One layer representing 40 meters is added to the model.

The Fourth Dimension of Participation

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Photographs by GIACOMO RAMBALDI

This article focuses on Participatory 3-D Modelling (P3-DM), a tool which merges Geographic Information System (GIS)-generated data and peoples' knowledge to produce a stand-alone relief model. The model provides stakeholders with an efficient, user-friendly and relatively accurate spatial research, planning and management tool, the information from which can be extracted and further elaborated by the GIS. Regular updating of the model allows for monitoring change and for integrating the fourth dimension: time, into the system. Therefore, by combining 3-D models with GIS it is possible to implement (Participatory) Monitoring and Evaluation over large areas.

The 3-D modelling process and its output (the scaled relief model) are the foundations upon which participatory GIS can release its full potential.

Background

In recent years there has been a strong drive towards integrating Geographic Information Systems (GIS) into participatory planning particularly to deal with spatial information gathering and decision-making.

A strong debate has sprung out of the concern that the nature of and access to GIS simultaneously marginalizes or empowers different groups in society with opposing interests (Poiker T. and Sheppard E., 1995). A recent workshop on the matter took place in Durham (UK) in 1998. Researchers and practitioners debated the pros and cons of combining participatory research and GIS. The outputs of the event, well summarised in PLA Notes 33, 1998 (Abbot. J et al. 1998), counsel caution in using "community-integrated GIS", especially in terms of final ownership and use of the generated information.

A follow-up workshop held in Santa Barbara (USA) in 1998 reminded us that the use of GIS in a genuine participatory context is still in its infancy. A number of cases presented as "participatory applications" of GIS merely used demographic information or secondary data within a standard GIS environment (Jordan G., 1999). What has formally emerged is (a) the need to define "best practice", allowing for true participation in generating accurate spatial information; (b) the importance of determining the "added value" of using GIS and what the nature of participation should be, (c) the need to place emphasis on detailed monitoring and evaluation of processes, methods, accuracy and outcomes; (d) the fact that the use of GIS means that accuracy issues become important, which has profound implications for the classic spatial participatory tools such as participatory sketch mapping (Jordan G., 1999).

Context

In line with the 1992 Earth Summit, the European Union and the Government of the Philippines, initiated and co-financed the National Integrated Protected Areas Programme (NIPAP).

This is a five-year (1995-2000) intervention aimed at establishing eight[2] protected areas within the framework of the Philippine protected area system. The system strongly supports the participation of local communities in planning and implementing policies and actions to conserve biodiversity.

The challenge faced by the Programme has been how to give due weight to the interests of local communities in delineating protected area boundaries, identifying resource-use zones and for-

mulating policies on protected area management.

While the relevant legislation provides for the establishment of Protected Area Management Boards (PAMBs), getting to the grassroots presents numerous practical difficulties. These range from logistical constraints to cultural, political and educational differences, language barriers and differing perspectives, all of which hinder a genuine sharing of information.

Visualising information

NIPAP started participatory 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 reservations about "translating" sketch maps into more precise, useable information. More importantly, experience has subsequently suggested that formal institutions tend to pay little attention to sketch maps.

In 1997, with the objective of generating durable, true-to-scale and "meaningful-to-all" information, the Programme developed a method, called Two-Stage Resource Mapping, a process fully adopted in the planning process of the protected area in El Nido, Palawan. Representatives from different local administrative units (barangays), together with local communities, produced resource sketch maps. Thereafter, they transferred the information to blown-up topographical maps. After a final community validation, the outputs were extracted and transferred with minimal distortion to the GIS. Plotted data were then returned to the communities for validation and were used in subsequent consultations on zoning within the protected area.

While the method integrated people's knowledge and perceptions with additional resource management information, and returned the output to the communities for further use, 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 a number of different administrative units (65 in Mt. Malindang National Park), the production of a sufficient number of community-specific sketch maps became unrealistic from both the practical and financial points of view. Furthermore, the Programme had to acknowledge that a consistent part of the comprehensive analysis was done far from the field. Communities were presented, after several months, with GIS outputs for their comments, 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 we experienced in integrating people's knowledge and GIS capabilities, but all this was linked to the nature of the areas, covering extensive terrestrial and marine components and diverse ecosystems.

Committed to involving protected area-dependent communities in the planning process, the Programme was faced with the challenge on how to provide all stakeholders the opportunity to portray their domain as they view and know it and to avail themselves of an accessible medium (other than the GIS) understood by all.

Making information tangible through Participatory 3-D Models

An answer suggested itself in the collation and plotting of data on scale relief models through a process outlined in Figure 1.

The methodology is based on the integration of participatory spatial research tools and scaled spatial information (contour lines) provided through a GIS.

Stakeholders are consulted on

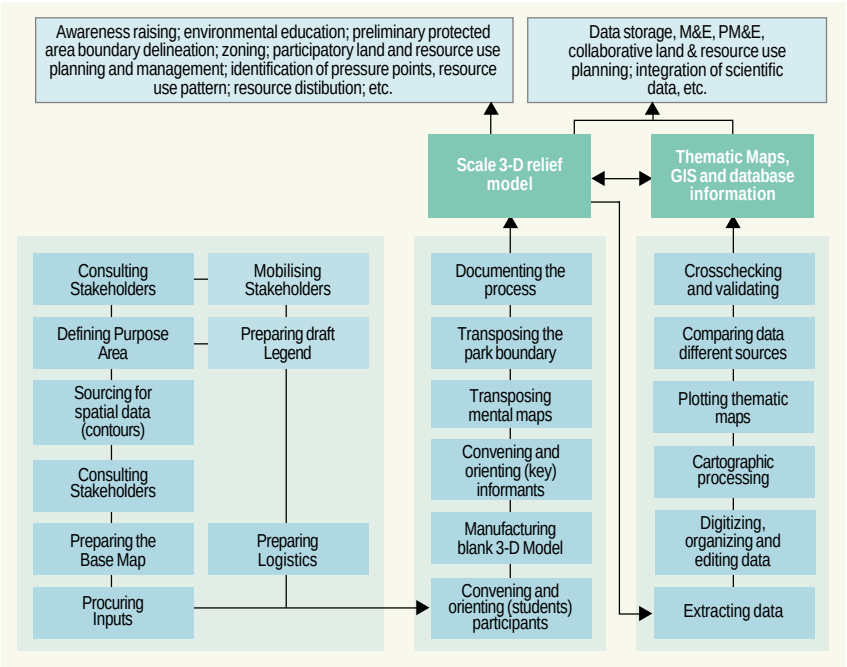

Figure 1: The participatory 3-D modelling process

their interest in availing of a locally based 3-D model for planning, management and monitoring. A consensus obtained, mobilization starts: the GIS produces a contour map at the desired scale (e.g. 1:10,000) including the protected area, buffer zones and other features of economic and ecological relevance. Facilitators procure the necessary inputs (carton, glue, colours, pushpins, colored yarn, etc) and mobilize the community for the phase where research, analysis and diagnosis are done sequentially.

The first step consists in the manufacturing of the blank relief model. High school students do this best. A group of 12 students and three facilitators can complete a 1:10,000 scale model measuring 5 m^2 (corresponding to an area of 500 km^2) in three to four days.

What follows represents the most important part of 3-D modelling and is based on the contribution of key informants and representatives from all stakeholder groups. Participants include elders, indigenous people, community representatives from the various sectors (fisherfolk, farmers, forest dwellers, etc.) local government officials, non-governmental organizations, government organizations, etc. Women's participation is encouraged to accommodate gender-related knowledge and perceptions.

A legend is prepared according to an array of colors and various media (pushpins, yarn and acrylic paint). In front of the blank relief model, participants are briefed on the process of transferring their knowledge ("mental maps") to the model.

Figure 3: Outlining of a river and a road by the use of colour-coded yarns.

Figure 4: Information is color-coded.

Figure 5: Adding women's perspective.

They are given pushpins, yarns and small labels, and asked to identify, locate and name in sequential order: water courses, roads, (Figure 3) mountain peaks, islets, trails, social and cultural features, and other landmarks they use to orient themselves when moving around within their domains. This critical process follows natural human orientation mechanisms and allows the participants to get a progressively deeper grasp of their whereabouts vis-à-vis the relief model.

Participants are then invited to delineate using colored yarns the vegetation types, land uses, and other features (e.g. cultural domains, sacred areas, burial grounds) they consider as relevant.

The initial contouring of areas with the use of yarns and pushpins instead of direct painting allows participants to discuss the outline, modify and mutually agree on single items of data. Participants are then invited to agree on the distribution, location and extent of individual features. Once a consensus is reached, color paint is applied and appropriately coded (Figure 4). The process generates great momentum and animated discussions (Box 1).

When the paint dries, participants locate with the use of color-coded pushpins and paper-tags, the administrative units, households and whatever else is considered important within the communities.

The process facilitates concurrent participation of men and women (Figure 5), people from different neighborhoods, social, educational, cultural and economic backgrounds. It allows for on-the-spot validation of the displayed information.

At this stage the relief model contains spatially defined detailed information on land use and land cover, settlements, communications, social infrastructure, sacred places and many other features. The output is self-contained and can be used as it stands for the desired analysis.

Nonetheless, within the context of the Programme, Protected Area-centered discussions could

Box 1
GROUP DYNAMICS

It has been observed that group dynamics are greatly facilitated if people discuss issues sitting or standing around a relief model.

This is probably linked to the fact that a bird's eye view on the territory is meaningful to everybody. In broadening the participant's perspective, the 3-D model facilitates the establishment of visual and tangible relations between resources and issues. It generates a common ground for reflection, debate and participatory problem analysis. Participation has been carefully monitored. The medium proved to be understood by all, insiders and outsiders, regardless of differences in language, education or culture and offers equal opportunities to the literate and illiterate, to women and men, to youth and elders, and to outsiders and insiders.

In some cases, some dominant participants tried imposing their view on others. The facilitators had to intervene and take appropriate measures.

Last, but not least, the presence of a focal point (the relief model) enhances the participants' concentration and reduces the need for establishing eye contact while discussing. This helps dissipate tensions arising from diverging opinions.

be initiated only after visualizing the protected area's boundary.

At this stage, GIS-generated information comes back into the scene. Based on the outline of the source map, a geo-referenced scaled grid is placed on top of the relief (Figure 6). For 1:10,000 scale models, the grid has 10-cm intervals. The resulting squares correspond to 100 hectares. Latitude and longitude co-ordinates of the boundary corners are identified on the source map and reflected on the relief model. The corners are connected by the use of a colour-coded yarn. At the end of the exercise, the outline of the protected area boundary is visible to everybody.

Figure 6: The reference grid is in place.

The relief model is now ready to be used for any type of discussion on resource use, distribution and access, for participatory problem analysis and for planning.

However, the reader should never consider that a P3-D model is ever completed. Like any dynamic system, changes are constant and the model (like a GIS) can be regularly updated. Unfortunately a relief model cannot memorize past scenarios. This is the context where GIS "adds value" and becomes a vital ingredient for Participatory Monitoring and Evaluation (PM&E).

Bringing in the fourth dimension

Updated at regular two- to three-year intervals, a 3-D model allows for actual Participatory Monitoring and Evaluation (PM&E) as shown in Figure 7. This is on the assumption that data contained in the model are dutifully updated and periodically extracted, digitized and plotted in the form of thematic maps.

In doing Participatory M&E, communities usually compare sketch maps, transect diagrams or other conventional spatial tools, produced at different times. The weakness in the process is the outputs are not geo-referenced and properly coded. 3-D modelling overcomes this weakness because the basis - the relief model - is constant and the coding is clearly defined in the legend and embedded in the model.

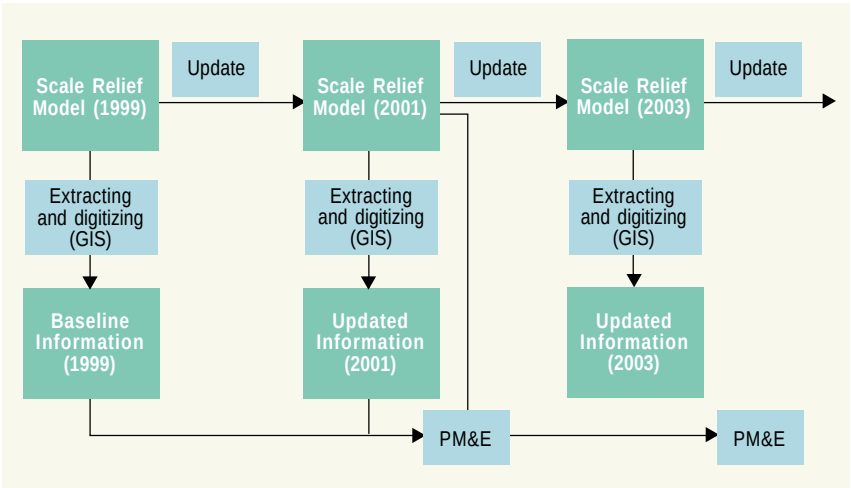

Figure 7: How to combine P3-DM and GIS to implement PM&E

Linking People's knowledge to the Geographic Information System

In order to use the 3-D model for Participatory M&E or for com-

Figure 8: Information is extracted.

bining thematic layers of different sources, the information has to be extracted and stored. In practice, whatever is displayed on the model is transferred to transparent, grid-referenced plastic sheets (Figure 8) in the form of points, lines and polygons. Attributes (non-graphic information like names, descriptions of land use or cover) are consigned to a legend. Plastic sheets and accompanying notes are handed over to the GIS, which digitizes, stores and edits the data. Administrative boundaries are integrated and attributes are assigned to points, lines and polygons.

Box 2
WHOSE KNOWLEDGE COUNTS?

During P3-D modelling exercises, participants corrected already mapped information ("these roads do not exist anymore" or "there is a road missing here"). Indigenous people rectified the names of important landmarks like mountain peaks and rivers appearing on official maps.

People's knowledge proved to be more accurate and diversified when comparing land use and land cover derived from P3-D Models with satellite-interpreted imagery.

- In Palawan, participants described vast areas, classified as brushland by JAFTA/NAMRIA (1994) study, as cashew plantations. In Palawan cashew is planted in swidden fields and left growing for the first four years among natural growth.
- In the Cordillera (Luzon), large areas classified as grassland by JAFTA/NAMRIA (19940 were portrayed as vegetable gardens and rice fields. Field verification confirmed the people's view.
- Participants in Rizal (Luzon) pointed out that an entire hill portrayed on the source map no longer existed due to rampant quarrying activities. The model now reflects the real situation.
- In Misamis Occidental (Mindanao) people differentiated five different types of forest. Official JAFTA/NAMRIA maps show only one type of forest covering the same area.

All models contain information not detectable through satellite imagery or aerial photography. This pertains to all socio-economic and cultural features.

Colors and symbols are allocated to the different attributes.

A legend is prepared and joined to other cartographic information like scale, title, source of information (including date), co-ordinates, and directional arrows. Customized thematic maps are produced at the desired scale.

Outputs are then compared with other spatial information like maps produced from satellite-interpreted imagery. In the cases examined by the Programme, maps based on people's knowledge contained many more features and were more detailed than satellite-interpreted information.

Inconsistencies among data sets were encountered in almost all sites. Validation has been done in the field by reconvening around the P3-D Models with a sufficient number of residents or through direct on-field investigation.

Experience has shown that "pooled people's knowledge" merged with traditional spatial information (contours) is not only accurate but more detailed and updated than that maintained in official circles (see Box 2).

The two physical outputs of the process are: the relief model and the GIS-generated maps. Both are permanently displayed within the proprietor community.

The use of P3-D Models in Protected Area Planning and Management

As shown in Table 1, eight relief models have been constructed in the framework of the Programme. Five are confined to inland ecosystems, while those of El Nido, Malampaya Sound and Mount Guiting-guiting include coastal and marine areas.

Protected areas listed in the table are distributed throughout the Philippines. Mt. Pulag National Park, the most northern, is

Protected Area	Scale	Area (km^2)	Active Participants (No.)	Women Participants (%)	Working Days (No.)
Mt. Pulag National Park (Benguet, Nueva Vizcaya and Ifugao)	1:10,000	360	75	19	270
Mt. Isarog National Park (Camarines Sur)	1:10,000	480	101	28	277
Mt. Malindang National Park (Misamis Occidental)	1:10,000	1,176	119	21	376
Pamitinan Protected Landscape (Rizal)	1:2,000	17	93	52	300
Mt. Guiting-guiting Natural Park (Romblon)	1:10,000	896	101	31	261
Community-Based Forest Management Area in the Buffer Zone of Mt. Guiting-guiting Natural Park	1: 5,000	10	10	30	40
El Nido-Taytay Managed Resources Protected Area (Palawan)	1:20,000	1,968	70	23	190
Malampaya Sound Protected Land and Seascape	1:20,000*	3,016	87	23	246

* Differentiated scaling (1:20,000 horizontal; 1:10,000 vertical) has been adopted in Malampaya Sound to enhance the perception of slope.

Table 1: Participatory 3-D models produced in the framework of the Programme

located in the Provinces of Benguet, Ifugao and Nueva Vizcaya and is inhabited mostly by Indigenous Peoples: the Kalanguya, the Ibaloy and the Kankana-ey. The most southerly, Mt. Malindang National Park, is located in Mindanao and is the ancestral land of the Subanen community. Two Palawan sites, El Nido and Malampaya Sound are settled mainly by recent migrants. Mt. Guiting-guiting in Romblon province and Mt. Isarog in Camarines Sur province are are home of a mix of indigenous groups and contemporary migrants.

In the construction of the 3-D models, remarkable differences have been noticed in terms of participation among different sites. Upland, indigenous people proved to be the most committed and knowledgeable about natural resources, names of locations and distribution of traditional use zones. Farmers know the territory at walking distance from their farm, while small-scale fisherfolk would be conversant with coastal and marine areas stretching over tens of kilometers of coastline. Men would be conversant with fishing and hunting grounds, while women with the location of social infrastructure, households and farmland. As shown in Table 1, women's participation has been variable, depending mainly on the local cultural settings. Except for a few dominant informants, no conflicts emerged between different groups.

Once completed, the models (and the GIS-generated maps) have been entrusted to the Protected Area Management Boards (care of one municipality) or to the concerned Protected Area Offices. The models are used for the following:

• Involve communities in developing management, zoning and resource use plans, and in geo-referencing their priorities, aspirations, concerns and needs;

• Overall protected area planning management and monitoring;

• Conducting preliminary consultations on boundary delineation;

• Monitoring the dynamics of settlements, infrastructures and access points vis-à-vis the protected areas;

• Substantiating public hearings and planning workshops;

• Introducing visitors to the area;

• Teaching local geography and enhancing the interest of students and residents in the conservation and/or restoration of natural resources;

• Identifying the distribution of selected species within the protected areas and their buffer zones.

To monitor the use of the models, a "visitors' book" has been opened for each model. Users or visitors are invited to record their

"generalities", "purpose of consulting or using the model" and their "comments".

Lessons learned

Relief models are excellent visual aids that capture the ruggedness and details of the territory (Box 3). Users can see and feel the contours of every mountain range and river valley. Two-dimensional maps cannot match their impact and appeal.

Compared to data appearing on a planimetric map (e.g. contour lines), a relief model enormously facilitates their assimilation, interpretation and understanding. A complete relief model highlights pressure points (concentration of households, converted portions of forest, access ways, etc.) making them visible and tangible to everyone.

Process and output proved to fuel self-esteem, awareness of interlocked ecosystems and intellectual ownership of the territory.

P3-D Models provide local stakeholders and official policy makers with a powerful medium for negotiation, easing communication and language barriers.

Especially when dealing with relatively extensive and remote areas, P-3D modelling bridges logistical and practical constraints and facilitates public participation in land/resource use planning and management.

Considering that in most protected areas of the Philippines no boundary has yet been demarcated, relief models allow stakeholders to get a first time understanding and factual perception of their location. This certainly facilitates the processes of boundary delineation and zoning, both activities otherwise characterised by heavy logistics and lengthy negotiations.

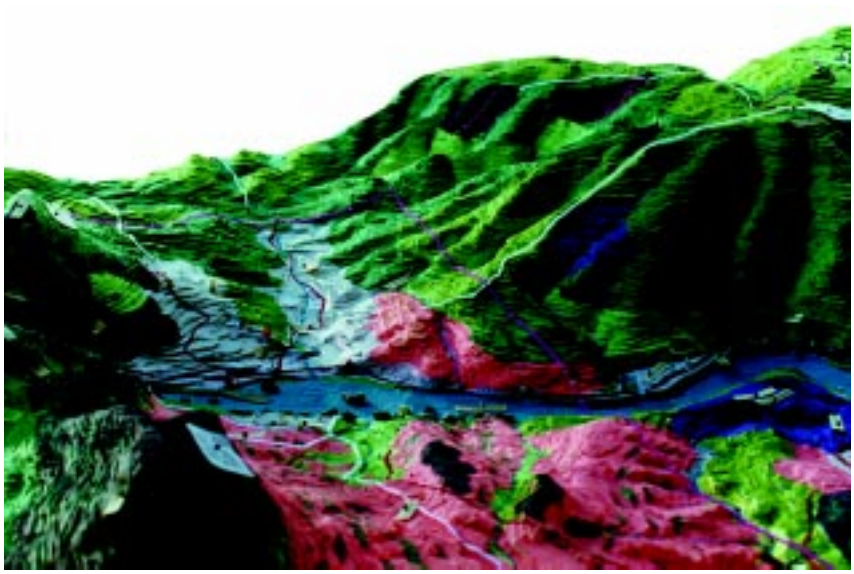

Figure 9: A birds's eye-view of the Pamitinan Protected Landscape.

In most cases Local Government Units (LGUs) become custodians of the models and the driving force for their regular up dating. Almost all concerned Mayors addressed the Programme to obtain complementary source maps to expand the models to cover their entire constituencies.

LGUs' interest in P3-D models is not limited to environmental issues. They see their use for infrastructure and tourism development, water delivery, land tenure, tax mapping and delineation of political boundaries. Public administrators stated their interest in using P3-D Models as a hands-on means for acquiring and storing information for municipal planning and management.

The complete process, including 1:10,000-scale P3-D modelling, extraction and digitising, allowed to generate comprehensive sets of geo-referenced information in a relatively short period of 3-4 months and at a Programme operating cost of 4-5 US$/km^2.

P3-D Modelling has many positive edges, but it is a demanding process entailing initial (mandatory) and final (optional) services of a Geographic Information System, accurate procurement of supplies, thorough groundwork to mobilise participants, skilled facilitation, space for storage and display, and caretakers. Lastly, relief models are hard to move around. Digitising the information and plotting it on maps, which are easy to store and carry around, overcome this.

Box 3
A QUESTION OF ACCURACY

Scale 3-D Modelling satisfies the demand for "accuracy' and spatially defined information, at the expense of "impressionistic" traits, which often characterize participatory sketch mapping. Informants tend to reflect their perception of a feature in blowing up or shrinking its shape depending on the importance they attach to it. In these cases, the facilitators have to intervene, firstly to take note of the perceptions of the particpants, and secondly to draw attention on the actual scale of the model.

Conclusions

In the context of the Philippines, Participatory 3-D modelling

Box 4
A CALL FOR CAUTION

P3-D models facilitate the selective pinpointing of resources, households and other features. This feature can have positive and negative effects.

Because of their accuracy, P3-D Models, alone or combined with GIS, turn local knowledge into public knowledge and conceivably out of local control. This can be used by outsiders to locate resources and development needs, or merely to extract more resources, or to increase control from the outside (J. Abbot et al. 1999)).

Planners should be aware of these realities and be careful in applying this process.

Thus, plotting endangered species, hardwoods, and other resources in demand on the black market, should be done with caution and eventually behind closed doors in the course of focused group discussions.

has gained tremendous interest. It has proved to be an extremely efficient community-based planning and management tool. With some additional improvements it may be viewed as "best practice" for allowing true participation in generating accurate geo-referenced information. Combined to GIS it opens the doors to collaborative planning and effective Participatory Monitoring and Evaluation.

Furthermore, the NIPAP experience illustrates that 3-D models produced through collaborative processes generate a tremendous and long-lasting enthusiasm among participants and generally among a large proportion of the concerned residents. An enormous amount of information is collated and permanently displayed at community level, where it is readily accessible to all stakeholders, local residents and outsiders.

As distinct from sketch maps or sole GIS outputs, a well-displayed and properly stored 3-D model is appealing, fuels community-esteem and sense of intellectual ownership. Thus it finally becomes part of the local cultural landscape.

Participants and users get a "bird's eye view" of their environment. This enhances analytical skills, broadens perspectives on interlocked ecosystems and helps in dealing with issues and conflicts associated with the territory and resource use.

Because all stakeholders play an active role in the realisation of the models, both administrators and communities easily understand the medium. A relief model makes information tangible, eases communication, helps bridge language barriers and increases the potential of all stakeholders to deal with their constituencies, central government and outsider institutions that are part of the concerned area.

In the Philippines the integration of P3-DM and GIS is proving to be extremely useful in the process of establishing and managing natural resources through a genuine participatory approach.

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