Chapter 16
Integrating Analytical and Participatory Techniques for Planning the Sustainable Use of Land Resources and Landscapes

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16.1 Introduction

Planning the sustainable use of land resources and landscapes must be a process in which stakeholders and the public work together to establish common guidelines for understanding the options of, and the implications for, future land uses. Key aspects of this process are the establishment of meaningful knowledge bases and tools, and methodologies based on the enhanced involvement of stakeholders in making decisions, and their subsequent implementation. The gradation of power or control in public participation proposed by Arnstein (1969), extending from 'citizen control' to 'manipulation', provides a conceptual basis for considering the evolution in political thinking about participation in areas such landscape planning.

This chapter discusses the integration of analytical and participatory techniques for planning the sustainable use of land resources and landscapes using two examples, one from South America and the second from Europe. The first example considers land use in the Amazon, and the second, the socio-economic, ecological and visual aspects of land-use changes in a European landscape. Each example involved active participation of stakeholders and the public in the process of decision making.

A framework is presented for the Amazonian example, which comprises methodologies and survey instruments for multi-level, integrated assessments of land-use and land-cover change. The framework was developed in collaboration between Indiana University and several Brazilian institutions. It adopts an historical ecological approach (Brondizio 2006) and applies a range of tools from the social, ecological and geographic sciences in fieldwork and laboratory analysis (Moran and Ostrom 2005). The framework and methodologies are being used by scientists in the Amazon Initiative (AI)—Land Degradation Assessment (LDA) thematic network as a tool for responding to land degradation problems occurring at farm to regional

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scales across the Amazon basin. A specific example was chosen of the application of the approach to agro forestry in Brazil which, in principle, can be adjusted and applied elsewhere.

In Europe, an example is presented of the development and testing of approaches to aid the assessment and implementation of options for sustainable landscape management. Visualisation tools, spatial models and scenarios of proposed changes in land use have been tested and evaluated for facilitating participation in managing landscape change (Miller *et al.* 2005). The focus was on the contribution of factors to change in the visual landscape, and on the development of proper institutions and capabilities for stakeholders' involvement, to aid in the assessment and implementation of options for sustainable landscape management. The involvement of stakeholders and the public has provided a means of developing their capability for landscape planning and management.

The outcomes from the experiences of these two actual planning activities, applied under the very different conditions of the Amazon and Europe, are used to illustrate stakeholder and community involvement in assessing environmental problems and potential solutions. These experiences suggest that wider stakeholder involvement in decision making has had a high level of participant satisfaction, and an increased understanding of the issues associated with landscape change. Comparisons of the similarities and differences between the studies provide a basis for discussion of common, and locally distinctive, guidelines and good practices in landscape use and planning.

16.2 Background

The Brundtland Commission (World Commission on Environment and Development 1987) identified the importance of information and participation in issues relating to the management and planning of change. Subsequent policies for sustainable development (Scottish Executive 2006; United Nations 2005) emphasise needs for education and capacity building to increase levels of public and professional engagement in environmental decision making. Such public policies set the context for political and social aims for the use of land, and the multiple functions it fulfils.

The challenge of developing methodologies and procedures to integrate analysis, for the study of rural development and land-use change, has been the subject of research at the Anthropological Center for Training and Research on Global Environmental Change (ACT), and the Center for the Study of Institutions, Population, and Environmental Change (CIPEC), in collaboration with colleagues from several Brazilian institutions. ACT-CIPEC research projects are focused on questions integrating socio-demographic, institutional and environmental aspects of land-use and agrarian change. Integrative methodologies, and strategies for research design, aim at linking data collected at the level of the household and farm lot to larger regions. Research instruments include ethnographic techniques, survey protocols, ecological assessment methods and procedures to use multi-temporal remote sensing data and geographic information technologies.

In Europe, the importance of the sustainable use of natural resources through linking socio-economic objectives for land use with a need to maintain or enhance its environmental quality and cultural functions has become of increased policy importance (Council of Europe 2003; European Commission 2005). The European Landscape Convention (Council of Europe 2003) recognizes the role of landscape in delivering on this mix of functions, as well as a resource favourable to economic activity. However, it is the effects of change on the visual landscape which are amongst the most widely perceived impacts of changes in land use (Lange and Bishop 2005). Visually representing the real world, and potential alterations, is essential for landscape planners to communicate their thinking to the wider public (Ball *et al.* 2008; Bishop 2007). The Scottish Executive (2007), in reforming the planning process, also noted that 3D modelling has potential for *"engaging communities and assisting planners and Councillors to visualise and assess the visual impact of development proposals"*. One tool being used to support such engagement is a 'Virtual Reality Theatre', with associated software tools, for use in public venues.

In order to support a sound stewardship of rural areas, the relationship between visual qualities and other functions of landscape, such as biodiversity, cultural heritage, amenity and sustainable production, was the subject of a recently completed project on European Commission (EC) funded project entitled 'Visualization tools for public participation in the management of landscape changes' (VisuLands). The project focused attention on the contribution of the location, dimension and geographic context of land-cover types and specific landscape elements to the visual landscape. The project consisted of partners in six countries across the European Union (as of 2003), with an international end-user group which assessed outputs for their relevance for operational use or strategic planning. Each country also had defined local end-users, the nature and role of which was designed to suit the management scenarios of that country.

The following sections include descriptions of how these two interdisciplinary projects use participatory techniques for planning and management of land resources. In each case, the process of stakeholder and public participation required as much consideration as the development of new technologies and tools.

16.3 Methodology for Assessing Processes of Land-use/Cover Change

A framework is presented for training and collaboration used amongst researchers from the different disciplines involved in the AI, a project supported by the United States Agency for International Development (USAID). The first phase of the project was implementation of collaborative activities between the International Center for Tropical Agriculture (CIAT), institutions in the Land Degradation Assessment thematic network of the AI Consortium, and the ACT. ACT students and scientists have developed and applied tools for capturing the values, objectives, and perspectives of local stakeholders on the feasibility and sustainability of their use of land resources in diverse social and ecological settings across the Amazon basin. Findings on the

sustainability of resource use by traditional populations in Amazonia have at times run counter to conventional wisdom. One reason for this is that land-use change assessments and planning often occur at regional or national levels, with assumptions about the role of local factors. A multi-level approach, which aggregates fine scale social and ecological processes to explain change observed at broader scales, has shed light on these assumptions and brings the perspective of the local actor to the assessment (Boucek and Moran 2004; Brondizio and Siquiera 1997; Moran *et al.* 2005).

Cernea (2005), writing on the role of social sciences within the Consultative Group on International Agricultural Research (CIGAR), argues that such institutions should consider how to put 'culture back in agriculture'. He describes a number of factors contributing to distancing social science researchers from mainstream agricultural development programmes. We argue that integrated socio-cultural and environmental methodologies can contribute to bridging this gap. Studying multi-faceted, multi-level phenomena of land use and agrarian change requires integrating processes taking place at the level of the farm lot as well as larger regions and commodity chains. Agricultural decision making at the level of a farm lot reflects factors working at the international level (e.g. commodity prices), national and regional (e.g. credit policies) as well as the local level (e.g. farmer's experience, available technology, soil fertility). Although these decisions are local (e.g. abandoning a pasture, deforesting land), they aggregate to form regional patterns of

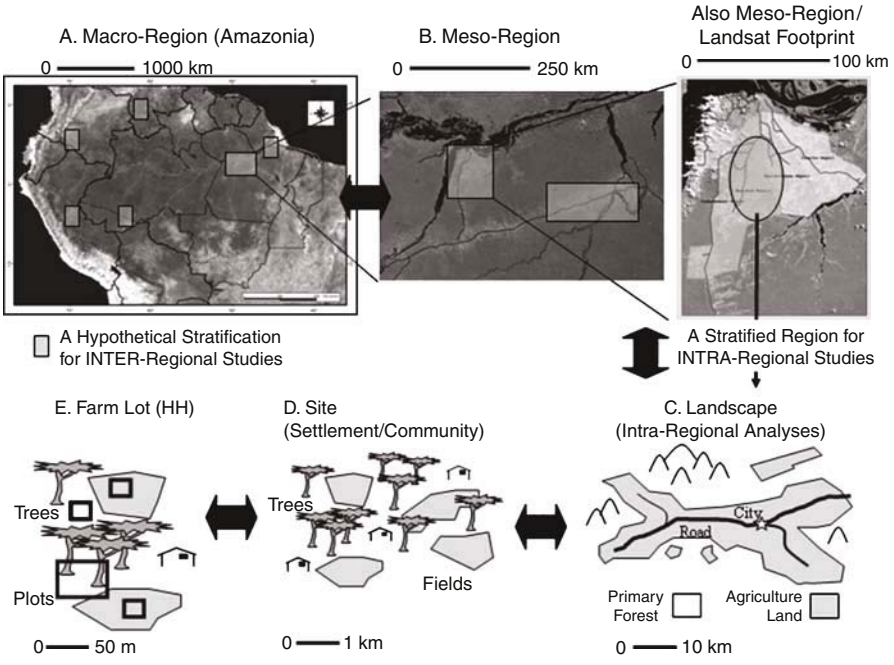

Fig. 16.1 Level of analysis and suggested terminology for bridging social and biophysical units of analysis (adapted from Green *et al.* 2005; ACT 2005_2008)

land-cover change. Understanding how these factors and levels interact requires expertise from both the social and physical sciences, and the sharing of methodologies, including a common language and terminology, and the development of shared hypotheses whilst drawing on disciplinary-based research approaches.

Such understanding also takes involvement of the actors, decision takers and end users. They are a source of technical information and policy, and aid in shaping the direction of investigation, influencing the problematic concepts, logical frameworks, analytical strategies, methods and scales of analysis. A framework to understand land use requires attention to both the scale and unit of analysis, and units of observation. Green *et al.* (2005) suggest a terminology intended to bring together heuristic notions of aggregation levels, and their spatial extent, from social and ecological perspectives. In this methodological framework, the terms chosen to depict different levels of spatial extent are 'macro-region', 'meso-region' (e.g. administrative units), 'landscape/micro-basins', 'settlement and community', and 'household and farm lot' (Fig. 16.1), where the examples are taken from the Brazilian Amazon.

16.3.1 Analytical Strategies for Assessing and Planning Land-use/Cover Change

Two common analytical strategies for land-use studies are the so-called 'driving forces' and 'process-pattern' analysis (Brondizio 2005). In both cases, there is an attempt to link changes in regional land-cover patterns, observable in a time series of satellite images, to the human and ecological factors that underlie them. Driving forces include the underlying, or fundamental, forces shaping land-use decisions, and proximate forces, which are the direct activities manipulating the biophysical environment, and mediating factors between them (Brondizio 2005; Geist and Lambin 2001; Millennium Ecosystem Assessment 2005). The challenge in land-use studies has been to characterize the pathways and feedback mechanisms between proximate and underlying driving forces, given the factors that mediate them, which can operate at multiple levels and spatial extent (Brondizio 2005; Geist and Lambin 2001). Process-pattern analysis, in comparison, aims at integrating datasets collected at the farm or community levels, and their contextual peculiarities. This supports greater insight into regional patterns of land cover observed in the satellite images. In doing so, this strategy seeks regional contextualization of variability of social and ecological processes observed in community and local level studies.

A hypothesis-driven study of land-use change processes often focuses on trying to understand the role of a particular factor in shaping the observable patterns of land-cover, or land-management problems at a particular level. A multi-level framework is necessary to account for the other factors that affect the process under investigation, of which the sampling strategy illustrated in Fig. 16.2 is an example. In order to understand the factors affecting deforestation, the region was divided into areas characterized by common history of occupation, characteristics of social

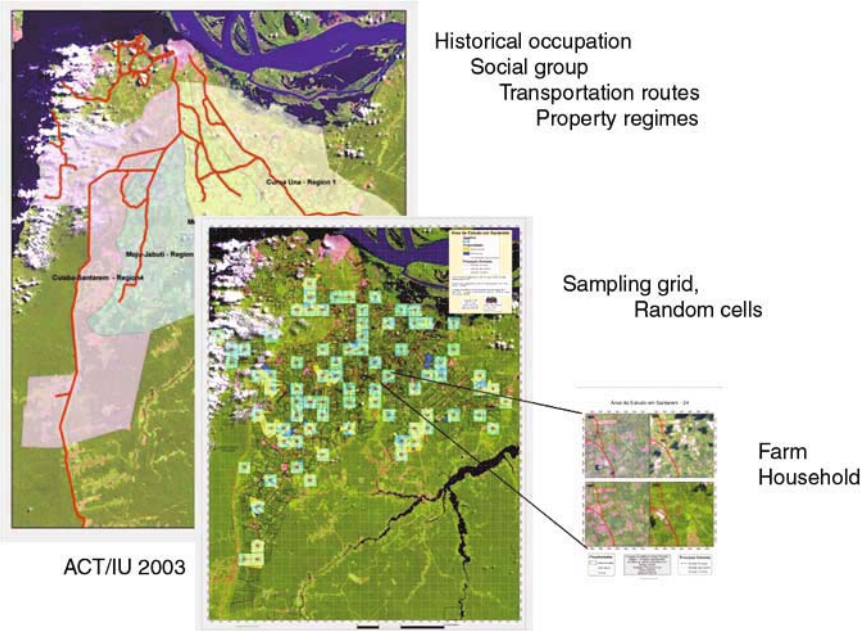

Fig. 16.2 Stratifying levels of analysis; images of the ACT study areas, Santarem-Belterra Region in the Brazilian state of Para (See also Plate 42 in the Colour Plate Section)

groups, transportation routs and property regimes. Smaller areas were then randomly selected, and interviews conducted in households randomly selected within grids.

The direct involvement of stakeholders was in the approach taken, and could not be substituted by literature-based derivations of specific processes driving land-use change between several locations. This was because, as discussed by McConnell and Keys (2005: 349), *"the directionality of the relationships between causal variables is multiple: high market demand can encourage investment in land capital, or it can spur the degradation of geographically dispersed resources"*. Full understanding of processes and relationships can only be achieved through the involvement of those directly affected or shaping these relationships and the directionality of change.

16.3.2 The Methodological Framework for Integrated Assessment of Change

The choice of social and ecological survey instruments, or protocols, applied within the integrative framework for assessing land-use change depends on the specific questions and hypotheses identified in the process of designing the collaborative study. The protocols, and questions or issues, illustrated at each level

of analysis derive from those developed by, and of interest to, scientists. These protocols and questions are intended to provide examples of research design which allow comparable sampling design and data integration between social and ecological studies of land-use change. The framework presented in Table 16.1 summarizes different levels of analysis (Table 16.2–16.7), aimed at illustrating a research design for elucidating key social and environmental factors influencing land-cover change. For each level, social and ecological processes relating to land use change are presented, together with an integrated assessment of change in the patterns of land cover.

The investigations of social and ecological processes address issues such as: (i) examples of influencing factors; (ii) examples of stratification strategies; (iii) information on sampling design; (iv) examples of data sources; and (v) examples of survey instruments. The Integrated Assessments of change in land-cover patterns contain notes of research questions, regarding specific social-ecological processes, relevant for addressing land-use issues. A study may be conducted at any level or at multiple levels but the framework provides a heuristic tool to create awareness of factors influencing the extent, rate, and direction of change at other levels that need to be considered, or controlled for, in an integrated assessment, such as that of agroforestry in the Amazon.

16.3.3 Participatory Perspective to Land-use Change: Agro-Forestry in Marajo Island, Para, Brazil

Proposals for future land uses can be made by researchers and extension agencies without consideration of how local land-use systems actually work and connect with external market chains. However, the land use of regions and communities can be shaped by employing robust research approaches which are able to take account of stakeholders' perspectives of the issues being investigated. The example which follows shows the evaluation of classified remotely sensed imagery with the involvement of stakeholders.

Population growth in urban Amazônia has created markets for regionally preferred food sources such as the *açaí* palm fruit (*Euterpe oleracea* Mart.), which is a regional staple food consumed by rural and urban populations alike. Since the late 1970s, the Amazon region has seen intensification of the production system following an increase in market demand. Today, *açaí* fruit is the most important source of income for the majority of riverine households, and the main economic activity of most municipalities, of the Amazon estuary. This production system builds upon existing knowledge and technology, such as the management of floodplain forests and the planting of *açaí* palm agro-forestry in multi-cropping systems. Despite its high economic productivity and the level of agro-forestry manipulation, such areas are often viewed as being only for extraction, with the work of producers and their management knowledge treated as extractivism (Brondizio 2008). Unlike a system based upon extractivism, the management and planting of *açaí* agro-forestry require

Table 16.1 Methodological framework for multi-level, integrated assessments of change in land-cover pattern (resource condition)

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
	Elucidating social-economic-cultural factors underlying patterns of land-cover change. Stratify levels of analysis based on social, political, and cultural organization of the population. Inform sampling design. Define key data sources and survey instruments.	Define research questions and hypothesize key social and ecological variables and processes explaining change in resource use and management decisions (and in turn observable land-cover patterns or land management problems). Develop a research design and sampling framework controlling for social and environmental variability at each level of analysis.	Elucidating environmental factors influencing patterns of land use and land-cover change. Stratify levels of analysis based on biophysical characteristics of the land (topography, soil, rainfall patterns, watershed, *et cetera*). Inform sampling design. Define key data sources and assessment instruments.

clear input of specialized agricultural and forestry labour in order to maintain and increase the productivity of crop stands.

The rigid boundary drawn between different food production systems has led to the characterization of forested areas, as in agro-forestry systems, as unproductive, or at best, under the category of agro-extractivism. Consequently, it is common to see land-cover classifications of the estuary which disregard *açaí* agro-forestry as a land-use class, despite its importance as a land-use system in the region (Fig. 16.3). Brondízio (2008) and Brondízio and Siqueira (1997) argue for a re-interpretation of local agro-forestry land-use systems as being intensive, and a change in the economic identity of local producers from extractivists to forest farmers. While *açaí* agro-forestry represent the most significant land-use system in the estuarine area, a generalized classification system of land cover (Fig. 16.3) in the area would, or could, ignore this production system, treating it as any other forest cover without regard for its important economic and social roles. Therefore, the most important regional land-use systems could be omitted from maps and models, as would a whole social group managing these forest and agro-forestry areas.

The coarse spectral, radiometric, and spatial resolution of satellite images does not always distinguish important land-use classes in forest biomes. However, equally important is the way researchers conceptualize land-use systems and how they should be represented in the landscape. These decisions and analyses carry

Table 16.2 Macro-regional level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Macro-regional	Broad descriptions of factors at this level are adequate. Examples of factors to focus on include major and planned transportation routes to key national and international markets, long term historical occupation of broader region, population distributions, economic development programs, national forestry or agriculture policies, etc… Data sources: historical census data (population and economy), baseline demographic and political maps, archival resources, policy documents, etc…	Computer model depicting the temporal interaction of few broadly defined variables underlying land cover change: economic policy (credit programs), infrastructure expansion (roads), total population change, and commodity market prices. Characterize interaction among demographic flows, economic and production areas, development programs, and political-cultural organization and changes. Macro-level land cover models may be integrated to climate, topography, and soil data. Describe historical trajectories (fluctuation in rates) of land use and cover change, areas of expansion and rapid population turn-over. Describe broad historical depth of regional occupation and resource use: Develop timelines and historical cartography (occupational history of region, change in regional access, etc…).	Examples of ecological factors to focus on at this level may be broad patterns of climate, relief, soil types and vegetation. Data sources: historical maps/databases of rainfall and temperature distributions; soil types, relief, and coarse resolution remote sensing data (e.g., MODIS or AVHRR) and thematic land cover maps. That is, data sets used in broad vegetation classification schemes. Regional sampling of major land cover and land use types (composition, seasonality, structural characteristics, etc…).

Table 16.3 Meso-regional level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Meso-Regional	Examples of social factors to focus on include trajectories of occupation, migration and emigration, the resource use and social and cultural organization of different groups, areas of conflicts and disputes, key markets for forest resources and cash crops, resource policy regimes and overall land tenure history. Articulate administrative units and develop timelines and his torical cartography (occupational history of region, change in regional access, *et cetera*). Stratify region by political and administrative units, census tracts, ethnic divisions, or land tenure and ownership categories. Survey instruments and data sources for characterizing broad, social processes per above strata include exploratory fieldwork (rapid participatory assessment of key processes with community representatives and key informants), archival research, census analysis, image land-use/cover pattern.	Pay attention to broad relationship between occupational histories, routes and forms of access, resource ownership, national or regional policies influencing land-use, demographic and economic history, and decadal change in land-cover. Measure and characterize historical rates of land cover change, areas of expansion and fast deforestation and re-growth dynamics. Describe historical depth of tional history of region, change in regional access, *et cetera.* Characterize interaction among demographic flows, economic and production areas, development programs, and political-cultural organization and changes. Describe cash crops produced and degree of commodity change development. Also at this level the quantitative focus is typically on "modelling" of contemporary, social and ecological forces on land-cover change. Qualitative or descriptive relationships may be conducted, also based on the multiple layers of spatially explicit, ancillary datasets. analysis. Appropriate key informants per strata include agriculture and forestry officials/extension workers, customary or formal leader at broader administrative levels, ministry of natural resource officials, *et cetera* who are familiar with State or Department level policies, planning, and histories related to natural resources for the study area.	Examples of ecological factors to focus on include broad soil types, landforms, differences in seasonal changes in weather and change in land-cover patterns. Stratify biophysical environment of meso/micro-region, geographically analyze historical change in land-cover per strata. Instruments and data sources include time-series assemblage, processing, and analyses of remote sensing data. Field assessment of soil andvegetation sampled over environmental gradients and/or compartments. Develop multi-level land cover classification systems and characterize major land-use/cover pathways. Utilize broader-scale classifications at this level.

Table 16.4 Landscape/intra-regional level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Landscape/ intra-regional	Examples of social factors to focus on include spatial and temporal patterns of change in resource allocation, property regimes for different resources, economic systems and land uses. Also identify interventions (by NGOs, *et cetera*), commodity chain of major production systems, structure of local government and its relation to resource use, location specific resource policies. Stratify and sample by social groups and institutional arrangements, community distributions, observable land-cover dynamics in a time-series of satellite images, patterns of economic and land use activities, *et cetera*. Survey instruments and data sources for characterizing social factors.	Focus on comparative analyses within a region and variability among different social groups. Important processes include spatial and temporal patterns in social groups settlement, resource allocation, historical rates of land cover change, areas of expansion and rapid population turnover, areas of fast deforestation and re-growth dynamics. Also important is the temporal and spatial shifts in major production systems, development of commodity chains for the major production systems and interventions. Characterize history of location specific policies or laws influencing resource use (e.g. forest and land management programs) in local government and problems or successes of them.	Examples of ecological factors to focus on include types of vegetation cover and their spatial patterns, soils types, topography, monthly distributions of temperature and rainfall. Stratify biophysical environment geographically (finer scale soil types, landforms, *et cetera*). Instruments and data sources include time-series assemblage (Landsat products or higher resolution, remotely sensed products), processing, and analyses of remote sensing data; field assessment of soil and vegetation sampled over

Table 16.4 (continued)

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
	Include participatory assessments of land-cover with community representatives and key informants; rapid assessment tools applied at the community/group level; multi-temporal remote sensing data, census data at the level of municipality and/or tracks/sectors. Key informants as above and also cooperative leaders organized around agriculture or natural resources, local government leaders, natural resource extension agents of local government, *et cetera* who are familiar with local administrative level policies, planning, and histories related to natural resources for the study area. Regional image print out for exploratory fieldwork.	Describe the structure of local government, who participates and how are they chosen, what are their values (and level of resource allocation) toward agricultural development and also resource conservation programs. Conceptual analysis may be conducted of the interaction among landforms, roads and rivers (market access routes), demographic dynamics, property regimes and land-cover dynamics upon patterns of land use and settlement.	different environmental compartments and vegetation types and/or areas characterized by distinct land cover spatial pattern. Utilize multi-level land-cover classification schemes (Utilize broader-scale classifications at this level as above level. Again, classes chosen will depend on issues to be addressed).

Table 16.5 Settlement/community level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Settlement/ Community	Examples of social factors to focus on include forms of social organization, community conflicts, socio-economic factors, migration patterns, demographic trends, cultural norms shared by community (values), type and number of businesses and philanthropic organizations, degree of market access, knowledge of agro-forestry technologies and ecological services provided to community by each land-use type in it. Stratify by social groups and/or community (e.g., by age, location, size, *et cetera*), resource user groups, patterns of land-cover trajectories, patterns of informal types of land ownership, *et cetera.* Survey instruments and data sources primarily used for characterizing important social factors at community level include participatory assessments as above regional level or use of household surveys that can be aggregated to represent a community or settlement. Appropriate informants at this level include long-term occupants/elderly of, administrators of community and heads of community organizations, resource user groups, *et cetera.*	Focus on community/settlement level processes, such as understanding forms of social organization, history of occupation, economic systems, migration patterns, collective activities, *et cetera.* Characterize rates of demographic and economic changes resulting from changes in production system and forms of resource use. Characterize any locally coordinated activities to produce, manage, or sell a resource in the community, attributes of customary institutional arrangements that regulate those collective activities, and how these arrangements emerged and are maintained. Characterize historical land-cover patterns, change in structure and composition of vegetation in key, community land-cover types (i.e. structure and composition of trees in agro-forestry systems, home-gardens, and forest patches), land-use pathways, *et cetera.* Conceptual analysis of interaction among settlement pattern, landforms, roads and access, formal and informal property regimes and relationship to land use systems. Capture history of land and economic conflicts and their impact on settlement and land use.	Examples of ecological factors to focus on include land-cover patterns and their change, structure and composition of land-cover types, land-use pathways. Stratify biophysical environment geographically (finer scale soil types, landforms, vegetation types, *et cetera*). Instruments and data sources include time-series assemblage, processing, and analyses of remote sensing data; field assessment of soil and vegetation sampled over environmental gradients and/or compartments, image interviews, GPS, *et cetera.* Utilize multi-level land-cover classification schemes (Utilize finer-scale classifications at this level. Again, classes chosen will depend on issues to be addressed). Instruments to produce finer-scale classifications for remotely sensed images include training sample collection at this level.

Table 16.6 Farm/household level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Farm/Household (HH)	Variety of ethnographic methodologies Key social factors to focus on include demographic and economic history of the household, family labour organization, HH composition, access to financial resources and technology; social organization (and position in them), kinship and social networks, economic and land-use decisions. Survey Instruments and data sources include participatory assessments at the family and farm level, lot mapping, structured and semi-structured socio-demographic and socio-economic surveys.	Important processes include demographic history of household, social organization and kinship networks overt-time, and change in economic and land-use decisions. Conceptual and statistical models depicting the interaction between household life cycle and land use and cover change. Comparative analysis of households: economic and land use portfolio, resource management and conservation strategies. HH position or involvement in collective activities that regulate resources important to the HH and community, rates of abandonment and expansion of activities, *et cetera.* Analysis of the inter-linkages between market signals (e.g. demand and price), household decision-making, and land cover change.	Key ecological factors include agricultural plots, resource use/condition (soil, water, pasture, forest, secondary forest, *et cetera* within the holding). Instruments and data sources for assessing resource use and condition on the farm include field inventories, image interviews, GPS, soil sampling, vegetation inventory.

Table 16.7 Individual level of analysis

Levels of analysis (heuristic units defined according to research questions)	Investigating social processes related to land-use change	Integrated assessments of change in land-cover patterns	Investigating ecological processes related to land-use change
Individual	Key factors to focus on include life history, knowledge system, social and political participation and social networks.	Characterize knowledge of resource use and management. Build narratives of social-environmental histories representative of the larger population. Describe perception and value of environmental resources, views of environmental and resource degradation, value of participating in collective activities to govern/use/conserve common-pool resources of community/settlement, and any solutions to environmental and land-use issues.	Largely as above. Other key factors to focus on include individual plants/trees of personal or economic importance to individual. Sample individual plant species (and other resources) based on transects with key informants, herbarium collection building.

significant political and economic implications. The integration of ethnographic and participatory assessments can help to bring greater detail to the analysis of land-use/cover patterns in remotely-sensed images and to help to better represent land users and their management of forest landscapes. The results indicate that the combination of diverse approaches and disciplinary (and often inter-disciplinary) perspectives, bringing together the diversity of stakeholders' attitudes, needs and impacts is fundamental for supporting decisions over policies and actions affecting changes in land-use practices.

16.4 Participatory and Visualisation Techniques for Sustainable Use of Land Resources and Landscapes

The improvement of understanding of the outcomes of landscape planning decisions is a political priority, which builds on the aspirations of Brundtland (WCED 1987), reinforced by international and national policies over subsequent years (Table 16.8). Progressively, these policies have led to investment in improving access to environmental information (as per European Union 1998b), increasing public engagement, and an evolution of processes leading to greater citizen control (as termed in the framework of Arnstein 1969).

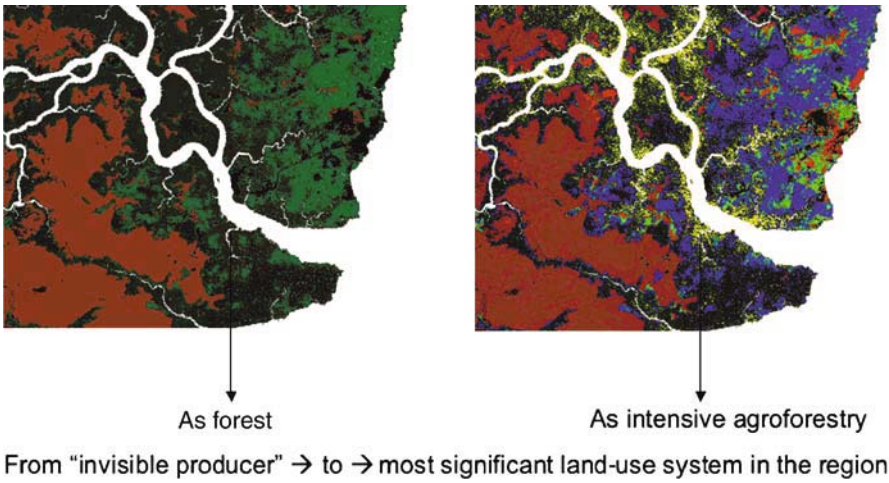

Fig. 16.3 Outputs from an ethnographic (participatory assessment) in which local input improved the classification process with the identification of areas of intensive agro-forestry (right-hand image) (See also Plate 43 in the Colour Plate Section)

Recognition of the interactions and balance between economic, environmental and social pillars of sustainability was reflected in a priority area of the EU (2001) Sixth Environmental Action Programme, in relation to protection of the wider countryside. The Programme recognises the importance of *"policy-making based on participation and sound knowledge"*, and that *"involvement of stakeholders will be central to its successful implementation."* To deliver on this priority there is a prerequisite for raising public awareness, and for providing people with opportunities to influence this change toward an improved quality of life in rural areas. A principal aim is therefore to enable the direct involvement of stakeholders in the development of landscape quality, and use public participation in the identification of objectives and in the evaluation of future landscapes with respect to their multiple functions.

The charging of governance with obligations relating to public participation has gradually permeated to national policies and regulations, resulting in guidelines for planning systems which acknowledge *"community involvement and dialogue, and negotiation"* as part of a process *"that respects the rights of the individual while acting in the interest of the wider community"* (Scottish Executive 2002). The inclusion of actors with multiple objectives in the planning process improves its potential to accommodate both socio-economic and environmental requirements (Scottish Executive 2007).

This section describes the involvement of stakeholders in the identification of the aims and functions demanded of the landscape (Landscape level in Table 16.4), and the use of virtual reality tools to facilitate information dissemination and consultation (Settlement/community level in Table 16.5).

Table 16.8 Milestones in progress towards planning of landscape change

Event	Outcome
The Brundtland Report: (1987)	Our Common Future: Detailed analysis of sustainable development
Rio Earth Summit (1992)	Agenda 21 – A Programme of Action for Global Action in all Areas of Sustainable Development. The Rio Declaration on Environment and Development
Aarhus Convention (1998)	Promoting public participation in decision-making, environmental awareness and access to related information
Doha Round of World Trade Talks (2001)	Removal of production-based support for agriculture, to be replaced by environmentally friendly land management
Johannesburg (UN 2002)	Affirmation of importance of broad-based participation in policy formulation, decision making and implementation at all levels
European Landscape Convention (Council of Europe, 2003)	Promotion of 'people centred landscapes', participatory planning and increased public understanding of change
United Nations (2005)	Increasing education and awareness of sustainable development

Source: Adapted from Miller *et al.* (2005)

16.4.1 Stakeholder Preferences and Attitudes Towards Landscapes and Change

Stakeholders were consulted to obtain their perspectives of multi-functional purposes of landscapes. In particular, those who directly interact with land-use systems, at a strategic or operational level, to identify appropriate courses for future management and planning. The 'people included' principle that identifies a creative management between the integrity of ecosystems and the livelihoods of people, living and working in the environment was employed in this research. Further details of the development and testing of the planning tools applied to a range of different case studies in Miller *et al.* (2005).

The details which follow are for a case study in north-east Scotland (Clashindarroch Forest). The design plan for the Clashindarroch Forest area was due for review, thus providing a real case for testing how visualisations might contribute to the stakeholder participatory decision-making process. The flowchart in Fig. 16.4 presents the interactions between user needs and data capture or analysis, and the stapes in which visualisation tools are used, and assessments of their fitness for purpose.

To quantitatively identify and analyse stakeholder opinions a Q-methodology was used, followed by a discourse analysis to explain the results obtained using statistical methods. Q-methodology is a quantitative means for examining human values and beliefs which enabled the identification and assessment of subjective structures, attitudes and perspectives of the public, from the standpoint of the people being observed. This approach provided insights into respondents' preferences, identified criteria of particular importance.

The sample included end-users with responsibilities for land management and planning, as well as the public. These were then analysed with respect to respondents' socio-economic backgrounds to reveal stakeholder and public attitudes, and of the elements of which they are composed (see Miller *et al.* 2005; Nijnik and Mather 2007, 2008; Nijnik *et al.* 2008).

Figure 16.5 shows that four alternative options have been identified concerning landscapes and land-use management decisions. The first impartial scenario is, broadly, an equal distribution of peoples' preconception towards financial investment (+3); environmental pillar (+3); social pillar (+2); economic pillar: farming (+4), and industrial/urban development (+2). The second environmental option reveals a quite strong environmental preference: with the environmental pillar (+5); social pillar (+2) and greater financial investment (+3). The second policy option rejects the economic pillar, with (–4) for farming activity and (–3) for industrial/urban development. The third essential economic alternative considers the development of farming activity (+5) in combination with industrial/urban development (+4) in rural landscape to meet the requirements of the social pillar (+4), whereas the importance of the environmental pillar (–3) and of financial investments (–3) is underestimated. The fourth fair economic option is similar in preference to the third option but with less pronounced inflection towards the other pillars: farming activity (+5); social pillar and industrial/urban development (+4); environmental pillar (–2) and the financial investment (–1). For more information on the method and on the results of its application, see Miller *et al.* (2005), and Nijnik and Mather (2008).

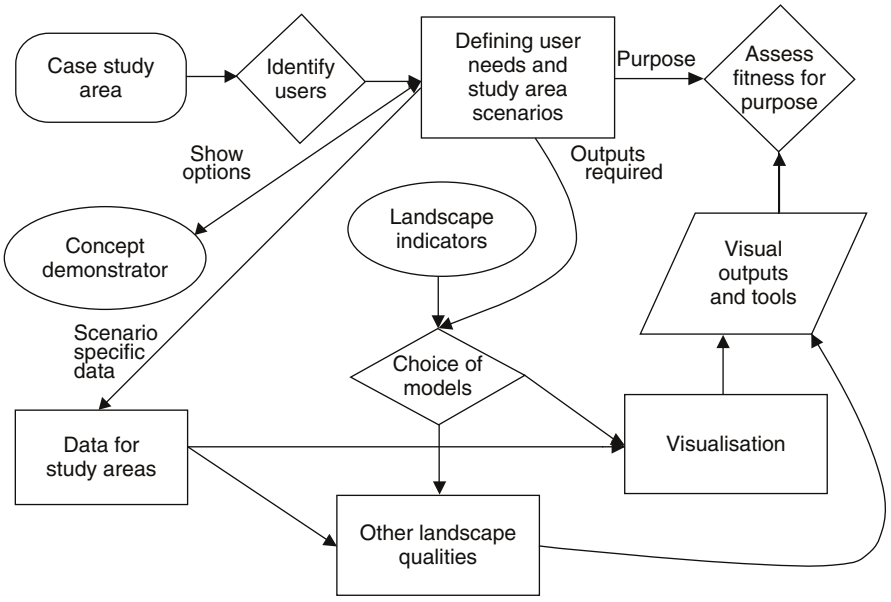

Fig. 16.4 Summary flow chart for the VisuLands research

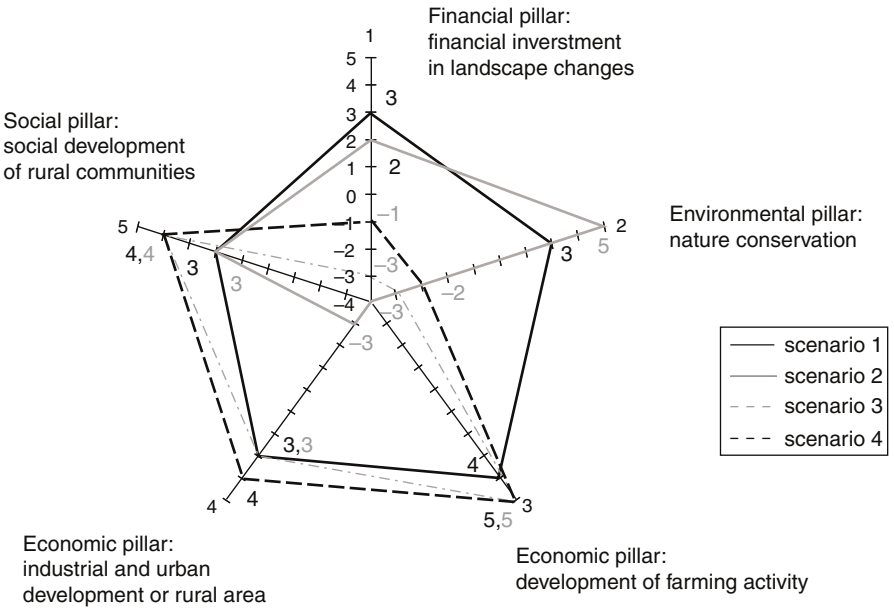

Fig. 16.5 Analysis of preference surveys, showing attitudinal diversity of stakeholders towards landscape changes

16.4.2 Awareness Raising and Participation in Landscape Planning and Management

Drawing on the results of the stakeholder and public attitudes and preferences for landscape change, the designs and plans for future management of the site were developed further with respect to layout and distribution of woodland species. This information was then used to develop representations of scenarios of proposed changes in land use, specifically in relation to the introduction of native woodlands in areas of pasture and moorland. Visualisation tools were then used to test public preferences for different scenarios of future landscape change.

The scenarios developed for the Clashindarroch area were: (i) maximising on the proportion of native woodland species (i.e. biodiversity), (ii) maximize on timber woodland (i.e. economic return), and (iii) diverse lands cover of moorland, forestry and agriculture (i.e. no change). These scenarios were presented in a mobile Virtual Reality Theatre, designed to support the sharing of views by audiences (Fig. 16.6), with electronic voting whilst navigating through landscape models. This was followed by a phase of knowledge transfer and raising of public awareness of the issues associated with each scenario. The output was an analysis of the preferences for the scenarios of change and an evaluation of the effectiveness of the associated programme of awareness raising.

The Theatre enabled scenarios of change to be presented to several audience groups, using a 'drive-through' of the area. As part of the presentations software functions were used to switch on and off groups of features (e.g. new woodlands), or movement of model features to audience selected locations in the landscape. Theses functions supported tests on audience preferences for landscapes under the scenario of change.

16.4.3 Survey of Preferences for Landscape

The participants completed a landscape preference survey, using images at eight set viewpoints in the model and at two points in time: the present and 100 years into the future. Participants scored the landscape view using voting handsets (Fig. 16.7), with the change in woodlands as the focus of the interest. The approach taken for the sessions was: (i) a short introduction to provide a context for the landscape planning process; (ii) a pre-set route through the study area enabling participants to 'experience' moving through the landscape in real-time; (iii) stops at eight viewpoints (Fig. 16.8) at which participants were invited to record their opinion of the landscape view and keywords that they would use to describe the view, using electronic voting handsets.

Table 16.9 shows an example of the central sections of the views at two viewpoints, under current conditions and the scenario of change. The principal keywords used by participants are included beside each image. The results for viewpoint 1 were not recorded so as to familiarise the audience with the facility, the views and the operation of the voting system.

In total, 139 responses were received for the test and survey. Only 20 per cent of respondents were employed in an activity directly related to land management or in a related advisory capacity. However, 35 per cent of respondents considered themselves to live in the countryside and 17 per cent in a village. Table 16.10 summarizes a finding that the scenes which are least preferred are those described as bleak, barren and bare, compared to the preferences for diverse, varied and scenic views. However, the discussion periods which followed the voting revealed groups whose preferences were for landscapes characterized as barren and bleak, which provide different types of experiences than those in the latter category. This range of views is reflected in the overall mean of scenes described with words such as barren or open being 3.2 (with a standard deviation of 0.61).

Experience is of considerable importance in people's preferences for landscapes, and in this regard the virtual environment can only convey an impression of the landscape and the changes proposed. Survey replies included comments that implied consideration of the view on the left, centre or right of the screen, with reference to the view on the 'left' and 'right'. This could be interpreted as suggesting that the Theatre did convey a sense of 'immersion' in the landscape. Further details of the surveys can be found in Miller *et al.* (2005).

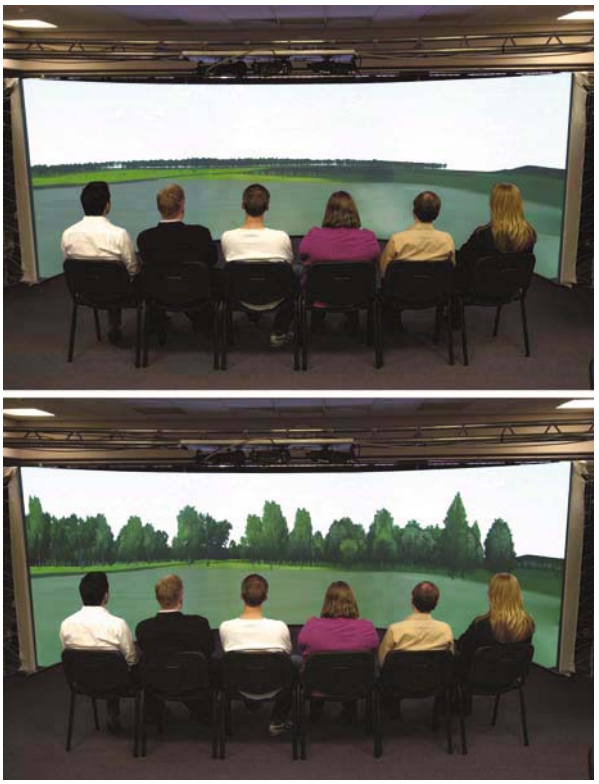

Fig. 16.6 Visualisation of 'before' and 'after' option for a change in woodland cover

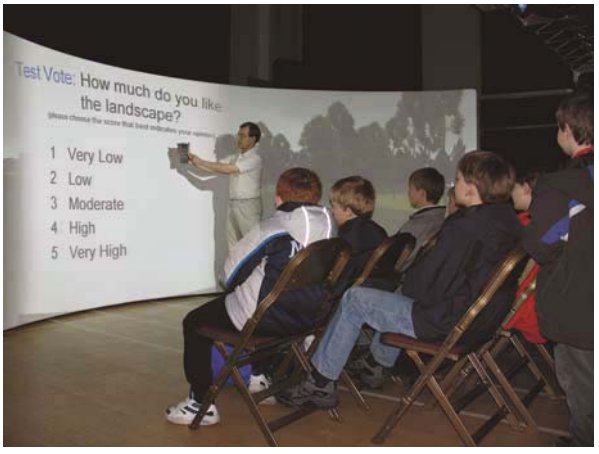

Fig. 16.7 Voting on landscape preferences using electronic handsets in the Virtual Landscape Theatre

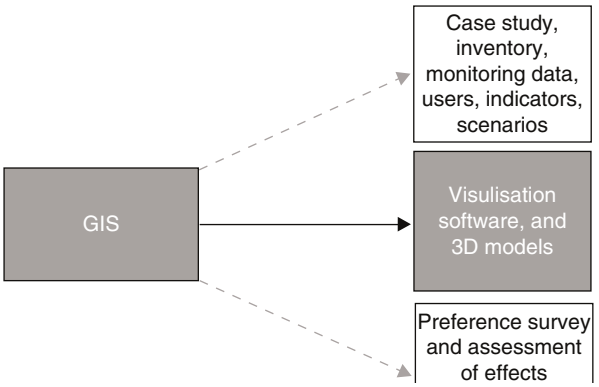

Fig. 16.8 Route of walk-through of landscape using the Virtual Landscape Theatre (Map reproduced from Ordnance Survey, Crown Copyright, under license to Macaulay Institute GD27237´2002) (See also Plate 44 in the Colour Plate Section)

In general, feedback from the participants was good, albeit with lessons to be learnt from specific remarks regarding people's experience in the Theatre, with a range of comments, such as:

- 'slightly sick-making'
- 'a much better impression than a computer screen'
- 'I would like to have sat back to see everything'.

The voting method via hand-held electronic devices seems to have been an effective way of collating quantitative data quickly and efficiently. However, through observing participants, it became clear that not all were voting in time (hence their vote was not counted) and some chose not to participate in the voting at all. In the latter instance, the use of a more discursive approach through the virtual journey proved very effective, perhaps more so than the voting/word association method,

Table 16.9 Extract of the centre of the view of the landscape as projected in the Virtual Landscape Theatre, with associated descriptive phrases for two viewpoints

Viewpoint Number	Current Situation	Keywords	Prospective Landscape	Keywords
2		Bare, stark, bland, spacious, uninteresting		Sheltered, improved, varied, interesting, pleasant
5		Barren, dull, open, boring, empty, unrestricted		Diverse, more interesting, better view

Table 16.10 Summary of ranking of landscape preferences and the associated keywords

	Least preferred	SD	Most preferred	SD
Mean ranking	1.55	0.46	4.23	0.34
Example keywords/phrase	Boring, barren, dull, bleak, bare		Diverse, varied, interesting, scenic	

in that it provided greater freedom to expand on answers and gave more time to consider each landscape. The virtual landscape tour appeared effective in engaging the public, providing a means of communicating environmental information and potential change in a comprehendible manner and thus enabling them to become involved in the decision-making process (Orland *et al.* 2001). Some aspects of the scenarios were pre-set in the model (e.g. density of woodland), thus limiting the nature of participation. However, the role of the facility has stimulated further use in participatory processes, opening it up to the public in the very early stages of the decision-making process and increasing transparency.

16.5 Conclusions and Further Research

The logical framework developed by ACT-CIPEC researchers (Brondizio 2005, 2006) shows how social and ecological scientists integrate disciplinary methodologies to assess processes of land use, and aid in land-use planning, from very local to regional scales. The framework outlined identifies examples of factors influencing change, stratification strategies, information on sampling design, examples of data sources, and examples of survey instruments for land-use change assessment and planning at different levels of analysis. Research instruments include ethnographic techniques, survey protocols, ecological assessment methods, and procedures to use multi-temporal remote sensing data and geographic information technologies during fieldwork and laboratory analysis. The actors, the decision takers, are at the centre of this approach by both providing information and shaping the direction the investigation take, an approach to explicitly capture the perspectives and values of the local stakeholder.

There are, however, challenges to successfully following through with this framework as there is a need for commitment to more interdisciplinary research. This is challenging, as it requires a significant investment of time to develop a common language, integrating those of the relevant disciplines, for a particular research topic or planning goal. Further challenges include the need for familiarization with the methodologies of different disciplines, and the development of an understanding of any trade-offs required between them. Underlying successful implementation of the framework is the development of specific research questions or planning goals for guidance, and the participation of actors and stakeholders at each needed level of analysis, study and planning phases.

The results of the VisuLands project show the potential for techniques and visualisation tools for public participation in decision making to improve the quality of planning for land-use change. The responses of professional and public stakeholders across the partner countries and case study areas suggest that the recognition of the European Landscape Convention (2000) of a public wishing to *"… play an active part in the development of landscapes"* is borne out. As with the work in the Amazon area, the decision-making process relies upon human and technical factors. Human factors include: the attitude towards participatory decision making of those who design and facilitate the planning process; adequate resourcing of the process to meet participatory objectives; and the perception of the role of visualization tools as a participatory tool. Technical factors include: the incorporation of necessary technological features in visualization tools for the particular stage, and context, of its use in the planning process; and the inclusion of appropriate levels of information content (including data on non-visual information) in visualisation tools to communicate information to those involved in the process.

Technological advances in landscape visualization offer approaches to representing landscapes of the past, present or future. However, they do not necessarily inform as to the information required for interpretation of the consequences of environmental change, nor how it should be tailored to different types of audiences. In addition, given the diversity of tools available, there are no transparent assessments of their effectiveness. This offers a challenge to further improvement of tools so that they are relevant, accessible and offer meaningful information for aiding decision making or an understanding of the consequences of environmental change (Fig. 16.9).

Areas of further research include the adaptation of interactive tools to enable different options for users to switch between scenarios, including changing the period of time over which the landscape changes may take place. Due of the range of requirements for linking technology, methodology and design of imagery, the research will gain from interdisciplinary co-operation between landscape-related

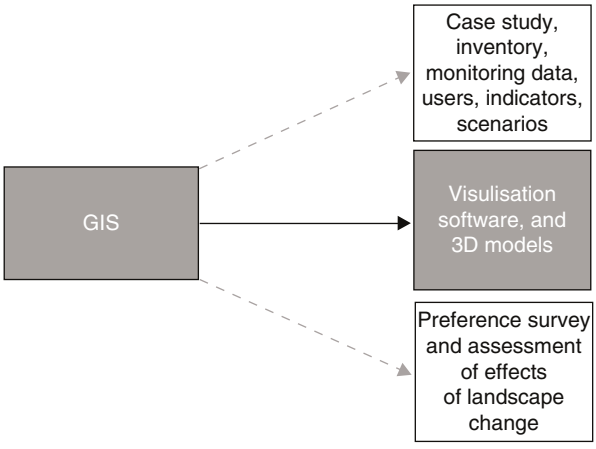

Fig. 16.9 Categorisation of participatory methods and techniques

sciences, with disciplines drawn from computer visualization, planning, design, social sciences as well as prospective end-users or their disciplines.

Widening the understanding of processes of change in landscapes amongst different stake holding groups should form the basis of planning their future (Council of Europe 2003; European Union 2001). The evolution of such processes is subject to largely social considerations at each of the levels identified in Table 16.1, but the acceptability and effectiveness may be greater in one area compared with another.

A categorization of participatory methods is shown in Fig. 16.10, in which the representation has been adapted from the concepts proposed by van Asselt *et al.* (2001) and Ball (2002), with a focus on divergence mapped on one axis and aspirations of participation on the other. For example, the top-left quadrant equates diversity and democratisation and contains methods developed, and processes initiated, by stakeholders. This represents initial, informative and exploratory stages in the decision-making process reflecting the plurality and diversity of values in society, and can reflect spontaneous civic movements which emerge to address special concerns.

The search for methods and tools for decision support in land planning and environmental policy areas has spurred scientists in Europe, and other parts of the world, into working in an interdisciplinary manner with concepts arising from areas of environmental assessments to improve public policy (e.g. Brondizio 2005; Mansvelt 1997; Munier *et al.* 2004; Potschin and Haines-Young 2003). Whether

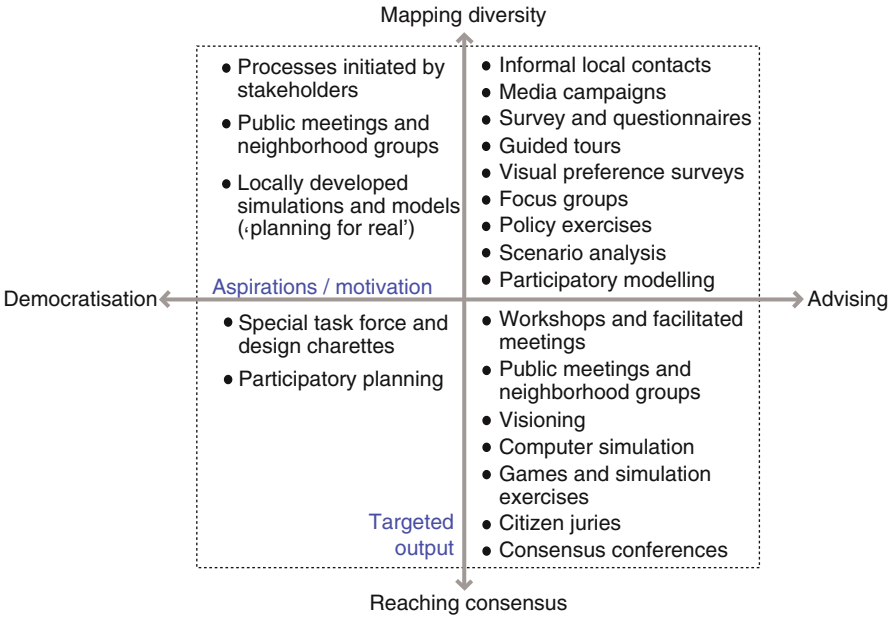

Fig. 16.10 Geographic information systems (GIS) provide inputs to different types of tools used in the assessment of landscape changes

the aim is awareness raising and information dissemination, or facilitating citizen actions, a framework which involves wider stakeholder participation requires to be adequately supported, not only in relation to the provision of information but also with the quality of awareness-raising. The impact of such participation may equate not to the level but rather the quality of involvement. This aspect of Arnstein's ladder of participation, and the related discussion by Sheppard (2005), will require greater consideration, as the risk of failing to deliver on expectations raised amongst participants could be the greatest challenge to the aims of public policy.

In the examples presented, stakeholder and public perspectives of landscape and land-use change have been combined with participatory techniques to enable stakeholder values, objectives and preferences to be incorporated into an analysis of options for future land uses. The process of research, scientific networking and communications with end users has led to identification of design features, and criteria for the development and use of techniques, methods and tools. However, more research is required on the how, and to what extent, stakeholder involvement affected decision making. Among the issues which arise are how stakeholder perspectives are best incorporated into new policies and programs that affect land-use and landscape change, and whether the increased social capital created through participation in research and consultation translates into more effective implementation of policies.

The approaches have built on research and participatory methodologies widely tested in the social sciences, and introduced new approaches that make use of advanced technologies. Further research should address the effectiveness and impact of technological applications in fostering stakeholder participation. The geographic, cultural, institutional or demographic context might impair the application of certain approaches, or distract from the content and the objectives of the participation. So, a question remains as to how the methodologies used affect the opportunity and ability of the stakeholder to freely and effectively contribute to the planning process?

The regions presented in this chapter have their own regulatory frameworks and cultural considerations which govern or influence the level of, and opportunities for, participation in land management and planning. In each, there is a pressure towards more participatory, interdisciplinary and holistic approaches for landscape planning and management to link sustainable development goals with local level priorities and practices. However, the effectiveness of the participation will depend upon the legal framework, socio-economic characteristics and geography of an area. Although the case studies discussed have operated at different scales and in different forms, the integration of technical, analytical and participatory techniques for planning the sustainable use of land resources and landscapes appeared to be of importance in both.

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