Who owns the Legend?

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Introduction

Maps are media in cartographic or digital formats. Communication occurs mainly by way of symbols which need to be interpreted via the map legend and its graphic vocabulary. Lacking universal standards each map has its own visual language. The language – or enough of it – has to be "common property" in order for communication of any kind to take place. This *ad hoc* language has become increasingly important since mapping and maps have evolved into multimedia and have been used in the contexts of interactive processes aimed at bridging communication barriers among actors having different backgrounds, perspectives and communication pattern. Intellectual ownership of such language and the *content of knowledge* which it communicates are critical factors in determining the success of the processes to which maps and mapping are put.

This paper analyses the role of the legend and its components: symbols and attributes (words which tell what the symbols mean), in shaping intellectual ownership of spatial information collated through collaborative processes designed to enhance and facilitate public participation in addressing issues and conflicts related to the territory.

Background

Mapping is a fundamental way for displaying spatial human cognition. "It is a representational medium that both has a history and is part of the practice of history" (Herrington 2003). For centuries and increasingly with the advent of Spatial Information Technologies (SIT), graphic representations of part or the whole of Earth in cartographic, electronic, two or three dimensional formats have been playing significant roles as media (Sui and Goodchild 2001) used to store, display and convey information and as basis of analysis for decision support.

In the past maps have been made primarily to serve precise tasks like describing discoveries, navigating space, defining boundaries, registering ownership and locating resources. In the early '90, Monmonier (1996:2) wrote that "*a single map is one of an indefinitely large number of graphical models of the spatial aspects of reality that might be produced for the same situation or from the same data*."

Changes have occurred since SIT have become accessible to civil society and graphic representations of space have been used as channels for two-way communication purposes to support social learning, dialogue and negotiation processes. In March 2004 more than 200 representatives from indigenous groups attended the International Forum on Indigenous Mapping[2] in British Columbia sharing the motto: "*Maps are*

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more than pieces of paper. They are stories, conversations, lives and songs lived out in a place, and are inseparable from the political and cultural contexts in which they are used" (Warren 2004, personal communication).

The participatory use of maps started in the late '80s. At that time development practitioners were inclined to adopt PRA[3] *sketch mapping* tools (Mascarenhas 1991) rather than venturing into more complex, demanding and time consuming *scale mapping*, particularly because preference was given to eliciting village dynamics and facilitating communication between insiders and outsiders (researchers), rather than to courses of action enabling communities to interact efficiently with policymakers (Rambaldi, 2002). In addition, in many developing countries aerial photography, satellite imagery and official large scale topographic maps were under governmental control and their access restricted because of national security concerns.

The situation changed in the '90s, with the diffusion of modern SIT including geographic information systems (GIS), low-cost global positioning systems (GPS), remote sensing image analysis software, open access to data via the Internet and steadily decreasing cost of hardware. Spatial data, previously controlled by government institutions became available to and mastered by non-governmental and community-based organisations, minority groups and sectors of society traditionally disenfranchised by maps and marginalized from decision making processes (Fox 2003). This new environment facilitated the integration of SIT into community-centred initiatives particularly to deal with spatial information and communication management (ICM). Practitioners and researchers around the world have been working on different approaches making use of a variety of SIT, but all sharing the goals of placing ordinary people in the position to generate, analyse, manage and exchange georeferenced data, integrate multiple realities and diverse forms of information to foster social learning and broaden public participation across socio-economic contexts, locations and sectors. This has spurred a rapid development in the management of spatial multimedia information through what is generally termed as Public Participation GIS (PPGIS), where maps are conceived as interactive vehicles for discussion and information exchange, are physical or virtual, in 2 or 3-dimensional formats and are enriched by an array of data types including sound and images (Aberley 2002).

Large scale maps (> 1:20,000 scale) and physical or digital terrain elevation models have been used for conducting collaborative research (Hampson 2003, Tran Trong Hieu 2002, Quan 2002, Martin 2001, Tan-Kim-Yong 1994 and 1992) community-based planning, monitoring change, asserting territorial claims (McCall 2004, Bersalona 2004, Rambaldi 2002a, Zingapan 1999, Poole 1998 and 1995, Denniston 1995), managing territorial disputes and supporting related negotiations (Cook 2003, Chacon 2003, Carton 2002a, Rambaldi 2002b, Wood 2000, Johnson 1999, Poole 1998) and consultative policy making (Carton, 2002b). While most authors point to the effectiveness of SIT used in a participative mode, McCall (2004), Fox (2003), Rambaldi (2002a), Abbot (1998) and Rundstrom (1995) call for caution as these may lead to increased conflict, resource privatization, and loss of common property.

[3] Participatory Rural Appraisal.

The power of maps

Maps are highly communicative forms of spatial representation. "Maps communicate information immediately and convey a sense of authority" (Alcorn 2000:11). Few dispute them, particularly when these are drawn as planimetric projection (in two dimensions) and at scales smaller than 1:20,000. This is due to the difficulty encountered by individuals in relating the information displayed on small-scale maps to their real life-world, thus limiting their capability of critical argumentation.

> "Maps produced by European explorers were an exemplar expression of cartographic power: by ignoring indigenous names, and barely alluding to the presence of local settlements, in effect they declared the land to be empty and available" (Poole 1998).

The communicative power of maps has been used for both noble and questionable purposes including among others education, awareness raising, advertisement, political propaganda, disinformation (Monmonier 1996), re/deterritorialisation and nationalisation (Wood 2000).

Maps as media

Mapmakers use maps to convey information mainly through a visual language[4] made out of legend items, a combination of symbols (points, lines, polygons and volumes[5]), their variables (hue, orientation, shading value, shape, size, and texture) and interpretation keys. Elevated terrain models (3D maps or 3D models) offer a more efficient interpretation base by displaying the vertical dimension which provides additional cues to memory and facilitates mental spatial knowledge processing.

The "talkative" capacity of maps rests in the selection of featured items, in the manner these have been depicted[6] and in the capability of users to understand, interpret and relate these to their life-worlds.

Particularly when a map is used to support a dialogue, it is important that its graphic vocabulary is fully understood. Each displayed feature needs a key to be interpreted. While font size and style concur in attributing increased or lesser relevance to textual information, symbols need an unambiguous definition to support their objective interpretation.

This is made possible by the legend which exposes all interpretation keys and allows users to decode and interpret displayed symbols, derive information and generate knowledge.

In an interactive process which leads to the composition of a map as a means for social learning and negotiation, the preparation of the legend, particularly the selection of features to display, the way these are depicted and textually defined, assumes a key role in determining the final intellectual ownership of the map, its resulting message and its usefulness in the process.

[4] Topology, the names of things, is used to a lesser extent when compared to graphic symbols.

[5] Pebbles, push pins, yarns, oil-based modelling clay are considered *volume* symbols.

[6] The symbols used to depict real world features are frequently not at scale and reflect through their choice and variables a selected interpretation of reality made by those who composed the map.

From pebbles to keyboards

When using SIT in genuine participative settings, technologies and systems should be in the position to allow two-way interactions, accommodate and visualize indigenous spatial knowledge and stakeholders' perspectives, and to store and display these.

Figure 1 Indigenous People in the Philippines featuring a catchment by the use of soil

The most basic method of *drawing ephemeral maps on the ground* (**Figure 1**) and using pebbles, sticks and leaves to locate and depict landmarks is the starting point for a deeper reflection. Informants use raw materials at the reach of their hands or collected at walking distance to display the desired spatial information. Discussion and finger pointing are the analytical instruments. Hardly any legend is produced and the map will disappear in a matter of a wind blow. Acquired knowledge will be stored in the mind of the participants and eventually recomposed in the form of individual mental maps when needed.

Figure 2 Villagers in Mindanao, Philippines preparing a resource distribution sketch map

Sketch mapping (**Figure 2**), a slightly more elaborated method making use of large sheets of craft paper, ensures storage and mobility of collated information. Features are depicted by the use of natural materials glued on it or more frequently by coloured marker pens or chalk. In both cases informants are in the position to make their choices in terms of what to use and how to visualize the desired features. Facilitators usually pay attention that the discussion is duly documented and interpretation keys are collated to compose a comprehensive legend which will support future uses of the output. These free drawn maps usually show features of relevance to the livelihoods of the informants, like natural and social resources, and relationships between the two.

Figure 3 1:5,000 scale participatory 3D model. Indigenous people outlining boundaries

More sophisticated methods of participatory 2 or 3 dimensional *scale modelling* (**Figure 3**) are aimed at generating georeferenced data and rely on a disciplined use of selected symbols for depicting desired features. The methods depend on the availability of topographic data like contour lines and require extensive preparatory work. Good facilitation ensures sufficient and varied stock of materials[7] for depicting symbols and their variables to be placed at the disposal of mapmakers. The legend may be proposed, imposed or better composed during the course of the mapping exercise and evolve dynamically through an iterative process.

Geographic Information Systems (GIS) used in a participatory manner allow communities to display and eventually handle spatial data but are necessarily fed via computer keyboards or USB ports receiving inputs from hand-held Global Positioning System devices, digital cameras and cassette recorders. When composing data layers in a digital environment the choice of symbols and their variables is usually vast, but depends on the software and available image collections.

Attributes, non-geographic data associated with a spatial element, describe in a textual (or audio-visual) format the single features. The relation of symbols and their attributes is exemplified in the legend items.

What is What?

There are a series of critical building blocks which determine the intellectual ownership of spatial data displayed on a map or on a screen: (i) their source, (ii) the elaboration and manipulation they have been subject, (iii) the choice of symbols and variables made to depict the results, (iv) the definition or quantification of their attributes and (iv) the ultimate display of symbols and attributes in the legend.

Choosing symbols and their variables. The most expressive variables associated to symbols are colour and size. More authoritative than others, colour (or hue) serves as a powerful system of differentiation, burdened with cultural meaning, overwhelmed by its associations and its history. Yet colour is a code that is constantly subject to change (Ferrier 2002). Nonetheless, when it comes to mapping Earth features there are some silent conventions which have become common practice: water bodies are shown as blue and vegetation as green; *more* is darker and *less* is lighter. Other hues are associated with traditional meanings depending on the cultural traits of the participating communities: death is associated to *white* in India, to *black* among westerners and *violet* amid Mangyans in the Philippines. "What these various figurative uses of colour have in common is the way that they present colour as linked with perception, and as perception that is not neutral or objective, but value added that is, overlaid with cultural value (Ferrier 2002). In mapmaking, the association of a specific hue to a symbol or feature is therefore far from being a neutral act and may even become provocative in a participatory setting like the false colour red which symbolises vegetation in remote sensing. The same applies to points, lines, areas and volumes, the remaining sets of symbols. When used to depict real world features their choice and their variation correspond to selected interpretations of reality made by those who compose the map.

Defining the attribute. For mapmakers and at large PPGIS practitioners, an *attribute* is the characteristic of a geographic (physical and social) feature described by numbers, characters, images or sounds. To be objectively interpreted, spatial characteristics depicted by the use of symbols need clearly defined attributes. This is quite straightforward with numbers and images, but becomes relatively critical when text is the chosen medium. This is particularly true when the purpose of assembling and

[7] Materials include but are not limited to assorted coloured paint, markers, pushpins, oil-based modelling clay, yarns, crêpe paper, etc.

analysing spatial information is to establishing a two-way communication channel. *Primary forest,* as an example, is a term that may have a different meaning for a scientist, a government official, a farmer, or mean nothing at all.

Lessons from the field

Prioritising and getting a consensus among mapmakers on which items are relevant and what should be featured on a map, is the first step in a participatory process aimed at addressing community-based issues related to the territory and its resources.

The key for depicting spatial information for communication purposes is to make such visualization objectively understandable through the development of a visual language having a clearly defined vocabulary. Shiffer (1996) writes, "information is only powerful when it is effectively comprehended by those who use it." Common ground and understanding need to be established and the use of local definitions and vernacular translations help.

In practical terms (see Table 1) when venturing into community-based mapping, facilitators have to draft a list of legend items ahead of the event to kick-start the process. Such a list has to be the result of preparatory consultations held with concerned stakeholders, with the objective of identifying features of the landscape which are relevant and known to those who will take part in mapmaking.

Table 1 Evolution of Legend Items during Phases of Participatory Mapmaking

On the field		On/off the field
Community consultation and/or raw data collection	Data collection & non-digital mapmaking	Data analysis, digital editing, manipulation, etc.
• Tentative list of features compiled • textual description of single features drafted • eventual customary associations between "features" and "their display" Identified • draft legend prepared	• Draft legend items revised; • new items Included • selected items excluded • sensitive features identified • makeshift legend(s) produced (showing public and/or restricted items)	• Content matching • Polishing • symbols and variables matched with available software graphics • display of layers (public and restricted access) agreed and defined • legends prepared

As the mapping process enfolds, facilitators would solicit the thorough revision of the proposed legend items, their unambiguous definition and their association with clearly identifiable and culturally acceptable symbols in order to distinctively[8] depict and describe physical, biological, socio-cultural and virtual features of the territory and to facilitate their objective interpretation.

The process of progressively adding data to a map or more significantly to a physical terrain elevation model has important discovery and social learning implications which may lead mapmakers to identify, prioritise and select new items to display (**Boxes 1, 2** and **3)** or in some cases to remove previously listed items because e.g. non existent, considered as non relevant or too broad.

Similar processes have been witnessed and documented in Vietnam (Hardcastle, 2004), the Philippines (Rambaldi 2003, 2002a and 2002b) and Europe (Carton 2002b) in the contexts of community-based mapping and modelling exercises.

[8] Boundaries may not necessarily be linear but blurred or fuzzy as in many cases when it comes to resource use and access, and customary tenure.

Choosing symbols and their variables facilitators should ensure that these are possibly visually linked to real world features, culturally significant and acceptable, sufficiently assorted, readily available and consistently applied. In defining the attributes these should be clear and unambiguous and objectively understandable.

Except for community maps making use of locally available materials, like soil, leaves, charcoal and other, community mapmakers have to match the features they want to depict with symbols made available by the technology in use. Participatory 3D models offer push and map pins, yarns and paint to depict points, lines and polygons. Digital maps[9] display results based on available sets of symbols which are numerous, but limited to the software and available add-ons.

Questions of ownership should arise in the mind of the facilitators: Who decides on what is “important”? Who defines the attribute of single items in objectively understandable terms? Who selects symbol and variable to depict a given feature? If made public, who decides on what to display on the map and its legend? Ultimately Who owns the pictorial language, its graphic vocabulary and the resulting message? Who own the legend?

Concluding remarks

The full potential of spatial information technologies as two-way communication channels will become a reality when practitioners and facilitators realise the importance of ensuring full involvement of concerned stakeholders throughout the process. This means, that besides putting stakeholders at the forefront in collating and analysing indigenous spatial knowledge, they must be prime actors in defining the map’s pictorial language and its graphic vocabulary, the legend. As Carton (2002b) puts it, the legend items form the kernels of the mapping language.

[9] In this paper "digital maps" include automated cartography, computer-assisted map tailoring, spatial statistical analysis, and terrain visualization.

Box 1

Context: Protected area management plan preparation – Pu Mat National Park - Social Forestry and Nature Conservation (SFNC) Project in Nghe An Province, Vietnam (1998-2004)

Purpose of the community mapping exercise: Improve relationships and foster reciprocating respect between National Park staff and local communities; induce a paradigm shift on "Who Knows" and "Whose Knowledge Counts"; provide stakeholders with a comprehensive, user-friendly research, planning and management instrument.

SITs used: P3DM and GIS

Key informants/mapmakers: 76 Dan Lai, Thai and Kinh hill tribe Peoples, 6 park rangers and 10 SFNC project staff.

Context issue: At the beginning of the activity informants were invited to review the draft legend, suggest changes, make integrations and improve definitions (**Figure 4**).

Figure 4 Hill tribe People discussing legend items during a P3DM exercise, Pu Mat, Vietnam

By the end of the exercise after 4 days of intensive dialogue the initial legend had expanded from 18 to a total of 55 features including points, lines and polygons.

Some items listed on the draft legend were removed, because non-existent or deemed as irrelevant or too sensitive as per community perspective. These included among others the following features: (i) points: gold mining site, abandoned village, hunter's hut, resting site for forest rangers; (ii) polygons: industrial crop (changed by informants to more specific definitions like sugarcane and tea plantations and planted bamboo forest); and (iii) lines: buffer zone boundary.

Figure 5 Final Legend of the 3D model of Pu Mat National Park, Vietnam

Others were added. These included (ii) points (i.e. locations) like Commune's People Committee, border police station, temple, cave, docking site along river, tree nursery, cemetery, etc. (ii) polygons identified as natural bamboo forest, resettlement area, crops on terraces, stony areas;.

Some features identifying wildlife sighting sites for tiger, bear, elephant, deer (saola), gayal, etc. were removed from the model and excluded from the final legend because deemed sensitive and at risk of exposing endangered species to increased pressure from poachers.

In addition to revising the listing of the legend items (**Figure 5**), the villagers in collaboration with government officials improved their textual definitions and ensured the translations of the various features to ensure an objective understanding across stakeholders (Rambaldi 2003).

Box 2

Figure 6 Villager inputting data on a 3D model by the use of colour coded paint

Context: Collaborative Protected Area Management Planning, Mount Malindang Natural Park, Misamis Occidental, Mindanao, Philippines. National Integrated Protected Area Programme (NIPAP), Philippines (1996-2001)

Purpose of the community mapping exercise: Contribute to the development of a protected area management plan based on a blend of indigenous technical knowledge (ITK) and scientific knowledge.

SITs used: P3DM and GIS

Key informants/mapmakers: 98 community members including representatives from the Subanen Indigenous Communities, residents of all local administrative units (barangays), Local Government Officials, DENR and NGOs.

Context issue: The 1:10,000-scale exercise covered a vast area (1,176 km^2) including portions of five Indigenous Peoples' Ancestral Domains. In order to assist participants in re-composing their mental maps, the facilitators produced base maps featuring roads in addition to contour lines, which are a standard feature for base maps used in P3DM.

When assisted in outlining the roads by transposing their coordinates from the base maps to the 3D model, participants contested the validity of the data stating that the roads no longer existed and that these were logging roads currently overgrown by natural vegetation. The legend item was modified and what was originally indicated as "road" was re-defined as "footpath (old logging road)" and depicted on the model only where applicable depending on its actual existence.

It is worth noting that the data used for the production of the base map were obtained from the National Mapping Resource and Information Agency (NAMRIA). The data, turned out to date back to the 2nd World War.

In reviewing and expanding the legend informants included new items like "landslide" and "landfill area" and further refined specific land uses (e.g. "coconut plantations", "vegetable gardens", "orchards", etc.) and vegetation types. In this latter case participants listed and depicted five different types of forest (**Figure 7**) which were not shown on pre-existing maps.

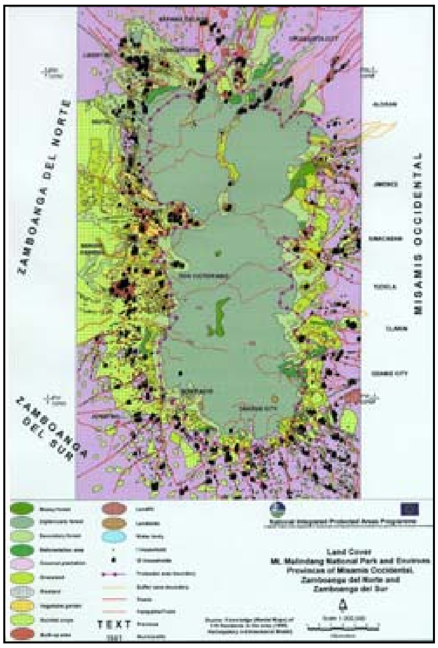

Figure 7 Map resulting from data extracted from a Participatory 3D Model, Mt. Malindang National Park, Philippines, 1999

Box 3

Context: Collaborative Protected Area Management Planning, Mount Pulag National Park, Benguet, Cordillera Region, Philippines. National Integrated Protected Area Programme (NIPAP), Philippines (1996-2001)

Purpose of the community mapping exercise: The model has been used by the Protected Area Office for raising awareness on the location of the park boundaries and important natural resources. More importantly it has been used for discussing the outlining and revision of protected area boundaries with local communities (**Figure 8**).

The Local Government Unit has used the model for revising local administrative boundaries and for planning purposes.

SITs used: P3DM and GIS

Key informants/mapmakers: 75 representatives from the Ibaloi, Kalanguya, Kankana-eys and Karaos Indigenous communities. Local Government Officials, DENR, NAPOCOR and NGOs.

Figure 8 Village Elders outlining linear features on a 3D model in the Cordillera Administrative Region, Philippines, 1999

Context issue: This has been the first P3DM exercise implemented in 1998 in the framework of NIPAP.

Informants were provided with a draft legend including 15 different features and were asked to check, update and further expand it.

Figure 9 Elders locating sacred areas in Mt. Pulag, Cordillera, Philippines, 1999

The definition and translation of each legend into vernacular required thorough discussion and levelling off among informants and facilitators.

Proposed items were re-defined, associated to clearly identifiable symbols. New items sprung up as the mapping process enfolded. These reflected deep-rooted community concerns and priorities.

“Landslides” and “bare land” were singled out as important items to be depicted on the model.

The discussion and depiction of administrative and cultural boundaries turned out to be an extremely sensitive topic among neighbouring tribal communities (**Figure 9**) and was toned down and finally dropped from the discussion. This was an important learning from the exercise, as boundaries are most frequently leaded with latent conflicts and need special well-prepared approaches to be dealt with, possibly after the “neutral” depiction of land use and cover, most likely in a separate exercise.

“Sacred areas” with extensive textual description took their due place among the listed legend items.

References

Abbot J., Chambers R., Dunn C., Harris T., De Merode E., Porter G., Townsend J., Weiner D. 1998. *Participatory GIS: Opportunity or Oxymoron?* PLA Notes 33: 27-34. IIED: London

Alcorn J. 2000. *Borders, Rules and Governance: Mapping to Catalyze Changes in Policy and Management*. Gatekeeper Series No. 91. IIED: London

Aberley D and Sieber R. (2002). *Public Participation GIS (PPGIS) Guiding Principles*. First International PPGIS Conference held by URISA at Rutgers University, New Brunswick, New Jersey, July 20-22, 2002.

Bersalona R. and Zingapan K. 2004. *P3DM: Mapping out the future of Indigenous Peoples in 3D*, ICT Update, Vol. 17, May 2004, CTA, Wageningen, The Netherlands. http://ictupdate.cta.int/index.php/article/articleview/305/1/56/

Carton L. 2002a. *The power of maps in interactive policymaking: Visualization as debating instrument in strategic spatial policy processes*. In: E.F. ten Heuvelhof (eds.); Proceedings of the first International Doctoral Consortium on Technology, Policy and Management (Delft, 17-18 June 2002). TU Delft, Delft, p. 269-283.

Carton L. 2002b. *Strengths and Weaknesses of Spatial Language: Mapping activities as debating instrument in a spatial planning process*. FIG XXII International Congress, Washington, D.C. USA, April 19-26 2002.

Chacon M. 2003. *Principles of PPGIS for Land Conflict Resolution in Guatemala*. Geography Department, UCGIS Summer Assembly 2003.

Cook, S.E., O'Brien R, Corner, R.J., and Oberthur T. (2003). *Is precision agriculture irrelevant to developing countries?* Paper presented at the European Conference on Precision Agriculture, 4th ECPA, Berlin, Germany 15-19 June, 2003.

Denniston, D. 1995. *Defending the Land with Maps*. PLA Notes (1995), Issue 22, pp.36–40, IIED London.

Ferrier L., Dauber C. 2002. *Colour*. M/C Journal, Vol. 5, 3.

Fox J. Krisnawati Suryanata Hershock P Hadi Pramono A. 2003. *Mapping power: Ironic effects of spatial information technology*. Spatial Information Technology and Society: Ethics, Values, and Practice Papers. East-West Center, Hawaii, USA.

Hampson K, Bennett D, Alviola P, Clements T, Galley C, Hilario M, Ledesma M, Manuba M, Pulumbarit A, Reyes M.A., Rico E and Walker S. 2003. *Wildlife and conservation in the Polillo Islands, Philippines.* Polillo Project Final Report. Viper Press.

Source: http://mampam.50megs.com/polillo/2001/index.htm

Hardcastle J, Rambaldi G, Long B, Le Van Lanh and Do Quoc Son. (2004). *The use of Participatory 3-Dimensional Modelling in Community-based Planning in Quang Nam province, Vietnam*. PLA Notes No. 49: 70-76, IIED, London, UK.

Harmsworth G.. 1998. Indigenous Values and GIS: a Method and a Framework. Indigenous Knowledge and Development Monitor Vol. 6 (3) December 1998

Herrington, S and McIver Lopes D. 2003. *Maps: here, then, and now.* Vancouver: Peter Wall Institute for Advanced Studies University of British Columbia.

Johnson, R. 1999. *Negotiating the Dayton Peace Accords through Digital Maps*, United States Institute of Peace (USIP) Virtual Diplomacy Report, 25 February.

McCall M. 2004. *Can Participatory GIS Strengthen Local-Level Planning? Suggestions for Better Practice*, the 7th International Conference on GIS for Developing Countries (GISDECO 2004), 10-12 May 2004, Universiti Teknologi Malaysia, Johor Malaysia

Martin C., Eguienta Y., Castella, J.C., T.T. Hieu and Lecompte P. 2001. *Combination of Participatory Landscape Analysis and Spatial Graphic Models as a Common Language between Researchers and Local Stakeholders*. SAM Paper Series. IRRI-IRD.

Mascarenhas J. and P.D. Prem Kumar. 1991. *Participatory Mapping and Modelling Users' Notes*. Source: RRA Notes (1991), Issue 12, pp.9–20, IIED London

Monmonier, M. 1996. *How to Lie with Maps*, second edition. Chicago and London: University of Chicago Press.

Poole, P. 1998. *Indigenous Lands and Power Mapping in the Americas: Merging Technologies*. Native Americas Journal, Vol. 15 No. 4.

Poole, P. 1995. *Indigenous Peoples, Mapping & Biodiversity Conservation, an Analysis of current Activities and Opportunities for Applying Geomatics Technologies*. Peoples and Forest Program Discussion Paper. Biodiversity Support Program (BSP). Washington DC.

Quan J., Oudwater N., Pender J. and Martin A. 2001. *GIS and Participatory Approaches in Natural Resources Research*. Socio-economic Methodologies for Natural Resources Research Best Practice Guidelines. Natural Resources Institute, Chatham, UK.

Rundstrom R. 1995. *GIS, Indigenous People, and Epistemological Diversity*. Cartography and geographic Information Systems, Vol. 22:1 45-57

Rambaldi G. and Le Van Lanh. 2003. *The Seventh Helper: the Vertical Dimension. Feedback from a training exercise in Vietnam*. PLA Notes No. 46: 77-83, IIED, London, UK.

Rambaldi G. and Callosa-Tarr J. 2002. *Participatory 3-Dimensional Modelling: Guiding Principles and Applications*. ASEAN Regional Centre for Biodiversity Conservation (ARCBC), Los Baños, Philippines.

Rambaldi G., Bugna S., Tiangco A. and de Vera D. 2002. *Bringing the Vertical Dimension to the Negotiating Table. Preliminary Assessment of a Conflict Resolution Case in the Philippines*. ASEAN Biodiversity, Vol. 2 No. 1, 17-26. ASEAN Centre for Biodiversity Conservation (ARCBC), Los Baños, Philippines.

Shiffer, M. 1996. *Community-Building Communications Technologies and Decision Support Systems*. Colloquium on Advanced Information Technology. Cambridge, MA: Department of Urban Studies and Planning, Massachusetts Institute of Technology.

Sui D. and Goodchild M. 2001. *GIS as Media?* International Journal of Geographical Information Science, Vol. 15, 5:387-390

Tan-Kim-Yong U.; Limchoowong S. and Gillogly K. 1994. *Participatory Land Use Planning: A Method of Implementing Natural Resource Management*. Paper presented at the UNDCP-ONCB Seminar "Two Decades of Thai-UN Cooperation in Highland Development and Drug Control: Lessons Learned-Outstanding Issues-Future Directions". Chiang Mai, 1994.

Tan-Kim-Yong U. 1992. *Participatory Land Use Planning for Natural Resource Management in Northern Thailand*, Rural Development Forestry Network. Network Paper 14b.

Tran Trong Hieu, Castella J.C. Eguienta Y. 2002. *Participatory 3-D Landscape Modeling: Towards a common spatial language among researchers and local stakeholders*. In: PAOPA (eds.) Scaling-up Innovative Approaches in Agricultural Development. Agricultural Publishing House, Hanoi, Vietnam. p 13.

Warren A. 2004. *International Forum on Indigenous Mapping for Indigenous Advocacy and Empowerment*; the Indigenous Communities Mapping Initiative.

Wood B. W. 2000. *GIS as a Tool for Territorial Negotiations*. IBRU Boundary and Security Bulletin. Vol. 8 No. 3:72-78

Zingapan K. and De Vera D. 1999. *Mapping the Ancestral Lands and Waters of the Calamian Tagbanwa of Coron, Northern Palawan*. PAFID, Quezon City, Philippines. Paper presented at the "Conference on NGO Best Practices", Davao City Philippines.