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PARTICIPATORY SPATIAL INFORMATION MANAGEMENT AND COMMUNICATION IN DEVELOPING COUNTRIES [1]

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HISTORIC PERSPECTIVE OF PARTICIPATORY SPATIAL INFORMATION MANAGEMENT

The participatory creation of maps, above and beyond their interpretation, started in the late 1980s. At that time, development practitioners were inclined to adopt Participatory Rural Appraisal (PRA) methods such as *sketch mapping* (Mascarenhas et al. 1991) rather than the more complex and time consuming *scale mapping.* Preference was given to eliciting local knowledge and building on local dynamics to facilitate communication between insiders (e.g. villagers) and outsiders (e.g. researchers, government officials, etc.). This approach placed little emphasis on charting courses of action that would enable ordinary people to interact efficiently with policymakers (Rambaldi 2005). The situation was further compounded by state control of aerial photography, satellite imagery and large-scale topographic maps under the pretext of national security concerns.

The state of affairs in mapping changed in the '90s, with the diffusion of modern spatial information technologies (including geographic information systems (GIS), global positioning systems (GPS), remote sensing image analysis software and open access to spatial data and imagery via the Internet into the industry. With the steadily decreasing cost of computer hardware and the availability of user-friendly software, spatial data that were previously controlled by government institutions became progressively more accessible[2] to, and mastered by non-governmental and community-based organisations, minority groups and sectors of society traditionally disenfranchised and excluded from spatial decision making processes (Fox et al. 2003). The new environment facilitated the integration of geo-spatial information technologies and systems (GIT&S) into community-centred initiatives. GIT practitioners and researchers around the world were able to adopt a range of GIT&S to integrate multiple realities and diverse forms of information with the objective of empowering underprivileged groups, promote social learning, support two-way communication and thereby broaden public participation across socio-economic contexts, locations and sectors. This merging of community development with geo-spatial technologies for the empowerment of less privileged communities has come to be known as Participatory Geographic Information Systems or PGIS.

[1] Mapping for Change International Conference, Nairobi, Kenya, 7-10 September 2005.

[2] Still in some countries access to topographical data at scales larger than 1:50,000 is restricted, mapping by communities is prohibited and limited to licensed geodetic engineers; "resource-grade mapping" is not allowed and only high-accuracy, "survey-grade" is accepted.

ABOUT PARTICIPATORY GIS

Participatory GIS is an emergent *practice* in its own right; developing out of participatory approaches to planning and spatial information and communication management (Rambaldi and Weiner 2004). The practice is the result of a spontaneous merger of Participatory Learning and Action (PLA) methods with GIT&S. PGIS combines a range of geo-spatial information management tools and methods such as sketch maps, Participatory 3D Models (P3DM), aerial photographs, satellite imagery, Global Positioning Systems (GPS) and Geographic Information Systems (GIS) to represent peoples' spatial knowledge in the forms of virtual or physical, 2 or 3 dimensional maps used as interactive vehicles for spatial learning, discussion, information exchange, analysis, decision making and advocacy. Participatory GIS implies making GIT&S available to disadvantaged groups in society in order to enhance their capacity in generating, managing, analysing and communicating spatial information.

PGIS practice is geared towards community empowerment through measured, demand-driven, user-friendly and integrated applications of geo-spatial technologies. GIS-based maps and spatial analysis become major conduits in the process. A good PGIS practice is embedded into long-lasting spatial decision-making processes, is flexible, adapts to different socio-cultural and bio-physical environments, depends on multidisciplinary facilitation and skills and builds essentially on visual language. The practice integrates several tools and methods whilst often relying on the combination of 'expert' skills with socially differentiated local knowledge. It promotes interactive participation of stakeholders in generating and managing spatial information and it uses information about specific landscapes to facilitate broadly-based decision making processes that support effective communication and community advocacy.

If appropriately utilized, the practice could exert profound impacts on community empowerment, innovation and social change. More importantly, by placing control of access and use of culturally sensitive spatial information in the hands of those who generated them, PGIS practice could protect traditional knowledge and wisdom from external exploitation.

COMMUNICATION AS A KEY INGREDIENT

Cartographers convey spatial information through a visual language [3] consisting of a combination of symbols (points, lines, polygons and volumes [4]), their variables (hue, orientation, shading value, shape, size, and texture) and interpretation keys printed on maps. Three dimensional elevation models of the landscape offer additional enhancements to facilitate efficient interpretation and mental processing of spatial data. The communicating capabilities of a map rest on the selection of features, in the manner these are depicted[5] and in the capability of users to objectively understand 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 by all parties involved and each feature is provided with a commonly defined key to be interpreted (Rambaldi 2005; Carton 2002).

Producing, geo-referencing and visualising indigenous spatial knowledge (ISK) helps communities engage in peer-to-peer dialogue and promotes their particular issues and concerns vis-à-vis higher level authorities and economic forces.

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

[4] Pebbles, push pins, yarns, oil-based modelling clay, 3D cartographic images are considered *volume* symbols.

[5] 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.

As well, maps based on ISK are used in adversarial contexts such as in the case of counter mapping where indigenous communities adopt participatory mapping methodologies to regain a measure of control over ancestral lands and resources (Peluso 1995; Poole 2005; Rambaldi et al. 2002b; Zingapan et al. 1999; Denniston 1995).

The integrated and multifaceted process of which PGIS is a component, provides legitimacy for local knowledge and generates a great sense of confidence and pride which prepares the people to deal with outsiders. The process fuels self-esteem and raises awareness about pressing issues in the community. Experiences from the Philippines have shown that exercises conducted at community level in response to local needs have fostered community-cohesion and identity building (Rambaldi et al. 2002b; Zingapan et al. 1999). As Janis Alcorn (2000:1-2) puts it "*old people share history with young people, passing on legends and religious beliefs, sacred rites and places so essential to conserving tradition*".

CONTEXTS

Participatory GIS practice implies making geographic information technologies and systems available to less-favoured groups in society to enhance their capacity to generate, manage and use their own ISK, as well as externally-generated spatial information in contexts such as:

- self-determination (e.g. protecting ancestral land and resource rights and entitlements);
- management and amelioration of conflicts amongst local community groups, and between communities and local authorities in regards to access, use, control and allocation of natural resources;
- collaborative research;
- collaborative resource use planning and management;
- intangible cultural heritage preservation and identity building among indigenous peoples and rural communities;
- good governance in regards to transparency and consensual spatial decision making;
- awareness raising and assisting with education and social learning for new generations;
- equity promotion with reference to ethnicity, culture, gender, environmental justice and hazard mitigation.

BUILDING ON INDIGENOUS SPATIAL KNOWLEDGE

PGIS builds on socially differentiated ISK and the willingness of custodians of such knowledge to share it. Typically, ISK covers the following areas in rural settings:

- Resource distribution: land cover and use, water sources, habitats;
- Resource use, control and access [6]: hunting, fishing, farming, grazing, mining, gathering and harvesting from the wild, etc.;
- Places of historic, cultural and religious significance, ancestral grounds and sacred areas;
- Indigenous names; cosmovisions, creation and origin myths, etc.

[6] Different maps on resource use control and access can be produced for the same area by different groups in society. Of particular interest are the differentiated spatial perspectives of women, elderly people youth and children (re: gender and age-related areas).

- Hazard perception (e.g. landslides, floods, malaria, etc.).

ISK may complement 'scientific knowledge' in cases related to resource location, water conservation, or livestock management. In such cases, ISK might be considered more relevant to the participatory processes than the technology because it embodies generations of practical knowledge of the people. Deeper than this, there is ISK which is cognitively different from scientific knowledge (i.e., mental maps). Mental maps may incorporate overlapping or layered zones, blurred or multiple boundaries, and uncertain or restricted locations (McCall 2004).

THE IMPORTANCE OF THE "P"

Effective participation is the key to good PGIS practice. Whilst the focus of traditional GIS applications is often on the outcome, PGIS initiatives tend to emphasize the processes by which outcomes are attained. At times the participatory process can obfuscate systematic inequalities through unequal and superficial participation. For example, PGIS applications may be used to legitimise decisions which in fact were taken by outsiders. The process can also easily be hijacked by community elites (Kyem 2004; Rambaldi and Weiner 2004). For the PGIS practice to be successful it has to be placed in a well thought out and demand-driven *process* based on the proactive collaboration of the custodians of local and traditional knowledge and of facilitators skilled in applying PGIS and transferring technical know-how to local actors. Participation cuts across the process from gaining a clear understanding of the existing legal and regulatory frameworks, to jointly setting project objectives, defining strategies and choosing appropriate geo-spatial information management tools.

PARTICIPATORY GIS IN THE SOUTH VS. PUBLIC PARTICIPATION GIS IN THE NORTH

The participatory use of spatial information technologies has evolved along different paths in the South and in the North.

In the South PGIS practice has emerged as an intersection of participatory progressive *development* and GIT&S through the integration of low and high tech spatial information management applications. In this scenario, where PGIS is practiced essentially in rural contexts, and heavily depend on external technology inputs, actors involved are mainly traditional societies, NGO, development scientists and other advocates who use GIT&S to empower native and indigenous groups. There are hundreds of non-documented cases where technology-intermediaries (mainly NGOs) support Community-based Organisations (CBOs) or Indigenous Peoples in using GIT&S to meet their spatial planning needs and / or achieve some leverage in their dealings with state bureaucracy. Most of these cases are hardly known, unpublished and at best found amidst grey literature.

In the North, Public Participation (PPGIS) has evolved as an intersection of participatory *planning* and GIT&S making use of increasingly sophisticated approaches. In inner cities and indigenous communities where technical competency and cost have been barriers to GIS implementation, PPGIS applications occur within several organizational arrangements including: Community-University partnerships with inner city communities (Ghose 2001; Craig and Elwood; 1998), grassroots social organizations (Sieber 2001), and Internet-based PPGIS (Carver et. al. 2001; Craig et al., 2002). These organizations combine GIS with a host of modern communication technologies to facilitate dialogue and data usage among local groups. Equity issues are frequently addressed, particularly the spatial implications of 'environmental justice', usually closely associated with discriminatory zoning of ethnic groups.

The two worlds of PGIS research and activism sometimes overlap and offer the best opportunities in terms of documenting genuine PGIS applications. On the other hand one can

find a wealth of case studies on so-called "participatory"[7] applications of GIT&S mostly driven by researchers and development scientists. A number of these end up with papers published on scientific journals and questionable impacts in terms of community empowerment and control on generated data.

TOOLS, METHODS AND TECHNOLOGIES IN THE PRACTICE

A broad range of participatory tools and methods are available to PGIS practitioners and community representatives. These range from low-tech sketch mapping to integrating hi-tech GIT&S.

Ephemeral maps: This most basic mapmaking method consists in *drawing maps on the ground*. Informants use raw materials like soil, pebbles, sticks and leaves, to reproduce the physical and cultural landscapes in the manner they perceive them to be. Such ephemeral maps disappear in a matter of a wind blow. Acquired knowledge is memorised by participants and mentally recomposed when needed.

Sketch mapping is a slightly more elaborate method which makes use of large sheets of Kraft paper. Features are depicted by the use of natural materials or more frequently by coloured marker pens or chalk. Participants usually have a range of choices regarding what materials to use for the drawing and how to visualize desired items. Features are exaggerated in size to match the importance participants attach to them. If properly facilitated, the process is documented and records are kept in terms of the keys necessary for interpreting depicted symbols. The lack of a consistent scale and geo-referencing of the data leaves room for subjective interpretation of the final map.

Scale mapping is a more sophisticated method aimed at generating geo-referenced data to facilitate discussions and allow community members to develop maps which can stand the scrutiny of adversarial parties. The method is based on effective selection of symbols and colours for depicting ISK on transparencies superimposed on a geo-coded and scaled map.

PGIS spatial analysis uses the functionality and data associated with GIS technology to explore community driven questions. In the process, local spatially referenced as well as non-spatial data are integrated and analyzed to support discussion and decision making processes. The spatial analytic functionalities allow much easier and rapid analysis by the users, of e.g. time and cost functions, of separation and contiguity, and of the effects of barriers and buffers.

*Participatory 3-Dimensional Modelling (*P3DM). This method integrates indigenous spatial knowledge with data on elevation of the land and depth of the sea to produce stand-alone, scaled and geo-referenced relief models[8]. Essentially based on ISK, land use and cover, and other features are depicted by informants on the model by the use of pushpins (points), yarns (lines) and paints (polygons). On completion, a scaled and geo-referenced grid is applied to facilitate data extraction or importation. Data depicted on the model are extracted, digitised and plotted. On completion of the exercise the model remains with the community (Rambaldi and Callosa-Tarr, 2002a)

[7] The term "participatory" is frequently used inappropriately to legitimize top-down approaches and externally driven-agendas.

[8] The difference between an ordinary contour map and a 3D relief model is the vertical dimension that provides important cues to stimulate memory and facilitates the establishment of spatial associations (Rambaldi et al., 2002a).

Photomaps are printouts of geometrically corrected aerial photographs (orthophotographs) placed in map coordinate systems. Orthophoto-maps are a source of accurate remotely sensed data that may be used for large scale community mapping projects. In the process villagers delineate land use and other significant features on transparencies laid-out over the photo. Information on the transparencies is later scanned or digitized and geo-referenced (Muller et al., 2003).

Mobile devices (PDA[9] and GPS). As Global Positioning System (GPS) technology has become cheaper and affordable, its use has spread among NGOs and Indigenous Peoples' organizations. The technology is used for the demarcation of ancestral lands and areas where access to and control over natural resources are in dispute. Data recorded are frequently used to add accuracy to information depicted on sketch maps, participatory 3D models and other less technology-rich community mapping methods.

ENABLING ENVIRONMENTS

A formidable challenge to the realization of the potentials that PGIS applications offer for community empowerment is the widespread lack of effective administrative mechanisms and structures through which decisions reached through participatory GIS applications could be executed and monitored (Kyem 2001).

Although in some countries legislation has created the space for PGIS practice to be operational (Rambaldi and Callosa-Tarr, 2002a) lack of enabling environments or even the presence of disabling regulatory instruments (e.g. Malaysia) present a serious obstacle to its adoption and application.

Accordingly, the disconnection between formal and traditional institutions may have to be reconciled to produce enabling environments that allow for effective PGIS applications.

There is a reciprocal relationship between PGIS and good governance' (GG): GG conditions, and the underlying elusive value of 'political will', are necessary for PGIS to function. At the same time, PGIS can provide a sustainable support for effective good governance – PGIS can be a practical mechanism as well as conceptual modality for accountability, legitimacy, transparency, responsiveness, participation, respect for rights, equity, local usability, and other dimensions of good governance. (McCall 2003; McCall et al. 2005)

FINAL CONSIDERATIONS

PGIS practice currently faces a number of methodological and implementation issues. The socio-political context that provides the basis for PGIS applications often alters the interaction between the PGIS organization and local institutions as the established structures cooperate to alienate the new organizations. Besides, community-based PGIS organizations in the South are resource poor and often need to conform to pre-set data standards, software models and the views and dictates of local Elite and external experts (Sieber 2000). This leaves the PGIS organizations vulnerable to being coerced by public officials and agents that oppose its agenda.

As PGIS becomes a more widespread and accepted development practice, there is evidence that local Elite and state agencies are attempting to control the practice as they have for decades with conventional development projects. PGIS projects in developing countries are often externally driven and geared towards data management instead of community empowerment. Some technocrats advocate for more robust transfer of technology to ensure

[9] E.g. iPaqs, or, Palms, or, hand-held computers.

sustainability of PGIS projects. However, important questions need to be addressed, when decisions are taken to implement geo-spatial technologies at community levels: Whose GIS is it? Whose questions are addressed? Who sets the agenda? What will happen when experts leave or when donor funding dries up? What is left with those who generated the data and shared their knowledge?

Even though PGIS applications have become widespread and computers and GIT&S are getting cheaper and more user-friendly, it is still difficult for community-based organizations to raise the required capital and recruit experts to implement, maintain and sustain high-tech GIT&S. As well, the technology is believed to be limited in procedures for incorporating subjective values (which abounds in the realm of ISK) into the quantitative analyses that occur in GIS applications (Heywood et. al., 1995).

The nature and form of participation are also critical factors in determining the outcome of the community empowerment process. However, we know that public participation takes on different forms (Arnstein 1969; Wiedermann and Femers 1993) each of which has a serious implication for community involvement and hence their empowerment.

Also of interest is the issue of "scale" as different community issues and questions require a particular scale of analysis. Also important is the degree of spatial or locational "precision"(or accuracy) which is required or appropriate in participatory (local-level) spatial planning (Minang and Rambaldi 2004).

PGIS often involves integrating local and modern scientific knowledge for applications that can potentially empower local communities. This involves combining low and high technology, and thus the resultant questions of accuracy tradeoffs, reliability and acceptability.

Other critical aspects comprise the identification of avenues for institutionalising PGIS practice within local planning and development agencies (if appropriate), mechanisms for ensuring protection of privacy and intellectual ownership of local knowledge and for promoting control and access to data and information to those who generated such data.

Among practitioners, researchers and activists, there is the general consensus that PGIS practice is more advanced than the theory behind the applications (Rambaldi and Weiner, 2004) and that there is a need to evaluate the experiences (failures and successes), and develop guidelines and strategies for good practice and for the sound adoption of PGIS to meet the needs of different groups within the developing world.

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