Innovative Tools for Mastering Space in Collaborative Natural Resource Management

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Introduction

Over the past two decades, development and conservation sectors have experienced a tangible shift from an earlier prevailing top-down, to an advocated bottom-up planning approach in the attempt at putting ordinary or disadvantaged people first (Chambers, 1983). Participatory technologies have fast developed becoming almost a requirement for development, land redistribution, natural resource management and biodiversity conservation initiatives.

At the community level, spatial analytical tools, including sketch mapping, participatory aerial photo-interpretation and participatory 3-D modeling have gained a progressively more important role since increased attention has been paid to the spatial relationships between the territory and its inhabitants, the resources and their users and/or customary custodians. These tools have acquired additional relevance with the diffusion of Global Positioning Systems (GPS), the onset of Geographic Information Systems (GIS) and the associated efforts made by many researchers, practitioners and facilitators, to assimilate these into participatory research, negotiation and planning processes.

In order to translate people's mental representation of space (i.e. cognitive maps) into high quality geo-referenced information, several methods have been developed, some of which brought about reproducing such knowledge in a cartographic and reproducible format accepted at the institutional level as part of a negotiation process.

Participatory 3-Dimensional Modeling

Participatory 3-Dimensional Modeling (P3DM) has been conceived as a communicative facilitation method aimed at bridging the gap between geographic information technologies and capacities found among marginalized, isolated, frequently natural resource-dependent communities. The method integrates people's knowledge and spatial information (contour lines) to produce stand-alone physical geo-referenced and scaled 3-D models[4], which have proved to be user-friendly and relatively accurate data storage and analysis devices and at the same time excellent communication media. In addition to people's knowledge, these models can accommodate data obtained from field surveys, GPS readings and secondary sources[5]. The method supports increased public participation in problem analysis, decision-making and conflict management, and is generally used within projects or initiatives designed to address issues bound to the territory, particularly in the context of collaborative natural resource management.

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[3] **Disclaimer**: The views expressed are those of the authors and do not necessarily represent any official view of the Asian Development Bank or of the Philippines Department of Environment and Natural Resources.

[4] The terms "3-D models" and "relief models" are used as synonyms throughout the document.

[5] Boundaries are a typical example. Boundaries may be political and administrative, or outline resource tenure, use and access pattern like in the case of protected areas.

Figure 1 The model: a focus for learning and negotiation

3-D modeling exercises require local and external inputs and skilled support. Participants are guided through a collective learning process (**Figure 1**) to the visualization of their economic and cultural domains in the form of scaled and geo-referenced relief models, which can be used for number of purposes, as discussed below. Once the models are done, their maintenance and use rest generally within local capacities. Considering that P3DM is a method which is fundamentally *proposed* to specific interest groups to address selected issues, it is important for the proponent to have a thorough understanding of the local socio-economic environment and have the ability to support participating communities in the implementation of strategies, plans and actions, and in addressing new realities which may emerge from the conduct of P3DM activities.

One major constraint of physical relief models derives from their sheer size and limited mobility. As such, their use is generally confined to those convening around them. Making their content *portable* and *shareable* is therefore necessary to up-scale their utilization. This is made possible by integrating P3DM with modern geographic information technologies like GPS and GIS. The synergies resulting from the combinations of the three systems make data depicted on relief models widely exchangeable through maps and digital datasets. These supplementary formats add veracity and authority to community knowledge (Alcorn, 2000, 2001; Poole, 1995, 1998; Rambaldi *& al.,* 2000) and make the power that comes from recording and controlling space available also to those who were traditionally disenfranchised by maps (undated, Fox *et al.*).

Experience gained by practitioners using physical 3-D models at community level has shown that when informants are provided with a blank relief model instead of a blank contour map or a blank sheet of paper, they can easily depict their spatial knowledge in a scaled, geo-referenced manner and add a lot of precise details (**Figure 2**).

The fact that 3-D models augment the power of mind and facilitate scaling, allows for filling in information more fully and accurately on a given area. This is not the case with sketch mapping which has been a widespread method used for representing spatial knowledge in the context of participatory action research.

Figure 2 Assembling the Cognitive Patchwork

Inherent Risks and Mitigating Measures

Because of their accuracy, relief models may have also negative implications. Alone or combined with GIS, they turn local knowledge into public knowledge and conceivably out of local control. This can be used by outsiders to locate resources and meet development needs, or merely, to extract more resources, or increase outside control (Abbot *et al*., 1999). Researchers, planners and practitioners should be aware of these possible drawbacks and be careful applying the method.

Being on a map, on one hand, means to exist vis-à-vis the external world, thus to be in the position to get or claim services and assistance. On the other hand, for communities wanting to maintain their cultural identity and traditions it may carry undesired development pressures. From a biodiversity conservation perspective, depicting habitats of endangered species, or rare resources in demand on the black market, may lead to their further depletion (Rambaldi *et al*., 2002).

Therefore, exercises dealing with sensitive issues should be carried out with caution and behind closed doors in the course of focus group discussions.

Data at risk of abuse or culturally sensitive, should be removed from the model and eventually stored as confidential GIS layers with limited or protected access (Harmsworth, 1998).

Experiences Gained and Lessons Learned in Southeast Asia.

The development of participatory 3-D modeling as a method used in collaborative natural resource management has drawn on experiences gained essentially in Southeast Asia by researchers, development workers, GIS practitioners, and protected area managers. The evolution and the use to which the method has been put in the different countries has depended on a number of factors and conditions which are examined in the cases of Thailand, the Philippines and Vietnam.

Thailand

Since the early 1960's, significant areas of the highlands were declared as national reserved forest, parks, and wildlife sanctuaries. A national watershed classification system was introduced in 1986 that imposed additional land use restrictions and gave the Royal Forest Department (RFD) great deal of control over people living in the northern uplands (SM-HDP, 1998). As a result, many settlements became illegal regardless of how long they had existed. This was in conflict with the national policy for social integration of the hill tribe population (Aguettant, 1996).

Commercial logging concessions in national forestlands were all revoked in 1989[6] to protect the remaining forests. As restrictions grew over human activities within government forestland, conflict increased over access and control of natural resources and over the outreach of users' rights at village and sub-district levels. Villagers had no legal authority to control harvesting of timber products by outsiders, or to establish community-accepted by-laws governing local use and trade of such resources. Moreover, no forum existed to allow village leaders to exchange opinions and experiences concerning these problems (Jantakad *et al*., 1998).

Adding participation to 3-D mapmaking

The use of relief models surfaced in this conflict situation primarily as a facilitating tool for establishing a dialogue on resource use and tenure among outsiders (government officials) and insiders (hill tribe people) in 1988 in the framework of the Thailand Upland Social Forestry Project (TUSFP, 1989; Tan-Kim-Yong, 1992; Poffenberger, 1993; Tan-Kim-Yong *et al*., 1994;

[6] The event is commonly known as the "logging ban".

TG-HDP, 1998). The project developed a Participatory Land Use Planning (PLUP) approach based on full, long-term immersion of community workers at village level and anchored on the use of relief models as learning and communication tools. Relief models demonstrated their key function in the PLUP process, particularly in providing open access to information. Since the process was geared towards inducing behavioral change of both insiders and outsiders through learning, negotiation and conflict resolution processes, information and communication systems were considered as key ingredients. This required all parties to gain equal access to information in order to develop a common understanding of resource management problems (Tan-Kim-Yong *et al.,* 1994). It became apparent that in a situation of existing language barriers[7], information exchange could best occur via *visual* communication means like diagrams, aerial photography and relief models in particular. These means provided focus for organized discussions and were instrumental in providing participants with a clearer understanding of local problems vis-à-vis wider social and environmental contexts. Through a progressive learning and negotiation process, this led to the settling of disputes among villagers, between villages, and between villagers and government officials, and opened up avenues for dialogue between people of different ethnic backgrounds and cultural conditioning (Tan-Kim-Yong 1992; Tan-Kim-Yong *et al.* 1994).

Recorded results of the PLUP process have been a more equitable distribution of farmland among villagers, clearly defined resource use (i.e. village) boundaries, the creation of fire protection groups, a notable decrease in opium cultivation and an improved agency-community dialogue. Added transparency on actual land use and regular interactions with government officials reduced the need for farmers to gain quick returns from temporary "illegally" occupied land and stimulated their interest in more long-lasting soil and water conservation investments. All this resulted in improved land management under the responsibility of the villagers and in co-operation with the project and government officials.

"The PLUP experience has since been widely recognized as an important example of effective local resource management by minority groups" (TG-HDP, 1998:27) and has been adopted by other projects in Thailand and neighboring countries, like Vietnam and Cambodia.

The Thai-German Highland Development Program (TG-HDP) which started in 1981 and went through several phases, adopted relief mapping in 1990. Three-dimensional polystyrene or cardboard models were used in meetings between the survey teams and members of the community as part of a process called Community-based Land Use Planning and local Watershed Management (CLM) (TG-HDP, 1998).

In 1995 the project started assisting villagers in updating 3-D models and periodically transferring the information to baseline maps to be used for monitoring purposes. In their 1998 final review and Lessons Learned, the TG-HDP management stated that "[…] of the many working tools such as maps, aerial photographs and GPS that have been used during CLM, the 3-dimensional model has been found to be the most useful" (TG-HDP, 1998a:48). This consideration has been reiterated by Jantakad and Carson (1998) as follows: "During actual implementation of the CLM process, the three-dimensional topographic model has been found to be a very effective and useful tool in assisting the community leaders and government officers to assess present land limitations, problems and conflicts".

The Upper Nan Watershed Management Project has been using relief models of different scales and sizes within 45 villages located within two national forest reserves in Nan province since 1997. Each village has at least one model and possibly larger models encompassing 6-8

[7] Government officials and project staff had difficulties in communicating with the hill tribe communities as spoken languages differed considerably.

villages to cater for intra-village dynamics and to support the development of village watershed network dealing with fire management, harvest of non-timber forest products and livestock grazing rights (Hoare *et al*. 2002). The analysis of the experience gained by this project in using models of different scales and geographical scopes has contributed to important learning aspects summarized in **Annex 1** at page 13.

Another project, which has made use of participatory relief models, has been Integrated Natural Resources Conservation Project (INRCP), which has been operating in the northern provinces of Chiang Mai and Mae Hong from1994 to 1999. In this context the models have been used with ample success in negotiation processes dealing with disputes over resource use and access and in favoring the use of more sustainable natural resource management practices (Srimongkontip, 2000). The Collaborative Natural Resources Management (CNRM) project (2000-2004) evolved from the INRC Project into an intervention having a wider geographical scope and focusing - in the light of the 1997 Thai constitution and associated local governance reforms - on institutional development for collaborative natural resource management at village, sub-watershed network, and sub-district government levels. Within INRCP the use of 3-D models has been incorporated as an primary component of elaborated spatial information and environmental monitoring systems owned and operated by local institutions (Thomas, personal communication, 2002)

In Thailand the use of 3-D models is quite common within activities of the Royal Forest Department and many research and development workers now believe that their use, increasingly linked with GIS, will continue to expand in the context of the recently introduced constitutional and local governance reforms and the evolving community forestry legislation (Thomas, personal communication, 2002).

The Philippines

For at least a century, the Philippines' biological and cultural diversities have been placed under great pressure by logging, mining, conversion of forests into farmland, population increase and movement of lowland communities into areas traditionally occupied by Indigenous Peoples (IPs). This ignited in the '70s long-lasting conflicts between minority groups and the central government. In 1992, a National Unification Commission was created to identify the root causes of the conflicts through nation-wide consultations. As a result, the Social Reform Agenda and other peace initiatives were launched.

Under present law, all land over 18-percent slope is deemed “public forest land” to which access is legally granted only in the form of time-bound agreements or concessions. Thus, while the Constitution (Art. XII, sec. 5) recognizes the “rights of Indigenous Cultural Communities to their ancestral lands,” until 1993 these were considered as “squatters" on public lands.

Cognitive Maps and People's Rights in natural resource management

The first significant steps towards fulfilling Indigenous Peoples' (IPs) constitutional rights were taken with the issuance of the Department Administrative Order No. 2, series of 1993 (DAO 2, S. 1993) by the Department of Environment and Natural Resources (DENR). This DAO established the Certificate of Ancestral Domain Claim (CADC) and stipulated a process through which IPs could delineate, document, and gain “recognition” of their “claim” to portions of the territory. In order to avail of the legal stewardship entitling IPs to live, manage and utilize their ancestral domain, an applicant group had to meet a series of requirements including providing proof of use and occupation of given portions of the territory for times immemorial.

In this context maps exerted all their power in stimulating change within the existing land tenure and resource access pattern and in influencing national policy making: cartography resulting from two and three dimensional community-based mapping supported by GPS and GIS applications formed the foundations upon which IPs filed numerous applications.

As early as November 1993, the Environmental Research Division of the Manila Observatory assisted the Mangyan Alangan community in Mindoro Oriental in generating cartographic information to support the filing of an ancestral domain claim and for preparing the related domain management plan (Walpole *et al.* 1994).

In year 1995 the Philippine Association for Inter-Cultural Development (PAFID) an NGO set up in 1967 to advocate for customary land tenure, adopted the technique and tailored it for developing ancestral domain management plans, supporting the delineation of domain boundaries and addressing boundary conflicts. As of the writing of this paper, PAFID assisted almost 90 indigenous groups in preparing their maps[8] and plans and in obtaining the desired tenurial instruments (PAFID, 2001).

In 1997 PAFID assisted Green Forum-Western Visayas (GF-WV) - a coalition of NGOs and People's Organizations - in adopting GPS, GIS and P3DM. A combination of these three technologies has since been used by the GF-WV for assisting indigenous communities in applying for tenurial instruments[8], raising local awareness on outsiders' interventions (e.g. large-scale mining operations) and enhancing community participation in natural resource management including protected areas (Purzuelo, personal communications, 2002, 2003).

The issuance of CADCs was suspended in September 1998, but by that time, the implementation of the DAO resulted in the issuance of 181 ancestral domain certificates covering 8.5% of the national territory. In addition the appeal and communication power of accurate, well presented community-generated maps has been instrumental in building public support for the passage of the Indigenous People's Rights Act (IPRA), which provides indigenous groups tenurial rights on their ancestral domains (Alcorn, 2000). The Philippine Congress ratified the Act in October 1997. Article 51 specifies that self-delineation[9] shall be the guiding principle in the identification and delineation of ancestral domains.

The Third Dimension in Conserving Biodiversity

In June 1992, at the Rio Earth Summit, the Government of the Philippines signed the Convention on Biological Diversity and adhered to Agenda 21, thereby endorsing the concepts of conservation through participatory resource management, and environmental protection as the basis for sustainable development. Concurrently, the Philippine Congress enacted the National Integrated Protected Areas System (NIPAS) Act aimed at conserving biodiversity through - among others - the full participation of local communities.

In this context the European Union and the Government of the Philippines, initiated and co-financed the National Integrated Protected Areas Program (NIPAP), a five and a half year (1995-2001) intervention aimed at establishing eight protected areas within the NIPAS framework. The challenge faced by the Program has been how to give due weight to the interests of local communities in delineating protected area boundaries, identifying resource-use zones and formulating policies on and participating in protected area management.

NIPAP started action research in 1996. Protected area dependent communities were introduced to participatory approaches in data collation, analysis and interpretation. Spatial methods such as transect diagramming and participatory resource mapping were readily adopted, yet with

[8] The delineation activities have been carried out under the auspices of the DENR and the National Commission on Indigenous People (NCIP).

[9] Self-delineation implies that designated and *trained* community representatives identify and survey, jointly with accredited geodetic engineers, cultural boundary markers.

reservations about "translating" sketch maps into more precise, useable information. In 1997, with the objective of generating durable, true-to-scale and "meaningful-to-all" information, the Program developed a method, called Two-Stage Resource Mapping (Rambaldi *et al.*1998) which was pilot-tested in the El Nido-Taytay Marine Protected Area in Palawan.

Basically, the system worked as follows: Local communities together with representatives from the local administrative units produced sketch maps portraying their economic domains and transferred the information to blown-up topographical maps. Following validation by all parties involved, information from topographical maps was imported into a GIS environment, plotted in the form of thematic maps and returned to the communities for a second validation. Once a consensus had been reached, community-specific resource maps were collated and used in subsequent consultations on zoning.

In a general assessment of this approach, it was observed that the basic input - the participatory resource maps - were spatially confined to the social, cultural and economic domains of those who had produced them. Thus, in the case of protected areas and their buffer zones, covering hundreds of square kilometers and numerous *barangays*[10], the production of a sufficient number of community-specific sketch maps became unrealistic from both practical and financial points of view. Furthermore, the Program had to acknowledge that a consistent part of the comprehensive analysis was carried out away from the field. Communities had to wait several months to "comment" upon the outputs, rather than being provided from the onset with a tool enabling them to do a comprehensive analysis of the protected area and its environs as a whole, locally. These were the limitations the Program experienced in integrating people's knowledge and GIS capabilities, through conventional participatory resource mapping, in a collaborative planning process. However, a solution to these difficulties suggested itself in upscaling the resource mapping process by using scaled relief models.

The development and fine-tuning of the method started in 1998 and was first carried out in Mt. Pulag National Park, Cordillera Administrative Region. Other protected areas followed and each exercise included a matching capacity building component addressing local government, NGOs and central government agencies. The institutionalization of the method followed three years later under DENR Memorandum Circular No. 01, series of 2001. Thanks to the capacity building effort undertaken by NIPAP and the Protected Areas and Wildlife Bureau (PAWB), and later on in 2001 by the ASEAN Regional Centre for Biodiversity Conservation (ARCBC), the use of P3DM in the context of collaborative protected area management has spread throughout the Philippines and in some countries in Southeast Asia.

So far almost 10% of the 209 (PAWB, 2002) initial components of the NIPAS have developed their own models. Available records and a recent survey carried out in eight protected areas (Manila, 2003) indicate that the models have been and are regularly used for the following purposes:

- Generating spatial geo-referenced data based on community knowledge on land use, vegetation cover, resource distribution, tenure, etc.
- Storing and displaying such data at protected area and/or community level;
- Monitoring location and number of settlements located within the protected area and their buffer zones;
- Managing conflicts bound to resource use and access[11];

[10] The *barangay* is the smallest unit of local government in the Philippines.

[11] 3-D models help in dealing with conflicts bound to the territory through the visualization of the landscape, the provision of shared vantage points, equitable access to information, added transparency and reduced space for subjective interpretations (Rambaldi *et al*., 2002).

- Facilitating boundary delineation and solution of boundary-related disputes;
- Planning out activities at the Protected Area Office level;
- Involving communities in developing resource use and management plans including zoning and boundary delineation[12];
- Conducting preliminary collaborative research on distribution of species;
- Monitoring jointly with the concerned communities changes in land use, vegetation cover, human settlement, infrastructure development and other features;
- Supporting public hearings and planning workshops;
- Serving as reference during Protected Area Management Boards' meetings;
- Supporting learning of local geography and environmental matters by students;
- Raising awareness on environmental services rendered by protected areas;
- Introducing visitors to the area.

Vietnam

Over the past decade, government policy in Vietnam has gradually shifted away from a centrally planned economy with collective resource tenure and management, towards a more decentralized system. The rights of individual households introduced in 1988, were further secured by the 1993 Land Law, and its 1998, 2000, and 2001 amendments where the State recognized customary land use as a prerequisite for receiving land use right certificates (LURC), and entitled the awardees to exchange, transfer, lease, inherit and mortgage such rights. Concurrently, the duration of land allocation was extended to 20 and 50 years for land respectively under annual and perennial crops, and made renewable provided careful use was being made. This new land policy has since represented a formidable challenge for the government, requiring the deployment of substantial resources and the promulgation of a supporting legal framework ensuring policy implementation. In this respect, the Government issued Decree 64/1993/CP on agricultural land allocation and Decree 163/1999/ND-CP. The former specifies that all agricultural land except land allocated to organizations and land required for public needs shall be allocated to households or individuals for agricultural production. Decree No.163 provides detailed guidance for the allocation and leasing of forestland to organizations, individuals and households for sustainable, long-term use in accordance with the Forest Protection and Development Act and the Land Law.

Recent and on-going experiences

As a contribution to this effort, in Song Da and Lai Chau provinces, the Social Forestry Development Project (1993–2004) has been actively involved in Participatory Land use Planning (PLUP), land allocation and watershed management. Since 1995, the project has been using 3-D models for addressing conflicts on land use, facilitating the land allocation, discussing potentials and constraints and developing land use plans (SFDP, 1999).

In August 2001, the Mountain Agrarian Systems Program produced a geo-referenced 1:3,000 scale model in Cho Don, Bac Kan Province as part of the CGIAR-coordinated initiative conducting a participatory diagnosis on spatial management of livestock systems (Castella *et al.,* 2001).

[12] Most protected areas in South East Asia do not have demarcated boundaries. Relief models can provide stakeholders with a first time factual understanding of their outlining. This facilitates a bottom-up approach to boundary negotiation and delineation and to zoning, all activities which are frequently characterized by heavy logistics, frequent confrontation based on insufficient or unequal access to information, and lengthily negotiations.

In November 2001, the National Environment Agency (NEA) organized in collaboration with the Social Forestry and Nature Conservation Project in Nghe An, the Vietnam National Parks and Protected Areas Association (VNPPA) and the ASEAN Regional Centre for Biodiversity Conservation (ARCBC), the conduct of the 3-D modeling exercise of the South-eastern portion of Pu Mat National Park. The model, covering a total area of 700 km^2, has been manufactured by locally residing ethnic minority groups and has since been used for collaborative planning and zoning. The exercise involved the training of representatives from a number of government institutions, NGOs, protected area staff and aid agencies (Rambaldi *et al*. 2003).

Building on the experience gained in Pu Mat, WWF and the Vietnam Forest Protection Department are now in the process of launching a 3-D modeling exercise in the framework of the MOSAIC project to support the identification of appropriate management regimes for the mountainous region of Quang Nam. These regimes include protected areas, community-based forestry, traditional land-use, and a variety of co-managed zones. Specifically the P3DM activities will contribute to re-demarcating existing protected area boundaries, documenting village land and resource use towards allocating land to community user-groups, to consolidating initial community sketch maps into district models and finally to establishing a replicable planning tool for collaborative natural resource management (2003, Hardcastle, personal communication).

Findings

During the last few years P3DM has been rapidly evolving in the Philippines in the sectors of natural resource management, biodiversity conservation and human rights advocacy, both from technical and political points of view. On January 4, 2001 the Philippine Department of Environment and Natural Resources institutionalised the method and recommended its nation-wide adoption in the context of protected area planning and natural resource management.

As of March 2003, about 10% of the initial 209 components of the NIPAS have developed through collaborative processes their own scaled relief models. These protected areas include terrestrial, coastal and marine ecosystems and quite frequently, ancestral domains.

Close to one hundred ethno-linguistic groups have been using relief models[13] for preparing ancestral domain management plans or for resolving boundary conflicts. Some Local Government Units manufactured their municipal 3-D models to support public participation in the preparation or revision of municipal development plans and some People's Organizations, holding Community-Based Forest Management Agreements, developed articulated resource use plans making use, among others, of relief models.

Compared to other ASEAN member countries, the Philippines have been offering a particularly favorable legal framework for community mapping, and 3-D modeling in particular, to take off and become key instruments for dialogue between the public and institutions.

In Thailand on the contrary, even though relief models started being used earlier, the evolution and impact of the method on natural resource management has been constrained by a number of factors including the rigid regulatory framework associated with the existing watershed classifications and the absence of a legal basis for community forestry and land tenure allocation in the highlands. These factors deeply conditioned the use to which community-generated maps could be put, thus narrowing the outreach of Participatory Land Use Planning (PLUP/P3DM) to localized decision-making.

[13] In some countries community mapping initiatives dealing with land and resource tenure have to be technically supported by licensed geodetic engineers.

Additional factors, which contributed in the early '90s to the stalling of PLUP include restricted access to official large scale (>1:50,000) topographic maps still under the control of the military and limited attention paid by the development community to geo-referenced and scaled people's knowledge until the relatively recent spread of geographic information technologies, which triggered enormous interest for geo-coded data. In addition, in the late '80s development practitioners were inclined to adopt PRA *sketch mapping* tools rather than venturing into more complex and time consuming *scale mapping*, particularly because preference was given to community process and interdisciplinary communication, rather than to courses of action enabling communities to interact efficiently with policy makers.

In recent years the situation has changed, with the diffusion of modern geographic information systems, low-cost global positioning systems, remote sensing image analysis software, open access to data via the Internet and steadily decreasing cost of hardware. This has resulted in spatial data, previously centrally controlled, becoming increasingly available on the open market to NGOs, people's organizations, minority groups and sectors of society traditionally disenfranchised by maps (undated, Fox *et al*).

The situation is likely to rapidly evolve in Thailand under recent constitutional and local governance reforms, and community forestry legislation currently pending in parliament. Article 46 of the 1997 Constitution recognizes communal rights in the conservation and use of natural resources, and spells out that "Communities shall have the right to preserve and restore the traditional culture, knowledge and fine arts of the local community and the nation, and participate in the management, maintenance, preservation and utilization of natural resources and the environment in a balanced way". Article 79 further emphasizes the duty of the state to promote and encourage public participation in the conservation and use of natural resources.

If enacted, the Community Forestry Bill will translate these articles into practice and give local communities the right to design their own rules governing the management, use and conservation of portions of forest. In this context, many research and development workers now believe that the use of 3-D models, *increasingly linked with GIS*, will rapidly expand and gain value in terms of actual natural resource governance.

A similar situation is evolving in Vietnam, where Government is progressively driving towards more consultative community-based decision-making processes and decentralization of powers.

From a technical point of view the lessons learned concern the choice of the scale and geographical scope of the single model as detailed in Annex 1 and the necessity to fully integrate Participatory 3-D Modeling with GIS and GPS.

Conclusions

The most important lessons learned with respect to the analysis done is that the use to which the P3DM outputs can be put, definitely depends on their integration with geographic information technologies and on the existence of an enabling national regulatory framework.

As part of a widespread capacity building effort involving institutional and customary custodians of natural resources, P3DM has been gaining increasing recognition as an efficient method to facilitate learning, analysis and proactive community involvement in dealing with spatial issues related to the territory. If properly administered, participatory 3-D models can support collaborative natural resource management initiatives and transcend the local contexts by establishing a peer-to-peer dialogue among communities and central institutions, agencies and projects.

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Annex 1 Advantages and disadvantages of small and large models

	Village model including its traditional natural resource use zones. (Usually at 1:5,000-scale, 1 ha corresponding to $4cm^2$)	Model including several villages and the respective natural resource use zones. (1:5,000- 1:10,000-scale. Usually at 1:10,000 scale)
Learning	Detailed but confined to the geographical coverage of the model.	Expanded, to include areas frequently beyond the usual cognition of the participants.
Community cohesion, self-actualization and self-determination	Of limited use for self-determination if used in isolation. Aggregating data from models representing adjacent villages that are part of the area of interest may overcome this limitation.	Relevant, provided the geographical scope of the model has been chosen on the basis of kinship and cultural affinity.
Awareness raising	Efficient if causes and effects (e.g. uphill erosion and downhill sedimentation areas) are visible within the geographical scope of the model.	
Land use planning	Allows detailed land use planning at farm and plot levels.	Best for overall land and resource use planning, zoning, etc.
Collaborative research	Allows quite detailed localization of resources.	Useful for outlining the distribution of resources over larger areas. Accommodates quite precise location of point information.
For supporting traditional knowledge	Useful.	Useful.
Protected Area management	Use limited to village based issues.	Useful, provided the model includes a substantial portion of the protected area and its buffer zones.
Participatory M&E	Of use mainly by the concerned village.	Quite productive, because its geographical coverage is likely to expand beyond the collective cognitive boundaries of the single villages.
Conflict management	Useful for dealing with territorial conflicts among villagers. Of limited use for negotiating conflicts between neighboring villages.	Useful for dealing with conflicts among adjacent villages.
Access to resources	Useful for defining zones within the geographical scope of the model. Confines the identification of outer village resource use boundaries to unilateral decisions.	Useful for defining zones within geographical scope of the model. Allows for conducting bilateral or multilateral boundary negotiations.
Watershed management	Valuable, if the geographical coverage includes pertinent watershed or sub-watershed.	Valuable, if the geographical coverage includes pertinent watershed or sub-watershed.
Tenure	Useful for discussing both individual and community tenure.	Best for defining community tenure (e.g. ancestral domains). The 1:10,000-scale is too small to discuss household tenure.
Fire management	Useful for village-based fire management	Broadens the scope of fire management to adjacent communities. Likely to yield better results.
Logistics	Model generally stored at village level. Easily accessible to those who produced it.	Because of its nature this type of model is located at most within one village among those depicted. Requires displacement of users for consultation.