geographic information and display as a basis for concept and site plans. This is the nature of the work by Al-Kodmany (1998, 1999).
10. *Computer simulation*—used to illustrate the potential results of planning, development, and design projects through computer modelling and photographic imaging techniques. The participants can visualise the outcome of a design or plan and assess its desirability. This technique is becoming more common with rapid increases in computer processing power and graphics capabilities.

11. *Gaming and simulation exercises*—used to involve participants in 'what if' scenarios. This technique can be effective in helping to overcome barriers of perception between different groups of stakeholders by allowing them to see the bigger picture or understand the problem from a different point of view.

There is a weakness in all these techniques that is highlighted by Sanoff (1990), who asserts that these sorts of traditional methods of participation actually disenfranchise community members because the process of communication has not changed to accommodate a lay, non-design oriented population. Al-Kodmany (1998) found that, even residents who had lived in an area for a long time, had difficulties in remembering a lot of small details about specific sites, thus hindering their ability to apply their community knowledge and expertise to help develop overall strategies with the planners. The planners and designers also grew frustrated with the design process and their inability to communicate effectively with the non-design oriented participants. McDowell (1987: 20) summarises the problem when she wrote:

> the public needs a language that can give its creativity a focus and help individuals turn their intuition and knowledge into a workable idea.

The question is how can the process of communication be modified to allow professionals and laypeople to understand each other and so make best use of the participatory techniques? The crux of the problem is not that the planners and designers are dealing with concepts that the participants have never come across, and nor is it that they are dealing with information that is too complex for the stakeholders to understand. It would be arrogant for planners or designers to assume this because in a cross-section of any stakeholder group it is reasonable to expect that there will be people who are at least, if not better educated and at least, if not more intelligent than they themselves. Therefore, it must be the way in which information is presented, which suggests that other means of presenting the information, that also allow the participant to provide their own information must be explored. Advances in computer technology have opened up a whole range of possibilities, especially in the area of visualisation.

2.2. Visualisation, hypermedia and GIS

There has always been a great deal of interest in visualisation and multimedia. The word multimedia has become such a part of everyday speech that, it can no longer be regarded as a neologistic portmanteau. Bill *et al.* (1999) summarise the four functions that media for the representation of information have according to cognitive science. These are:

1. *Demonstration*—to help the user get a suitable 'picture', a correct and complete idea of the phenomenon. Pictures, videos, realistic graphic representations, animations and virtual reality (VR) are best for this purpose and can be augmented by sound to increase orientation.
2. *Putting into context*—to help the user put information into a greater context. Media showing a wide spatial area such as satellite images or video are best and can be usefully augmented with sound and text.

3. *Construction*—to help the user create complex mental models based on information about elements, their relationships and co-operation. Mental models are constructions of knowledge about single information units or relationships and abstract media such as maps, diagrams and graphs are best in this context. Appropriate animations can also prove effective but pictures and videos are not useful in this context.
4. *Motivation*—to arouse the user's interest and attention. Attractive pictures and animations are best for this purpose, especially flythroughs.

Multimedia can, if used appropriately, improve information processing by emphasising important aspects or spatial phenomena. Multimedia can also help to avoid the overloading of a single, usually the visual sense. The main method of alleviating this is by the introduction of sound, for instance audio in in-car navigation systems; although the sense of touch can now also be stimulated through force-feedback controls and this is an example of how the computer games industry is leading some aspects of the research. A further advantage of multimedia is that it encourages double encoding. Double encoding is a mechanism by which the human brain stores information as both pictorial and textual memories. Experts are used to understanding or interpreting abstract representations of data in their own specialism but such representations are often hard for the layperson to understand and they need cognitive help. However, there is a negative aspect to the use of multimedia. It is that the human short-term memory can only maintain seven information units (or facts) simultaneously (Bill *et al.*, 1999). To transfer these units to long-term memory, repetition or elaboration is needed. If the units are not transferred to long-term memory they are forgotten, which poses a problem for the planner trying to present large amounts of unfamiliar information to untrained participants. Dynamic presentations such as video, transmit a considerable amount of data and the limit of seven units can be quickly exceeded without sufficient repetition for retention. That said, certain types of visualisation are best demonstrated by dynamic presentations because that is the way they are best understood, e.g. dynamic processes are best presented through video or animation.

From the user's perspective there is a clear pattern of preference of the level of dimensionality and/or use of multimedia depending on whether the user is interested in numerical or statistical analysis or a phenomenological experience (Fig. 1). Sarjakoski (1998) describes how 3D visualisations, and especially photo-realistic visualisations, have the two important attributes of being sub-symbolic and therefore understandable intuitively. In other words, a layperson viewing such a presentation is able to understand it without the need for extensive training or familiarity with cartography (in the case of area or mapped data). A further important point, from the perspective of the viewer is that a 3D visualisation has, *de facto*, a central perspective view. Obviously, objects closer to the view are larger and more distinct than objects farther away. Therefore, the viewer's point of interest is focussed on closer objects, which have a greater level of importance by virtue of their proximity. This means that the 'here-and-now' aspect of a 3D visualisation, and especially a walk-through, should help reduce the cognitive overload by automatically filtering objects that are more distant. Bertin (1983) came to a similar conclusion when he developed his continuum from 'map-to-read' through 'map-to-see' through 'space-to-observe' to 'space-to-feel'. It was decided that this continuum was a little obscure and was reinterpreted in the light of Sarjakoski to give Fig. 1.

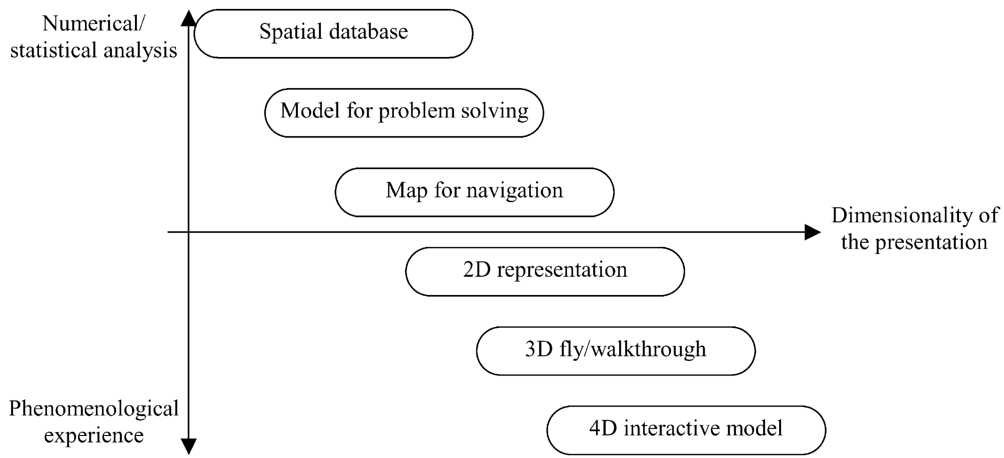

Fig. 1. There is a tendency to favour higher dimensional presentations for visualisation of the physical environment (re-interpreted from Bertin (1983) and Sarjakoski (1998)).

Faust (1995) argues that a truly interactive 3D VR geographical information systems (GIS) has three critical abilities in addition to all the normal functions of a GIS (search, query, select, overlay, statistical comparisons, etc):

1. to present a very realistic representation of the 3D nature of real geographic areas;
2. to allow the user freedom of movement within and outside the selected geographical terrain;
3. to incorporate natural functions of visibility through the user interface such as lines of sight, obstruction and ray tracing, etc.

Modern 3D computer action and adventure games achieve all these functions with the exception of the analysis ability of a GIS. True 3D GIS systems are starting to become available although much of what is advertised as 3D is really '$2\frac{1}{2}$D'. $2\frac{1}{2}$D is a term that is used to describe a visualisation that has *X*, *Y* and *Z* coordinates but lacks information bellow the surface. A traditional digital terrain model is a good example of $2\frac{1}{2}$D. Whether a truly 3D representation is needed or not depends greatly on the application and is now more dependent of the availability of data than the software. Sarjakoski (1998) was not strictly accurate when he asserted that truly 3D GIS are not commercially available. Even when he was writing, there were a number of products available commercially and many more bespoke systems, particularly in the oil exploration and mining industries where the need to model in three dimensions has provided considerable demand. A good example of such development can be drawn from the 'Expo'98 Multimedia System for Environmental Exploration' (Fonseca *et al.*, 1999) that incorporated 3D GIS with video, animations, text and numerical data. 3D GIS are a long way from being perfect and there is likely to be considerable development in this area over the next few years. In the meantime, the integration of computer aided design (CAD) and GIS can help in the production of 3D models. The use of GIS in visualisation is now becoming known as Geographic Visualisation or 'GVis' (Krygier, 1998).

Howard (1998) summarises different types of GIT, which includes associated multimedia as follows:

1. *Audio*—recorded sounds from public planning and design meetings, or sounds from a specific location within the community. Audio clips can be integrated into a multimedia GIS.
2. *Video*—images of locations within the community used at meetings or on television to illustrate plan alternatives. Video clips can be integrated into a multimedia GIS.
3. *Community networking* (Sarjakoski, 1998)—the use of maps and photos delivered through synchronous and asynchronous Internet communication and use of the WWW.
4. *Automated visualisation techniques* (Krygier, 1998)—enable processing and display of aerial photography, computer simulation and animation on television, the Internet, or in a planning/design meeting.
5. *Collaborative planning system* (Shiffer, 1995)—interactive planning system employed during meetings, or located at information kiosks in public places. Although the CPS may depend upon GIS, the direct interaction with GIS software is limited, and supported by the use of hypermedia.

6. *Geographic information system (GIS)*—individual or personal access to GIS software.
7. *Distributed geographic information*—the Internet is used to provide access to spatial information and GIS. Mapping through intra and inter nets is a growth area.

In the past few years, the pace of development in information technology has increased. In particular, there has been a great increase in public access to the WWW with most schools and more than half of all households having a computer. For those who do not have a computer, most libraries in Britain have a computing facility with access to the WWW and technology now exists for mobile phones and television sets to gain access too. The WWW is classed by Schuler (1994) as the fourth medium in the information age, with a level of accessibility equal to that of radio, television and print. The power of computer networks lies in their potential for interactivity that, although this does not make the WWW a panacea for participation, is an attribute that the other three lack. Schuler (1994) lists the attributes of computer networks, from a community perspective, as follows:

- *Community-based*—shared aspirations, needs and issues and everyone has a stake.
- *Reciprocal*—any participant can be both a consumer and a producer of information.
- *Contribution-based*—there are many forums, both moderated and unmoderated, serious and trivial, in which participation is the shaping force.
- *Unrestricted*—anyone can access the networks and are free from control (strictly speaking, Schuler is not correct in this as access to a network or part of a network is deniable to certain individuals or groups).
- *Accessible and inexpensive*—networks can be accessed from a variety of public and private locations, a situation that even helps to break down some of the barriers of disempowerment of physically handicapped individuals.
- *Modifiable*—users have the potential to modify the networks and user interfaces through the software substrate. Schuler should have added that, for most people, the modification possible is within the limits of the software and/or choice of software, although the prevalence of a large number of scripting languages such as HTML, Perl and Java, mean that it is theoretically possible for community members to have a greater degree of control. Major change to a network and its software will still remain the preserve of the network specialists and software engineers, however.

These attributes prompted Sarjakoski (1998) to state that it can be concluded that computer networks, including both the wide area information servers (WAIS) and local area networks (LAN), are an almost exact match for the criteria of an interactive medium required for public participation. Presumably, Sarjakoski also includes metropolitan area networks (MAN) and even organisational intranets.

From the point of view of hosting 3D visualisations on the WWW, the recent advances in virtual reality modelling language (VRML) are making such a venture increasingly possible. VRML is a platform independent language (in the same way as HTML is not platform dependent) that can be interpreted by plug-ins to most popular WWW browsers. At the time of writing the VRML version 2 standard had been published. VRML2 was a considerable advance on version 1 although the advances were of such a magnitude that there were considerable compatibility problems between the two standards. However, VRML2 allowed for much more interactivity and the use of sound in an environmentally appropriate way. Force feedback control is planned for incorporation into VRML3. Major commercial products for both CAD and GIS (e.g. AutoCAD and ArcView) have the facility to export their models as VRML files. VRML was not originally designed with geographic visualisation in mind, which does pose some problems at present for cartographic interpretation (Moore *et al.*, 1999). However, web developments such as VRML and Java are making the delivery of PPGIS over the web an increasingly viable proposition. There is a growing body of research into geo-referenced 3D visualisation using the Internet as the medium of delivery (Lin *et al.*, 1999; Moore *et al.*, 1999; Dykes, 2000) and the desirability of using VRML for web-based delivery of geo-referenced visualisations has resulted in the creation of an official GeoVRML Working Group (http://www.ai.sti.com/geovrml) as part of the VRML Consortium (http://www.vrml.org/). The Working Group is addressing issues to improve the way VRML handles geographical data (Moore *et al.*, 1999).

The appropriate marriage of GIT and participation technique is needed. Howard (1998) considered pairs of GIT and participation techniques to try to determine what the most appropriate combinations of technologies and techniques might be. His analysis is interesting and, in the majority of cases, produces some good general guidelines, but is possibly flawed in the case of a couple of techniques in particular. However, Howard does state in his own defence that:

> the criteria and my assessments are subjective and may be disputed; indeed a goal of this paper is to initiate consideration of the appropriate uses of GIT with respect to common planning participation techniques. The optimal criteria to use for this assessment should be the subject of research based upon case studies of several applications.

Comparison of Howard (1998) is reproduced in Table 5, with some modifications in the spirit of the above quote. The participation techniques are in increasing order of their operational complexity and decreasing order of their need for the formation of stakeholder groups. This does not necessarily mean that techniques lower in the list are not susceptible to being used in groups, just that they are more amenable to use by individuals. The GITs are in increasing order, left to right, of technical complexity, applicability to group decision making; and ability to empower citizens by improving their spatial cognition of the planning environment. The categories for participation techniques within Howard's table were translated to conform to the categories listed above, and thus allow comparisons to be made more easily. The rating of some cells in the table required changing not only to reflect the changes in the categorisation but also to reflect the work of many more authors including Bishop (1997), Sarjakoski (1998), Heywood *et al.* (1998), Krygier (1998), Al-Kodmany (1998, 1999), Wherret (1999), Kingston *et al.* (2000) and Ball (2000). In particular, increases in ratings were made to reflect the advances and increasing interoperability between CAD, VRML, GIS and the WWW.

At the top of the table, Howard showed the continua of various technology characteristics. A further adaptation of the original table is the addition of the continuum of the technology's capacity to elicit information from the stakeholder participants. Some technologies are better suited to just present information but others have a considerable capacity to accept input. The potential exists for data to be added by the participants, assuming that the technology, format and user interface are sufficiently well known. The actual ability of the stakeholders to input information using the particular technology is not considered for the table but is recognised as a very important issue and is discussed elsewhere.

Howard developed an 'index of spatial empowerment' for the technologies and techniques by assigning a value of 0–3 (0 = no application, 3 = strong application) to each of the symbols in the table and then summing the rows and columns. The same process has been followed for Table 5. The totals were then all scaled, for comparison, to lie within the same range of 0–10, rounding to the nearest whole number. This procedure was repeated to get new values to reflect the changes to the original assessment. While Howard presented these values in separate tables, they have been appended to Table 5 as an additional row and additional column so that the process of deriving the cumulative scores for the spatial empowerment index (SEI) is more obvious. Howard then compared his SEIs against criteria of Anderson (1995: 36) for good participatory practice, which are as follows:

1. to stimulate local people to produce sound, workable ideas;
2. to develop consensus;
3. to use the available professional skills of local planners.

Although this is a sensible measure against which to interpret the SEI scores, it lacks any assessment of the techniques in terms of the appropriateness of their media and efficacy within a community network. Therefore the new SEIs from Table 5 were interpreted against the multicriteria of participatory practice by Anderson (1995), criteria for community network by Schuler (1994) and functions for representative media by Bill *et al.* (1999). Interpretation of the SEIs against these three sets of criteria and functions suggests that, with the exception of informal local contacts, guided tours and questionnaire surveys, GIT can provide moderate to strong spatial empowerment of traditional participation techniques. The results suggest a skew in favour of GITs being most spatially empowering where participative exercises are more individually oriented. More interesting than the actual values of the SEIs is the pattern of the level of application. The level of application is highest, closest to the diagonal from the top left (least complex technique and least complex technology pairing) to the bottom right (most complex technique and most complex technology pairing) in Table 5. The functions of Bill *et al.* (1999) and their descriptions can also be aligned on this diagonal of complexity. Perhaps unsurprisingly, it can be concluded that the complexity of GIT should closely match the complexity of the participation technique, bearing in mind that greater participation requires a greater range and complexity of techniques. There are also other factors such as budget, availability of technology and community characteristics that should be considered.

Another major factor in the choice of GIT is its desired function in the participation technique. True participation requires two-way communication. Table 4 shows that the participatory techniques with the greatest level of two-way communication are informal contacts, workshops and advisory meetings, and gaming simulations. There is no application for GITs in informal contacts so, from the viewpoint of GITs, this suggests that the more complex technologies are better for eliciting information, not just presenting it. Increasingly complex GITs can handle and convey visualisations of greater complexity and allow greater immersion in the media by the participant. However, the interface of such systems is of crucial importance. If the user interface is not simple enough for the majority of participants to interact successfully, then the advantages of greater immersivity are lost. This is particularly the case in situations where there is little or no opportunity for technical support, as in the case of DGI. The fact that gaming simulation is a good vehicle for two-way communication suggests that a computer games–style medium may be a mechanism for overcoming the difficulties of complex user interfaces. The other advantage is that, because of the element of immersion in the scene, the computer game scenario can help overcome a weakness of laypeople to understand aerial views, traditional maps and plans. This is a lack of ability that has been noted by a number of authors (Keates, 1996; Monmonier, 1996). Using computer games–style interfaces in an academic situation is an area in need of development and research, though.

CHAPTER 3

Community mapping and visioning

3.1. GIS in community mapping

Successful, applied research is typically simpler, more participatory, democratic and egalitarian (Briggs, 1995) than over-specialised or pseudo-multidisciplinary research, which tends not to relate well to real communities and their relationship with their actual environment (Amanor, 1994). It is sometimes argued that the disempowerment by research is exacerbated by technology transfer (Utting, 1994) through its reduction of choice and comprehensibility as a result of the constraints and complexities, respectively, of the technology (Klosterman, 1990). These charges are principally levelled at GIS in the case of landscape planning and research into landscape ecology.

The ability of GIS to increase democratisation by, in particular, an increase in the level of public involvement and value-added benefits from the efficient use of information for the common good (Dobson, 1990; Harris and Elmes, 1993) has been greatly debated. Pickles (1993) criticises advocacy of PPGIS as a techno-utopia, which more usually leads to a reduction in participation and understanding. Pickles goes further to quote the cost of the technology making its use prohibitive outside the government agencies and large institutions. While there was some veracity in such statements at the time Pickles was writing the situation is now quite different with large reductions in the cost of systems, some of which even have ‘cut-down’ versions available free of charge. Linehan and Gross (1998) quotes an old reference (Ottens, 1990: 21–22) when they counter the reduction in cost as being irrelevant because ‘the availability of ‘low-end’, user friendly GIS has been outpaced by ‘high end’ GIS development’. It is a non-sequeture to say that, because low-end development has been exceeded by high-end development, popular use of GIS remains prohibitively expensive. In the intervening 10 years since Ottens’ comments and Linehan and Gross’ paper there have continued to be many more developments in GIS technology that have seen a considerable shift from mainframe-based systems to desktop applications. Furthermore, mapping extensions are becoming available for many computer-aided design (CAD) packages. In addition, there has been an explosion of the use of home computers and the Internet with considerable recent progress in the field of Internet delivered GIS and mapping recently. Indeed, Wilson (1997) suggests that the users of GIS are gaining considerably as the technology begins to catch up with the demand for easy-to-use interfaces and integration of data that means more time can now be spent concentrating on adding value to spatial data through the application of GIS than in developing the tools. Linehan and Gross (1998) are right to say that the low-end user will always be less informed and less capable of generating comparatively technical arguments than the high end user. This is not because of any respective pace of developments as Linehan and Gross claim but simply because the former is a low-end user and the latter is a high-end user. The disparity is the definition of the terms and can be found in any comparison of extremes of any continuum of technology use. The level at which the technology is being used is, in itself, irrelevant. What is important is whether the level of use is sufficient for its intended purpose.

The preceding arguments are in no way sufficient to negate the usefulness of GIS as a tool in landscape planning, not least in view of the explosive growth in recent years of GIS applications (Longley *et al.*, 1999). There are other far more important issues that inhibit the use of GIS. One is the availability of data, rather than the software. Copyright and confidentiality issues are a major difficulty in Europe and particularly the UK (Heywood *et al.*, 1998: 22), although less so in the USA where data paid for from the public purse is more likely to be freely available to the public. Lake (1993) asserts that GIS can only facilitate participation to the extent to which people are willing to set aside or forego their own local knowledge, beliefs and values in favour of forms of knowledge that is amenable to use in a GIS. Such a statement is surprising when the capabilities of GIS are such that it is amenable to any spatial data, whether strictly geographical or not. Indeed, one of the great potentials of GIS is that it should be able to be used by communities to put their local knowledge on an equal footing with professionally developed databases. There is a lack of widespread training and awareness of the capabilities of GIS (Heywood *et al.*, 1998: 39–49) and so community groups wishing to use GIS will probably need technical assistance in the use of their chosen system. However, to be restricted by mainstream, professional databases is a restriction of the imagination, without underestimating how time consuming the creation of databases can be. Such a limited use of GIS defeats the purpose of community groups gaining advantage from the technology and, this far at least, fears of Lake (1993) would be confirmed. The fears of some authors notwithstanding, there are many examples of successful use of GIS in community situations that show how GIS can be used in a positive way in community-centred projects (Mitchell, 1997).

The participatory mapping exercise appears to lend itself to delivery over the Internet using GIS. Bishop (1997) has shown that the Internet is a very convenient medium for studies involving public perception. Although it is a very attractive medium, there are currently still some limitations of technology and public skill-levels that need to be overcome (Doyle *et al.*, 1998). Therefore, the Internet is not a total solution to inclusive participation but it has much to recommend it as a supplement to traditional meetings. Kingston *et al.* (2000) describe how the exchange can be two ways, both informing the public and enabling involvement through the medium of a web-based GIS, leading to greater participation in planning. This is a technique that is starting to be called public participation GIS (PPGIS) and the growing interest in PPGIS means that theories on the contents and nature of PPGISs are starting to develop. A useful synopsis of the current state of thought on this subject can be drawn from the findings of the specialist meeting on 'Empowerment, Marginalisation, and Public Participation GIS' (Craig *et al.*, 1999):

1. a web-based PPGIS should provide equal access to data and information for all sectors of the community;
2. it should have the capability to empower the community by providing the necessary data and information which matches the needs of the community who are, or potentially, participating; and
3. a high degree of trust and transparency needs to be established and maintained within the public realm to give the process legitimacy and accountability.

Through the medium of the map, GIS can enable people from different backgrounds express and exchange ideas and compare possible solutions (Heywood *et al.*, 1998: 9). It is for this reason that GIS has received considerable interest in recent years for its potential for use as a participatory problem-solving tool (Carver *et al.*, 1997).

3.2. Bioregional mapping

Bioregionalism has been mentioned a number of times already. Because it is not a mainstream body of thought it deserves some deeper explanation. Bioregionalism is finally emerging from being a counter-cultural movement to almost respectable acceptance in some mainstream areas. Bioregionalism has its proponents (Aberley, 1993; McGinnis, 1999a,b) and detractors (Parsons, 1985) alike. The literature on the subject varies from the well researched to the fancifully poetic and care is needed to sift useful, reflective material from un-critical 'evangelical' bioregionalist advocacy. In some parts of the world, notably North America, bioregionalism can be seen as a contemporary social movement (Flores, 1999). However, it appears to be more popularist than rationally based and McTaggart (1993), in his paper comparing bioregionalism to regional geography, puts bioregionalism somewhere between a delineated ideology and a research tool. However, a close study of the bioregionalist literature shows that bioregionalism is not too dissimilar from landscape ecology, albeit from a more radical, community action perspective. The lessons to be learned are in the way bioregionalism fosters participation and a bottom-up approach to information provision through the process of communities mapping their bioregions. Bioregionalism is what Naess (1989) would define as an 'ecosophy'. Therefore, a distinction between *bioregions*, as self-supporting landscapes defined by their stakeholders, and *bioregionalism*, as an all-embracing philosophy for life, needs to be drawn in much the same way as a distinction should be made between ecology and the social and political ecology movement. Such a distinction allows the methodological tools for assisting participation in holistic landscape ecology planning to be drawn from bioregionalism without having to justify the rest of the bioregional philosophy that goes beyond the bottom-up approach of stakeholder definition of their landscapes (Ball, 2001).

The term 'bioregion' needs definition. Berg (1977) links, in the word 'bioregion', the sense of a geographical terrain and the sense of a 'terrain of consciousness'. Although this is a somewhat woolly term from a scientific standpoint, it provides a useful metaphor from the perspective of the creation of a vision for the future, shared by scientists, resource managers and stakeholders. At the core of bioregionalism is the bioregions construct, which can be most briefly described as being similar to the ecosystems construct but including humans and their social and economic activities. It is a place-based expression of the total human environment. Bioregionalists advocate that environmental restoration can only be achieved by re-establishing a sense of place in communities (McGinnis *et al.*, 1999). Such a sense of place would be rooted in an understanding of the environment and the part that humans play in affecting it.

For all its support from some quarters, the notion of the bioregions construct had not, until recently, been subjected to rigorous statistical analysis. From such analysis it emerges that, whatever the philosophy behind bioregionalism, bioregions can be shown to be demonstrable entities (Ball, 2000). In other words, the practical construct has the potential to be applied across a broad spectrum of environmental philosophies on which

Table 2
Proposed new hierarchy of overlaying regions, from the most fundamental to the most human-centric, on which bioregions can be built

Type of region	Description
Georegion	Geology and soil substrate of the region providing the parent material
Climatic region	Level and type of precipitation, temperatures and wind all of which is partly dependent on the shape of the land masses of the region
Toporegion	Clear physiographic features, such as water catchments, mountain ranges which are dependent largely on the local geology and climate
Ecoregion	Distinct composition of the floral and faunal communities. The flora is dependent on the substrate and climate. The fauna is dependent on the plant life.
Economic region	Economy of the region is defined historically by its agriculture and the availability of minerals. The type of economy that a region can support and therefore the density of human population is dependent on the preceding distinctions of a region
Socioregion	Cultural distinction of a region. Bioregionalism is nothing without the communities. The behaviour of communities is guided by their culture and social heritage. This is the final level

planning is based as long as the mapping process involves the community whose landscape will be affected by the planning proposals. The mapping for the assessment of bioregions by Ball (2000) did not rely on the more 'ecosophical' aspects (Naess, 1989) of bioregionalism, but more on the layering of thematic data and approaches to mapping, particularly the inclusion of social layers in the manner called for by Luz (2000). This further demonstrates the potential for divorcing the mapping technique from the bioregionalist ecosophy (or point of view). In other words, the useful tool is distinguished from the rhetoric.

The process of mapping bioregions has potential to provide an important tool for environmental information management for two reasons. Firstly, the act of mapping provides a forum for community participation and the expression of local needs and perceptions of the community, their landscape and their economy (Aberley, 1993; Al-Kodmany, 1999). Secondly, the mapping exercise establishes a shared knowledge base that is intended to marry specialist or quantitative, scientific knowledge with local or qualitative, intuitive cultural knowledge. From this shared knowledge base a shared vision of the future can be created and a shared plan of action can be established. In other words, bioregional mapping has the potential for establishing a common language and allowing meaningful dialogue between the planner and the stakeholders.

Bioregions are identified by building up as a series of overlays that give both the subjective zone of cultural values as well as objective boundaries of other thematic 'surfaces' such as land-use or soil capability for agriculture. Taxonomy of bioregions of Sale (1985) is comprised of an 'ecoregion', a 'georegion' and a 'morphoregion'. Elements of each of the regions in the taxonomy do not necessarily appear to be in their most logical categories and therefore a new taxonomy is proposed (Table 2) to describe bioregions. Taxonomy of Sale (1985) is useful but the bioregional mapping process as detailed by Berg (1988) is at a more appropriate level of simplicity for a community participatory session. Al-Kodmany (1999) found that freehand sketching in conjunction with GIS and photomontage was the most effective way of identifying problems and expressing ideas with a non-technical participatory group during a town planning design exercise. In environmental planning terms, the freehand sketching equates to what Berg (1988) calls ‘barefoot mapping’. It can be refined by using professionally produced base maps that show basic and easily recognisable geographic features. The participants then draw on their own features or delineate areas of importance over the top of the base maps. These non-technical maps can then be compared to the scientific data using GIS. This technique will be shown to have proved useful in participatory exercises.

The concept of fuzzy boundaries is important for the logical consistency of bioregionalism (Stevenson and Ball, 1998; McGinnis, 1999b). When Scottish Natural Heritage were preparing to conduct their zonation study (Usher and Balharry, 1996), they came to the similar conclusion that there can be no one ‘right’ zonation pattern or system and that the intended end-use of a zonation was a prime factor in affecting the type of zonation required (Thomson, 1996). In practical terms, however, as far as a participatory mapping exercise is concerned, the fuzziness of the boundary is of little importance beyond an appreciation by the participants that it is not a sharp cut-off point. Therefore the final boundaries of a bioregion are best described by its inhabitants, through human recognition of the realities of living-in-place (Berg and Dasmann, 1977).

3.3. Examples of bioregions

There are a number of regional organisations and even states, particularly in North America, which use bioregionalism as a land use management tool (Holmes, 1994). More specifically there are bioregional efforts in the form of watershed councils centred on areas such as the Greater Yellowstone ecosystem and the Colorado Plateau (Kemmis, 1999).

The bioregions approach has been used in this way in Australia to help with official designation and management of conservation areas through stakeholder participation (Thackway and Cresswell, 1997). There have been many significant trends in nature conservation in Australia in response to the problems that faces a national strategy which include the diversity of characteristics of both the physical geography and the natural community structures. Thackway (1997) discusses these trends. To compound the problem there are a further two problems. The first is the distinct cultural differences between the Aboriginal people and European descendants. The second is the continental scale at which any national nature conservation strategy must work.

In Australia, there has been a change in community attitudes away from the expectation that central government will manage nature reserves through legislation. The move has been towards a community-based embracing of greater community participation in conservation management, unconstrained by a defined reserve boundary through the acceptance of the principles of ecologically sustainable development (Thackway and Cresswell, 1997). This is a positive move because national parks often fail to reflect local and regional community needs and attitudes which is important for the success of any scheme (Batisse, 1982).

The bioregional framework grew out of the Interim Biogeographic Regionalisation for Australia (IBRA; Thackway and Cresswell, 1995). The IBRA framework was based on a hierarchy of environmental data that were specific to a particular state or territory. In this way, Australia was divided into 80 natural regions, each of which reflects an identifiable assemblage of characteristics of landform, climate, geology, flora and fauna. Some similarities can be seen between the IBRA and the Heritage Zones devised by Scottish Natural Heritage (Crofts, 1995) although the IBRA seem to be a little closer to bioregionalism but it still lacks the societal element.

A similar initiative that appears to be an extension of the IBRA is the indigenous protected areas (IPAs), which does involve communities directly, but specific indigenous people, the Aborigines (Thackway, 1997). The IPA framework has a specific task of fostering co-operation between Aboriginal people and nature conservation agencies. Through the IPA scheme, indigenous people can voluntarily enter a partnership to manage their lands for nature conservation. Other initiatives exist to address the problems of conservation of biodiversity in agricultural landscapes, regional forest assessments, and regional species recovery planes. There seem to be many successes (Thackway, 1997).

The foregoing sets the scene for Australia's bioregional planning initiative. Despite the success of the schemes mentioned there were still deficiencies in the national system of protected areas and a need for greater flexibility. The result was a recommendation at the parliamentary level that a bioregional framework be introduced to help cover the gaps and assist integration. The stated aim of the bioregional framework is to reflect not only the natural environment in the way the IBRA does but also to reflect the human society that lives within it (Thackway, 1997). The process of setting up the bioregional framework began with the parliamentary report in 1993 and is still under implementation, a fact that is not surprising in the light of the enormity of the task. The first step in the implementation was to establish a consistent national biogeographical regionalisation (the IBRA) which was begun in 1994 and involves a GIS mapping process. The next step was to develop conservation planning attributes (CPAs) for each region. The CPAs defined what gaps there were in the IBRA data and the national system of protected areas. In addition to a top-down approach, a bottom-up approach was initiated to gain community participation in the development of an ecological framework for appropriate resource use and conservation. The bottom-up approach sub-divided the bioregions so that the greatest participation by the communities could be ensured and to maximise the integration of local, indigenous knowledge. During this process, three key tasks were identified as necessary for the successful integration of local communities into the bioregional planning process. Thackway and Cresswell (1997) list them as follows:

- development of model projects in bioregional planning at a finer scale;
- initiation of an education and public relations programme;
- development of a programme of collaboration with indigenous people for them to manage their lands in a way consistent with nature conservation.

To this list can be added the synthesis of culturally meaningful criteria for planning. Public comment, invited on the IBRA from stakeholders who included industry groups, approved of the regional divisions. Various small-scale regional projects have been initiated and the indications are promising. An education programme is now in place. It is clear that the Australian government have understood the concept of bioregionalism and applied the principles in a pragmatic and forward thinking way. Some more time will need to elapse before the true success of the scheme can be determined. The main obstacle that was encountered was the narrow focus of many and disparate conventional management and planning regimes. Divisions of focus and domain exist between management and planning systems that are based on ecosystem management, watershed management, wildlife management, community projects and rural development. Integrated planning must overcome this obstacle of narrow discipline focus and departmental jealousies. The Australian experience will be revisited in the discussion towards the end of this thesis.

Another example where the concept of bioregions has been officially recognised comes from California (Welsh, 1994). In 1991 the California Biodiversity Council (CBC[†]) was formed to facilitate better co-ordination and co-operation between the many organisations with interests in natural resource management and environmental protection (CBC, 1999). Unlike the example from Australia, the aim of the council was neither to start new projects nor to add a new layer of administration. It had the expressed purpose of assisting the development of strategies and complementary policies for conserving biodiversity.

It was decided that the environment of California was too complex to understand and manage as a single unit and a way of breaking it down into more manageable units was needed, moreover a system that recognised important assemblies of ecosystems, landscapes and the people living within them. Members of California's Interagency Natural Areas Co-ordinating Committee (INACC) drew up the original bioregional map in 1988, which divided California into 10 bioregions (Wheeler, 1996). Wheeler reports that the INACC discovered that

> Despite development over the years and the imposition of superficial Subdivisions, the strength of natural systems remains evident, and the logic of their alignments compelling… Thus no matter what lines may have been superimposed, or alterations to the landscape made, we return inevitably to the enduring reality of California's bioregions as a guide to the management of natural resources, including the land itself.

They found that the state's watersheds and mid-19th century settlement patterns bore a remarkable similarity to the bioregional divisions of California. The early settlers would have been very heavily dependent on the natural resources of timber, fish, and agriculture and, perforce, had to work with the natural environment not against it.

One of the first steps in the process to officially instituting a bioregional approach to biodiversity management was the drafting of a memorandum of understanding (MOU[‡]). It was through the MOU that the CBC was established (Press, 1995). The MOU required its signatories to make the maintenance and enhancement of biodiversity a pre-eminent goal and to work in co-ordination with the other parties to adopt a regional strategy that ensures

[†]The California Biodiversity Council has a website that contains this information plus additional material. At the time of writing the Internet address for this site was http://ceres.ca.gov/biodiv. The '.gov' within the address denotes this site to be an official North American government website.

[‡]A copy of the MOU can be found on the Internet through a link from the California Biodiversity Council web page or directly at http://ceres.ca.gov/biodiv/text/mou.html. This address was correct when the site was accessed at 12.54 on 9 August, 1999.

the protection of biodiversity and the maintenance of economic viability throughout California. The MOU recognised the importance of community and public support. It was recognised that local communities and their economies formed part of the important attributes that define a region. The involvement of the community was seen to include education.

Administration of California's bioregions was to be achieved by a hierarchical organisational structure that represents the scale of operation. In, brief the organisation was as follows:

- State-wide Executive Council—responsible for setting state-wide goals for biodiversity enhancement, educational outreach, land use strategies, monitoring, research and co-ordination between all levels within the hierarchy.
- Sponsors—includes special interest groups or organisations that support the MOU and have a particular responsibility to promote strategies that meet and further the aims of the MOU.
- Bioregional Councils—work with local and regional authorities to implement biodiversity policies. The councils include local industry, community and environmental groups. They have a responsibility for fostering watershed and landscape associations.
- Watershed and landscape associations—act at the local level directly with landowners and private organisations to develop specific co-operative projects to address local needs and meet the over-arching goals identified by the MOU and the State-wide Executive Council. The associations are the primary forums for the resolution of local issues and conflicts that relate to biodiversity issues.

There appears to be some promise in the Californian experience of bioregionalism in the way in which it has managed to pull together a number of very different environmental agencies. However, one of the real powers of bioregionalism, that of enabling community participation, was ignored. The agencies did little analysis of local self-sufficiency and made no attempt to raise the consciousness of the inhabitants of the regions to environmental issues (Press, 1995). Nonetheless, little could be expected in the way of significant change in the political climate current at the time of the inception of the MOU (Press, 1995).

Other examples of bioregional intent exist and in each case, participative mapping was important although evidence of the use of GIS is lacking. All the following cases are examples of mapping exercises that have been carried out by some of the local inhabitants of their respective regions. These areas have not necessarily been adopted in any official or political capacity. This is, in part, because bioregionalism divorces itself from the artificial limitations of current political boundaries but can cause a conflict of interest where a bioregion or significant watershed crosses a political boundary. Without the forward thinking of a ruling power on the scale of the case in Australia, they are unlikely ever to be adopted officially. Australia has another advantage of being an island with one government (albeit divided into states). Such a set-up can only facilitate the adoption of bioregionalism. Apart from a comparatively short border with England, the Scottish situation is (now) not too dissimilar. Further, they are predominantly defined by their watersheds with other natural features mapped within them rather than these other features serving to help inform the boundaries and little reference has been made to indigenous people by and large. As such, it must be debatable whether they are truly bioregions, not taking into account all the principles.

1. The Sonoran Desert Bioregion: The Sonoran Desert covers three Mexican States (Sonora, Baja Norte and Baja Sur) and parts of two US states (Southern California and Southern Arizona). The Sonoran Desert has a greater diversity of plants and plant communities than any other New World desert and many of the indigenous cultures survive (Nabham, 1981).
2. Cascadia: 'Cascadia' is one of the most prominent bioregionally defined areas in the literature and on the Internet. It can be found on the north Pacific Rim, America. Cascadia is an area of 750,000 square miles (McCloskey, 1996) and includes the states of Oregon, Washington, Idaho, north-western California, Montana to the West of the divide, two-thirds of British Columbia and south-east Alaska.
3. The Wild Onion Bioregion, Chicago: The Wild Onion Bioregion lies at the south-western end of Lake Michigan. It is within a glacial lake plain within the watersheds of four rivers including the Chicago. The bioregion was given its name from the once common wild onion that used to grow on the original prairie and oak savannah that is now greater metropolitan Chicago (Briggs, 1993).
4. Nortansjski National Park, Solvania: Bioregionalism has been a driving force in the ecological thinking of the Nortansjski National Park project (Aberley, 1993; Alexander, 1996). Following independence from the former Soviet Union, the new government of Solvania lent its support to the protection of the area and adopted a bioregionalist approach to community involvement in the mapping process.
5. Dartia: The bioregion called Dartia is centred on Schumacher College in Dartington, near Totnes and Plymouth. The principal river is the Dart that flows out into the English Channel at Dartmouth. Sale (1993), guided an exercise in bioregional identification at the college. The mapping of Dartia was, however, a training exercise.

3.4. Scale

Scale is important to the success of a decentralised approach to ecological restoration. If the scale is too small the region has little capacity for autonomous action or continuance. If the scale is too large then its reactivity is lost. Defined as a territory revealed by similarities of biophysical and cultural phenomenon, the bioregion suggests itself as a scale of decentralisation best able to support the achievement of ecological integrity while maintaining cultural and social progress. The results of bioregional mapping exercises usually produce regions that are considerably larger than the scale of the community (Ball, 2000). Planning, to be effective and holistic must take place at the scale of the landscape (Gibson *et al.*, 2000; Naveh, 2000) that is analogous to a bioregion. However, action must take place at the scale of the community and bottom-up information about the landscape must come from individuals.

The hierarchical nature of natural systems must not be forgotten. The bioregion is a part of such a system. Therefore, if it is not the focus for action as is the suggestion that follows from the earlier discussion, there needs to be another concept to identify that part of the

Table 3
A practical comparison of bioregions and bioplaces based on their respective scales

Scale of region	Bioregions/landscape	Bioplaces/community
Scale of foresight	Visions	'Visionlets'
Scale of planning	Strategy	Ploys and tactics
Main participants	Planners	Stakeholders
Concensus?	Often difficult	Achievable

bioregion that is the focus for stakeholder participation in environmental management. The concept of the 'bioplace' is put forward in this paper as the community-scale sub-units of the bioregion. The bioplace is a community-centric sub-region appropriate for the implementation of a plan. National and international strategy is developed at scales above the bioregion. The bioregion provides the focus for the local strategic vision. The bioplace provides the human scale for action and equates to '*my/our* environment' as opposed to '*the* environment' (Goodwin, 1999). A comparison of the scales is shown in Table 3.

3.5. Other participative mapping and visioning techniques

Another popular methodology is the planning for real (PFR) idea that has been patented by Neighbourhood Initiatives Foundation (NIF). PFR is a process for involving local people more closely in decision making about local environmental planning problems. NIF is a UK National Charity that was founded in 1988 by Dr Tony Gibson, who first devised PFR in the 1970s. PFR was first used experimentally in the east end of Glasgow in Dalmamock in 1977 (The Highland Council, 2000) and has been used successfully in many parts of the world. Through the process, people are provided with knowledge that can be used by the local community and the wider local authority for future planning and as a repository of local opinion. The broad outlines of the method are defined by Kingston *et al.* (2000) as follows:

1. the development of a 1:1000 scale 3D model of the area (a 2 km square region of Slaithwaite) on which the public can place ideas and comments about their community now and in the future;
2. an 'anything goes' philosophy towards suggestions and comments from the public;
3. ideally community led, rather than led by planners or 'official bodies';
4. through the process people are provided with knowledge that can be used by the local community and the wider local authority in terms of future planning and a repository of local opinion.

In addition to bioregional mapping and PFR, there is another technique that deserves mention: 'Parish mapping' (Clifford, 2000). Parish mapping is a more free-ranging and visual approach to community appraisal of a locality. However, it is risky being entirely incompatible with mapping information from expert sources. The advantage of compatibility with expert sources is that the maps are more acceptable to and usable by planning authorities and the community members themselves are better able to make use of expert data, but chosen or rejected by them for their own purposes to augment their own mapping data. The focus on homemade, qualitative maps in the Parish mapping process has a parallel with what Berg (1988) calls 'barefoot mapping' in bioregional mapping. However, both PFR and Parish mapping are weak in terms of visioning.

Other established visioning or backcasting techniques include 'future search' (FS). FS is a process that is structured more like a conference. An FS conference usually involves 60–70 people, which is a group large enough to include many perspectives but small enough that the full group can be in dialogue at each step in the process (Weisford and Janoff, 2000). This makes possible a shared picture of the 'whole elephant'. Conferences usually run over 2 or 3 days to allow time for a notable shift in their trust of each other and in their capability for action. 'Village appraisal' is a another approach and is predominantly questionnaire-based survey method. While it does elicit information at the grass-roots level, it has a weakness in that there is no forum for conflict resolution and, by formulating a questionnaire, the scope and content of the appraisal risk is limited. Good, unambiguous questionnaires are notoriously difficult to formulate.

The two processes are similar in that they are both, essentially, forms of backcasting. They are also both designed to provide a vehicle for eliciting information from stakeholder participants and try to achieve consensus by providing a forum for the development of trust and the establishment of common ground between opposing groups. FS is a stronger process from a visionary planning point of view while VA has the advantage of speed and obviates the need to convene group meetings. However, this very advantage can undermine the development of consensus and neither process explicitly includes any element of mapping.

Parish mapping, village appraisals and PFR techniques all have a potential drawback in relation to scale. While being successful techniques at the 'very' local level, they do not address the wider context, which the bioregionalist would maintain is the appropriate scale of planning for sustainability (i.e. the bioregion). Neither are they best equipped to take account of environmental factors that affect sustainability. These methods can contribute much to local visioning exercises at the level of the bioplace and their use has been successful in planning many community projects. If action is to be considered that affects systems higher up the environmental hierarchy (e.g. at the landscape level) a broadening of these approaches is needed. Furthermore, existing approaches tend to concentrate on either some aspect of mapping or visioning. By combining techniques such as bioregional mapping and visioning, there is the potential for enhancing participative planning relating to sustainability through the complimentarity of bioregional mapping and visioning.

CHAPTER 4

Case studies of PPGIS

PPGIS is an area of growing interest and one where it is still early days; nonetheless, there have been a number of experiments in PPGIS that may prove instructive. Four case studies will be discussed to broaden the scope of this paper. The case studies were chosen to show contrasting approaches to PPGIS. The words in parentheses below the title of each case study refer to the type of participatory technique that predominates in the model and then, separated by a vertical line, the predominant GIT(s) to relate them to Table 4 and the preceding discussions.

4.1. Case study 1: GIS and the artist: the Pilsen community model (Design Charette/GIS, photo-manipulation, artwork)

Al-Kodmany (1998, 1999) provides a detailed account of the work he and his team of co-workers undertook with the Pilsen community of Chicago (near the same area that a bioregionalist group defined as the ‘Wild Onion Bioregion’, mentioned earlier). However, a considerable amount of information has already been drawn from this example, so only a brief description will be given here.

Al-Kodmany and his team used a combination of techniques for visualisation in a design charette setting. They (Al-Kodmany, 1999) found that freehand sketching in conjunction with GIS and photomontage was the most effective way of identifying problems and expressing ideas with a non-technical participatory group during a town planning design exercise. The participants were able to call on a GIS operator to bring up information about specific areas and see, graphically, statistical and other data superimposed on the area in question. This process helped to resolve disagreements between participants, thus fostering consensus. The participants were also able to interact directly with a sketch artist, seeing instant results of their ideas and being able to discuss options and changes on the spot. The artist then developed higher quality versions of the participants’ ideas overnight. The artist also worked on producing photomontages of the ideas superimposed on real photographs of the locations in question. The results were reviewed at the next day’s session. The GIS provided instant access to a huge variety of information including demographics, transportation, housing and property information, socio-economics, history, and crime statistics. The GIS also fulfilled an important role in assisting visualisation by hot-linking photographs and images to locations of interest on the base map.

It was found that the GIS provided ‘tremendous’ assistance, particularly through the image database side of the operation that helped everyone involved to visualise past, present and future conditions of the neighbourhood. The interactivity of the GIS also helped to engage the community in the planning process to develop alternative solutions and identify neighbourhood problems of which the planners would not otherwise be aware. The drawback of the GIS was the amount of equipment that needed to be transported to the location where the design charette was held, with the attendant ‘technical glitches’ that can be expected from assembling and disassembling computer equipment.

The speed of the computers was another problem but can be easily solved by using a faster machine. The speed of portable computers has about doubled since Al-Kodmany was conducting the experiment (from around 350 to over 700 mHz at the time of writing for commonly available PCs). The storage capacity of portable computers has increased dramatically as well, with laptops being available now with hard-disk storage in the order of many gigabytes. The artist could immediately respond to the participants, allowing them to play an active part in the design process. The sketching process became a sort of storyboard of the community conversations with the unexpected benefit of making it possible to physically recreate the design process. The process of sketching was found to be very important for generating active participation and as a communication tool, but was limited by its lack of precision and abstract nature for the generation of final designs. The photo-manipulation was found to be very beneficial in helping visualisation of the proposals and was less abstract than the sketching. However, it required a considerable amount of preparation before the workshop and was considered to be best for situations where the design issues have already been defined.

4.2. Case study 2: the Slaithwaite 'planning for real' model (survey and questionnaire/ Internet DGIS)

The Slaithwaite PPGIS model was based on the PFR methodology. It was run primarily by The Centre for Computational Geography at the University of Leeds, which opted for a web based system to allow people to use the system anytime and from anywhere with a long residence time on their Internet server, so that people did not need to attend a particular meeting at a particular time. The Slaithwaite PFR exercise involved field-workers from NIF to facilitate the process. The need to attend specific meetings is often the single most inhibiting factor of traditional participatory systems (Kingston *et al.*, 2000). It was believed that the concept of '24/7' (24 h a day, 7 days a week) would enable more people to be involved in the participation process.

A system was devised for the Internet, delivering a 'Virtual Slaithwaite' PPGIS, using Java applets to automate the map interactivity. Users are prompted to fill in a profile on entering the site. The profiles helped to validate the users by cross-checking questions such as age and profession. They also helped to build statistics on the background of the users. The users were then able to click on a map to select features about which they wished to comment on-line, using a pop-up form. Users also had the ability to navigate the map by simple pan and zoom controls.

It was found that most users were able to navigate the map through the web browser with ease. Where they were unfamiliar with their relative location within the map, users adopted strategies such as locating a prominent landmark and navigating in an intuitive way, as though they were actually on the street. The results were encouraging. There were some problems with the approach however. One was the ownership of the Ordnance Survey (OS) base maps. In the UK the OS has strict copyright policies, which can present problems for people wishing to use the maps in this way. The cost can become prohibitive as a fee is needed to buy the data and then for every time a user visited the site. There are some changes in OS policy promise but they are slow in coming. Other countries, particularly the US have more enlightened attitudes to access to data held by government

Table 4
Descriptive dimensions of public participation techniques (Vindasius, 1974; Sewell and Coppock, 1977; involvement: (•) low; (●) medium; (⬤) high)

Mechanism of public involvement	Descriptive dimensions				
	Focus in scope	Focus in specificity	Level of two-way communication	Public activity required	Agency staff time required
Informal local contacts	•	⬤	⬤	●	●
Mass media (press, TV, radio)	⬤	•	•	•	•
Publications	⬤	●	•	•	●
Surveys and questionnaires	●	⬤	•	●	●
Workshops	•	⬤	⬤	⬤	⬤
Advisory committees	•	⬤	⬤	⬤	⬤
Public hearings	●	•	•	⬤	●
Public meetings	●	•	●	●	●
Public inquiry	⬤	•	•	●	●
Special task forces	•	⬤	⬤	⬤	⬤
Gaming simulations	•	⬤	⬤	⬤	⬤

bodies, acquired using public funds, which means that PPGIS may prove more popular outside the UK in the future. Another consideration that both the Slaithwaite and the Pilsen Community projects highlight is the need for experienced personnel to put the computer materials together, including the website.

The model of Slaithwaite was built with the assistance of local school children to produce an impressive 3D physical model. However, a 3D model was not available on the website. It is interesting that people behaved as though they were in a model when they were presented with an unfamiliar map situation. The experience of the Slaithwaite experiment demonstrates the value of a 3D model, even in the computer situation. This is achievable across the web through the use of VRML, although download times are a consideration for the home user. In amelioration of the latter drawback, there are continual advances in telecom technology and British Telecom have recently announced two systems to increase the speed of Internet use through the phone network.

4.3. Case study 3: Eastport mapping project (public meetings and neighbourhood groups/GIS, Bioregional mapping)

Bonavista Bay Newfoundland Fishing Community was the location for this case study, which was focussed on the exploration of marine conservation activities in the area (Macnab, 1998). The region had an economy that was inextricably linked to groundfish harvesting. In 1992 the Atlantic Groundfish Moratorium was declared as a result of falling catches and the detection of a serious decline in offshore biomass. The study was part of a dialogue between the local fishing communities, governmental and conservation bodies on how to manage the remaining reserves, while allowing the generation of some income from fishing.

Table 5
Assessment of the application of geographical information technologies to public participation techniques. The spatial empowerment index (SEI) cumulative scores are out of a theoretical maximum of 10 points each (this author, with particular reference to Howard, 1998; Vindasius, 1974; Application: N, none; (•) limited; (●) moderate; (⬤) strong)

Continua of technology characteristics

Complexity	Simple ↔ complex
Decision support orientation	Group ↔ individual
Spatial cognition	Limited ↔ significant
Capacity for data input from stakeholders	Low ↔ high

Geographic information technologies

Public participation techniques	Audio recording	Visual recording	Community network	Automated visualisation	Collaborative planning system	Geographic information system	Distributed geographic information	SEI cumulative score
Informal local contacts	•	•	N	N	N	N	•	1
Media campaign	⬤	⬤	●	⬤	•	●	●	8
Surveys and questionnaires	•	•	⬤	●	N	•	●	5
Guided tours	●	●	•	●	N	•	•	4
Workshops and facilitated meeting	⬤	⬤	•	⬤	●	⬤	N	7
Public meetings and neighbourhood groups	⬤	⬤	⬤	⬤	⬤	⬤	•	9
Visioning	●	•	●	⬤	●	⬤	⬤	7
Visual preference survey	•	●	•	⬤	●	⬤	⬤	7
Special task force and design charettes	•	●	•	⬤	●	⬤	⬤	7
Computer simulation	•	●	●	⬤	⬤	⬤	⬤	8
Games and simulation exercise	•	•	•	⬤	⬤	⬤	⬤	7
SEI cumulative score	6	6	5	8	6	8	6	

The project involved local small boat fishers in a collaborative project with the local national parks conservation areas agency to produce harvest area maps that allowed for the designation of protected areas to ensure the biophysical balance of the area. The main difference between this mapping project and the other case studies is that the stakeholders involved were all experienced in using cartographic material, being required by their work to understand navigational charts. The area involved was also considerably larger than the previous case studies and included mapping of the seafloor.

The project quickly identified a number of areas where information was poor or lacking altogether. Information on human activities was lacking; in particular, areas fished by small boats remained uncharted and unknown to those outside the fishery. The existing nautical chart for the Bay had been produced by the British Admiralty in 1869. It was inaccurate, small-scaled and largely unsuitable for inventory purposes and modern hydrographical charts were not due for publication yet, for a number years.

The fisher community worked with a GIS expert, using data supplied by government and conservation agencies in association with their own local knowledge to map the area. The mapping process drew on a number of approaches, including bioregional mapping (Aberley, 1993). A 1:25,000 scale base map was produced by the fishers by a process of successively reworking topo-bathy maps. The thematic mapping sessions used Mylar sheets overlaid on the base maps on which the fishers sketched their information to delineate the base maps to the extent of activities and features. The mapping sessions were facilitated but the fishers were well informed and clearly knew which categories of information were important, and therefore needed little prompting. The sketching and map delineation was done by the community members themselves in the style of a bioregional mapping exercise. The extent of local knowledge was found to be considerable in quantity and detail, demonstrating 'tremendous above and below water recall as they documented the harvest of lobster, squid, herring and crab' (Macnab, 1998). The Mylar sheets were compiled and digitised to form thematic mapping layers in the GIS. It was found that, during the mapping process, the groups of community members acted as an automatic peer review of the information. Once the information had been collated, draft output was produced from the GIS for review and correction by the participants.

The project was successful in generating maps of fishing zones and zones of conservation that were agreed with the consensus of the community. These maps have been used by the community since to inform their fishing activities. The Government has also highlighted possibilities for the use of the material in other areas, such as oil-spill preparedness, providing further proof of the effectiveness of the approach.

The main problem that was encountered was the comparatively long lead-time in the output of material from the GIS. To a large extent this was due to the lack of base-mapping information to kick-start the system. However, this is a problem that any agency wishing to invest in GIS must face. This highlighted the need for a project champion with a background in GIS and data collections available. The community was empowered by the process but has also been marginalised by their lack of subsequent access to the computer data, which is held by the government.

4.4. Case study 4: Mpumalanga, South Africa (public meetings and neighbourhood groups, visioning/GIS, Bioregional-style mapping, video and audio recordings)

Harris and Weiner (1998) describe the development of a community integrated GIS for land reform in the province of Mpumalanga, South Africa. The area in question has a considerable diversity of culture and ecology. There are also many traditional homeland territories in the area that were encroached by the forced removals of the apartheid era. The relics of this land policy mean that forestry companies control large tracts of land with high arable potential, the government controls other areas and other commercial activities, such as fruit growing, all cut across the traditional homelands (Harris and Weiner, 1998). Any project in this area would need to be diplomatically sensitive.

Harris and Weiner (1998) state that the use of GIS in South Africa is ‘mostly top-down, technicist and elitist’. The purpose of the project was to test the potential for an alternative GIS for participatory land reform. In other words, just as GIS was used by government and commercial enterprises in a socially disempowering way, whether intentionally or not, the project would attempt to harness the power of GIS to empower the community during the process of post-apartheid land reform. Harris and Weiner (1998) outline the scope of the project as addressing the following critical research issues:

1. *The historical geography of forced removals*—including the identification of regional histories, homelands and to develop an understanding of overlapping claims.
2. *Differential perspectives on land potential*—addressing differing perspectives on the criteria and location of land identified as having ‘high’, ‘medium’, and ‘low’ production potential.
3. *Socially appropriate/inappropriate land use*—understanding land use from the perspective of peoples’ needs and to go beyond a very narrow ‘market-led’ perspective.
4. *Politics of access to natural resources*—including access to land, water and biomass as social and political processes.
5. *Identification of areas where land reform should take place*—the use of local knowledge in the identification of potential projects.
6. *Participatory land use planning*—to move from top-down to bottom-up reform.

This project did not consciously adopt a bioregionalist approach but the mapping methods used fit well within the mainstream of bioregionalism. Workshops were held as part of the project to try and tap as many sources of socially differentiated knowledge as possible. The mapping process involved the use of tracing paper overlays on paper base maps and groups of community members undertaking the mapping of the above issues. The groups, of between 5 and 8 people, were selected by the community members themselves, and men and women were interviewed separately to help overcome social and cultural barriers that might otherwise have influenced the ability of certain community members to provide information. The mapping exercises were taped and transcribed, providing a record of the discussions from which the final maps emerged. Photographs and video provided another layer of information. After the mapping exercises were completed, the groups engaged in a visioning process. They were asked to draw maps of how they would like to see their land used if they had access to it. Visioning is a purely imaginative process but can produce very interesting results. The tracing paper maps were then collated using a GIS.

This study shows that the political and social marginalisation of some sectors of communities means that PPGIS requires both a champion and expert assistance if it is to be empowering for the communities involved. Ironically, GIS is a powerful tool that can be used equally to empower and to disempower a community. However, there are benefits to be gained by the inclusion of valuable local knowledge, which can often challenge the hegemonic interpretations of the present and future landscape (Harris and Weiner, 1998).

CHAPTER 5

Findings and discussion

5.1. The lessons from PPGIS so far

The case studies show some promising results from trials of PPGIS 'in the field'. From these and other projects, an evaluation of PPGIS can be made, which will contribute to the formulation of an outline methodology for the use of PPGIS in mapping regions for sustainability.

One lesson that emerges from most of the literature is that PPGIS must first overcome a considerable amount of anti-technology prejudice and misconceptions before it is accepted. This is understandable because it is seen as 'big science', which is regarded with suspicion by many lay members of the public. This problem is clearly illustrated by a PPGIS experiment in Southern Ghana that sought to involve community participation in forest management. As part of the experiment, people's perception of GIS was tested before and after the experiment to gauge their attitude to the use and efficacy of the technology. The results of this test are presented in Table 6. Of members of local community members who responded to the questions before the project, 85% felt GIS would hinder their participation in discussions held within the forest committees (Kyem, 1998). Furthermore, they were cynical about how the technology could promote meaningful dialogue between foresters and local forest user groups. Despite this negative attitude, after the experiment the majority of the participants had become satisfied with the role GIS had played in ensuring successful collaboration between the groups. Kyem (1998) writes that the members of the local forest user groups were particularly impressed with data gathering, analysis and decision support capabilities the GIS offered. He adds that there were also three additional benefits that included the dissipation of emotional confrontation, focussing on issues and ideas and not personalities, and the integration of diverse viewpoints.

Table 6
Results of pre- and post-study questionnaire on users' perception of the role of GIS (source: Kyem, 1998)

Question	Responses ($n = 75$)	
	Before the project (%)	After the project (%)
The GIS technology will …		
1. …hinder my participation in discussions within the Forest Committee	85	11
2. …help make the collaborative process worthwhile	20	91
3. …foster understanding between foresters and local Community representatives on the Forest Committee	5	85
4. …reduce the time we will spend searching for data and answers to forest problems	15	80
5. …make it difficult for me to understand and follow discussions	91	7

The lessons that can be drawn from the literature on PPGIS and the examples used here, are summarised below:

1. GIS has a tremendous normative power in the integration of different data types and sources, allowing digital data from professional organisations and expert researchers to be integrated with hand-drawn maps on Mylar and tracing paper produced by non-expert community participants.
2. GIS and the public participation process can be equally empowering and disempowering, depending on the context, the abilities and allegiances of the facilitating GIS experts. An empowering PPGIS should include a reassessment stage where the data are evaluated and reviewed by the community groups, to ensure that outside facilitators have not misrepresented, intentionally or otherwise, the information provided by the stakeholders.
3. There is a need for the establishment of trust between the facilitator(s) and the community groups. This can be fostered by continual referral back to the community groups and transparency in the use and presentation of the data and free access to the results of the mapping process, perhaps through the Internet, although other means may be necessary depending on the community's location and resources.
4. The need for technical expertise can be overcome through a variety of user interfaces or the use of a human intermediary between the GIS and the 'users' but this is an area requiring more research and development.
5. There is a lead-time associated with the use of GIS in any planning situation. Investment in a new system does not lead to an instant result. This can lead to frustration in the participants and as much preparation should be done before the start of the process as possible.
6. The use of GIS helps to integrate the different viewpoints of the various groups and foster a common vision, overcoming the barriers that different perceptions of the local resources creates. This facilitates the identification of hidden conflicts among members of committees.
7. The use of GIS in public participation can ameliorate an emotionally charged atmosphere that can be characteristic of discussions between traditionally opposed interest or stakeholder groups. The GIS focuses attention on the facts and ideas rather than on the proponents of the views, restoring issues as being more important than personalities. This helps to reduce direct confrontation.
8. A methodology should be devised with specific procedures for the group discussions and a formal meeting structure. The adoption of a PPGIS method can aid in a democratic decision making process, promoting equal participation. Adherence to agreed procedures helps participants to stay focused on the issues in hand, thereby reducing the time required for decision making.
9. Kyem (1998) warns that the Western origins of GIS can present problems regarding interpretation of concepts and technical terms.

Krygier (1998) concludes that the most important issues facing PPGIS and public participation visualisation are not technical, existing software and commonly available hardware being capable of delivering solutions. The list above demonstrates that the areas of greatest concern are the development of:

- an appropriate interface, whether it be through an intermediary GIS-expert or direct stakeholder interaction with the system;
- a clear methodology for the use and role of the system in the participation process;
- a means of ensuring transparency in the process so that it cannot be 'hijacked' for the benefit of one particular interest group.

Sections 5.2 and 5.3 will explore methodologies for mapping regions for sustainability and for the implementation of the PPGIS scenario proposed in a little more depth. The aim of these sections is not to repeat material from the examples of PPGIS given in Chapter 4 but to draw out some lessons and propose approaches to these two issues. However, it is clear from Fig. 3 that there is a considerable amount of research still to be done in this area.

5.2. From 'bioregions' to 'regions for sustainability'

To avoid confusion over the term 'bioregional' (e.g. as a concatenation of the phrase biogeographic regions) and to avoid destructive arguments over philosophical aspects of bioregionalism that do not effect the efficacy of the mapping process, it is proposed that the process be called 'mapping regions for sustainability' rather than 'bioregional mapping'. The use of the word 'for' in 'regions for sustainability' is used advisedly, in preference to the word 'of'. The latter might be the more obvious choice but there is an important, if subtle, semantic difference.

The main debate on how to plan for the needs of economic growth in balance with ecological maintenance has centred on the popular concept of 'sustainable development'. A question mark hangs above the over-used phrase 'sustainable development'. Few people would admit to not being supporters of sustainable development but the phrase has been too glibly used to have much real meaning anymore without carefully considering its definition and context. Holdgate (1997), President of the Zoological Society of London, observed that:

> 'Sustainable development' has become one of the politically correct theses of our era. Everybody is in favour of it—and everybody defines the term, on Humpty Dumpty's principle, to mean what they want it to mean.

Indeed, the pedant might argue that, by definition and given the finite nature of the globe, development cannot be maintained indefinitely and, therefore, can never be truly sustainable (McBurney, 1990). Be that as it may, it is clear that the notion of sustainable development is important and therefore rightly high on the agenda. Too often the definition of 'sustainable' is focussed on a very narrow set of criteria, usually low energy use or recyclability. This is too limited, particularly from the perspective of landscape ecology and planning.

The Rio Declaration on Environment and Development presents 27 principles on which Agenda 21 is based. It is worth looking at three in particular, in relation to the wider issues of sustainable development:

> Human beings are at the centre of concerns for sustainable development. They are

entitled to a healthy and productive life in harmony with nature. Rio Declaration, Principle 1 (United Nations, 1993: 9)

In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. Rio Declaration, Principle 4 (United Nations, 1993: 9)

To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies. Rio Declaration, Principle 8 (United Nations, 1993: 10)

The concept of sustainability in its modern guise was first developed in response to impacts on the natural environment where the loss of a certain species or even life as a whole became a threat. One of the most quoted definitions of sustainability comes from the report of the United Nations World Commission on Environment and Development (WCED, 1987) usually referred to as the Report Brundtland (1987). In this often quoted report, 'Our Common Future', sustainable development is defined as

development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Whatever the definition, sustainability is a prerequisite for continued existence, whether human or not. Sustainable development is a broader concept than sustainability and includes issues on the quality of life (English Heritage, 1995) and the integration of social, economic and environmental spheres of activity.

Sustainable development includes concepts such as the sense and meaning of place, community identity and aesthetics. Sustainable development must also be considered at the level of multiple time frames (Jacobs and Mulvihill, 1995) to allow for the different periodicities of integrated natural and social systems. Despite the recognition of the different habitats and environments required by a myriad of other species, real recognition of the significance of the human environment did not arrive, politically, until the Rio package (United Nations, 1993).

Sustainability is about the maintenance of the health of the biosphere and the husbanding of key resources of air, water, land and minerals. Barton *et al.* (1995)

The most prevalent notion of development currently restricts itself primarily to economic growth. Some might argue that the words 'sustainable', in the environmentalist sense, and 'development', in the business sense, cannot be meaningfully juxtaposed. Be that as it may, sustainable development, as defined by the government means:

…living on the earth's income rather than eroding its capital. It means keeping the consumption of renewable natural resources within the limits of their replenishment. It means handing down to successive generations not only man-made wealth (such as buildings, roads, railways) but also natural wealth, such as clean and adequate water supplies, good arable land, a wealth of wildlife and ample forests.
Department of the Environment Command 2426 1994, in Barton *et al.* (1995)

The effect of this statement can be seen in practice through the Scottish Office statement that sustainable development of the construction industry and associated businesses would be enhanced by the development of a new vernacular architecture (Scottish Office, 1995) based on a regionally appropriate approach to environmentally benign building materials. This is in opposition to the widely held ethos of globalisation and unification of standards and materials (or harmonisation as the process is often euphemistically called) and calls for a new approach to planning. A good social criterion here must be the variations in the local response to the environment and its resources (Stevenson and Ball, 1998). These are brought together in the prevalence and distribution of styles of vernacular buildings. The vernacular builder is unlikely to have extensive financial resources to import exotic materials and must, perforce, make do with what is to hand. This imparts, in conjunction with local proclivities of stylistic detail, regional distinctiveness into vernacular buildings. A survey was carried out during the early 1980s, on behalf of the then Countryside Commission for Scotland, of 23,500 small buildings, randomly selected, across Scotland (a ratio of about 1:10) excluding large buildings such as mansions and churches (which might be expected to have employed exotic materials and more prestigious non-local architects). The result of this detailed survey was a regional classification of Scotland into 12 mainland and three island-group character zones (Naismith, 1989). The results of such a survey can provide a good definition of regions that account for social criteria as an expression of materiality and the investment of local culture in the built environment through the communities' responses to the natural environment, as evidenced by the distinctiveness of regional vernacular buildings.

Definitions of regions have implications for planning the built environment where not only the availability, but also the traditional use, of timber, slate, aggregates, stone and thatch (for instance) is important. So, an approach such as the one above may appear a satisfactory answer to how account can be taken of social criteria and how to choose an appropriate definition of the social landscape that readily lends itself to analysis. By using a readily measurable definition of culture/community the social landscape can almost define itself without the need for a lengthy participative process. Nonetheless, an approach of this nature is still top-down and dependent on how the criteria are set in the initial investigative research that determined the social region (in this case Naismith's work). It also fails to aid communication.

As Healey (1998) discusses, there are advantages to be gained in fostering collaboration, by shifting the collaboration from projects to strategies. The basis of mapping regions for sustainability is to establish a common agenda and baseline for information. They are the arena for sharing local knowledge. The act of identifying the regions does not make them sustainable any more than drawing a political boundary would. The regions are units that are identified as being the most naturally cohesive and, therefore, susceptible to policy aimed at sustainability where that term is taken to include environmental, ecological and community issues. In short, they are landscapes but not ones determined purely by outside scientific means, and therefore more likely to be capable of overcoming apathy from the stakeholders through a sense of ownership. The purpose of naming the regions at all is to distinguish them from any other regional unit of planning and to remind participants of the purpose of the mapping exercise. For these reasons the term 'regions for sustainability' will be adopted.

5.3. Towards a methodology for unassisted PPGIS

The guidelines for content and principles in the preceding sections are an excellent start in formulating best practice in PPGIS but they do not go far enough because the processes they cover are essentially one-sided. The user is always asked to respond to information that is presented. Although this is an essential part of any public participation process, full stakeholder involvement requires that those participating should be able to be proactive themselves and not merely reactive. A focus on reactivity may be a valid charge against web-based PPGIS, although constant advances in the technology may make it easier to incorporate greater interactivity. A purely responsive PPGIS process risks falling foul of the criticisms raised earlier for the use of GIS in landscape planning, and particularly that lay stakeholders must accept the limits of the knowledge in the form that it is presented to them. The missing piece in the PPGIS jigsaw is how it can be used to enable local community members and groups to *provide their view of their landscape* to the outside experts.

It may be difficult to elicit data from the lay public in a form that can be subjected to analysis for the purposes of planning, but that is the whole purpose of stakeholder participation as supported by the signatories of the 'Rio Package' from the United Nations Earth Summit (United Nations, 1993). There must be a means in both planning and research of mapping the community's landscape as opposed to 'the landscape'. Without such a means, neither the planning process nor scientific research can claim to have had real stakeholder participation. This is not least in light of the fact that the value of local knowledge is becoming recognised as of equal importance to scientific knowledge (Chambers, 1983; Linehan and Gross, 1998; Luz, 2000). It is here that bioregional mapping, as discussed earlier, comes into its own.

The bare-foot mapping process of bioregional mapping must be translated into the mapping of regions for sustainability through PPGIS. This is unlikely to be achievable if the participants are simply given access to a GIS and asked to get on with it. Guidance is necessary not only to enable the participants to provide information but also to allow comparability of the results from many different participants. Drawing together the successful aspects of PPGIS projects and accounting for the pitfalls suggested by some authors, the following is offered as a methodology to achieve a two-way PPGIS (schematically represented in Fig. 2):

1. Intuitive computer games–style interactivity should be incorporated to overcome the lack of general training in the use of GIS highlighted by Heywood (1997) and to overcome the paucity of computer skills in certain sectors of the population noted by Kingston *et al.* (2000). Such an approach also reduces the need for facilitator intervention.
2. To achieve point one there is a need to make more use of developments in 3D spatial multimedia and VR. The use of such a medium for presentation will help to overcome the limitations of the traditional map (Bodum, 1999) and reduce cognitive reliance on a single sense or method of interpretation (Bill *et al.*, 1999) to enhance communication by a reduction in the level of abstraction. It is a more intuitive representation of the real world, which a layperson can understand (in much the same manner as the fictional VR

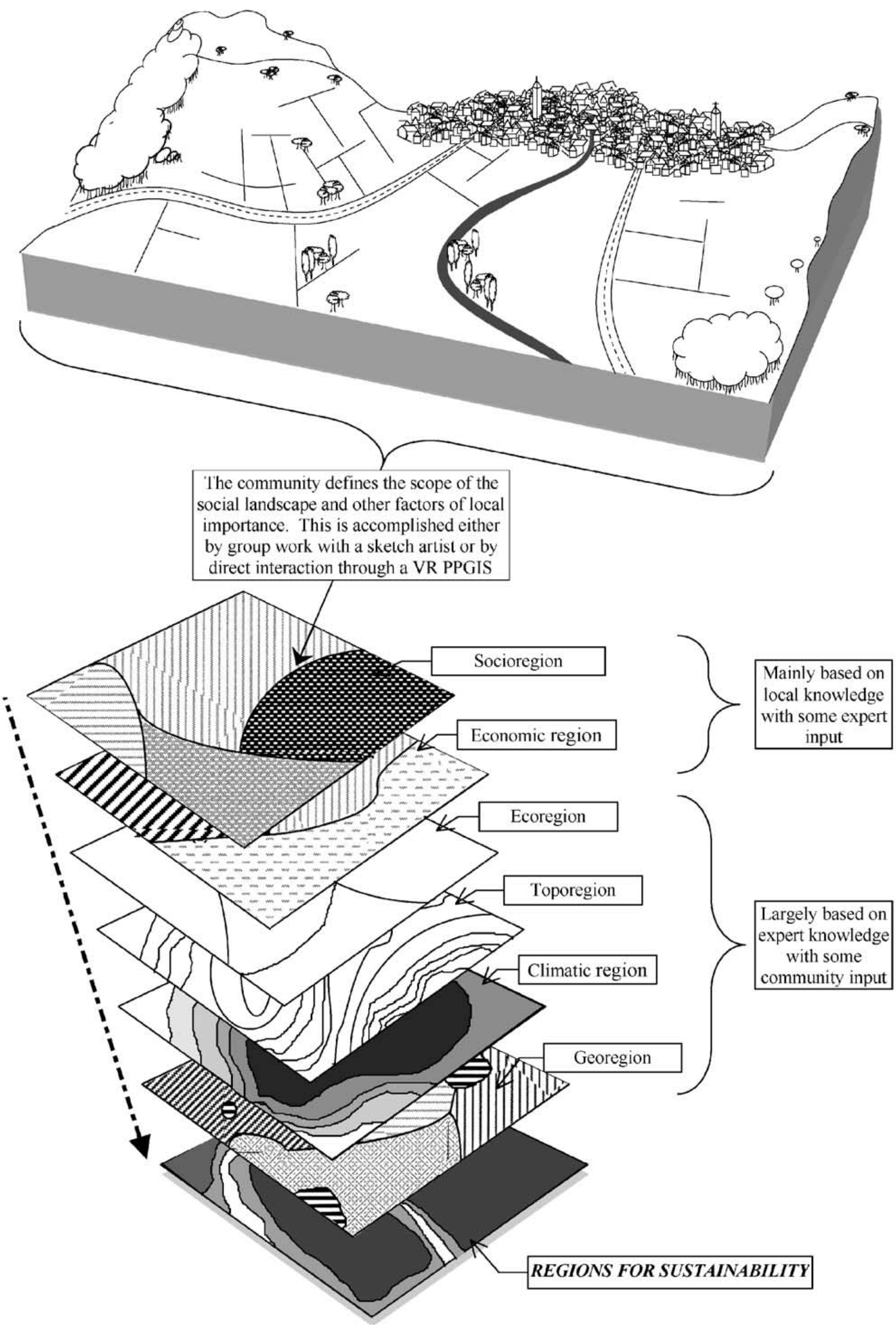

Fig. 2. Locally driven definitions of the landscape feed into the PPGIS process to give 'regions for sustainability', which represent a holistic unit of landscape for planning purposes.

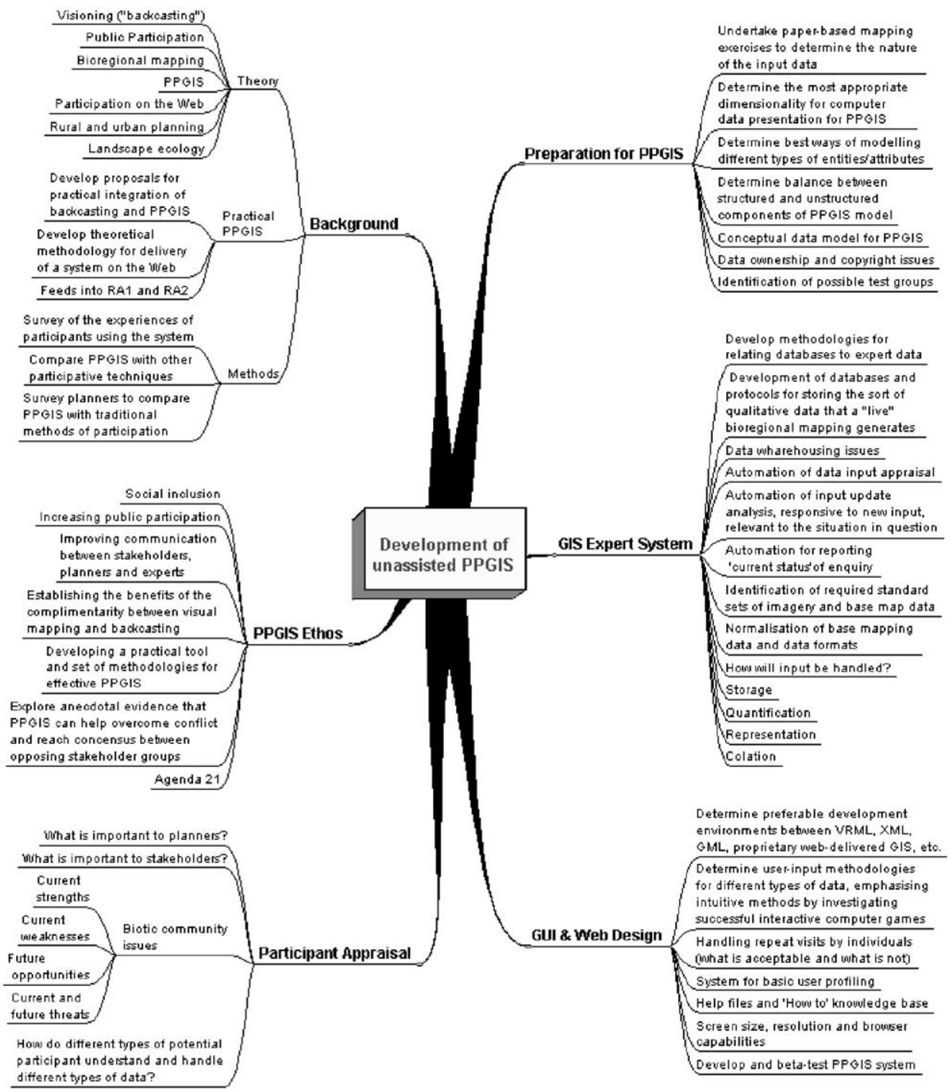

Fig. 3. A mind map showing some of the key issues for PPGIS. The left-hand side represents the theoretical aspects and the right-hand side represents the more practical issues for the implementation of unassisted PPGIS.

database system developed in the film 'Disclosure'—1994, starring Michael Douglas and Demi Moore).

3. The use of web-based systems is beneficial in increasing accessibility, not least with the rise in use of the Internet and overcomes problems of social exclusion through remoteness. However, the web is probably not yet the best medium for simultaneous group participation in the style of Al-Kodmany (1999), which would require video conferencing. Although the technology exists, it is not widely available and less well known than perhaps GIS.

4. The first stage in the mapping process must be to get the participants to define the extent of their landscape. This is the 'boundary of home' (Aberley, 1993) or the community territory of emotional and social relevance (Luz, 2000) and is often associated with geomorphological landforms (Berg, 1976; Sale, 1985). The inclusion of social layers in thematic mapping is important but does not go far enough as it fails to incorporate meanings in the landscape and remains 'external' (or imposed) knowledge. However, it is insufficient to externally impose a definition based on the most convenient watershed (McGinnis, 1999b; Ball, 2000), which all too often becomes the shorthand for a community-based landscape (Berg, 1988). Many cultures have had traditions of 'beating the bounds' where community members annually travelled around the traditional boarders of their territory. In the UK, this is a tradition that is still maintained in many parishes and one that gave rise to the 'Ridings' of Yorkshire. Using VRGIS such an exercise could be accomplished regardless of the physical fitness of the participants, not to reinforce traditional routes but rather to define what the boundaries are. No one person's landscape limits will match another's but the GIS can be used to identify the core area, important to all people and reach a consensus of the limits of the community's landscape by analysis of how the boundaries overlap and whether there is a tendency to follow linear features in the landscape such as ridges, streams and roads.
5. The second step is for the participants to identify features within the landscape that are of social and economic importance and specify why. For instance a war memorial might have an emotional and focal significance through what it signifies and its location. A road might prove to be of particular importance for commuting or an expanse of water for recreation.
6. In the third step the participants identify features of particular environmental significance to them, such as sewage outflows, agricultural fields, etc.
7. The fourth step requires the identification of features that the participants consider to be of particular visual significance, such as the view from a favourite lookout point, or a prominent landmark or building.
8. The fifth step in the mapping process is for participants to identify negative impacts on the landscape. Such impacts could include what the community regards as a particularly polluting factory or concerns about the route of over-head power cables, etc.
9. Finally, using these methods, the participants can make proposals. Interactivity here might be enhanced by the 'live sketching' methods being developed by Nobre and Câmara (1999). However, this may prove difficult in an unassisted situation.

The assimilation of this information then allows a full picture of the community's landscape with a detailed record of *why* features are important, which is as important as *what* features are important. From this point the planners will be able to formulate plans that conflict least with the community's sense of its landscape and return to them with a second stage PPGIS along the line described by Al-Kodmany (1999) and Kingston *et al.* (2000). The process outlined above is likely to be time consuming, although probably an enjoyable and informative experience for the participants through the use of multimedia, VR and the exploratory possibilities offered by the technology. During the process there is the possibility of community members learning about their environment from the overlay of scientific information. It is a process that should form part of a periodic or on-going survey by local authorities, which becomes feasible if it is web-based. There are other possible spin-off advantages for approaching the problem in this way, such as the knowledge base becoming available for identifying tourism potential (and therefore revenue generation).

Section 5.2 proposed a methodology for practical participative mapping, which should form an important core to PPGIS as can be seen from Fig. 3. From Section 5.1, it was noted that an unassisted PPGIS would also require an appropriate graphical computer interface and a means of ensuring transparency in the process. Fig. 3 also draws together the other main issues that face the development of PPGIS and, in particular, what might be termed 'unassisted PPGIS' (i.e. delivered on the internet). The material is presented in the form of a mind-map in which the left-hand side represents some of the more theoretical material presented earlier in this paper, and the right-hand side represents some of the more practical issues that face the implementation of the kind of PPGIS recommended in this paper. In part, these practical implications have been drawn from the foregoing examples and, in part, by extrapolating the implications of the demands of an unassisted PPGIS. Fig. 3 is not intended to be an all-encompassing statement, which would require a considerably more complex diagram because most of the branches could be extended with more sub-branches. It is, instead, a rehearsal of the main issues and demonstrates the three principal needs of the PPGIS as outlined earlier.

One of the remaining issues is that of an appropriate interface between the data and the user. Fig. 4 schematically represents the integration of a PPGIS interface with the GIS database and modelling environment. This schematically relates to the physical and conceptual data models that will be required for an unassisted PPGIS and these are standard questions of good relational database design. However, any unassisted PPGIS system must go further than this because it must overcome limitations in the intended users' abilities, both in terms of computer use and cartographical understanding.

In an unassisted PPGIS, the graphical user interface (GUI) will have two jobs to perform. The first is the medium for display and input of data. The second task will be, through the display, to ensure that transparency in the participative process is achieved. The stakeholders must feel comfortable with how analysis is performed and by whom (or what). Therefore, the PPGIS GUI must present the user with the following options:

1. an intuitive method of data input, probably by executing a virtual round-trip through a 3D representation of the landscape;
2. an intuitive method of inputting point data, probably by planting a virtual flag which is associated with a textual input window;
3. a method of allowing the user to define qualitative attributes about the local community, probably by offering a number of user-definable symbols that can be inserted into the scene;
4. an intuitive method of identifying regular journeys, such as routes travelled to work, probably by executing a virtual journey or journeys;
5. a simple method of allowing the user to view the scene from many different views, including axonometric, perspective, bird's-eye, walk-through (human eye level), with the ability to zoom in and out, pan, pitch, roll and yaw;
6. a method of showing the current cumulative effect of data input from stakeholders through a graphical window;

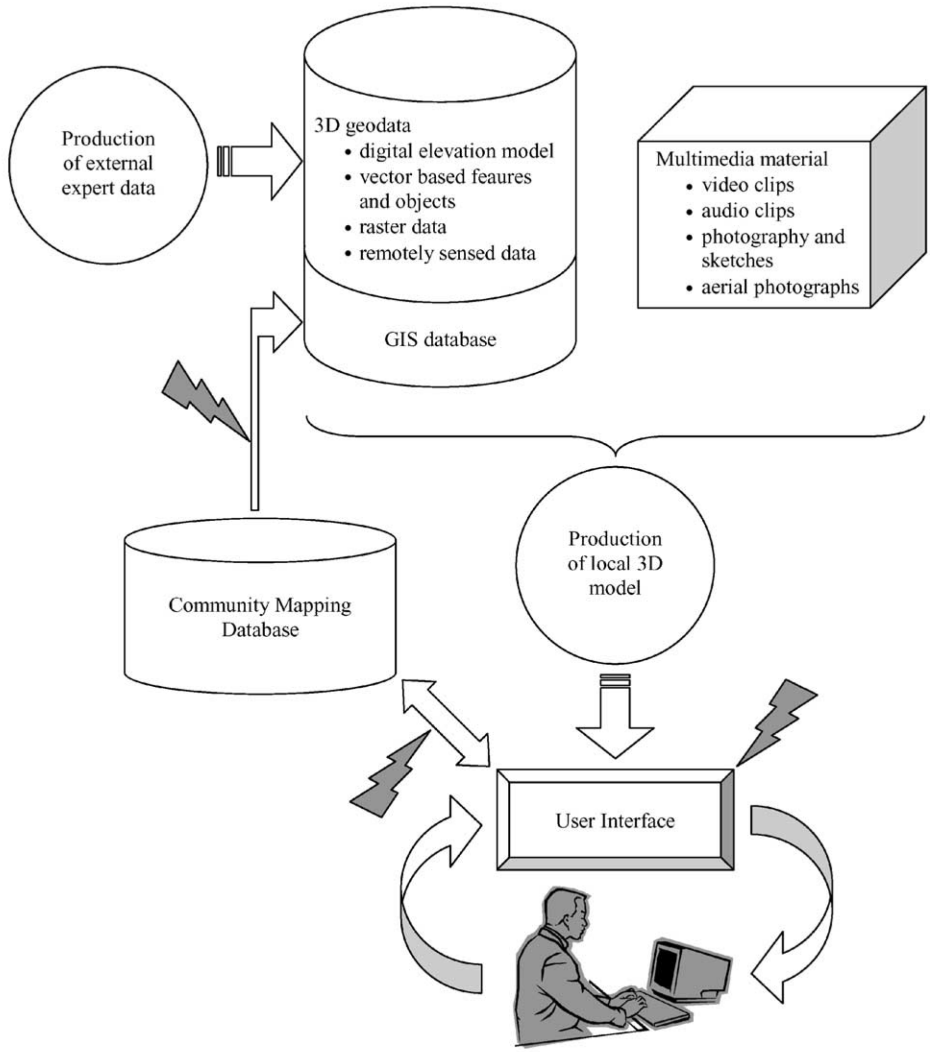

Fig. 4. A generic schematic for the delivery of a PPGIS. The lightning flashes indicate points within the process that are in need of research and development, not as a result of a lack of technology but the best way to employ it.

7. a method of graphically showing proposals or responses from planners while allowing some text inclusion, possibly through the use of active objects.

The preceding list is not exhaustive but these functions of the GUI are essential. They are also currently achievable. The main concern is the smooth integration of these functions with each other and with the spatial, relational database behind the GUI. Current developments in the object oriented to spatial entities may prove particularly beneficial to unassisted PPGIS in that an object oriented database management system

(OODBMS) can achieve a higher level of abstraction than is possible in a traditional RDBMS. In other words, the conceptual modelling is moving further away from the technicalities of computing and closer to real-world events and entities. The OO model offers a potentially more satisfactory method of approaching the problem of qualitative data. Although it is quite possible to record and represent qualitative data in the traditional relational model, the encapsulation of qualities within the entities in the OO model appears to be a better approach. There are many possible ways of achieving unassisted PPGIS and this should be a time of experimentation to achieve greater understanding not only of the computer systems themselves but also of how people interact with them and the data they represent.

CHAPTER 6

Conclusions

Environmental problems are too complex and too dependent on community participation, both for planning and operational success, to rely on an imposed top-down, non-holistic approach to environmental management. For effective participation, there needs to be a visual tool suitable for expressing the desired future environment and the plans that are necessary to get there from the present environment. The tool has to bridge the communication gap between the, often diverse, groups involved in participatory planning. This communication takes place within an environmental frame of reference that is of relevance to the stakeholders rather than imposed top-down. If such a frame of reference is not established in this way, the planning process will remain a top-down process despite the element of participation. However, the planner still needs to achieve consensus and produce workable strategies.

Satisfactory long-term management and change may be better approached through a process of environmental future state visioning so long as the strengths of each component (participatory visioning and bioregional mapping) are sought and the pitfalls avoided. The combination of visioning adapted for environmental planning combined with mapping regions for sustainability is proposed as a tool to facilitate communication and accommodate the different scales that lead to local consensus and strategic workability of plans.

The question that consistently emerges is that, although it is easy enough to present data to the public and elicit a response from them particularly with modern web-based GIS, how can the public contribute spatial data that will clearly lack the crispness of, say, Ordnance Survey base maps (Kingston *et al.*, 2000)? By looking at both the successful applications of mapping (whether 'bare-foot' or using GIS) and taking on board the warnings about the need for social applicability of GIS, some outlines of a methodology can be drawn together for participative landscape mapping to facilitate planning.

The criticism that GIS proponents can be overly positivist and exclude other perspectives (Smith, 1992) should not be merely dismissed because GIS is not a route to the solution but a tool to ease the journey on the route. In the same way, a car is not the route to a destination but facilitation to the traveller. The type of car must be chosen to suit the nature of the road being travelled and a decision made as to whether it is the best form of transport for the purposes of the trip. GIS is not a panacea for all the problems of participation but it does offer to community groups a means by which they can be empowered to explore scientific data in juxtaposition with their own interpretation of their landscape. Perhaps for the first time there is an opportunity for local communities to put themselves on the same footing, in terms of knowledge and presentation, as planning authorities (Heywood and Carver, 1994). The key to successful use of the technology lies in a better understanding not only in the lay community but also in the scientific and planning communities, of the capabilities and limitations of the technology. A caveat is essential, though. In the same way that there has always been the potential for misrepresentation of data, either intentionally or accidentally, through any process of visual representation, not least in cartography (Monmonier, 1996) the same is true of public participation GIS (Kingston *et al.*, 2000). It could even be argued that, with the large analytical and modelling power of the technology, there is an even greater prospect for such misrepresentation. So long as the social, economic and environmental contexts of a mapping process are borne in mind, GIS has much to offer in terms of a tool for spatial analysis, modelling and importantly for communication.

Setting examples of visioning (e.g. CES, 1994), visualisation (Al-Kodmany, 1999) and bioregional mapping (Thackway and Cresswell, 1997) alongside each other is an interesting exercise because is suggests that each of these approaches, far from being alternatives are complimentary. The practical application of bioregions is through the community mapping process. This is in line with the package of policies from the Rio Summit (United Nations, 1993) and the implications of participation from Local Agenda 21. It is essential to understand that bioregional mapping does not provide the 'answer' but a framework for the answer, which comes from the visioning process. The integration of bioregional mapping and visioning can be likened to 'lay' cartographic modelling informing a soft systems approach to the solution of an unstructured problem (Skidmore and Wroe, 1988) which includes the element of the human meaning of the place or problem (Checkland, 1988). Visualisation of the nature experimented by Al-Kodmany (1999) and Fonseca *et al.* (1999) appear to allow a dialogue between the lay stakeholder and the professional and also between the mapping exercise and the visioning exercise. If the bioregional mapping process can learn from other strategies such as PFR and FS, it stands to gain much from its complimentarity with visioning as a tool for the participatory process.

Environmental future state visioning appears to map onto the paradigm of consensus building processes of self-organisation, decentralisation and adaptiveness (Innes and Booher, 1999), bearing in mind the potential pitfalls already discussed. The practical implication of undertaking participative visioning and subsequent action planning at the level of 'regions of sustainability' in such a way that it can be integrated into a wider planning context is that there must be a method of integrating qualitative and quantitative data in a visual format that is compatible with spatial analysis tool commonly used by planners. The obvious mapping tool is a GIS and there is a growing body of research into PPGIS that shows the viability of this approach (Kyem, 1998; Al-Kodmany, 1999; Kingston *et al.*, 2000).

Three key principles for PPGIS emerge, which include accessibility, understandability and accountability. In brief, a PPGIS must be easily accessed by the public, which explains the interest in the potential of web-based systems. The data and the way it is presented in a PPGIS must be understandable by all users and some types of cartographic information may not fit this requirement. Finally, there must be ways of protecting the interests of minorities because as, even with web-based PPGIS, there is still the possibility of certain sectors of the public marginalising other sectors to steer the participation process to promote their interests.

The simple addition of an externally analysed social layer(s) into the mapping process is a start but is insufficient to really include the human element of the landscape. To foster participation and to generate the provision of bottom-up information, a mechanism by which the community's perception of the landscape can be put on an equal footing as the scientific data is needed. Community members must be able to proactively provide information rather than be restricted to responding to information supplied to them, which is not real participation. This means that a medium is needed for all sides in the process to be able to communicate with each other that will allow all data to be analysed on an equal footing. This is a daunting challenge but early experiments with PPGIS have proved promising. However, they have not included a proactive input of information from participants and so still only paint half the picture. Non-GIS based mapping methods, revolving around a bioregionalist approach, have been successful in America and Australia at generating new information from participants and integrating them into the planning process. This paper proposes that a possible solution is to incorporate a bioregional-style mapping process into PPGIS, with the adaptation of the user interface to mimic the popular computer-game controls and thus overcome many of the problems with unfamiliar technology.

Clearly, there is a long way to go from theory to practice as is highlighted by Fig. 3, which shows some of the areas that will need more work to achieve an unassisted PPGIS but the potential exists as can be seen from Al-Kodmany (1999) and Kingston *et al.* (2000). In particular, there are some difficulties still inherent with the technology. However, the projects detailed in the book of Câmara and Raper (1999) on spatial multimedia and VR show some of the advances that are currently being made. Bioregional mapping exercises (Thackway and Cresswell, 1997; McGinnis, 1999a,b) demonstrate the efficacy of a participative mapping approach and there are many examples that demonstrate the efficacy of GIS for planning and management in the more complex urban context (Harris and Elmes, 1993; Doyle *et al.*, 1998; Fedra, 1999). It is concluded that, combining the potential of backcasting and mapping techniques to identify regions for sustainability, through PPGIS, delivered by a suitable bespoke system on the internet has considerable potential for use in the participative planning context.

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