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**Nexus of GeoData Analysis & Local Spatial Knowledge:  
Applications of P-Mapping and PGIS to issues in NRM and  
Community Development:  
A Partial Review (Draft) [1]**

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April 2005

**Applying P-Mapping and PGIS – towards what ends? and where?**

The best measure of the feasibility of the P-GIS approach is the actual success stories of indigenous communities acquiring and applying the GI technologies. There are differing estimates of this, but all estimates are positive,

A survey of First Nations GIS capacity by the Canada-BC Information Sharing Protocol found that, as of 2002, 44% of 109 1<sup>st</sup> Nations (or Bands, Councils, etc) currently use GIS (and another 36% are interested to do so.) The majority use ArcView and ArcInfo, largely because of the promotion and practical as well as political-moral support provided over many years by ESRI. The commonest application is “Traditional Use Studies”, followed by treaty processes including land selection and NRM. (AMN 2002)

In the USA, 50 out of c. 550 tribes associated with the BIA were utilising its digital spatial data bases by 1995, 10 years after the BIA introduced its Geographic Data Service Center – and mostly for NRM. (Goes in Center, 2000)

In NZ, eight *iwi* (Maori clans) were using GIS for resource identification and management as of 1996 (Harmsworth 1997).

However, it is notable that outside of Canada, the USA, followed by NZ and Australia, applications of community GIS by indigenous peoples are not so easy to find. In Poole’s seminal study (1994, 1995) he reviewed the following: Canada 17, USA 3, Brazil 6, Philippines 5, Indonesia 6, Peru 2, Thailand 2, Kenya 3, other Latin America - Argentina, Bolivia, Paraguay, Venezuela, Belize, Dominican Rep., Honduras, Nicaragua, Panama, one each; other Africa – Ethiopia, Senegal, Guinea Bissau one each; other Asia – PNG, Nepal, Bangladesh one each.

In the ESRI listing (1997), there are far fewer, one representative each from Guyana, Indonesia (Borneo), Kenya, Uganda, Laos, and Philippines, as compared with about 75

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<sup>1</sup> All references are found in the associated bibliography: McCall (2005) “*pgis - psp – ik – (cb)nrm: Applying Participatory-GIS & Participatory Mapping to Participatory Spatial Planning and to Local-level Land & Land Resources Management utilising Indigenous & Local Spatial Knowledge. a Bibliography.*”

And for regular updates, see: [http://ppgis.iapad.org/pdf/pgis\\_psp\\_itk\\_cbnrm\\_biblio\\_mccall.pdf](http://ppgis.iapad.org/pdf/pgis_psp_itk_cbnrm_biblio_mccall.pdf)

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from the USA and Canada; though this is unsurprising given ESRI's main interest in the First Nations of North America.

Convis (2001) ESRI round-up of community GIS and participatory GIS for conservation includes Europe, Russia, USA, Canada, Kenya, Brasil, Chile, Peru, Malaysia, Philippines, Indonesia-Kalimantan, Madagascar, Cameroun, etc.

McCall (2005) bibliography on 1000+ PGIS applications finds the top ten countries as India, Indonesia, Philippines, Thailand, Nepal, Mexico, South Africa, Thailand, Kenya, and considerable numbers from the indigenous communities of four North countries, Canada, USA, Australia, and New Zealand.

King (2002) reviewed ten P-GIS examples, and they do not all come out of the local communities, but he investigates to some extent their degree of participatoriness – were ethnic groups or women or local NGOs involved?, and did the P-GIS include geo-data analysis, or only map representations?

In a seminal review of local-level mapping and geomatics [2] of ISK, Poole (1994, 1995) categorized six types of applications, of which he interprets the first 5 as inexorably progressing from one to the next in a development process.

- To gain recognition of land rights.
- To demarcate traditional territories.
- Protecting demarcated lands.
- Gathering and guarding traditional knowledge.
- Managing traditional lands & resources.
- Mobilizing community awareness & resolving conflicts.

The categorisation used in this paper builds on and modifies this sound analysis.

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- 1) Claiming 'Our Land'
    - a. Demarcate traditional boundaries; Land Claims
    - b. Legal recognition of customary land rights
  - 2) 'Knowing & Using Resources means Mapping Resources'
    - a. Identify, locate, analyse specific natural resources  
Forest & Woodland & NTFP resources; Trees and NTFPs 'outside the forest', incl. Ethnomedicine; Water resources & Irrigation; Pastoralism & Livestock; Ethnopedology & Land Suitability; Wildlife; Wetland farming systems; Fisheries - Marine & Inland.
    - b. Manage Traditionally-held Land Resources *Systems*  
Land Use and Land Cover; Landscape Units; (Integrated) Farming Systems; Landuse management; Coastal zones; Conservation management; *Traditional Use* studies; *Bioregional mapping*; Hazards & Risks
  - 3) Managing Conflicts – Internal & External
    - a. Ameliorate Conflicts; Exacerbate conflicts; Working with External Management Plans; EIA
  - 4) Mapping Equity

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<sup>2</sup> Poole uses "geomatics" to mean "digital information technology for acquiring, analyzing, and manipulating earth images." (Poole 1995, p.1)

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- a. Environmental equity; Socio-economic equity; Gender factors; 'Integrated' equity mapping
- 5) Building the Community
  - o Community Awareness; Institutional Strengthening, Empowerment, Cultural-historical knowledge; 'For the Ancestors'; Sacred Values

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## 1. Claiming 'Our Land'

### 1.a *Demarcate Traditional Boundaries of Lands and other NR. Make Land Claims*

### 1.b *Gain Legal Recognition of Customary Land Rights*

The first type of application to be reviewed are the functions and dimensions of mapping/ GIS/ P-GIS for land claims and boundaries. The concept of traditional "boundary" should always be approached carefully and contextually; for instance, in Australian Aboriginal usage, boundaries are seen as 'limits of influence of sacred sites', rather than as strict lines on the ground. (cf. similarly for Canada & North America, Rundstrom, 1995).

The four functions typologised here were applied to First Nation land claims in Canada, - but they are generally applicable to customary land claims in other regions.

Four functions:

- GIS to **identify the areas of use and occupancy** based on IK, oral & written histories, secondary sources, cultural sites, archaeological remains, managed landscape impacts, etc.
- Identification of **priorities for the claims** – Duerden & Johnson (1993, 727) point out that the indigenous communities typically end up with less than 10% of their traditional lands after settling with the government. GIS overlays are vital in selecting priority areas depending on resources, uses, etc. (cf. Johnson '97)  
N.B. overlapping claims and conflicts deriving from them, are not confined to indigenous societies vis-à-vis the state. There are also many overlapping interests and conflicts within and between clans, tribes, communities, nations, relating to land and resources claims, boundaries, etc. (e.g. Philippines (Rambaldi 2002); Thailand (Hoare et al. 2002); Australia (e.g. Brazenor 2000); Canada (AMN))
- GIS, if used interactively (real-time?), can easily, quickly and cheaply generate, display, and assist in **evaluating scenarios** of alternative land allocation / tenure proposals. New tools under development or already in service, such as interactive displays, scenario generation, impact prediction, e.g. GIS WallBoard (Florence et al. 1996); and MAPTALK (Wien et al. 2003; <http://www.maptalk.com/> )
- GIS provides the accuracy and rigour required for **court procedures**.  
"[GIS] builds on local knowledge and .. presents them in a format that facilitates transactions with external agencies." (Mohamed & Ventura 2000). Provides a apparent legitimacy.

This is well illustrated by the many examples below from Canada, USA, NZ, Australia.

Chief Calvin Hyzims of the Eagle Clan of the Gitksan believes there is great power in a map. "The government won't recognize anyone without a map. It has been essential for the reclamation of our territory." He reminds us that their approach to territory did not

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require written maps. "Our culture and the elders did not use or need maps as part of their traditions. They knew who they were and they knew whose land they were on and whose land they could cross over. To make the maps we walked the trails blazed by our elders years ago. We found walking sticks, shelters and food storage sites from the early 1900s. Elders had been living in these areas in 30 to 40 degrees below zero. We are re-blazing the trails and this information about our land has been used in Court as evidence of our title." (Quoted in Lydon 2000)

Marozas (1991) and Johnson (1997) argue that "GIS technology is well suited to provide litigation support" in Canadian First nation land claims. A high degree of spatial precision is needed to provide the legal rigour expected for land claims in court. "A .. map is likely to enhance a court's understanding, synthesis, and resolution of a land dispute" (Marozas, 1991, p.78) Also referring to Canada, Duerden & Johnson (1993, p.729) assert that "GIS [is] a useful tool in bridging the gap between traditional landscape images and the demand for formal cartographic representations of land necessary for land claim negotiation."

Peluso justifies her use of *counter-mapping* in Kalimantan as a means to ".. appropriate the state's techniques and manner of representation to bolster the legitimacy of 'customary' claims to resources." (Peluso 1995, p.384). McConchie & McKinnon (2002, 28) argue for the Chinese case, that "Often getting "onto the map" is the first step in groups gaining public acknowledge of their condition." 'the key text for modern states to take over resource tenure is the map' (after Vandergeest 1996)

Poole (1995, p.1) alludes to the gap to be bridged with an interesting distinction between *mapping* and *geomatics*. "[Local/community] mapping signifies what is happening *within* communities" and "geomatics serves ... communities in responding to *external* pressures and concerns, rather than mobilizing internal energies."

### EXAMPLES

Canada:

Alberta: 'inventory of geographical area of the Reserve' as a result of a user needs analysis, Beaver Lake, Alberta (Makokis & Buckley 1991)

British Columbia (BC): (Aberley 1993; 1999 // Aberley & George 1998 BC; // Giese 1996 // Gitxsan people (Collier & Rose 2000)

B.C. ".. employment of significant maps to establish aboriginal title to .. traditional territories." (Goes in Center 2000) // [http://www.nativemaps.org/map\\_gallery.html](http://www.nativemaps.org/map_gallery.html) Map of the "overlapping First Nation and Land & Resource Management. Plan LRMP boundaries in BC"

Dene Mapping Project, northern Canada has used digital mapping since 1981, 1:250,000 maps of i.a. hunting & fishing zones, trapping trails, cabins, camps, species, seasonality, etc. used to designate land use & occupancy, 1890-1975. Designated use boundaries. (Asch & Tychon 1993; Johnson 1997; Nahanni 1997; Deh Cho LUPC 2003; Norwegian & Cizek 2004 )

Clayoquot (Goetze 2000) // Gitxsan (Anon 2000) // Shuswap Nation, BC (Le Dressay '93 IN: Johnson 1997) // Six Nations; Geo-Systems of Ontario (Goes in Center 2000) // Squamish (Calla & Koett 2000)

Yukon Territory: CY1 1:250,000 digital mapping coverage of Yukon Territory used to settle with Federal Govt . over 41,000 sq. km. (Duerden & Johnson 1993; Duerden & Keller 1992; Duerden & Kuhn 1996)

USA:

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Cherokee Nation in Oklahoma mapping and GIS of fractionated tribal lands. (Bond 2002)  
Zuni Pueblo of New Mexico translated 'non-graphic descriptions' of lands appropriated between 1846-1939 into digital maps to identify ¼ million additional acres of their land, and enabled them to receive considerable compensation (Marozas 1991)  
USA: burial in customary sites, (Goes In Center 1999); Wisconsin (He 1995)

### Latin America:

Mexico, Chiapas State, Zapatista groups: land rights & land tenure. (Froehling 1995)  
Panama: (Gonzalez et al 1995; Chapin & Threlkeld 2000). Eastern Panama, Darien Province, Kuna, Embera & Wounaan peoples. (Herlihy 2003)  
Southern Belize, Maya people: protecting Mayan land rights with P-mapping & P-GIS; training. (Toledo Maya Cultural Council 1997)  
Nicaragua, Miskito Reefs: (11600 sq. km.) define Miskito people's community marine waters & reefs; thus help to justify Miskito actions against poachers, destructive commercial fisheries, Colombian drug smugglers, toxic waste dumpers, etc. "mapping with sail, scuba & satellite(GPS)" (Nietschmann 1995).  
Nicaragua, Bosawas: Miskito people 'but need parallel processes of political support, scientific data, protection, institutional strengthening' (Stocks 2003) // Mosquitia (Herlihy & Leake 1997)  
NE Nicaragua: Miskito people, P-mapping, cultural-historical meanings & identity of place. signifiers of toponyms, cultural landscapes. (Offen 2003)  
Nicaragua, Caribbean Coast, Miskito peoples Garifuna & Afro-Creole communities (Gordon et al. 2003)

Guyana: Upper Mazaruni area; Akawaio, Arekuna & 4 other Amerindian peoples, ancestral land titles; *bodawa*: hunting and fishing reserves (Griffiths 2002)

Venezuela, Ye'kuana people: (Arvelo-Jimenez & Conn 1995)

### Brasil:

470 Mengraknoti Kayapo people have regained control over 4.4. m. ha. of land. Largest part of the \$600,000 bill for customary lands demarcation was for helicopters to airlift cement for markers. (Arvelo-Jimenez & Conn 1995; Poole 1995)

Brasil: Chico Mendes Extractive Reserve, Acre State indigenous groups of rubber tappers' maps of forest clearings and rubber collection areas & trails. Transcribed to 1:100,000 topographic survey maps. (Foster Brown et al 1995)

Peru: Amazonia, Purus River, Nahua people (MacLennan 2003)

Peru: Rio Galvez Basin (Iquitos), Matsés peoples. SICNA= Native Communities IS of geological-hydrological geodata, and socio-economic & demographic & cultural databases, for Land claims & proposed Communal Reserve. (Chase Smith et al. 2003)

Argentina: Pilcomayo River, Wishi people, mapping customary lands 1991, >1000 indigenous place names. (Survival International 2000?)

### Asia & Pacific:

#### Indonesia:

Kalimantan GPS & GIS (Sirait et al. 1984; Prasadjo et al. 1984; Fox 1986; 1998) // Kalimantan - 'counter-mapping' as deliberate, directed strategy to promote interests of the excluded (Peluso 1994, 1995)

Mapping indigenous lands to create protected area borders & management plans. Conflict between prior rights of local people & recent rights claims over same territory. (Eghenter 2000); ditto Dayak lands (Natalia 2000) ditto Upper Malinau R. (Wollenberg 1999) // GPS + GIS mapping traditional territory & LU of villages E. Kalimantan. (Stockdale & Ambrose 1996; Stockdale & Corbett 2002) //

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West Java & Irian Jaya (Fox 1989/90)

Sulawesi: P-mapping of forests & resources – but not legalised? (Yayasan Tanah Merdeka)

Philippines:

1993 Philippines Congress passed native ancestral rights for usufructure rights to land.

1997 “Indigenous People’s Rights Act” allowed for full Ancestral Domain claims.

CADC – Certificate of Ancestral Domain Claim and CADT – Certificate of Ancestral Domain Title – one condition of which is to prepare an Ancestral Domain Resource Management Plan for the area. (Rambaldi & Callosa-Tarr 2002))

PAFID – Philippines Assoc. for Inter-Cultural Development.

cf. Bennagen & Royo (2000); Rambaldi & Callosa-Tarr (2000, 2001, 2002); Gonzalez (2000)

Ifugao people – delineation of Ifugao ancestral lands (Gonzalez 2000) // Mindanao: Ancestral Domain Claim of Higa-onon people, in Impasug-ong, Bukidnon using PGIS, P-mapping, (with PAFID & Agtulawon-Mintapod Higaonon Cumadon) (Abelo et al. 2004) //

Malaysia:

Sarawak, Rumah Nor (Iban) people. legal actions in court for land rights (vs. the state & forestry concession Borneo Paper & Pulp Co.) But Malaysian state has invalidated the Court ruling by setting survey requirements threshold (Land Surveyor’s Bill, 2001) which are too high for feasible P-GIS anyway (AMN 2002 Sarawak) // Land rights in Sarawak (Scollon 2000/2001); Sarawak: Sahabat Alam Malaysia (Friends of the Earth Malaysia). Evong & Thompson (2001) // Summary of community mapping & PGIS, West Malaysia & Sarawak, for resource management & protecting indigenous territorial rights & training-Orang Asli, Dayaks, (PACOS Trust & JOAS- Indigenous Network of Malaysia). (Lasimbang 2004) // Sarawak: mapping Dayak customary lands & land tenure with PGIS, legal status of P-maps (Borneo Resources Institute BRIMAS) (Bujang 2004)

Solomon Islands: protection of ancestral forests from southeast Asian commercial loggers (McKinnon 2001)

Nepal: property rights vis-à-vis Makalu-Baran NP (Forbes 1995)

Thailand: village boundaries for indigenous mountain peoples, especially employing long-term fallows swidden cultivation (Akha, Hmong, Yao, Lisu, Karen, etc.) (Uraivan 1992, 1993; Puginier 2001, 2002) // Upper Nan watershed, Nan Province (Hoare et al. 2002) // Northern Thailand - Vandergeest (1996) // mapping of **land titling** oversimplifies overlapping claims from different family members and reduces them to a simplistic 2-D space of ‘household title’ – leads to exclusion, dispossession, & conflicts (Ganjanapan 1994)

Australia:

(Brazenor 2000; Brazenor et al. 1999; Bowen 1997; Crerar 1998; Guthrie & James 1996; Neate 1999); Sutton 1996; Turk 1996; Turk & Mackaness 1995; Turnbull 1989; Wigston 2001)

‘Mabo’ decision of the Australian High Court, 1992. Aboriginal & Torres Strait islanders Meriam people, entitled to ‘possess, occupy, use & enjoy’ the Murray islands. The key decisions of the Court were: common law concept of “native title” in place of previously-accepted “Terra Nullius”; source and content of native title is determined by traditional occupation of, or connection to, land; but native title can be extinguished by the Crown [<sup>3</sup>]

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<sup>3</sup> Mabo & others v. the State of Queensland (no. 2) (1992) 175 CLR 1.

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Wik people v. State of Queensland 1996. (Wik & Thayorre peoples, challenging pastoral leases.)

NZ: (Harmsworth 1997, 1998); (Laituri 2002); Solomon and Watson (2001); Morad & Jay (1997);

South Africa, E. Transvaal, Kiepersol: P-GIS to represent and analyse local perceptions and conceptualisations of spatial inequalities in post-apartheid access to land and land reform. (Harris et al 1995; Weiner et al. 1995, 1997; Weiner & Harris 1995, 1999, 2002)

South Africa, Algeria village: using video for land tenure information in a communal property association (Roux & Barry 2001)

Mozambique: property delimitation & community boundaries using large-scale APs (Anderson 2000) // community mapping (with GPS) for community *régulo* land entitlements Gondola Dist., Beira Corridor (MARENA 2003)

## **2. 'Knowing & Using Resources means Mapping Resources' To identify, locate, and analyse specific natural resources; To Manage Traditionally-held Lands and Land Resources Systems**

Many conventional applications of GIS are aimed at 'efficient management' of natural resources. What is the implication of utilising geo-information and GIS with regard to common property regimes and customary resource law? [<sup>4</sup>]

"Management" of environment and natural resources is used here at any of three levels of natural resource management intensity –

- (i) simple, exploitative use of a resource or of a eco-unit,
- (ii) maintenance or reproduction of a particular resource or unit,
- (iii) management of the broader ecosystem containing and nurturing the resource.

e.g. in a simple, knowledge-mining, exploitative, RRA approach

e.g. *Bioregional Maps* (Aberley 1993; Aberley & George 1998)

e.g. *TUS – Traditional Use Studies* (Weinstein 1997)

e.g. local knowledge of hazards (e.g. CESS 1991; Gupta 1989; Harris et al 1995; ERCS 1989; Williams & Dunn 2003)

e.g. *Land Literacy* ('environmental appraisal') Kerala (e.g. Franke & Chasin 1994)

e.g. Resource identification and management, - in NZ, 1996, 8 *iwi* were using GIS. (Harmsworth 1997)

### **2.a. Identify, Locate, and Analyse Specific Natural Resources**

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The High Court 'Mabo' decision itself did not determine native title rights, but it set the precedent that native title could co-exist with leaseholds under Australian statute law. The Native Title Act 1993 defined native title. (Brazenor 2000; et al.)

<sup>4</sup> Fox et al. (2003) find that one outcome of improved resource mapping (including P-GIS) is the *loss* of common property resources as privatized and individualized.

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Which resources are most important to local people? This question can only be adequately answered within the context of a specific population group and their natural resource system. For instance, Aberley (1993) answers this question for British Columbia as water resources and distribution of wildlife and vegetation.

### **ITK/ISK of Forest and Woodland Resources: [5]**

These include timber, woodfuel, non-timber forest resources (NTFP) A growing institutional application is PGIS for communities involved in official certification of their marketed timber, wood, or NTFP products.

Forest and wood resources is the single most widespread application of PGIS, and Nepal has led the way.

Nepal: “integrating GIS & GPS” (Adhikari et al 1997) // Nepal et al. (Carter et al 1996) // community forestry, Forestry User Groups (Jordan 1999, 2002; Jordan & Shrestha 2000) // Community Forestry, Yarsha Khola watershed, Nepal used participatory photo mapping, participatory inventories + GPS surveys and GIS with FUGs (Jordan 1999; Jordan & Shrestha 1998); // Jhikhu Khola watershed, use of orthophotographs (Bitter & Shrestha 2000; Shrestha & Tuladhar 1999?) // landuse changes and community forestry, Middle Hills (Gautam et al 2002) // Parbat Dist., Dhauligiri, Middle Hills aerial photos, participatory photo-mapping for community forestry with FUGs (Mather 1999, 2000, 2000; Mather et al 1998) // Dhanuka District (Maharjan et al. 1998) // Makalu-Baran NP participatory management plan (Forbes 1995) // using API for resource mapping & management (Carson 1987) // participatory mapping for community forestry (Jackson et al 1994)

Botswana: wood fuel for villages (van Heist & Kooiman 1992). // Kung! Bushmen – seasonal boundaries of N!ore (zones of resource gathering) (in: Alcorn 2000 a)

Cameroun: designation of areas for Community Forestry under Forest law (of 1994) – legal requirements include mapping CF areas, inventories, former use, and management plans. Scenario maps of stakeholders and objectives into GIS (Lescuyer et al. 2001; Minang p.c. 2002). “Participatory mapping at landscape levels” including P-GIS training related to community forest claims and designation (Brown 2001; Brown & Hutchinson 2000; Mount Cameroon Project 1998, 1999; Mbile et al. 2000?)

Ghana: the powerful didn't like the openness of community P-GIS of forest resources (Kyem 2002)

Madagascar: Sussman et al (1994); Ford & McConnell (2001?)

South Africa: firewood locations Namaqualand (N. Cape), Peddie Dist. (E. Cape) Coloured population groups. (SEI 2001)

Tanzania: East Usambara mountains, NTFPs especially cardamom. (Sah 1996)

Zambia: community forestry (Jordan 1999)

Indonesia: (Eghenter 2000) (Fox 1986) // alternative inventory techniques NTFPs & participatory forest profiling & zoning, East Kalimantan (Kayang Mentarang Nature Reserve) (Stockdale & Ambrose 1996; Sirait et al. 1994) (Momborg et al 1994). E. Kalimantan ITTO project (Wollenberg et al. 2002); E. Kalimantan- Dayak people (Stockdale & Corbett 2002); Traditional forest management & social forestry E. Java (Fox 1989, 1990) // Kalimantan, the maps produced and used by RePPProt (the *transmigrasi* agency) did not show

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<sup>5</sup> Mangroves: see coastal resources

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indigenous village communities or local homesteads; local people used GPS and GIS. (Peluso 1995)

Indonesia, Sulawesi: P-mapping of rattan & construction materials (Yayasan Tanah Merdeka)

China, Yunnan: PLA and 'mobile interactive GIS' to identify, map, design and test scenarios for local forest management plans, including riparian buffers. Fuelwood demand (including for distilling lemon grass) and supply sources (McConchie & McKinnon 2002).

Papua New Guinea: rainforest conservation (Barry 1996)

Malaysia: forest resource rights in Sarawak (Scollon 2000/2001); Sarawak: Sahabat Alam Malaysia (Friends of the Earth Malaysia) (Evong & Thompson (2001)

Philippines, Ifugao, extent of forest reserved for *muyong*. (Gonzalez 2000) // rattan harvesting by Dumagat people, Dupinga watershed. (Tengco 1995)

India: CFM decision-making: GIS supporting CFM groups to manage their natural resources at a "landscape level". (Singh & Rangoori, 2004)

NWFP, Pakistan - Malakand Division social forestry, land ownership & land use mapping by ethnic groups & gender. (ESCAP 2002?)

Solomon Is. (McKinnon 2001)

USA: Appalachians (Brooks et al 1999)

Fort William 1<sup>st</sup> Nation (part of LSFNDD-Lake Superior 1<sup>st</sup> Nations Development Trust) forest reserve management (Johnson 1997)

Canada, Alberta (Makokis & Buckley 1991); BC Gitksan people (Collier & Rose 2000)

Mexico: (Bocco et al 2000, 2001);

Chile: southern Chilean Andes, Mapuche-Pewenche people (Herrmann 2001)

Brazil, Chico Mendes Extractive Reserve, Acre State indigenous groups of rubber tappers. Mental land cover maps of forest clearings and rubber collection areas & trails. Being very large areas, these are transcribed to 1:100,000 topographic survey maps with a focus on hydrography. (Foster Brown et al 1995)

Peru: participatory zoning, mapping, and planning 'shortest-route' paths, for Brazil nuts collection (Mitchell & Espinel 2001)

A recent addition is the application to 'environmental services' of forests, notably for carbon sequestration, in response to potential opportunities under Kyoto protocol on global climate change (Tanzania - Verplanke 2004; India & Nepal)

### **Trees, (TROF), NTFPs and Vegetation 'outside the forest':**

Zimbabwe: Village (gender) (Fortmann 1996).

Vietnam: Bio-resources on "wastelands" in Vietnam, Dao people (Sowerwine 2001) // NTFPs.

Australia valuable vegetation types Yolgnu people, Arafura Swamp, Arnhem Land (Bartolo & Hill 2001)

Dominican Rep., Zambrana-Chacuey, tree resources & gender (Rocheleau & Ross 1995)

Nicaragua: plant use & landuse in home gardens. (Méndez et al. 2001)

### **Water Resources and Irrigation:**

Nepal: Adhikari et al 1997.

Philippines, Ifugao: Locate highest water sources, irrigation canal routes, maintenance & repair of terraces. (Gonzalez, 2000 )

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India: Water Table Depth Kerala PRM programme (Franke & Chasin 1994, 2000).  
Jordan, Bedu people: PRA, ITK, participatory interpretation of RS images with Bedu shepherds identify water harvesting potentials (Patrick 2002)  
Kenya, Lake Baringo area: PRA, ITK and expert systems with GIS for water harvesting potentials (Patrick 1996)  
South Africa: water points Namaqualand (N. Cape), Peddie Dist. (E. Cape) Coloured pop. groups. (SEI 2001)  
Uganda, refugee camp - P-mapping for location of water stands (Morgan 1994)

### **Pastoralism / Livestock**

Burkina Faso: pastoralism, mapping ITK of quality of grazing lands, etc. (Sedogo & Groten 2000; Sedogo 2002; Sedogo et al. 2003)  
West Africa: using PRA methods including mapping pastoralists management practices (Waters-Bayer & Bayer, 1994)  
Niger: use herders' accounts to map & GIS livestock activities (ecology, distribution, landuse, grazing patterns, seasonality) in agro-pastoral landscapes in semi-arid Niger, (Turner & Hiernaux 2002)  
Somalia: pastoral common property regimes using some P-mapping (Ford et al. 1994)  
Tanzania, Maasai people: four counter-mapping examples of pastoralists' interests & rights vis-à-vis Parks, etc. (Hodgson & Schroeder 2002)  
Tanzania, Kilosa District: use of GIS with local stakeholders (Shishira et al. 1997)  
East African pastoralists: participatory risk mapping (Smith et al. 2000)  
Namibia: nomadic pastoralists (Powell 1997, 1998); // North Central Namibia – grazing & water supplies (Verlinden & Dayot 2000)  
South Africa: grazing quality Namaqualand, N. Cape, Peddie Dist. E. Cape, (SEI 2001)  
Russian Arctic, Nenets Autonomous Okrug: degenerative change to grassland tundra in reindeer herding areas using Landsat RS & ITK (Rees et al. 2002)  
Nomadic reindeer pastoralism in northern Sweden: PRA to collect and analyse traditional ecological and landscape knowledge of reindeer habitat use, integrate with RS-based vegetation classifications & land use maps [leading towards conflict management] (Sandstrom et al 2003)  
Tibetan Plateau: P-mapping of pastoral land use (Ryavec 1999)  
Mongolia: pastoralists use RS & GIS to identify grazing limitations and opportunities (Rasmussen et al. 1999)  
Nepal, Langtang National Park: mapping conflicts between biodiversity and livestock & other human needs (Fox et al. 1994, 1996; Prasadjo et al. 1994),  
India, shepherds, using GIS to combine environmental, land use & land cover knowledge of herders, professional foresters, and traditional communities (Robbins 2003)

### **Soils (Ethnopedology), and Land Suitability / Evaluation**

Ethno-pedology is probably the second biggest application sector in indigenous technical knowledge (ITK), but there are limited uses made of P-mapping and P-GIS. A very comprehensive review of ethno-pedology in general, with some examples of using geo-information tools, is (Barrera Bassols & Zinck 2000; Barrera Bassols 2003). Also see: (Waldron & Sui 1999). Classifications in ITK are usually assumed to be more based on functionality or purposiveness such as resource management systems (e.g. Tabor & Hutchinson 1994) than those of Scientific Knowledge; though there is evidence countering this, e.g. Birmingham's (1998) ethno-pedology study in Burkina found local capability to use ITK to classify soils from isolated soil samples, not just in a landscape context.

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Mexico- Cent. Mexico, Michoacan State, forestry & land evaluation (Bocco & Toledo 1997)  
// Mexico- Nayarit State, Costa Norte, participatory land suitability (Bojorquez-Tapia et al 2001) // Valley of Mexico, maize soils (Cajuste 1991)  
Michoacan, San Francisco Pichátaro, comparisons of indigenous maize farmers' ITK maps of soils and scientific soil surveys (Barrera Bassols 2003).  
Costa Rica: mapping indigenous soils & land classifications (Box 1991); // (R. Gonzalez 1995); // land evaluation, Neguev Settlement (van Uffelen 1990)  
Lebanon: PRA & farmers' ITK for inputs into soil classification & land capability mapping (Zurayk et al. 2001)  
Egypt: Bedouin pastoralists, ITK & location of soils for pasture for small stock, & for cereals (FitzSimons et al. 2002)  
Senegal: Senegal River valley - comparison of farmers' soil classification and scientific classification; ITK of landscapes, land capability (Tabor & Hutchinson 1994)  
Neimeijer & Mazzucato  
South Africa, E. Transvaal, Kiepersol: P-GIS to identify indigenous knowledge of soils and land potentials. (Harris et al 1995; Weiner et al. 1995, 1997; Weiner & Harris 1995, 1999, 2002)  
South Africa: Namaqualand, Peddie Dist. Coloured pop. groups. Grazing land quality classes compared P-mapping & RS interpretation. (SEI 2001)

### **Terrestrial Wildlife (Hunting):**

Australia: Crerar et al 1998 (crows).  
Canada: Grenier '98 Spatial & temporal distribution, migration patterns, breeding sites, population dynamics, inventories, (ecosystems) of whales caribou, fish, etc.) // Nunavik Inuit, fox, wolf, eider duck, geese, ptarmigan, (Kemp & Brooke 1995) // Inuit (Rundstrom 1987) // Gitksan people trapping & hunting (Collier & Rose 2000)  
Dene Nations, NW Territory, Canada P-mapping & PGIS & digital mapping since 1981, 1:250,000 maps of hunting & fishing zones, trapping trails, cabins & camps, species, seasonality, etc. (Asch & Tychon 1993; Johnson 1997; Nahanni 1997; Deh Cho LUPC 2003; Norwegian & Cizek 2004 )  
USA: buffalo ranges, Wisconsin Winnebago Nation (He 1995) // Lakota means of locating buffalo herds (Rundstrom 1995, 47)

Brasil: Mamirauá project, biodiversity conservation (Ayres 2001)  
Panama: western, Buglé people, extensive survey & P-mapping of sites (Derek Smith 2003).  
Paraguayan Chaco. Locations, regions & resources used traditionally for hunting, fishing & gathering subsistence activities by Angaité Indian groups – animals, fish, honey. Used ephemeral maps, sketch maps, air photos, GIS. (Leake 1996)  
Guyana: Upper Mazaruni area; Akawaio, Arekuna Amerindian peoples, *bodawa*: hunting reserves (Griffiths 2002)

Botswana: N!ore resource zones of the Kung! Bushmen (in: Alcorn 2000 a)  
Cameroun: P-village management of buffer zones around national parks, e.g. Korup (Mbile et al 2000?)  
Namibia: wildlife monitoring & management (Tagg et al 1996)  
Zambia: wildlife management. – chiefs and agencies participated in the process, but not the 'community'. (Lewis, D.M. 1995)

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*Social & Spatial Boundaries among Foragers, Fishers, Pastoralists & Peripatetics.*  
(Casimir & Rao 1992)

## **Wetland Farming Systems**

Guinea-Bissau: PRA, P-maps and air photos in wetland drainage development for rice  
(Neefjes 1993)

## **Fisheries:**

### **Marine Bio-Resources:**

Canada: (Grenier 1998 {see above} // Clayoquot Sound, Ahousat First Nations, gray whales – combine elders' oral histories of culture of hunting + habitat with hi-tech mapping & recording of whale habitats. (Hines 1999?) // Nunavik Inuit, beluga whale, arctic char, river fish, (Kemp & Brooke 1995) // Great Lakes EAGLE project (Bird 1995) // Quebec-Labrador marine resources (QLF 2001)

Newfoundland: participatory mapping ('memory maps') of conservation areas for lobster, etc. fisheries, post- the Grand Banks cod moratorium (MacNab 1998, 2002)

USA, Gloucester Maine: "map-biography" - P-mapping of lobster fishing grounds utilising ecological ITK. (St. Martin, 1999, 2001)

Turks & Caicos Islands: P-GIS of ISK of small-scale fisheries, conch & lobster (Close 2003)

Nicaragua: Miskito Reefs, reef fisheries, turtles, lobsters (Nietschmann 1995)

Dominican Rep.: coral reef fisheries (Stouffle et al. 1994)

St. Lucia: Mapping Laborie Bay – mainly for reefs, not for fishing. (Smith 2003) // Soufriere Marine Management Area protected area, P-maps of zoning, conflicts between fisheries, tourism, conservation. (Romulus 2003)

Philippines: fisheries, reefs, mangroves, seagrass, over fishing (Walters 1998, 1999) // 'PCRA' (partic. coastal resource assessment) of ITK of coastal resources, P-mapping at 1:10-20,000, over-fishing, habitats, reefs, mangroves, etc. (Burke et al 2002) // PRA integrated with GIS to devolution of fisheries & mangrove, Panay, Capiz. "Community very reliable identification of spp, location, density, but inaccurate on spatial extent of fish" (Agdalipe & Somsak 2003) // Participatory resource assessment in Philippines fishing community. (Walters PhD 1997); Coastal Resource Management Project & Silliman University: marine fisheries, reefs, seagrass, resource degrade, 1:10,000 & 20,000 community maps and GIS, Training Handbook for Community Workers & Coastal Resource Managers. (Walters et al. 1998)

South Pacific: Customary marine tenure (Townsend et al. 1997) // traditional ecological knowledge with GIS for marine & coastal resources (Calamia 1999) // French Polynesia, Moorea; coastal lagoon fishing by women, p-mapping of women's resource use & locations (Walker 1998)

New Zealand: Maori CPR fisheries. (WWF 1999)

### **Inland Fisheries:**

Laos: ITK in inland fisheries CPR, aquatic management. (Rahman 199?)

Guyana: Upper Mazaruni area; Akawaio, Arekuna Amerindian peoples, *bodawa*: hunting and fishing reserves (Griffiths 2002)

*Social & Spatial Boundaries among Foragers, Fishers, Pastoralists & Peripatetics.*  
(Casimir & Rao 1992)

## ***2.b. Manage Traditionally-held Lands and Land Resources Systems [<sup>6</sup>]***

### **Land Use and Land Cover; Landscape Units** (mainly descriptive studies)

Canada: & general: mapping of 'folk taxonomies' of land, land use, NRM using ITK, indigenous names. (Poole 1995; Brodnig & Schonberger 2000)  
Canada, Inuit: Rundstrom (1987)  
Mexico: (Bocco & Toledo 1997)  
Nicaragua: mapping land use & tenure on the Caribbean coast. (Dana 1998)  
China: Yunnan (McKinnon 2001)  
India: Kerala - Land Use; Landforms & Surface Material. Kerala PRM programme (op cit).  
Lebanon: PRA & farmers' ITK for inputs into agro-ecological zoning & GIS (Zurayk et al. 2001)  
Thailand: (data-exploitation) 'ground truthing' for RS. (Bronsveld et al 1994 )  
Thailand: Karen peoples (McKinnon 2001) // Akha, Hmong, Yao, Lisu, Karen, etc. indigenous peoples (Uraivan 1992, 1993; Puginier 2001, 2002)  
Zimbabwe: Mafungautsi Forest, land cover changes with GIS & P-mapping (Mapedza et al. 2003)

### **Land Use Management & Planning / incl. Watershed Management**

Brasil: Chico Mendes Extractive Reserve. (Foster Brown et al 1995)  
Central America: sloping lands, hillside agric., Farming Systems Research (CIAT) (Ashby et al 1999)  
CIAT - hillside environments in Central America (Ashby, Sanz et al. 1999), (Vernooy et al. 1999)  
Nicaragua – P-mapping in micro-watersheds (Vernooy 2000)  
Jamaica: participatory watershed planning (Rybaczuk 2001)  
Canada: & general: mapping of 'folk taxonomies' of land, land use, NRM using ITK , indigenous names. (Poole 1995; Brodnig & Schonberger 2000)  
Canada: SWAT (Strategic Watershed Analysis Team); Canada, BC: Gitxsan people (Collier & Rose 2000)  
USA: Hawai'i (Dizol 2001A, B) // Oklahoma Mvskoke (Creek) people management of fire (Rundstrom 1995 46, brief ref. but not specific geo).  
  
Ifugao, Philippines: Shifting Agriculture. Locate and sequence fallow lands; monitor location & extent of field damage; watershed management. Broadening the spatial extent (scale) under consideration for watershed management (Gonzalez, 2000 ) // Monitoring & evaluation of land use changes (e.g., Rambaldi et al. 2000, etc.)  
Yunnan, China: watershed management, riparian buffer zones; identify environmental (hazard) constraints on development, e.g. from slope, aspect (McConchie & McKinnon 2002).  
Vanuatu: community landuse planning (Tellus 2003?)

Australia, Arafura Swamp NRM in Arnhem Land (Bartolo & Hill 2001)

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<sup>6</sup> Most of the land planning & management, NRM, Agro-Ecosystems management, etc. methodologies involve integration of bio-physical and socio-economic information which is problematic at the best of times, and more so when dealing with spatial data and local knowledge. (cf. Quon et al. 2001; and many other commentators)

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NZ: conservation management using ecological ITK (Laituri & Harvey 1995)  
India: application of the water table depth map to select possible vegetable growing plots in dry season - Kerala PRM programme.

Burkina Faso: pastoralism, grazing lands, P-mapping of land use, and LU management (Sedogo & Groten 2000, 2003?; Sedogo 2002; West Africa: (Waters-Bayer & Bayer, 1994)  
Ethiopia: aerial photographs for land use planning. (Sandford, 1989)  
Malawi: 'environmental management, Shire River - RS, RRA & PRA (Toledano et al 2000)  
Namibia: north central Namibia, ITK of 'indigenous land units' for improved NRM with communities (Verlinden & Dayot 2000; Namibia Govt. 2002?)  
South Africa, E. Transvaal, Kiepersol: P-GIS to identify and analyse local perceptions of land use problems and alternative solutions. (Harris et al 1995; Weiner et al. 1995, 1997; Weiner & Harris 1995, 1999, 2002)  
South Africa: Namaqualand, Peddie Dist. Coloured population groups. Grazing land quality classes compared RS interpretation & P-Mapping which includes land management & social factors, e.g. water, carnivores, proximity to village. (SEI 2001)  
Zimbabwe: gendered access and control of village lands and resources (Fortmann 1996)  
Russian Arctic, Nenets Autonomous Okrug: degenerative change to grassland tundra in reindeer herding areas using Landsat RS & ITK (Rees et al. 2002)

### **(Integrated) Farming Systems (FSR)**

Thailand: Karen peoples (McKinnon '01)  
Philippines, Ifugao people. Water sources & irrigation canal routes, location & sequencing of fallow lands, maintenance needs of terraces and fields. (Gonzalez 2000)  
North Central Namibia – ITK of eco-hydrology, grazing & water supplies (Verlinden & Dayot 2000)

### **Coastal Zones**

(see also: Fisheries)

Philippines: 'PCRA' (participatory coastal resource assessment) of ITK of coastal resources, P-mapping at 1:10-20,000, over-fishing, habitats, reefs, mangroves, etc. (Burke et al 2002) // PRA integrated with GIS to devolution of mangrove management, Panay, Capiz. "Community very reliable identification of spp, location, density, but inaccurate on spatial extent" (Agdalipe & Somsak 2003) // CRMP – Coastal Resource Management Project. Sketch maps & drawing over base map. (CRMP website) // Participatory resource mapping for community-based coastal resource management Rambaldi, Fernan & Siar (1998 a., b.) // Participatory resource assessment in Philippines fishing community. (Walters PhD 1997); // Coastal Resource Management Project & Silliman University: coastal resource degrade (mangroves), 1:10,000 & 20,000 community maps & GIS Training Handbook for Community & Coastal Resource Managers. (Walters et al. 1998)

South Pacific: traditional ecological knowledge & GIS for coastal resources (Calamia 1999)  
USA- Hawai'i: Pili Pa'a Pili Pu Pili Pono: restoring balance, integrate indigenous with new coastal zone management, GIS applied to culture areas, historic land management / terraces (Kaiaokamalie 2001) // GIS overlay maps of Native Hawaiian cultural & NR in coastal zone. (Matsuoka et al. 1997)

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USA –Oregon, Nehalem and Umpqua Estuaries PPGIS and multiple criteria DSS for estuarine wetland restoration site prioritisation (Khemarith So 2004??)  
Nicaragua: mapping land use & tenure on the Caribbean coast. (Dana 1998)

### **Conservation Management**

NGOs and community groups using GIS and computer mapping (with varying degrees of local people's participation. Europe, Russia, USA, Canada, Kenya, Brasil, Chile, Peru, Malaysia, Philippines, Indonesia-Kalimantan, Madagascar, Cameroun, etc. (Convis 2001).  
NZ: conservation management using ecological ITK (Laituri & Harvey 1995)  
Collaborative GIS method for integrating local and technical knowledge in biodiversity conservation priorities. (Balram et al. 2004)  
Madagascar - Ford & McConnel (2001?)  
Ecuador: (Martin 2000)  
Mexico, and Canada - CB-GIS for biodiversity conservation (Meredith et al. 2002)  
Mexico - Sierra de Manantlan biosphere reserve, Jalisco & Colima states, GIS-based approach for participatory decision making (Cardenas-Hernandez & Martinez Rivera 2003??)  
Tanzania, Gombe Nat. Park, community P mapping in 6 neighbouring villages, landuse, tenure, related to map chimp behaviour & activity, habitat (Pintea et al 2004)

**Traditional Use Studies (TUS)** is an established methodology in BC, Canada.

Following various legislative & judicial requirements re. First Nations, Weinstein (1997) (also Usher et al) make an important distinction between NR use & management which is only traditional and historical, i.e. native peoples have some cultural link only to traditional hunting & fishing habits; and a 'sustenance harvesting adaptation' in which peoples are combining traditional hunting/gathering/fishing with modern economy jobs and technology, whilst adapting their traditional organisational set-ups. This latter form of Traditional Use is widely found amongst northern peoples and requires new approaches to land evaluation, resource assessment, NRM, and mapping.

Neskonlith Band, Shuswap Nation, BC. used GIS to set 3 NRM scenarios for exploration, not selection: Economic - incl. Forestry, golf, aquaculture, etc.; Ecological - 25 data layers inc; wildlife corridors, culture sites, traditional use zones, etc.; and Balanced – middle ground. (Mackasey '93 in: Johnson 1997)

**Bioregional Mapping**, in BC, western Canada.

Ben Johnson (2000) defines and explains 'bioregional mapping'. (Aberley et al. 1993; Aberley 1999; Aberley & George 1998; Ecotrust Canada 1995, 1997; Harrington 1999) "collective biophysical & Cultural knowledge of a First Nation" in layers.

Its basis also lies in community-based planning, community-based NRM, indigenous land & resource *stewardship*. It uses sketch maps, etc., sometimes RS images; GPS & GIS.

e.gs. Tsleil-Waututh First Nation bioregional map, 1997. (Aberley & George 1998) NB also used for purposes of making land claims, and for community awareness)

Goetze 2000 Clayoquot Sound

### **Hazards (& Risk Assessment)**

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It is surprising how few applications there are of P-GIS or P-mapping to natural hazard identification and mapping. Local people's direct experience or historical 'folk memories' of floods, water-logging, landslides, avalanches, storm damage, coastal inundation, etc., also of pest outbreaks, vulnerability to earth movements, etc., should be essential inputs to scientific assessments of the extent of hazards and the degree of risk. There are no strong reasons why there should not be many more cases, because P-mapping and PGIS are excellently suited to the needs for local knowledge, participatory needs assessment & analysis, participatory prioritising, etc., and for visualisation.

India: PRM programme Kerala (CESS 1991; Chattopadhyay 1993, 1996; Franke & Chasin 1994, 2000; IRTC 1995). An early e.g. - farmers' PRA mapping of risk, India (Gupta 1989)  
Farmers' P-mapping of industrial air polluting agriculture, Haryana (Mukherjee et al 2001)  
Pakistan: risk mapping included in PRA training (McCracken et al 1988)  
Indonesia: P-mapping of land degradation, Java (Fox 1989/1990)  
Cambodia, northwest: P-mapping of hazard areas from landmines (Williams & Dunn 2003)  
Yunnan, China: identify environmental (hazard) constraints on development, e.g. from slope, aspect (McConchie & McKinnon 2002).

Canada: Grenier 1998/ (Sallenave 1994) ITK in water quality sampling near a copper-zinc mine, Manitoba (IK of changes in taste in local meat & water)  
Mexico: urban expansion of Mexico City into volcanic activity areas, air pollution (Moctezuma-Barragan )  
Australia: N. Queensland, Threat Identification Model (TIM) DSS linked to GIS assesses sustainability of agric land management, incl. hazards (Smith et al. 2000)

Ethiopia: Wollo, P-mapping of environmental risks (ERCS 1989)  
Sn. Ethiopia & N. Kenya: Participatory mapping of environmental & conflict risks with pastoralist peoples (Boran Gabra, Samburu et al.) in arid lands (Smith et al. 2000)  
Malawi: environmental degradation & its causal history in Shire River area – use mix of RS, RRA & PRA (Toledano et al 2000)

There are more experiences from situations in the USA and UK dealing with industrial and urban waste and pollution, and especially with the handling of nuclear waste and siting of nuclear power plants, etc.

e.g. the influence of geographical data on decision making for nuclear waste disposal using a web-based GIS (Evans, Kingston, & Carver 2004). Padgett (1993) worked with people's participation in GIS in siting decisions for LULUs (locally unacceptable land uses) including environmental hazards; Kellogg (1999) applied GIS to develop a neighbourhood environmental information system for inner-city communities in Cleveland, keeping track of environmental hazards and resources.

A co-sited combination of the nuclear risk space with regions of indigenous NRM interests is in: USA: mapping nuclear hazard implications for the hunting grounds of the Southern Palute people,, etc. (Clark Labs 2002)

### **Disaster Mitigation Mapping**

MapAction, <http://www.mapaction.org/index.html> is a UK-based charity, staffed by specialist volunteers, whose core role is supporting humanitarian operations through provision of spatial data collection and mapping capabilities in the field. Large-scale maps focused on specific relief requirements through sectoral overlays; Maps formatted to

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specific needs of aid agencies; Interactive Geographic Information Systems technology (GIS) on web based servers, enabling interrogation on-line; enhance existing baseline maps in the field through computer-linked GPS/GIS systems.

See also: Douglas-Bate (2003) for Aid Workers Network - Local "Humanitarian mapping", but not really P-mapping.

## **3. Managing Conflicts**

### **To Manage Internal Conflicts. To Manage and Mitigate Conflicts between a Community and the Outside.**

#### **3.a Reduce Conflicts**

by mediation / negotiation etc. with GIS

P-GIS is supposed to support and enhance "spatial conflict analysis and amelioration" by investigating and arriving at decisions acceptable to the parties, mainly through consensus building.

There are different conceptualisations of what could constitute the 'best' compromise to form a 'social justice' solution to a conflict. Recognition and understanding of these alternative conceptualisations is all the more pertinent when dealing in conflicts between indigenous peoples and outsider agencies.

What is a "fair" or "just" solution?

- Maximising the 'average' satisfaction for all the various stakeholders?
- Minimising the 'deviations' of group satisfactions from the 'norm'?
- Majority group's vs. minority group's degrees of 'satisfaction' with the outcome?
- 'Magnitude' (i.e. 'objective' aspects), or,
- the 'Intensity' (i.e. 'subjective importance') of the impacts of alternative solutions? (cf. Shields et al. 1998)

These alternatives are more problematic in the case of indigenous peoples with ISK, and political considerations of minority rights.

Cousins (2000), based on Swallow (1996) et al., discusses concepts of spatial boundaries in conflict situations in indigenous societies, which are not easily translated into digital format. 'Flexible' boundaries are identifiable, but nevertheless open to change through negotiation or force; 'fuzzy' boundaries exist where there are no delimited, discrete spatial units corresponding to specific, unique social groups. The social groups may be similarly 'fuzzy' and 'flexible' due to their multiple social-cultural identities or nesting of smaller units within bigger ones of clans, chiefdoms, tribes, etc. Flexibility and fuzziness have the advantage of increasing the number of spatial landscape or resource units to which different groups can have differential access.

Chacon (2002?) discusses the importance of culture-specific and language-specific comprehension of maps, spatial information in general, and cognitive semantics (in a Guatemalan conflict resolution context).

Canada: To assess, integrate and use a diversity of stand alone GIS databases currently in use for Treaty Indian Bands by several Provincial & Federal agencies, or even within the one agency, Dept. of Indian & Northern affairs, Alberta, Canada (Makokis & Buckley 1991) //

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Dene Mapping Project , northern Canada used digital 1:250,000 maps to designate land use & occupancy, 1890-1975. Note that boundaries designated and spatial conflicts reduced, not only with Federal Govt. and Nunavut Province, but also with neighbouring indigenous peoples, Dene/Métis and Inuvialut. (Asch & Tychon 1993; Johnson 1997; Nahanni 1997; Deh Cho LUPC 2003; Norwegian & Cizek 2004)

Nomadic reindeer pastoralism in northern Sweden: PRA to collect and systemize traditional ecological and landscape knowledge of reindeer habitat use; integrate this with field inventories and RS-based vegetation classifications; map activities of other land users. Resulting land-use maps provide information to facilitate consultation between reindeer herders and other stakeholders towards conflict resolution. (Sandstrom et al 2003)

Philippines: Community GIS for institutional strengthening of Ifugao community groups in handling conflicts with provincial / municipality authorities re. ancestral lands (Gonzalez 2000). Use of P3DM (participatory 3-dimensional mapping) for conflict analysis and resolution. Indigenous tribal groups used to prepare a *bodong* – a bilateral verbal agreement – between the tribes in conflict, and should reduce possibilities or extent of inter-group warfare over land and land resources. The 3D model helps to clarify the disputed areas, lines of agreement, etc. (Rambaldi, Bugna et al. 2002; Rambaldi & Manila 2003; Rambaldi & Callosa-Tarr 2002) Working with PAFID – Philippines Assoc. for Inter-Cultural Development; gives example of ‘more than 70 local, inter-tribal boundary conflicts avoided by the use of a single 3D model’. (Rambaldi et al. 2002) “a 3D model can be named, seen, felt and touched” and overcomes language barriers.

French Polynesia, Moorea; P-mapping of women’s coastal lagoon fishing, property rights conflicts vs. tourism & commercial (male) fishing (Walker 1998)

Thailand (Hoare et al 2002) (cf. Kwan 2002 from a gender perspective)

The use of P3DM in negotiation between village community and Song Thanh Nature Reserve, Quang Nam Province, Vietnam. (Hardcastle et al. 2004)

Indonesia: conflicts over prior resource rights and recent claims. (Eghenter 2000) (c.f. Peluso 1995) // Upper Malinau R., E. Kalimantan, developing participatory mapping (& GPS) as means towards forest NR conflict management, village boundaries, etc. (Wollenberg 1999) // Mapping conflicts between farmers and State Forest Corp., West Java. (Fox 1989/1990)

In Indonesia, conflicts over land and natural resources have been categorised according to two different methodologies: (Idham Kurniawan; & Imam Hanafi 2004; pp. 2-3) [<sup>7</sup>]

(1) Based on the parties in dispute:

- a) Conflict amongst and between local peoples, as in the case of determining boundaries.
- b) Conflict between people and the state, - clarifying government and non-governmental land.
- c) Conflict between communities & local people, the state, and commercial enterprises, over allocating lands for the “common plan of Spatial Usage” (RUTR) (regional Land Use Plan).

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<sup>7</sup> Typology of conflicts is according to National Land Affairs Indonesia, Participatory Mapping Workshop "Opportunity and Challenge against the Democracy of Spatial" Cikopo, March 2003

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- d) Conflict between groups within the private sector, concerning disputes about land ownership between groups.
- (2) The types of land conflicts – specifically in Indonesia - consist of disputes over:
- a) plantation lands.
  - b) forest lands under State Forest Corp., and others.
  - c) land released by developers for housing/ industrial area, among others.
  - d) land subject to *land reform* objectives (citizens rights to use state land).
  - e) second hand private land, ex-regulation No. 1 / 1958.
  - f) land under ex-colonial ownership (?)’rights;
  - g) issues relating to the land registry, from the overlap of *girik* (land certificates used in colonial era) and *eigendom* (company’s right to use state land in the colonial era); overlaps of *girik*; and the conflicts coming from execution of legal decisions.
  - h) lands possessed by TNI (Indonesia Armed Forces);
  - i) lands controlled by PT KAI (Indonesia Railways Company).

Tanzania- Maasailand: Hodgson & Schroeder (2002) reviewed 4 cases of counter-mapping community resources and customary claims of pastoral peoples vis-à-vis claims of national parks, conservation NGOs, ecotourism enterprises, etc.

Ethiopia & Kenya: Participatory mapping of environmental & conflict risks with pastoralist peoples (Boran Gabra, Samburu et al.) in arid lands (Smith et al. 2000)

Mexico, Chiapas State, Zapatista groups: land rights & land tenure. (Froehling 1995)

Nicaragua: community mapping with GPS & PGIS, for NR conflict analysis, management & prevention, Training Manual (Gonda, Pommier et al. 2004)

St. Lucia, Soufriere Marine protected area, P-maps of zoning & conflicts between fisheries, tourism, conservation. (Romulus 2003)

NIMBY literature e.g. Coucelis & Monmonier 95

GIS in war situations - analysis of war-related land use changes by integrating expert knowledge and remote sensing. (Klaassen & van Hoeve 2001)

### **3.b Increase Conflicts?**

On the other hand, more or better (spatial) information may actually lead to increased or exacerbated conflict.

In conflict analysis theory, there is a distinction between conflicts over facts, and conflicts over interests. Obermeyer (1994) differentiates between “*cognitive (fact) conflicts*” which are relatively superficial disagreements about the facts behind a dispute, and, “*interest (value) conflicts*” which relate to the parties’ cultural or social values. Beyond this, “*interest (value) conflicts*” may correspond to immediate, specific *objectives* leading to current competitive behaviour, or, they reflect underlying, deep-rooted *interests* or motivations of the parties. “Interests... are what .. parties really need to achieve: security, recognition, respect, justice, .. .” (Wehr 2001). A traditional (settled) society is likely to include values for lands and natural resources that would be ‘zero-rated’ in modern societies, especially mystical attachments to sacred sites and mystical spaces.

Whether GIS ameliorates land and resource conflicts rests on, not only the untestable assertion that more information is necessarily better, but also the assumption that all participants agree on the validity of the data, “ ... that there is an objective reality on which all parties can agree.” (Obermeyer 1994) The credibility of a GIS assumes that participants

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in the decision process agree on the relative importance of the facts (data) and construe the facts identically. In reality, there are more than enough 'facts' for each party to choose which to use, and there can be multiple interpretations of many 'facts'.

Thus the likelihood, seen in practice by Fox (1998), Fox et al. (2003), and Sirait et al. (1994) for Kalimantan, (c.f. Brodnig et al. 2000), that mapping the boundaries will itself exacerbate the adversarial conflict – the more (spatial) facts, the more opportunity to play the game of selective facts. Fox et al. (2003) find that one outcome of improved resource mapping (including P-GIS) is the loss of common property resources as privatised & individualized. When the actual-because-cognitive 'fuzzy boundaries' become codified as seemingly-fixed lines drawn on a map, the conflicts between stakeholders are set loose and realised. (cf. Cinderby 1999 IN: Quan et al. 2001) Similar findings in the Mosquitia region of Nicaragua where some communities argued that overlapping subsistence area would be sealed off from neighbouring communities. In Bolivia this project decided after lengthy disunions not to mark sharp, hardline boundaries. (Chapin & Threlkeld, 2001, p. 133)

"We identified several revenge or ironic effects of mapping. These include increased conflict, ... " (Fox et al. 2003)

In Northern Thailand - mapping of land titling oversimplifies overlapping claims from different family members and reduces them to a simplistic 2-D space of 'household title' – leads to exclusion, dispossession, & conflicts (Ganjanapan 1994)

Also in Kalimantan, Wollenberg et al (2002) point out that most of the stakeholder agreements discussed or implemented are partial and transient and should not be expected to persist – the deeper the underlying conflicts, the more fluid any agreement is likely to be.

They also argue the necessity for proactive, positive discrimination in supporting weaker, less articulate actors in the process.

### **3.c Working with External Management Plans**

Incorporating traditional use and ITK of NRM into 'higher-level' **resource management plans** of outside agencies, e.g. Canada: Forest Depts., Wildlife Depts. Clayoquot Sound Sliammon 1<sup>st</sup> Nation (Roddan & Harry 2000)

Tanzania, Gombe National Park, community P mapping in 6 neighbouring villages, landuse, tenure, related to map chimp behaviour & activity, habitat (Pintea et al 2004)

### **Participatory environmental appraisal**

Used in LUP and prior to developing local action plans.

India: Map legends include erosion areas, abandoned clay mines, flood areas & potentials. Kerala PRM programme (Franke & Chasin 1994, 2000; Chattopadhyay 1993, 1996).

**Urban** neighbourhood participatory environmental planning using large scale maps & physical models Neighbourhood Initiatives Foundation NIF in UK(?) (Gibson 1996 in: Carver 2001) (USA- NY and Connecticut; examples in Convis, 2001) [<sup>8</sup>]

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<sup>8</sup> This paper is not directed particularly at urban community participation, or urban P-mapping and P-GIS. (cf. McCall 2005)

### **3d. EIA**

Canada: Nunavut Impact Review Board states that IK “ .. considered as being (at least) equal to scientific knowledge. ITK will be used as an element in all EIA/ EIS/ SEA in Canada and the province, though much remains to be operationalised. (Grenier 1998; Lajoie 2002; Paci et al. 2002)

Alberta, Canada P-GIS as an element of EIA (Makokis & Buckley 1991)

EAGLE project, mapping effect of toxic pollutants of traditional fishing grounds in Great Lakes (Bird 1995; Johnson 1997)

UK: a non-NRM case is that of interactive, web-based PGIS applied to people’s views on the siting of nuclear waste facilities (Kingston et al. 1999; Carver et al. n.d.).

Many more urban examples, especially in USA and Canada, association with environmental justice. E.g. Kellogg 1999

### **Environmental Sustainability**

Based on local ITK and ISK, identify and *map* the most vulnerable and sensitive environmental features in the district. They may be individual *sites* or *zones* of bio-physical features, e.g. vegetation, wildlife, coastal areas, watersheds, or they may be directly connected to specific human groups and socio-economic activities. Location and spatial extent of the impacts or "downstream effects" can also be *mapped*.

## **4. Mapping Equity**

There are comparatively few studies of P-mapping and P-GIS in South countries related to equity or distribution issues. Mapping equity in urban or rural settings in North countries, such as US or UK, is however well-developed, particularly in urban community situations.. For example, mapping people’s accessibility to urban services, schools, medical facilities, retail or employment opportunities, etc. Typically, tools like gravity model, travel cost minimisation, critical distance zones, etc. are utilised within a GIS context, using distance functionalities. The participatory element comes in where the equity indicators and/or data emerge from participatory surveys, and/or there is the opportunity for local community to participate (initiate, not just respond) in the consequent planning decisions.

E.g. USA, diversity of needs and status in an urban neighbourhood, unequal benefits, some groups are empowered, whilst others are disenfranchised. (Elwood & Leitner, 1998)

Talen (1998) summarising several approaches, argues that there are four ‘categories’ of ‘equity’ objectives in the spatial relationships between people and services –:

- (i) equity simply as equality;
- (ii) “compensatory” equity according to needs (or mitigating inequities);
- (iii) equitable distribution in response to active demand (‘economic demand’ = demonstrated use, ‘political demand’ = “vociferous advocacy”);
- (iv) applying market criteria, which include the cost of service provision.

### **4.a. Environmental Equity**

Scott & Cutter (1996) applied GIS to environmental equity in the US context, “environmental equity is where no subpopulations are bearing a disproportionate risk from environmental hazards”, and they distinguish between distributional equity of outcomes and the equity within

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the (causal) processes. They look at difficulties in measuring and mapping environmental equity, including the common issues of relevant and comparable data availability, and aggregation / scale distortions.

cf. *Environmental justice* includes the spatial distribution of environmental impacts, or environmental equity, and utilises participatory mapping and P-GIS as well as conventional mapping of spatial indicators. 'Ecological Footprints' is associated topic. Clary-Meuser Research Network (US site mapping environmental justice issues)

<http://www.mapcruzin.com/> e.g. Schlossberg (1995) evaluated environmental inequity in Silicon Valley using GIS and Census data.

PGIS applied to local air quality management projects. Is "GIS-P" (sic) a useful tool for (a) extracting non-specialist 'lay' knowledge, perceptions of environmental problems and hazards, and (b) presenting and communicating it to environmental scientists. 'The clarity and conciseness of 'citizen maps' allows decision makers to take into account citizen inputs which used to be ignored.' UK (Forrester et al. 2003)

Ditto in the public health policy sector, regarding local knowledge of environmental risk of breast cancer. UK (Forrester et al. 2003)

### **4.b. Socio-Economic Equity**

Sri Lanka: HIRDEP Social Development Component (HIRDEP McCall)

Identify social factors and the socio-economic groups which are relatively disadvantaged, whether by location, economic class, ethnicity, caste, gender, etc. The disadvantages may be due to low income, poor quality of life, poor access to jobs or to markets, or to education or health, etc.

Disadvantaged groups can be spatially *mapped* as distinct *sites*, or as *zones* of deficiency.

Using GIS with PRA techniques for more equitable sub-district planning under decentralisation in Uganda, (Turyatunga, 2004)

### **Poverty Mapping**

Poverty maps are spatial representations of poverty assessments. The assessment information comes from a variety of sources and can be presented at various levels (global, national and local). Indicators of income poverty (such as GDP per capita or daily subsistence levels), or of well-being (such as life expectancy, child mortality, or literacy) are most frequently used in poverty maps, and are derived from national census data or household surveys. Sometimes various indicators are combined to give an index of poverty or human development (such as the Human Development Index, a composite of life expectancy, literacy and income). GIS based poverty analysis makes it easier to integrate poverty data from various sources.

"Poverty Mapping" project <http://www.povertymap.net/> is joint initiative by FAO, UNEP and CGIAR to promote the use of poverty maps in policy making and targeting assistance, particularly in the areas of food security and environmental management.

Nepal & Himalaya-Hindu Kush countries (Sadeque 2000)

Uganda: Application of P-mapping to location of water stands in a refugee camp, women as key informants (Morgan 1994)

#### **4.c. Gender factors:**

Men's secure control of NR knowledge and the consequent exclusion of women become legitimised by 'traditions'.

Most census data do not show the richness of women's real lives because of their general focus on monetised activities, and because they make highly restrictive assumptions about the roles and capacities, and thus the spatial activity patterns, of women, it follows that the mapped versions or other spatial databases are unable to show them. "... women's spaces are often nested between and within lands controlled by men." (Rocheleau et al., 1995, p.64)

Similarly, gender differences in levels of mobility as seen in Kenya are mirrored in the restrictions, and thus the "invisibility", of the large proportion of house-bound and non-car owning women in the US (Hall 1996).

Zimbabwe: Tree & resource tenure. (Fortmann 1996)

Ghana: Women in agriculture, [but little use of GIS.] (Grieco & Apt 1998).

Indonesia: E. Kalimantan, gendered (& 'aged') alternatives for village zoning (women wanted restricted NTFP zone) (Stockdale & Ambrose 1996)

Dominican Rep.: Zambrana-Chacuey, tree resources & gender (Rocheleau & Ross 1995; Rocheleau et al. 1995)

Peru, Amazonia: participatory planning and resource tenure in Amazonian forest area, including gender factors, gender surveys (Smith 1995)

Honduras: Participatory gender resource mapping (Wilmer & Ketzis 1998)

Sudanese refugee camp, Uganda: P-mapping to locate water stands with women as key informants (Morgan 1994)

French Polynesia, Moorea; coastal lagoon fishing is primarily by women, thus property rights conflicts vs. tourism & commercial (male) fishing. Used p-mapping of women's resource use & locations (Walker 1998)

#### **4.d. 'Integrated' Equity Mapping – Environmental & Socio-Economic Factors**

USA, West Virginia and South Africa, Kiepersol: the long-running work of Trevor Harris and Daniel Weiner and others on 'regional political ecology' is aimed at eliciting, understanding, representing and analysing local people's perceptions and conceptualisations of environmental and health risks and spatial inequalities, especially in post-apartheid access to land. The research makes use of PRA, P-mapping and P-GIS among others. (e.g. Harris et al 1995; Weiner et al. 1995; Weiner & Harris 1999, 2002)

Kerala India. Mapping for Local Development – social-political framework

Kerala PRM local volunteers trained and aided by geographers to map land use, landforms, water resources, surface materials, etc. and infrastructure. Much use of Community participation and PRA methods. However it was the professional geographers who integrated the local maps into an 'Environmental Appraisal for LUP' map; 1991-2 in 25 target panchayats. The objective was not simply to produce the maps, but their application to a panchayat development action plan, a much slower job. Very significant that PRM is but one component of an overarching participatory, socially progressive, equity-driven, high literacy and women's empowerment, NB. strong civil society, long-term social 'experiment' in Kerala under successive left of centre state governments. Includes 'evaluating local resources (not only NR, though 75% of panchayats have at least included a transect walk of resources), and local Panchayat Development reports, with

neighbourhood groups. (CESS 1991; Chattopadhyay 1993, 1996; Franke & Chasin 1994, 2000).

In Vietnam, a PAR case of P-GIS application to “Village Development Planning” (Trang 2004)

## **5. Building the Community Promote Community Awareness, Institutional Strengthening, Empowerment,**

P-Mapping and P-GIS are employed in order to elicit, structure, and guard Traditional Knowledge (ITK/ISK), as well as being an important element in promoting empowerment. In practice, usually it would be difficult and pointless to distinguish between these two goals.

Moreover, it is frequently pointed out by practitioners and analysts that all processes themselves of participatory survey, research, analysis and planning are ‘empowering’. Thus the very actions of P-mapping and P-GIS help to empower through peoples practical involvement, influence on problem prioritising, information selection, intervention identification, learning, skill development, sense of ‘ownership’, etc. (e.g. Alcorn 2001; Jordan’s (1999) observations re. P-GIS with Forest User Groups in Nepal). [<sup>9</sup>] The so-called subjects of the research, the Miskitu Indians in Nicaragua actively produce and transform the knowledge - ‘the very process of data collection transforms the object of inquiry’ (Gordon et al 2003). Becomes pointless to distinguish between ‘original, essentialist’ attitudes, entitlements, and conceptualisations of land, and invented or constructed identities, they elide into each other.

In the urban community context, it is argued that community mapping provides an inclusive and graphic framework for people to affirm and pool their experiences and knowledge about their home place. Community mapping is as much about process as it is about ‘getting the map done.’ As a participatory and creative educational tool, mapping, including “Green Maps”, relies on the active engagement of participants. (Common Ground Community Mapping Project. Victoria BC, website <http://www3.telus.net/cground/mapping> . (Lydon 2000)

“Narrating place and identity” implies P-mapping of cultural-historical meanings and identity of place, signifiers of toponyms, in cultural landscapes. Offen (2003) calls it using “Miskitu flag & biblical lessons” to create awareness for young people (Offen 2003)

Uxin Ju, Inner Mongolia, China: cultural change and human perceptions as they relate to landscape, becoming cultural landscapes. Jiang shows other ethnographers how RS analysis offers additional stories about changes in the cultural & natural landscape, stories not told by interviewees. (Jiang 2003)

In the Philippines, the local community development of P-GIS resulted in the expansion of the [spatial] horizons of the Ifugao people– they could see their central place in the region for the protection of the catchment to safeguard the Magat HEP dam. (Gonzalez 2000)

Various forms of IT used by and for the Zapatista social political movement in Chiapas, Mexico, for representation and better understanding of their cultural and environmental situation, both internally for community solidarity and education of younger generations,

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<sup>9</sup> c.f. Analysis of the objectives / intentions explaining why external agencies or projects get engaged in ‘promoting participation’ – to facilitate projects, to mediate, or to promote ‘empowerment’. (McCall 2002)

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and for external communication and propaganda to counter government propaganda. (Pitkin 2001)

### **5.a Cultural Historical Knowledge**

USA: Local history as a priority for local population to map (Aberley 1993) // Mapping languages and dialects (e.g. [Online](#) 1999)

Hawai'i: Historical Land Management. (Dizol 2001)

Southern Belize, Giving training to Mayan people to protect Mayan land rights with P-mapping & P-GIS. (Toledo Maya Cultural Council 1997)

Land Areas as land units to protect: (Makokis & Buckley 1991)

- sacred areas; burial grounds; ancestral lands; ceremonial areas; circumcision sites;
- traditional gathering areas; traditional hunting or trapping or fishing areas; traditional grazing lands; traditional fuel collection areas; ditto for minerals
- outer boundaries of culture areas, clans, tribes, etc.
- traditional property delineations/demarcations within the culture group boundary, e.g. by clan, lineage, bands, household, intra-household, male and female areas within the community; age-group areas.

Canada: Yukon (Duerden & Johnson 1993) // Yukon- Ft. William 1<sup>st</sup> Nation (Johnson 1997); Mapping of archaeological sites, burial grounds, and cultural sites using a DTM base. (CYI)

A well-founded fear of native American tribes in the US is that of vandalism of burial and sacred sites by souvenir-hunters. ([Online](#) 1999).

Philippines: re-discover cultural history "remnants of a spatial information system embedded in traditional agricultural practices; and awareness of cultural pride. (Gonzalez 2000)

NZ: Manaaki Whenua – Landcare Research approach in New Zealand classifies eight layers of increasing cultural confidentiality, and thus secrecy. (Harmsworth 1997) cf. (Laituri 2002)

- vegetation, fauna, land, soil, water, air data
- remnant forests & biodiversity sites
- traditional food & medicine & handicraft resource gathering sites
- historic places, battlegrounds, old villages, anchorages
- sacred sites, burial grounds, places to wash corpses, shrines, altars, buried art
- indigenous place names, cosmological & metaphysical-valued locations.

### **5.b Landscapes and Cultural Landscapes.**

Combining bio-regionalisation (based on ITK as well as scientific classifications) with geo-physical zoning (soil units, land units, land facets, etc.) and with cultural interpretations and social history of the areas, leads to identification, understanding and analysis of landscapes. (related to 5.c & 5. d, sacred and ancestral values of lands, below) cf. UNESCO Cultural Landscapes; GeoPark concept.

India: "Landscape Management" by communities: effective decision-making with GIS role in supporting community forest management groups to manage their natural resources at a landscape level. (Singh & Rangoori, 2004)

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Uxin Ju, Inner Mongolia, China: cultural change and human perceptions as they relate to landscape, becoming cultural landscapes. RS analysis also provides stories about changes in the cultural & natural landscape. (Jiang 2003)

Landscapes, houses, bodies, things: "Place" and the archaeology of Inuit imaginaries. 'Places emerge as sites of the hybrid articulation of representations, practices, & things, as spatialized imaginaries', Thule Inuit people, Greenland, (Whitridge 2004)

India, shepherds, using GIS to combine environmental, land use & land cover knowledge of herders, professional foresters, and traditional communities the cultural meaning of landscapes is dependent on their roles in regional production and resource politics. (Robbins 2003)

### **5.c For the Ancestors.**

USA: the Native American Graves Protection & Repatriation Act requires stringent criteria for bringing back American Indian remains for burial. The tribe must firmly establish the cultural credentials of the remains for which GIS can be and is used to overlay aboriginal tribal boundaries, traditional settlement and burial sites, etc. Proper burial in customary sites is highly significant in Indian (e.g. Lakota) culture and will help to "start the healing process". (Goes In Center 1999)

Winnebago or Ho Chunk Nation, Wisconsin. GIS in locating and mapping burial mounds. (He 1995)

Native American tribes in the US fear vandalism of burial and sacred sites by souvenir-hunters. (Online 1999).

New Zealand: for example in the Auckland region, over 50% of significant pā (fortified village) sites have been destroyed, and less than 2.5% of stone field wāhi tapu (sacred sites) remain. (Harmsworth 1997)

### **5.d Sacred Values of Land and Space (Spatial cosmologies and Cosmovisions)**

NZ: Harmsworth (1997) puts it for Maori values, that land has tapu (respect [for resources]), mana (authority), and mauri (life force, life energy) values which are 'operationalised' through ritenga and tikanga (customs, rituals, protocols). (c.f. Solomon & Watson 2001).

Similar values are easily identified in the concepts of land as the source and maintainer of life of numerous indigenous peoples who retain a spiritual and sacred feeling for land.

e.g. Philippines (Gonzalez 2000)

Australia: "land is meaningful because it has specific places that belong to kinship networks, mother-land, father-land, grandmother-land, etc." (Brazenor 2000; cf. Neate)

US and Canadian egs. Rundstrom 1990, 1993, 1995; et al. Thule, Inuit people, Greenland. (Whitridge 2004)

Mexico & Meso American cosmovisions: detailed case study examples: Patzcuaro basin, Michoacán: (Barrera-Bassols & Zinck 2003); Morelos (Hersch-Martínez et al. 2004); Tenochtitlan (Bernal-García ¿?); and overview in the Atlas Etnoecológico de México y Centroamérica. (Toledo et al. 2001)