

Assessing participatory GIS for community-based natural resource management: claiming community forests in Cameroon

MICHAEL K McCALL AND PETER A MINANG

*International Institute for GeoInformation Science and Earth Observation (ITC), PO Box 6,
7500 AA Enschede, The Netherlands*

E-mail: mccall@itc.nl; minang@itc.nl

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This paper critically reviews and analyses participatory GIS (PGIS) and participatory mapping applications within participatory spatial planning for community-based natural resource management in developing countries. There is an often implicit assumption that PGIS use is effective, in that it meets content needs, satisfies underlying local stakeholder interests and therefore is a tool for better governance. The analytical framework looks at participatory spatial planning performance with respect to key dimensions of governance, especially the intensity of community participation and empowerment, equity within communities and between 'governed' and 'governing', respect for indigenous knowledge, rights, ownership, legitimacy, and effectiveness. Specific development focus is given by a case study using participatory mapping and PGIS in community forest legitimization, planning and management in Tinto, Cameroon. 'Good governance' criteria are applied ex-post to the implementation procedures, the geo-information outputs, and the longer-term outcomes of the PGIS processes. Impacts of incorporating PGIS were examined in terms of the types and degrees of participation in the process; access to, and the uses made of, the geographic information; whether the information outputs met stakeholders' requirements; and the overall changes in equity and empowerment in the community. It was found that PGIS/participatory mapping processes contributed – positively, though not comprehensively – to good governance, by improving dialogue, redistributing resource access and control rights – though not always equitably – legitimizing and using local knowledge, exposing local stakeholders to geospatial analysis, and creating some actor empowerment through training. PGIS promoted empowerment by supporting community members' participation in decision-making and actions, and by enabling land use planning decisions beyond community forestry itself.

KEY WORDS: Cameroon, participatory GIS, good governance, community forest management, participatory spatial planning

Introduction

This study addresses participatory-GIS (PGIS) and participatory mapping in participatory spatial planning applications for community-based natural resource management. It queries the implicit assumption that the participatory application of GIS at the local level is effective, simultaneously meeting the content needs and satisfying the

underlying interests of stakeholders, and thus is a tool for better governance. We use 'good governance' dimensions (Figure 1) in an ex-post evaluation of the process of applying PGIS in the planning and authentication of a Community Forest Management (CFM) project.

In the first section we critically review PGIS applications in local level Natural Resource Management (NRM) in developing countries in

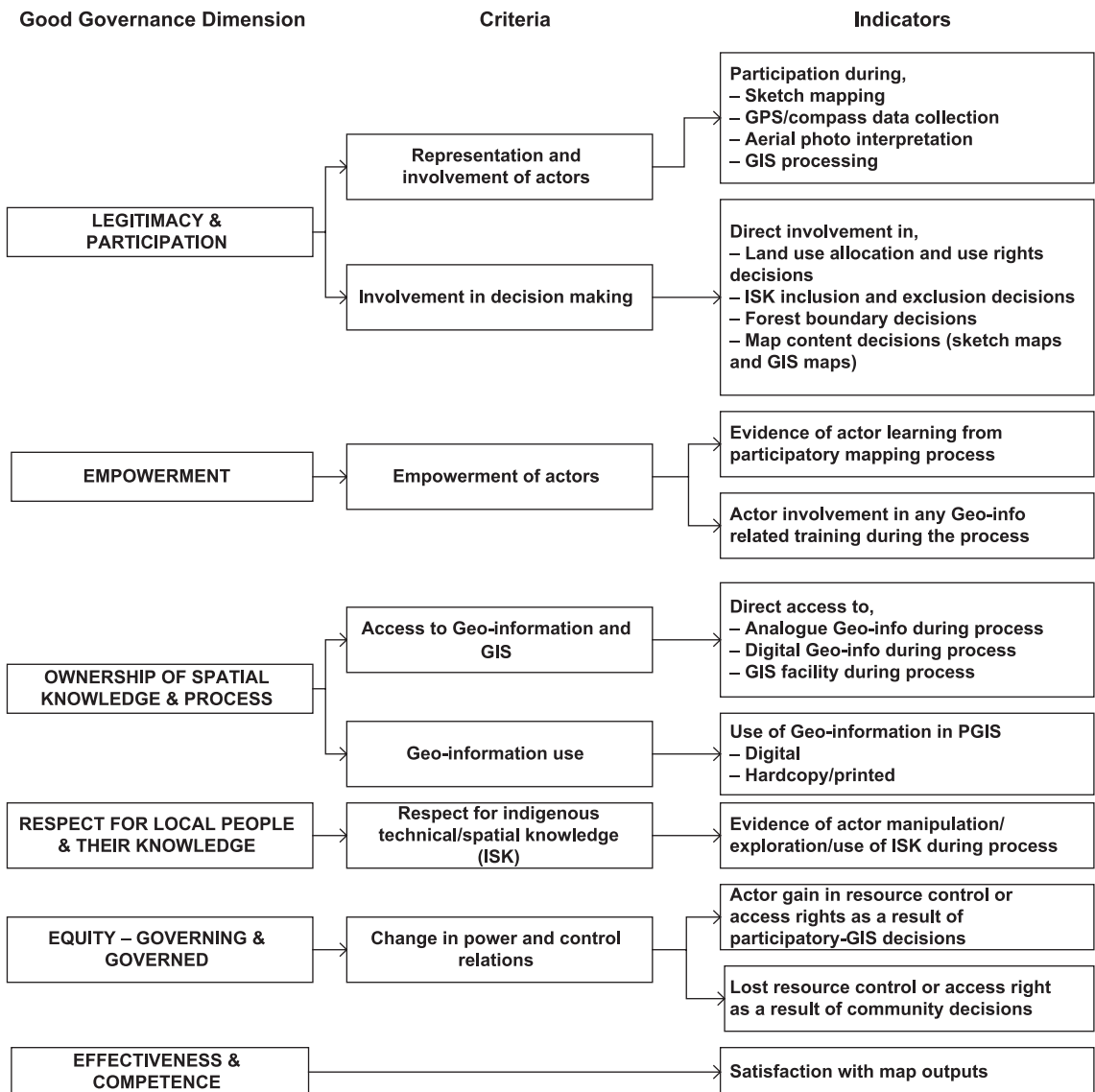


Figure 1 Good governance criteria and indicators used in this study

terms of participation and good governance. The following section assesses the application of PGIS over a period of years in a community forest management project in Tinto, Cameroon, by employing key dimensions of good governance. The third section concludes by discussing salient issues in empowerment impacts and functional effectiveness in PGIS processes that should contribute to well-governed resource management.

Participatory spatial planning and good governance: principles and practices

PGIS and participatory mapping have two decades of applications in participatory spatial planning, whether manifested as rural-located ‘community-based natural resources’ (for examples, see Poole 1995; McCall 2004), or as ‘participatory neighbourhood planning’ in urban settings (for examples, see Craig *et al.* 2002; McCall 2003):

- 'Claiming land' – legal recognition of customary land and resource rights, or demarcating neighbourhood boundaries.
- Management of customary land and resources, usually under 'traditional' management systems.
- Managing competition and ameliorating conflicts.
- Mapping social and environmental inequalities.
- 'Building community', strengthening community awareness and cultural identity.

Participation is a key element among the criteria of 'good governance' for effective participatory spatial planning. Governance is a set of measures of the relationships between the 'governed' (civil society and the public) and the 'governing' (the government, its institutions, and private sector interests). The pertinent power relationships are those involving policy setting, decision-making, planning and implementation. Core concepts for understanding governance are accountability – closely related to legitimacy, and effectiveness, and within these concepts are categories such as lawfulness and subsidiarity and inclusion (or participation). But, 'good' governance is hard to define unambiguously, since it introduces relativist political and ethical categories and priorities – the prescriptive contextual questions are as follows. Accountability for what types of actions? Legitimacy for what ends? Effective for whose purposes? (See discussions in, for example, Aubut (2004), Goetz and Gaventa (2001), van Kersbergen and van Waarden (2001), OECD (2001) and UNDP (1997).)

The analysis in this paper is based on a set of characteristics and dimensions of good governance which incorporate prescriptive objectives and initiatives to strengthen civil society in order to make the governing more accountable, more transparent (open policy-setting and decisions), responsive, and effective. Thus we follow the more progressive goal-directed interpretations of good governance of the OECD (2001) and UNDP (1997). Accountability, legitimacy and effectiveness, therefore, are interpreted as the means towards political-ethical higher values of strengthening legitimacy of the governing, empowering the governed especially the marginalized, creating respect for rights, ensuring ownership (of geo-information), emphasizing equity, and reinforcing competence in dealing with geo-information.

Legitimacy and participation

Legitimacy demands interactive participation throughout the spatial planning processes, by all stakeholders, in all stages from problem prioritization, data collection, spatial analysis, through to decision-making. 'All stakeholders' here implies the

commercial sector and government agencies, as well as civil society, community representatives, traditional leaders and NGOs. 'Homogeneous' communities cannot be presumed when there are significant ethnic, economic class, socio-cultural, and gender divisions. Essential questions about legitimacy are: 'Who controls the types, analysis, and uses of data and knowledge?' 'Who handles the spatial data and information?' 'Is there open access to the spatial planning instruments?' 'Who uses, and, who has access to, the outputs?' 'Who is actively participating?'

Participation in PGIS can be characterized both into types and intensities (cf. participation ladders of, for example, Arnstein 1969; McCall 1988 2003; Catley 1999; Ingles *et al.* 1999; Carver 2003), from lowest to highest.

- Manipulative and passive participation involving information flows between local people and 'outsiders', regarding primarily technical information, such as resource assessment, e.g. participatory mapping in many rapid rural appraisal exercises.
- Consultation or functional participation – outsiders refer selected, focused issues to local stakeholders, and interpret their responses into 'scientific' frameworks, such as maps of 'needs'.
- Interactive involvement in decision-making by all actors in most stages – 'participation seen as a right, not just as the means to achieve outsiders' project goals'.
- Initiating actions – independent initiatives from, and 'owned' by, local people; or self-mobilization. This is a strong indicator of empowerment.

Empowerment

The four intensities of participation can be seen as related to underlying intentions of whatever agencies are 'pushing' participatory spatial planning – or PGIS or participatory mapping – as a strategy. At one extreme is 'facilitation', when participation is promoted to introduce and lubricate outside programmes, whilst the other extreme is 'empowerment', where participation is intended to prioritize local decision-making and reinforce responsibilities. Coming in between is 'mediation' or 'collaboration', where the intention is for the participatory approach to trade-off the interests and priorities of outside projects and local people. An 'empowerment functionality' of PGIS approaches should give voice to local people by putting them and their indigenous technical and spatial knowledge on an equal footing with the external experts.

There are many examples of 'empowerment' PGIS used to '*claim our land*', that is, the demand

for legal recognition of customary land and resource rights (cf. Poole 1995; McCall 2004). For instance; in Guyana, Amerindian peoples claimed ancestral land titles (Griffiths 2002); the Zuni pueblo of New Mexico prepared digital maps of 'non-graphic descriptions' of their appropriated lands to receive a quarter of a million acres as compensation (Marozas 1991); in the Philippines, claiming Ancestral Domain Title is conditional on preparing a resource management map for the area (Rambaldi and Callosa-Tarr 2002); and in Indonesia, participatory mapping and PGIS identify traditional village territories and competing rights claims (Eghenter 2000; Sirait *et al.* 1994).

Respect for local peoples and their local and indigenous knowledge

Indigenous knowledge is a measure of local community capability, with the potential to set community members on an equal status with outsider 'experts', and maybe the only resource of which local groups, especially the 'resource-poor', have unhindered ownership. Indigenous knowledge and scientific knowledge frequently have similar cognitive structures, although the referents and units may be difficult to translate – as with, for instance, much indigenous technical knowledge (ITK) of pest management, soil and water conservation, ethnopedology, ethno-veterinary knowledge and ethno-medicine. Indigenous technical knowledge is normally more reliable, and maybe also more accurate, because it embodies generations of practical essential knowledge, and it operates in interactive, holistic systems.

Many examples of PGIS – applied to ethnopedology – can be found; for instance, comparison of farmers' and scientific soil classifications in the Senegal River valley (Tabor and Hutchinson 1994), a 'folk expert system' for classifying soils in the Colca Valley, Peru (Furbee 1989), and an extensive review by Barrera-Bassols and Zinck (2000). Another common natural resource management field using PGIS to map indigenous technical knowledge is pastoral management, e.g. remotely sensed images interpreted with Bedu shepherds in Jordan (Patrick 2002); and mapping indigenous knowledge of grazing lands in Burkina Faso (Sedogo 2002).

Beyond indigenous technical knowledge, there is indigenous knowledge that is apparently qualitatively different from scientific knowledge. This indigenous knowledge is symbolic, metaphoric, and visionary – mystical in 'scientific' terms – and commonly related to the land and land features. This deep knowledge, with its obligations of stewardship of the land, together with the

specialized, location- and resource-specific, problem-oriented indigenous technical knowledge, provide a basis for local people's participation in resource management.

Respect for indigenous spatial knowledge and people's cognition of land

Indigenous or local spatial knowledge is specific and ongoing knowledge about the land and land resources, and local people's management of them. It is usually problem and solution oriented, it sets people in their environmental context by describing activity spaces and responsibility spaces, and uses an understood natural language. Often enough there are functional connections between indigenous spatial knowledge and 'scientific' explanations, as in customary restrictions on using 'sacred land' which is also a traditionally protected forest or grazing reserve.

Land and place, however, have visceral cultural values, on a higher plane than simple economic categories of 'high value', 'marginal', or 'wastelands'. The sense of place associated by people in perceptual or mental maps is a quality, fuzzy, metaphorical, emotional and holistic, not reductionist place. For example, Maori land embodies *tapu* (respect for resources), *mana* (authority), and *mauri* (life force) (Harmsworth 1997), and Australian Aboriginal sacred sites signify '... stability, a spatial and temporal anchorage in specific place names and the ancestors bound within' (Brazenor 2000).

It is arguable that GIS and indigenous spatial knowledge may be inherently incompatible because of a dichotomy between the reductionism and ultra-precision of digitized geo-data, and the fuzziness, ambiguity, and synthesicity of 'natural language' spatial knowledge. Rundstrom (1995) expressed extreme scepticism that GIS can work with indigenous cognitive, spatial concepts and communication – 'representation is *re-presentation*', when outsiders elicit and present indigenous knowledge in a map, they effectively alter and control it. However, the widespread and productive applications of PGIS utilizing indigenous technical knowledge by indigenous peoples in North America, Australasia, and Southeast Asia, provide a counter argument. Participatory spatial planning using PGIS tools should guarantee some respect for people's rights by their abilities to elicit and handle local conceptualizations of space and spatial values. It should not only capture and translate 'mental maps' of boundaries, locations, and zones into geo-referenced mapable outputs, but also build geo-information into the local knowledge process.

Ownership of spatial knowledge and process

A strong position on ownership, and therefore on limiting access to spatial cultural knowledge (of locations, uses, even stories), is taken by Harmsworth (1997) with regard to Maori peoples, with similar initiatives in Australia and North America. There are moves towards a 'communal right of privacy', that is, for customary leaders to take responsibility for data protection and control over GIS data layers such as sacred sites. Such protectionism could also be interpreted as maintaining the privilege of elite, and usually male, elders. Amongst First Nations, examples of spatial data layers to be restricted, with increasing resolution, are as follows.

- Traditional hunting, fishing, grazing and fuel collection lands, tool sources, waterholes.
- Boundaries of culture and ethnic areas, and indigenous place names.
- Customary delineations within the cultural boundary, by clan, household, male and female areas.
- Historic places, battlegrounds and old settlements.
- Sacred sites, burial grounds, ceremonial areas, buried art and sites of creation myths.

'Who chooses the items depicted on the map and decoded in the map legend?' (Rambaldi 2004). There are crucial questions of *who* in the community provides the legend items? Empowerment can be promoted by transferring ownership from the conventionally powerful to the disadvantaged by the use of *counter maps* that challenge the (spatial) views of the powerful (e.g. Peluso 1995; McConchie and McKinnon 2002). Getting 'onto the map' is often the first step for marginalized groups to gain public acknowledgement.

Equity within the 'governed', and between 'governing' and 'governed'

Participatory mapping and PGIS, as well as conventional mapping of spatial indicators, are utilized in environmental justice and equity analyses of the spatial distribution of environmental impacts (e.g. Clary-Meuser website). PGIS methods, however, do not necessarily contribute to equity goals by supporting disadvantaged groups, whether in access to services and markets, or by protecting their property rights and entitlements. GIS tools do not easily handle knowledge about *power* relations (cf. Abbott *et al.* 1998). Having the information is not the same as having the power, the resources, the legal back-up and political clout to implement change. Moreover, it is the elites who obtain the powers, and who are likely also to monopolize the GIS outputs.

Gendered space contains the socio-cultural spatial and time restrictions on women visiting and using places (see, e.g., Mehta's (1996) study of seclusion and female 'discomfort' in male public spaces in Himalayan India). Indigenous spatial knowledge includes gendered knowledge of resource distributions, the differential access and ownership of resources, and overlapping cultural-economic landscapes associated with men and women. Rural women have specific indigenous technical knowledge of livelihoods concerning foods, medicinal herbs, fibres, and fuels. When these are denigrated as simply women's materials for women's work, they remain often 'invisible' in local (men's) accounts, government statistics, and in maps. Management of women's working spaces remains equally invisible, even though participatory mapping with women (and some PGIS) is well developed (for example, mapping of tree and resource tenure in Zimbabwe or Dominican Republic; Fortmann 1996; Rocheleau *et al.* 1996). 'Countermaps' of resource use and management constructed by rural women can be used to re-label 'standard' land use maps (Peluso 1995).

Effectiveness and competence: dealing with imperfect data and spatial (im)precision

Participatory spatial planning, in its various manifestations, demonstrates the common 'imperfect data' characteristics of 'naïve geography' (Egenhofer and Mark 1995):

- fuzzy and layered zones and zonal information (area data);
- simultaneity of views and 'jumping scale' – people's consciousness and cognition operate at several spatial scales simultaneously;
- fuzzy, blurred, flexible and multiple boundaries (line data);
- perceived distances which are asymmetric and/or nonlinear;
- ambivalent, hidden or restricted spatial locations (point data);
- dynamics – the flows of resources, information, ideas, influence, power;
- use of empirically graspable, but indistinct spatial terms like 'near', 'far', 'isolated', 'crowded', 'central', 'peripheral';
- soundscapes and smellscape.

(cf. Aitken 2002; Porteous 1990; Rundstrom 1995; Scott and Cutter 1996; Weiner *et al.* 2002).

A few GIS tools, such as IDRISI, recognize and handle 'imperfect data' in their ambiguity, non-exclusivity, fuzziness, incompleteness, and imprecision. However, few GIS users sufficiently understand and have the skills to represent such

imprecise data within the confines of standard GIS tools such as ArcView/ArcGIS. Concomitantly, GIS flashiness can create a false precision and legitimization of what is actually 'Garbage In Garbage Out' (Abbott *et al.* 1998). Hall (1996) takes the arguments further with her identification of GIS as a 'masculinist technology', being materialist and positivist, handling only bounded, pre-set units of analysis, and avoiding ambiguous or emotional concepts.

GIS approaches, especially those built on remote sensing data, may place misleading emphasis on spatial precision. Most participatory spatial planning activities do not need a high degree of spatial exactitude, being concerned with ambiguous, non-exclusive values and categories about communities or zones, as relatively large spatial entities without precise boundaries. The important questions are: 'what degrees of accuracy/precision are needed in PGIS?', and, 'what are the costs of working with lower levels of accuracy/precision?'

There are significant current developments in geo-information software and hardware that will better accommodate the 'imperfect and fuzzy spaces' of indigenous spatial knowledge, such as with mobile GIS, innovative visualization software, dynamic web cartography and interactive web GIS, GIS wall boards, participatory 3D modelling, multimedia and virtual reality displays.

Effectiveness: technical manageability of PGIS at the local level by local people

Technical manageability of GIS and PGIS by local groups has a number of requirements, notably the following.

- Feasibility, which can be interpreted as the adaptability of geographic information technology hardware – such as Global Positioning System and mobile GIS – to local physical and climatic conditions, e.g. solar charging, cockroach and termite damage, and the maintenance support needed.
- Local cultural and social conditions referring to information interchange, multi-application capacities, simplicity to learn and use, and literacy, numeracy and computer literacy requirements.
- Operational inclusiveness – PGIS should be a community enterprise, not just using 'key informants' who are likely to be educated, adult, and senior males.
- Maintaining the currency of data – updating information is costly, time-consuming, and liable to be overlooked.
- Cost-effectiveness in local terms, meaning looking at the full implications of the costs of 'voluntary' time investments and comparative returns.

Participatory mapping and PGIS in community forestry in Cameroon: a case study

After reviewing the good governance dimensions of PGIS used in community level participatory spatial planning applications, this section assesses a recent PGIS experience from Tinto Community Forest in Cameroon, using good governance criteria and indicators. The research critically looks at the PGIS process, seeking to answer the questions of whether or not, and how, PGIS experiences in Tinto have promoted good governance. The policy provisions for Community Forest planning in Cameroon are first introduced.

Community forestry policy and geo-information

The Cameroon Government's forestry management reforms resulted in a 1994 environmental law that introduced *inter alia* the concept of community forest. Community forest is defined therein as 'that part of non-permanent forest estate (not more than 5000 ha.) that is the object of an agreement between government and a community in which communities undertake sustainable forest management for a period of 25 years, renewable'. The aims of the introduction of community forests were to enhance local governance through community participation, to integrate indigenous forest management practices, to provide direct economic benefits to communities, and to improve forest/biodiversity conservation.

The procedures of the Cameroon Ministry of Environment and Forestry (MINEF) prescribe the following geo-information needed for granting a community forest:

- a map showing the boundaries of the intended community forest (community forest boundary map);
- a clear description of activities previously carried out in the proposed community forest area;
- an inventory report of community forest resources;
- a final management plan, zoning the forest into compartments.

In the last few years the community forestry constituency has been growing. By October 2002, the Ministry had received 190 applications for community forests (Brown *et al.* 2003). International donor and NGO interest has also grown since the promulgation of the community forestry law. Many communities, with NGO support, have been able to incorporate the use of GIS and geographic information technology to fulfil the geo-information requirements. These experiences qualify as a form of PGIS, given both the use of participatory rural appraisal and participation

methods, and the involvement of people in standard GIS tools.

The Tinto community

Tinto, in the South West Province of Cameroon, is well drained, between 160 and 280 m in altitude, with a rainfall of about 2000 mm/year and is located within the evergreen forest areas of Cameroon known for endemism. The community of 1700–2000 consists of three neighbouring villages of the same clan, very homogenous with fewer than 1% 'outsiders', typically rural, but it is an administrative (District) headquarters with a Forestry Office. Most farmers grow cocoa or coffee as cash crops, along with cassava, maize and other subsistence crops. Forest activities include hunting, collecting non-timber forest products and timber.

The three village chiefs and councils are represented on the Tinto Clan Council whose decision-making is based on customary laws. The Clan Council oversees local resource management policy, especially farming rights given to clear forest, and the administration of sacred groves. Some local controls are enforced, such as to reduce poisons in fishing. Part of the forest within the clan boundaries lies in the Banyang Mbo Sanctuary, wherein the Council works with Ministry of Environment and Forests projects to regulate forest activities. Tinto began the community forest planning process, with Ministry staff and an NGO (Living Earth Foundation), in November 1999. Actual community management of a 1300 ha community forest started in December 2002.

Actors The current distribution of roles and functions and diverse interests of the multiple actors in the Tinto context is important for understanding forest governance. The Tinto Clan Community Forest Management Committee represents and organizes the community in community forest activities, while the Chiefs and Clan Council remain the custodians of the forest with all the customary powers to authorize and monitor resource access. The local Ministry staff are supposed to assist communities technically in community forest management, as well as to oversee the management plan implementation, but they are often inadequately staffed and lack resources. Hunters are very important in sharing their knowledge with the community in the planning process, and, as such, are key players in the demarcation process, mapping and inventories. They, however, need to be assured of access rights within the community forest. Farmers are particularly concerned with rights of access to forestland in the process. Women as a group, like farmers,

participate in many community forest planning activities and are particularly concerned with access rights to non-timber forest activities. Living Earth Foundation (the NGO) facilitated the planning process, providing access to finance, technical knowledge, geo-information technology, lobby and facilitation skills and links with partners outside the community. Other stakeholders playing roles in conflict resolution and political support to the process include Tinto Rural Council and the elite of Tinto living in other parts of the country.

The PGIS process in Tinto

The PGIS process in Tinto can be divided into four main phases: the preparatory stage; land use mapping and planning; community forest boundary mapping; and the community forest management plan mapping phase. The preparatory phase was aimed mainly at the Ministry's Forest Plan at national, regional and local levels to see if forests in the area were eligible for community forestry, based on the provisions of the 1994 forestry law. In order to designate part of the local forest area as a potential community forest, the community must proceed through a sort of land use mapping and planning process as in phase two. The designated area was then demarcated and the boundaries mapped in the third phase. The last phase constituted planning and mapping the forest into forest management zones. A summary of the phases is presented in Table 1; Figures 2 and 3 can also be interpreted as a work flowchart. The process can be characterized as 'learning by doing' over a four-year period. It should, therefore, not be interpreted as uni-linear; the tabular rendition is a simplification for presentation purposes, because in reality there was a good deal of iteration.

Research methods in the case study

The field research (Minang 2003) was designed to assess the extent to which PGIS promoted good governance by supporting community participation in decision-making and actions within the community forest process, and possible extensions into land use planning decisions. The first step in the research was to select and describe a number of indicators to represent 'good governance' dimensions, based on the principles in the first section, and on governance literature (UNDP 1997; OECD 2001; van Kersbergen and van Waarden 2001; McCall 2003). The dimensions and indicators were selected to be relevant, reliable and valid in describing and assessing complex PGIS processes. Figure 1 shows the seven initial good governance dimensions and criteria, and the

Table 1 PGIS process in Tinto

	Phases			
	I. Preparatory phase	II. Land use mapping	III. Community forest boundary mapping	IV. Management plan mapping
Activities involved	Stakeholder analysis; PRA; baseline survey; manual overlay; transparencies	Sketch mapping; transects; mapping the forest; specifications from community	Boundary agreement demarcated on ground by villagers (by men); GPS (by villagers); GIS (by consultant)	Participatory forest inventory; desk cartography (consultant + villagers); agreement on zones
Actors	Chiefs; NGO; Ministry	NGO; Ministry; chiefs; hunters; village women; family and quarter reps	14 hunters; NGO; Ministry; GIS consultant	23 villagers; inventory team; NGO; Ministry; consultants
GIT tools	Topo sheets; transparency overlays	Topographic sheets	GPS; air photo interpretation; GIS mapping (ArcView)	GPS and compass for inventory; topo sheets; desk cartography
Outputs	Village study report	Village sketch map; social map of village; forest use map	Forest boundary map; (GIS) shows land use zones; transects; P-map of current uses	Map of management zones
Tools of participation	PRA tools	Participatory mapping; forest use survey	Participatory mapping for forest description	Participatory inventory
Degree of participation	Consultation	Decision-making; empowerment	Mediation; empowerment	Decision-making for zoning; some empowerment

corresponding indicators selected and used in this study.

The second step in the analysis consisted of critically reviewing project documentation to assess the project design and implementation. (One of the authors had previously worked on the project for about three years.) The third step involved the application of participatory-rapid rural appraisal techniques, such as focus group discussions, semi-structured interviews, diagramming and meetings. The choice of method was guided by the mainly discursive nature of the data required in the analysis, and the fact that these tools are flexible and put fewer restrictions on expression than pre-structured tools (Nyerges *et al.* 2002), thereby allowing 'looking for and learning from exceptions, oddities and dissenters' (Chambers 1994). Four 3–4 h meetings were held in the Tinto area and 18 interviews were held with key informants. These informants were specifically chosen in order to include actors who had participated in the process, some who had not participated, and representatives from amongst various stakeholders. Project staff were deliberately left out of the meetings to avoid biased responses. All formal meetings and interviews

were recorded, and transcripts made, with the transcripts later read back to the interviewees and discussion group members for validation. All discussions, formal or informal, were based on the same checklists using the indicators in Figure 1. This ensured rigour and validity in the process through triangulation both of sources and in the methods. A rigorous content analysis was employed to analyse the transcripts from the 18 semi-structured interviews, three focus group discussions and diagramming session notes made by the researcher in order to elicit the answers for various indicators. Because most of the data are based on people's perceptions, we have been careful to make conclusions only on data from multiple sources.

Findings on the selected good governance dimensions

Participation (legitimacy) Participation in sketch mapping and using GPS was widespread, whereas the actors involved in the aerial photo interpretation and GIS tools were restricted to mainly the outsiders, although hunters were included (see

Table 2 Participation (legitimacy)

Involvement of actors	Activities	Tinto						
		Committee	Chiefs	Farmers	Hunters	Women	MINEF	NGO
Involvement of actors in mapping processes	Sketch mapping	Y	Y	Y	Y	Y	N	Y
	GPS	Y	N	Y	Y	P	Y	Y
	Aerial photo interpretation	Y	N	N	Y	N	N	Y
Involvement in decision-making in:	GIS processing	N	N	N	N	N	N	P
	Land use allocation and land use rights decisions	Y	Y	Y	Y	Y	Y	N
	Forest boundary decisions	Y	Y	Y	Y	P	P	P
	Indigenous spatial knowledge inclusion / exclusion decisions	N	Y	N	Y	N	N	N
	Map content decisions:							
	(a) Sketch maps	Y	Y	Y	Y	Y	N	P
	(b) GIS outputs	N	N	N	N	N	Y	Y
Final map representation decisions	N	N	N	N	N	Y	Y	

Key: Y = significantly involved, N = not involved, P = partial involvement.

Respect for indigenous knowledge and indigenous spatial knowledge Some actors were empowered through the external recognition and use of their local knowledge in the map outputs. There was evidence of the community protecting spatial information about sensitive (sacred) sites. After consultation with the elders, the team of 14 appointed to carry out the initial forest boundary demarcation decided that the sacred part of the forest, in which the king tree (or 'king stick' as it is called locally) is found, should be excised out of the community forest. The participatory sketch maps showed more indigenous spatial knowledge than did subsequent GIS products, including village boundaries, forest farm areas, forest tracks and local names for villages and streams. However, females were not included in the mapping in the forest (Table 2), which results in missing out considerable women's indigenous technical knowledge of forest products' locations and use.

Ownership (legitimacy) Access to standard geo-information, mainly maps, was relatively easy for the community through the Community Forest Officer, but digital geo-information facilities and information access were difficult or impossible, except for the Ministry of Environment and Forests and the NGO (see Tables 3 and 5).

Uses of geo-information The uses of geo-information are categorized as follows: for administrative and management purposes; for strategic planning; for tactical interventions; and for generally organizing and promoting participation (see Figure 3, adapted

from the geo-information use framework of Craig and Elwood 1998). Geo-information produced in the Tinto community forest PGIS process was applied for all purposes: for strategic planning and assessing resources; in community organization, especially for facilitating meetings; in tactical operations, as geo-information was significant in highlighting specific resource locations; and it was in general use for administration.

There was, however, little community use of digital geo-information. The Tinto community used many paper maps for land use planning, in the community forest application process, in conflict resolution, and for choosing representatives.

Equity: inclusiveness, and gender In the PGIS process and decision-making, some actors lost previously held resource access rights or control powers, whilst others gained, which thus changed the social power equations (see Table 4). However, it cannot be ruled out that some power shifts were the result of extraneous globalization factors. Moreover, the PGIS processes provided a platform for innovative meetings between stakeholders, and helped build relationships and institutions. New structures emerged with responsibility for forest management, which gave disadvantaged groups, including women, a louder voice in decision-making. Records and attendance sheets analysis for Tinto show that women were involved in the village meetings (although less than a quarter of participants), but only two women were present for activities in the forest.

Table 3 Legitimacy, ownership and empowerment

Legitimacy–ownership							
'Ownership' of geo-information	Types of geo-information	Tinto CFMC	Chiefs	Farmers	Hunters	Women	MINEF
Access to geo-information and to GIS	Analogue geo-information	Y	Y	P	P	P	Y
	Digital geo-information	N	N	N	N	N	P
Use of geo-information	GIS facilities	N	N	N	N	N	P
	Hard copies	Y	Y	Y	Y	Y	Y
	Digital geo-information	N	N	N	N	N	N
Empowerment of actors							
Actors empowered by:	Manipulation or use of indigenous spatial knowledge	Y	Y	Y	Y	Y	N
	Learning from process	Y	Y	Y	Y	Y	Y
	Involvement in geo-information training (mainly GPS)	Y	N	Y	Y	Y	Y

Key: Y = significantly positive, N = negative, P = partial access.

Table 4 Equity changes in resource control and access

		Tinto Committee	Chiefs	Farmers	Hunters	Women	MINEF	NGO
Shifts in power relations (after community forest designation)	Changes in resource control powers	Gained control powers	Gained control powers	No change	No change	No change	Lost control powers	N/A
	Changes in resource access rights	No change	No change	No change	Lost access rights	Lost access rights	No change	N/A

Effectiveness and competence: delivery of map products An assessment was made of actors' satisfaction with the maps delivered during the PGIS process. Table 5 shows the degree to which the main actors were satisfied that the three map products – the sketch maps, the community forest boundary map, and the final management plan – met their specific interests and needs. Their interests were elicited from policy documents and through interviews.

Emerging issues for 'good governance' enhancement through PGIS

Analysis of the findings reveals significant governance issues relating to planning PGIS processes,

and to the interactions along various PGIS interfaces applied to community-based natural resource management.

Geographic information technology/GIS issues

When participatory mapping and PGIS interventions are aimed at mediation and empowerment purposes, the outcome from combining insider and outsider knowledge of the problems and potential solutions should be expected to lead to greater competence, fewer wasted efforts and increased efficiency. The results in this case demonstrated reasonably good achievements along these lines, but also revealed a number of problematic issues.

Table 5 Meeting the geo-information needs

Three main actors	Geo-information needs	Satisfaction of needs by geoinformation outputs
MINEF's geo-information	External and internal boundaries of community forest	Final Management Plan (FMP) map ✓✓ Boundary map ✓
Requirements	1:50 000 or 1:200 000 Major natural features	Boundary map ✓✓ Boundary map ✓✓ FMP map ✓
	Socio-economical features: e.g. protected forests, settlements	Boundary map ✓✓ FMP map ✓
	Compartment (zone) descriptions	FMP map ✓✓
	Location of plant/animal species	None
Tinto community's mapping needs	Community forest and farm zone boundaries ∅	Boundary map ✓ Sketch map ✓
	Area under indigenous control	Boundary map ✓✓ Sketch map ✓✓
	Potential landmark areas: ∅, e.g. tourist sites and eco-trails	None
	Area reserved for farm extension ∅	Boundary map ✓
	Foot-paths ∅	Boundary map ✓
	Monitoring information on: farm expansion, exploited areas	Boundary map ✓ Sketch map ✓
NGO (Living Earth) needs map of:	Conservation area	Boundary map ✓✓ FMP map ✓✓

Key: ✓✓ = largely meets the need, ✓ = partially meets the need, ∅ = geo-information particularly requested by the community.

Overall, the maps and GIS products satisfied between a half and two-thirds of the actors' goals regarding geo-information.

Firstly, the scales of the maps in the process – input maps of 1:50 000 and aerial photos of 1:20 000, and output maps of 1:50 000 and 1:200 000 – were not appropriate for discussions and knowledge exchange between community stakeholders working in large groups. Scales of between 1:12 500 and 1:1000 are found to be more appropriate for participatory local planning (Eagles 1984; Groten 1997), whereas the scales of these maps are more suited to regional or national planning levels. Moreover, a strength of PGIS in such processes should be the production of maps of varied scales and content related to different actor and process purposes. In this case, however, the process was tied to the requirements specified for community forest planning in Cameroon by the Ministry's prescriptions for maps of 1:50 000 and 1:200 000 (MINEF 1998).

Secondly, it is the community and its actors that should be the agents to decide on, and thus 'own', the map contents (cf. Rambaldi 2004). For instance, many interviewees in Tinto argued that

there should have been caves and other special sites marked on the maps, because they believe them to be ecotourism sites with potential. Beyond this is the vision that the recording of the community's indigenous spatial knowledge, and the participatory mapping, are pre-conditions for the community to make broader claims for global or national compensation for resource rights and environmental values, including biodiversity and/or endangered species conservation, watershed protection, landscape values and carbon sequestration funds.

Thirdly, the access, use and storage of the geographic information influenced the efficiency of participatory mapping and PGIS interventions in their contributions to good governance. Information access and use are highly relevant for issues of power, advocacy, institutionalization and decision-making in community-based natural resource management (Alcorn 2000). From the results (as seen in Figures 2 and 3), a positive relationship can be established between the activities in which the highest intensities of participation and purpose are achieved, and those activities in which most use of geo-information is made. This supports findings,

such as those of Kyem (2002), that improved communication and more robust relationship building are achieved with a greater use of geo-information. Taking advantage of improvements in analytical and presentation/visualization facilities in future PGIS would help promote deeper levels of decision-making in communities. In the Tinto case, it was primarily just the location and descriptive uses of GIS that were taken up.

Whilst the hard copies of maps were stored by the Tinto community, and therefore accessible to most members, access to digital geo-information was the exclusive preserve of the consultant, and, to some extent, the NGO that facilitated the process. Although this can be explained by the lack of basic GIS technology in the community, the issue was not addressed at any point in the development of the PGIS. Upon reflection, it would have served a good purpose for the Tinto community to keep the digital data on disk, since they have access to the influential elite in the country that could help access and process this information when required for management plan reviews and monitoring. Digital geodata would also be cost-effective for base map development. Currently, updating and use for advocacy purposes are inhibited by the inaccessibility of these data. This issue leaves the real ownership of the products questionable, as no such restrictions apply to the use of this information by the consultants or the NGO involved in the processes.

Participation in PGIS and its organization

These are key factors helping to determine the contribution of PGIS to good governance, especially with respect to legitimacy. In Tinto, the participation was structured in terms of village representatives relating to the various process activities, notably, forest demarcation, inventories and field zoning where geo-information tools were used. People's participation was most common and widespread in traditional participatory rural appraisal tools, such as sketch mapping.

Despite the fact that meaningful levels of stakeholder participation were reached in this case, there can be no guarantee for long-term sustainable community forest management, because some forest user groups could have been missed out or were not actively represented in the process, and thus would not be well informed or in agreement with decisions reached. However, the approach adopted by the Tinto community should not be discredited, since it comes out of a reliable village representation system that has effectively managed a common water system for the three-clan villages for over 20 years. This approach, based on

demographic equity within the community, is appropriate when it comes to benefit sharing, because basic forest resources are part of a common property system.

It is also useful to consider a user group approach alongside popular representative participation, since these groups are the day-to-day users and real beneficiaries of the forest and its products, and therefore should be involved in the management plans of the different compartments. User group representation has been found beneficial in other community-based natural resource management cases (Springate-Baginski *et al.* 2003; Jordan 2002). Taken together, representation by village units and resource user groups in PGIS and community forest management processes both accommodates the political necessity of popular representation in communities, and also caters for the skilled user management of indigenous spatial knowledge and indigenous technical knowledge on the ground, crucial to sustainable resource management.

Equity and gender

Overall, the expected positive gains in equity did not appear. The majority of stakeholders neither gained, nor lost, much in terms of powers of control or access to forest resources. The Tinto Community Forest Management Council and the Chiefs gained some control over the forest dominion, but this was an inevitable result of the changed legal status, rather than from the PGIS process itself.

Some gender-related deficiencies remain, independent of either user group or settlement unit-based participation. Women and other underprivileged or under-represented groups deserve specific attention in negotiations and decision-making, not only for equity and justice reasons. In Tinto, although there is evidence that some effort was made to include women in the village meetings, only two women were present for the mapping of indigenous technical knowledge and indigenous spatial knowledge in the forest. Considering that a community survey (Minang 2000) showed women to be the main collectors of non-timber forest products, it implies that women were badly under-represented in this part of the PGIS process, putting in doubt the long-term sustainability of the management plans for various forest compartments.

Conclusions

The implicit assumptions addressed by the paper are that articulating PGIS at the local level is more effective than relying on conventional mapping and

GIS. PGIS is believed to have the capacity to simultaneously meet the content needs, answer the questions asked of the geo-information, and address and satisfy the local stakeholders' underlying interests. Thus there is the often-made assumption that PGIS is a tool for better governance.

The case study was an ex-post assessment of the effectiveness of a PGIS approach in strengthening good governance in a community forestry determination process in Tinto, Cameroon. Good governance is initially interpreted as the empowering of community members' participation in decision-making and actions. Other governance dimensions and indicators, relating to legitimization, promoting respect for local people and their ownership of indigenous knowledge, strengthening equity and improving effectiveness, were also employed.

The study found that the PGIS and participatory mapping processes contributed – positively, though not comprehensively – to good governance, by improving dialogue, legitimizing and using local knowledge, generating some redistribution of resource access and control rights, and enabling local community groups by means of new skills training in geospatial analysis. PGIS further empowered people by supporting community members' participation in decision-making and mapping actions, and by enabling land use planning decisions beyond community forestry itself. There were, however, only slightly progressive impacts on equity within the community, either in terms of differential resource access rights, or of full ownership of digital GIS outputs.

In general, the intensive and enlightening process of developing a GIS in a participatory manner is itself capacity building and empowering. Essentially, the more community geo-information users who participate in the mapping processes, and the more local applications there are of the geo-information, the more robust the decision-making processes and, by extension, the more vigorous 'good governance'. Central to this are the improved transparency and visibility of the relationships between the people and the state (and commercial interests) that are exposed by the map and GIS outputs. PGIS and participatory mapping create opportunities to visualize the interests and potentials of disparate groups in and around the community. Thus, the 'governed' see the spatial implications of policies and actions, and the 'governing' can recognize and appreciate the legitimacy of local interests.

When participatory mapping and PGIS interventions are aimed towards mediation, to combine outsider and insider knowledge of the problems and potential solutions, the result should be less

wasted effort and greater efficiency. A key element is that a genuine participatory approach enables respect for, and the integrity of, indigenous knowledge, by eliciting, analysing, and presenting conceptualizations of space and spatial values. In this case, the community felt empowered by the PGIS usage and deep consultations to protect a sacred area of forest, demonstrating the capacity of 'working with maps' for engaging debate on sensitive issues and enhancing accountability.

The study demonstrates that, when it is the good governance criterion, chiefly participation, which is recognized as the primary concern and goal, both underlying and overriding the specific objectives of producing precise or detailed maps and GIS products, then participatory mapping and PGIS are acceptable, productive, reliable and effective tools to support and strengthen participatory spatial planning and management.

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